CHAPTER 1

Chemical Reaction and Equations

Chapter Analysis with respect to Last 3 Years' Board Exams

List of Topics	**2016**	**2017**	**2018**
Chemical Equation, Balanced Chemical Equation, Implications of a Balanced Chemical Equation	1Q (3 marks), 1Q (5 marks)	3Q (2 marks), 2Q (3 marks)	2Q (2 marks)
Types of Chemical Reactions: Combination, decomposition, displacement, double displacement, precipitation, neutralization, oxidation and reduction.	3Q (1 mark),	3Q (1 mark), 1Q (2 marks)	2Q (3 marks)

On the basis of above analysis, it can be said that from exam point of view, chemical reactions and their types are the most important topics of the chapter.

Topic 1: Chemical Reactions & Equations

Summary

Knowing your Chapter at Glance:

- Universe is recognised by two major changes:- chemical changes and physical changes.

Types of Changes

Physical Changes (No new substance is formed)	Chemical Changes (A new substance is formed)
e.g. Melting of ice, boiling of water, breaking of a glass tumbler.	e.g. Souring of milk in summers, Rusting of iron articles, Burning of any substance, Digestion of food in our body.

- **Chemical reaction** is the process of breaking and making of bonds between different atoms to produce new substances.

Examples

Rutherford observed the deflection of alpha particles after passing through metal sheet and proposed his atomic model

Digestion of food

The burning of magnesium in air to form magnesium oxide

The two main components of the chemical reaction are

Reactants which are the substances that take part in a chemical reaction.

Product(s) that are formed as a result of chemical reaction between the reactants.

$$\underset{\text{Reactants}}{Zn + H_2SO_4} \longrightarrow \underset{\text{Products}}{ZnSO_4 + H_2}$$

A chemical reaction is accompanied by the following chemical change that is observed as:

- Change in state
- Change in colour
- Evolution of gas
- Change in temperature
- Formation of precipitate

- Chemical equation is the representation of chemical reactions in the form of formulae.

  While writing a chemical reaction the following steps must be employed
- The symbols and formulae of the reacting substances are written on the LHS with a plus sign(+) between them.
- The symbols and the formulae of the product formed are written on the RHS with a plus sign(+) between them.
- The LHS and RHS are connected by an arrow sign(→).
- To make the equation more informative, states of the reactants and the products are also mentioned.

Example

$$2CO(g) + O_2(g) \longrightarrow 2CO_2(g)$$

- Balanced equation is the one which has same number of atoms of each element on the LHS and RHS of the equation.

  Balancing is done in accordance with the **law of conservation of mass** which states that "the total mass of the elements present in the products of the chemical reaction is equal to the total mass of the elements present in the reactants.

  Example of Balancing a Chemical Equation (? means coefficient missing)

  $$? CH_4 + ? O_2 \longrightarrow ? CO_2 + ? H_2O$$
- Identify the elements in the equation: C, H, O

- Identify the net charge: no net charge, which makes this one easy!
- H is found in CH_4 and H_2O, so it's a good starting element.

  You have 4 'H' in CH_4 yet only 2 'H' in H_2O, so you need to double the coefficient of H_2O to balance H.

  $1CH_4 + ?\ O_2 \longrightarrow ?\ CO_2 + 2H_2O_2$
- Looking at carbon, you can see that CH_4 and CO_2 must have the same coefficient.

  $1CH_4 + ?\ O_2\ ? \longrightarrow 1CO_2 + 2H_2O$
- Finally, determine the 'O' coefficient. You can see you need to double the O_2 coefficient in order to get 4 'O' seen on the product side of the reaction.

  $1CH_4 + 2O_2 \longrightarrow 1CO_2 + 2H_2O$

  So the final balanced equation would be written:

  $CH_4 + 2O_2 \longrightarrow CO_2 + 2H_2O$

PREVIOUS YEARS' EXAMINATION QUESTIONS

TOPIC 1

1 Mark Questions

1. Which one is a chemical change – rusting of iron or melting of iron?

[TERM 1, 2011]

2. Why do silver articles become black after some time when exposed to air?

[TERM 1, 2011]

3. The aqueous solutions of copper sulphate and zinc sulphate appear
(a) Blue and green respectively
(b) Green and colourless respectively
(c) Blue and brown respectively
(d) Blue and colourless respectively

[TERM 1, 2012]

4. When crystals of $FeSO_4$ are strongly heated the residue obtained is
(a) reddish brown in colour.
(b) blue in colour.
(c) green in colour.
(d) colourless.

[TERM 1, 2013]

5. A student took solid quicklime in a china dish and added a small amount of water to it. He would hear:
(a) A pop sound
(b) A crackling sound
(c) A hissing sound
(d) No sound at all

[TERM 1, 2015]

6. The chemical reaction between barium chloride and sodium sulphate is an example of
(a) combination reaction
(b) decomposition reaction
(c) displacement reaction
(d) double displacement reaction

[TERM 1, 2016]

7. Which gas is evolved in the reaction of Zinc metal and $NaOH$
(a) Cl_2
(b) H_2O
(c) O_2
(d) H_2

[TERM 1, 2016]

8. Barium Sulphate is:
(a) White
(b) Yellow
(c) Green
(d) Red

[TERM 1, 2016]

9. When sodium sulphate solution and barium chloride solution are mixed together, the colour of precipitate formed is:
(a) Yellow
(b) Green
(c) White
(d) Red

[TERM 1, 2017]

10. While doing an experiment a student observed that the blue colour of the aqueous copper sulphate was changed to pale green by immersing a metal rod in it. The metal of the rod used by the student is:
(a) iron
(b) zinc
(c) silver
(d) aluminium

[TERM 1, 2017]

2 Marks Questions

11. Reddish brown deposit observed on iron nails, when these are kept in aqueous solution of copper sulphate solution is that of
(a) Cu_2O
(b) CuO
(c) Cu
(d) CuS

[TERM 1, 2013, 2017]

12. Write chemical equations for the reactions taking place when
(i) Zinc sulphide is heated in air
(ii) Calcination of zinc carbonate is done.
[TERM 1, 2017]

13. "Respiration is an exothermic reaction." Justify this statement giving the chemical equation for the reaction involved.
[TERM 1, 2017]

14. What is observed when a solution of sodium sulphate is added to a solution of barium chloride taken in a test tube? Write equation for the chemical reaction involved and name the type of reaction in this case.
[TERM 1, 2018]

15. A student added few pieces of aluminium metal to two test tubes *A* and *B* containing aqueous solutions of iron sulphate and copper sulphate. In the second part of her experiment, she added iron metal to another test tubes *C* and *D* containing aqueous solutions of aluminium sulphate and copper sulphate.
In which test tube or test tubes will she observe color change? On the basis of this experiment, state which one is the most reactive metal and why?
[TERM 1, 2018]

3 Marks Questions

16. (a) Oil and fat containing food items are flushed with nitrogen while packing them why?
(b) Why do we apply paint on iron articles?
[TERM 1, 2011]

17. A solution of a substance 'X' is used for white washing.
(i) Name the substance 'X' and write its formula.
(ii) Write the reaction of the substance 'X' named in (i) above with water.
(iii) Write the balanced equation for the following chemical reaction.
[TERM 1, 2013, 2015]

18. Complete the following reactions and write the balanced equations:

$$FeSo_4(s) \xrightarrow[\text{Decomposition}]{\text{Heat}}$$

$$Pb(NO_3)_2(s) \xrightarrow[\text{Decomposition}]{\text{Heat}}$$

[TERM 1, 2014]

19. Write balanced chemical equations for the following chemical reactions
(a) Hydrogen + Chlorine → Hydrogen Chloride
(b) Lead + Copper Chloride → Lead Chloride + Copper
(c) Zinc Oxide + Carbon → Zinc + Carbon Monoxide
[TERM 1, 2016]

20. The color of copper sulphate solution changes when an iron nail is dipped in it. State the giving chemical equation for the reaction involved. Write the name of reaction involved.
[TERM 1, 2017]

21. (a) Identify the substance oxidized, substance reduced, oxidizing agent and reducing agent in the following reaction: ZnO + C → Zn + Co
(b) Packets of potato chips are flushed with nitrogen gas, why?
[TERM 1, 2017]

5 Marks Questions

22. Write balanced chemical equation for the reactions taking place when
(a) Zinc carbonate is calcinated.
(b) Zinc sulphide is roasted.
(c) Zinc oxide is reduced to Zinc.
(d) Cinnabar is heated in the air.
(e) Manganese dioxide is heated with Aluminium Powder

Solutions

1. Rusting of iron is a chemical change. In a chemical change the reactants react together to form a new product and it is not a reversible change i.e. we cannot get back the reactants from the product .That is why rusting of iron is said to be a chemical change because the pure iron metal cannot be extracted from the rusted iron. [1]

2. When silver articles are exposed to air it becomes black after some time because the silver metal reacts with hydrogen sulphide present in the atmosphere that leads to the formation of silver sulphide (Ag_2S) because of which they appear dull and black. This is a kind of corrosion of silver metal. [½]

$Ag + H_2S \rightarrow Ag_2S + H_2$ [½]

3. Any reaction that produces a precipitate can be called a precipitation reaction. For example, a white precipitate is formed when aqueous solution of barium chloride is reacted with an aqueous solution of sodium sulphate. The chemical reaction can be represented as: [½]

$Na_2SO_4\ (aq) + BaCl_2\ (aq) \rightarrow BaSO_4\ (s) + 2NaCl\ (aq)$

The white precipitate of $BaSO_4$ is formed by the reaction of SO_4^{2-} and Ba^{2+}. The other product formed is sodium chloride which remains in the solution. Such reactions in which there is an exchange of ions between the reactants are called double displacement reactions. [½]

Hence, option (d) is correct.

4. The aqueous solutions of copper sulphate and zinc sulphate appear blue and colourless respectively. [1]

5. In the given reaction, Lead oxide (undergoing reduction) loses oxygen hence it is getting reduced and carbon (undergoing oxidation) gains oxygen hence, it is getting oxidized. [1]

Therefore, statement (i) and (ii) are incorrect.

Hence, the correct answer is option A.

6. In the decomposition reaction one substance decomposes into two or more substances whereas in a combination reaction two or more substances are combined to form a new substance. Therefore, decomposition reactions and combination reactions are basically the opposite of each other. [1]

Examples:

$2H_2O \xrightarrow{elecricity} 2H_2 + O_2$

(Decomposition Reaction)

$H_2 + Cl_2 \rightarrow 2\ HCl$ (Combionation Reaction)

7. A student took solid quicklime in a china dish and added a small amount of water to it. As it is an exothermic reaction he would hear a steady hissing sound till the chemical reaction completes [½]

$CaO + H_2O \rightarrow Ca(OH)_2 + 15.6\ KCal$ [½]

8. $BaCl_2 + Na_2SO_4 \rightarrow BaSO_4 + 2NaCl$ [½]

Above reaction shows the chemical reaction between barium chloride and sodium sulphate, which is essentially a double displacement reaction (as there is exchange of ions between reactants). [½]

Hence the correct option is option (d).

9. Barium Sulphate is white in colour. Hence, the correct option is (a). [1]

10. When zinc carbonate is heated in absence of air, it releases carbon dioxide gas and forms Zinc oxide. [½]

$ZnCO_3(s) \xrightarrow{heat} ZnO(s) + CO_2(g)$ [½]

11. When iron rod is immersed in copper sulphate solution, a green colour solution of ferrous sulphate ($FeSO_4$) and copper (Cu) is obtained due to displacement reaction [2]

12. (i) When zinc sulphide is heated in presence of air, it forms zinc oxide and sulphur dioxide.

$2ZnS(s) + 3O_2\ (g) \rightarrow 2ZnO(s) + 2SO_2(g)$ [1]

(ii) When zinc carbonate is calcinated, it forms zinc oxide and carbon dioxide gas.

$ZnCO_3(s) \xrightarrow{heat} ZnO(s) + CO_2(g)$ [1]

13. During respiration, the carbohydrates are broken down to form glucose. This glucose combines with oxygen in our cells to form carbon dioxide and water along with the production of energy (heat). [1]

$C_6H_{12}O_6(aq) \rightarrow 6CO_2(aq) + 6H_2O(l) + Energy$

Respiration is termed as exothermic process since energy is released during the process. [1]

14. This is a double displacement reaction. A white precipitate of barium sulphate is formed, when sodium sulphate is added to a solution of barium chloride. This precipitate is insoluble in water. Sodium chloride is also formed which is dissolved in water. [1]

$Na_2SO_4 + BaCl_2 \rightarrow 2NaCl + BaSO_4\downarrow$ [1]

15. In test tube A, aluminium is added to aqueous solution of iron sulphate where green color of iron sulphate disappears. [½]

In test tube B, aluminium is added to aqueous solution of copper sulphate where blue color of copper sulphate disappears and brown colored particles of copper settles at the bottom. [½]

In test tube C, Iron is added to aluminium sulphate solution where iron cannot displace aluminium being less reactive so the solution remains colorless. [½]

In test tube D, iron is added to copper sulphate solution where blue color of copper sulphate changes to light green color. [½]

Color change is observed in test tube A, B and D.

Aluminium metal is the most reactive as it does not get displaced. It lies above all other metals in the reactivity series.

16. (a) Nitrogen acts an antioxidant and it prevents the food material from being oxidised. It is an inert gas and does not react easily with the oil and fat present in the food substances. [1½]

(b) Paint is applied on the iron articles to prevent them from rusting. Paints prevent iron from coming in contact with moisture and air. [1½]

17. (i) The substance 'X' is calcium oxide which is also known as Quick lime. The formula of calcium oxide is. [1]

(ii) Calcium oxide after reacting with water gives calcium hydroxide or Slaked lime.

$CaO + H_2O \rightarrow Ca(OH)_2$ [1]

(iii) Following is the balanced equation of the above chemical reaction:

$2CaO + 2H_2O \rightarrow 2Ca(OH)_2$ [1]

18. Ferrous sulphate crystals ($FeSO_4.7H_2O$) lose water when heated and the colour of the crystals changes. It then decomposes to ferric oxide (Fe_2O_3), sulphur dioxide (SO_2) and sulphur trioxide (SO_3). Ferric oxide is a solid, while (SO_2) and (SO_3) are gases.

$$2FeSO_4(s) \xrightarrow[Decomposition]{Heat} Fe_2O_3(s) + SO_2(g) + SO_3(g)$$

[1]

Lead nitrate decomposes to form solid Lead oxide (PbO) and Nitrogen dioxide (NO_2) and oxygen (O_2) .

$$2Pb(NO_3)_2(s) \xrightarrow[Decomposition]{Heat} 2PbO(s) + 4NO_2(g) + O_2(g)$$

[1]

19. (a) Hydrogen + Chlorine → Hydrogen Chloride

$H_2(g) + Cl_2(g) \rightarrow 2HCl(g)$

Lead + Copper Chloride → Lead Chloride + Copper

$Pb \rightarrow CuCl_2 \rightarrow PbCl_2 + Cu$ [1½]

(b) Zinc Oxide + Carbon → Zinc + Carbon Monoxide

$ZnO + C \rightarrow Zn + CO$ [1½]

20. The color of copper sulphate solution changes when an iron nail is dipped in it. This happens because iron is more reactive than copper and therefore it displaces copper from the copper sulphate solution. Therefore the change in color is from blue to green. [1½]

The reaction involved is:

$Fe(s) + CuSO_4(aq) \rightarrow FeSO_4(aq) + Cu(s)$ [1½]

This is a displacement reaction.

21. (a) In the given reaction,

$ZnO + C \rightarrow Zn + CO$

Substance oxidized:- C

Substance reduced:- ZnO

Oxidizing agent:- ZnO

Reducing agent:- C [1½]

(b) The packet of the potato chips is filled with nitrogen gas to prevent it from oxidizing. As nitrogen gas is very stable and unreactive so it prevents the chips from rancidity.[1½]

22. $ZnCO_3(s) \xrightarrow{heat} ZnO(s) + CO_2(g)$

When zinc carbonate is calcinated, it gives zinc oxide and carbon dioxide. [1]

$$ZnS + 3O_2 \xrightarrow{Heat} 2ZnO + 2SO_2$$

Zinc sulphide, when roasted in presence of air, gives zinc oxide and sulphur dioxide. [1]

$2ZnO + C \rightarrow 2Zn + CO_2$

When zinc oxide is reacted with carbon, it is reduced to zinc with evolution of carbon dioxide gas. [1]

Cinnabar is the common name for Mercury sulfide (HgS). When cinnabar is heated in the air, following reaction takes place

$$2HgS(s) + 3O_2(g) \longrightarrow 2HgO + 2SO_2(g)$$ [1]

Manganese dioxide when heated with aluminium powder gives following reaction.

$$3MnO_2 + 4Al \longrightarrow 2Al_2O_3 + 3Mn + heat$$ [1]

Topic 2: Types of Chemical Reactions, Corrosion and Rancidity

The chemical reactions are of the following types-

- In combination reactions, two or more than two elements combine to give one single product.

  $NH_3(g)$ + $HCl(g)$ $\longrightarrow$ $NH_4Cl(s)$

  Ammonia Hydrogen chloride Ammonium chloride

  $2CO(g)$ + $O_{2(}g)$ $\longrightarrow$ $2CO_2$ (g)

  Carbon monoxide Oxygen Carbon dioxide

  This reaction is a combination reaction, as ammonia and hydrogen chloride combine together to form ammonium chloride as a single product.

- Decomposition is splitting of a compound into two or more simpler products.

  $2\ Pb(NO_3)_2(s) \xrightarrow{Heat} 2\ PbO(s) + 4\,NO_2(g) + O_2(g)$

  Lead nitrate (Colourless) — Lead oxide (yellow) — Nitrogen dioxide (Brown fumes) — Oxygen

  Decomposition reaction can be accomplished by supplying energy in the form of heat,electricity or light.

- **Thermal decomposition** reaction is the one where energy is supplied as heat.

  $2\ KClO_3(s) \xrightarrow[(MnO_2)]{Heat} 2KCl(s) + 3O_2(g)$

  Potassium Chlorate — Potassium Chloride — Oxygen

- **Photo decomposition** reaction is the one where energy is supplied as light.

  $2H_2O_2(l) \xrightarrow{Light} 2H_2O(l) + O_2(g)$

  Hydrogen peroxide — Water — Oxygen

- **Electrolytic decomposition** reaction is the one where energy is supplied as electricity.

  $2H_2O(l) \xrightarrow[current]{electric} 2H_2(g) + O_2(g)$

  Water — hydrogen (2 Volume) — oxygen (1 volume)

- In **displacement reaction**, the more reactive metal displaces the less reactive metal from a compound.

  $Zn(s) + CuSO_4(aq) \rightarrow ZnSO_4(aq) + Cu(s)$

  Zinc — Copper sulphate (Blue) — Zinc sulphate (Colourless) — Copper (Reddish brown)

  $Cu(s) + 2\ AgNO_3(aq) \rightarrow Cu(NO_3)_2(aq) + 2\ Ag(s)$

  Copper — Silver nitrate (Colourless) — Copper nitrate (Blue) — Silver

- The reactions in which the different atoms or group of atoms are displaced by other atoms or group of atoms, i.e two compounds exchange their ions and one of the products formed is insoluble are said to be **double displacement reactions**.

  $Na_2SO_4(aq) + BaCl_2(aq) \rightarrow BaSO_4(s) + 2NaCl(aq)$

  Sodium sulphate Sol. — Barium chloride Sol. — Barium sulphate (white ppt) — Sodium chloride

- **Redox reactions**

  In the term 'redox', 'red' stands for reduction and 'ox' stands for oxidation.

  Thus the reactions in which oxidation and reduction take place simultaneously are called Redox reactions, i.e. in redox reactions one substance is oxidized and other is reduced.

  $CuO(s) + H_2(g) \rightarrow Cu(s) + H_2O(g)$

  Copper (II) oxide (black) — hydrogen — Copper (brown)

IMPORTANT TERMS IN REDOX REACTION

Oxidation: Reaction that involves the gain of oxygen or loss of hydrogen.

Reduction: Reaction that shows the loss of oxygen or gain of hydrogen.

Oxidising agent: It is a substance which itself gets reduced but oxidizes the other substance.

Reducing agent: It is a substance which itself gets oxidized but reduces the other substance.

$$\underset{\text{Copper (II) oxide (black)}}{CuO(s)} + \underset{\text{hydrogen}}{H_2(g)} \rightarrow \underset{\text{Copper (brown)}}{Cu(s)} + H_2O(g)$$

In the above equation CuO is undergoing reduction and H_2 is undergoing oxidation. Hence CuO acts as oxidising agent and H_2 acts as reducing agent.

- **Corrosion:** The surface of the reactive metals are attacked by air, water and the other substances around it, and corrodes while the process is called corrosion. It is a redox reaction where metal gets oxidised to metal oxide and oxygen gets reduced to oxide ions.

Oxidation

$$\underset{\text{iron}}{4Fe(s)} + 3O_2(g) + 2xH_2O(l) \rightarrow \underset{\text{Hydrated ferric oxide (Rust)}}{2Fe_2O_3.xH_2O(s)}$$

from moist ari

This reaction is called corrosion of iron or rusting.

Prevention of rusting

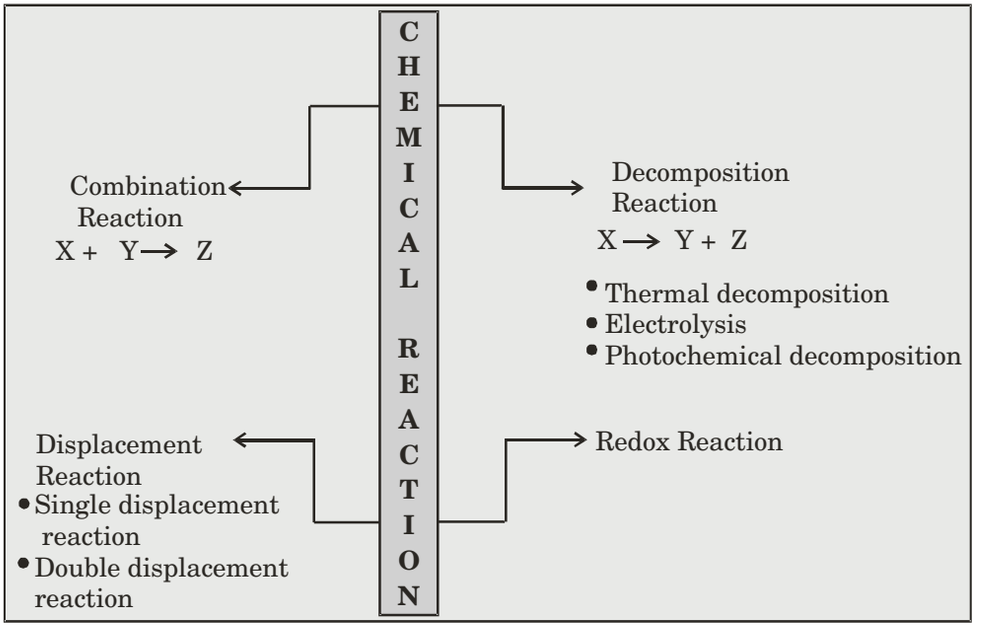
- By painting
- By lubricating it with oil or grease
- By galvanising (coating with active metals like zinc)
- By alloying
- **Rancidity:** Oils and fats when get oxidized on exposure to air results in the production of foul odour and taste in them.

Methods to prevent Rancidity

Packing of food materials in air tight containers flushed with inert gases like nitrogen.

Refrigeration of cooked food at low temperature.

Chapter in Brief:



PREVIOUS YEARS' EXAMINATION QUESTIONS TOPIC 2

1 Mark Questions

1. Rahul adds aqueous solution of barium chloride to an aqueous solution of sodium sulphate. He would observe that
(a) a pungent smelling gas is evolved.
(b) the colour of the solution turns red.
(c) a yellow precipitate is formed after sometime.
(d) a white precipitate is formed almost immediately
[TERM 1, 2011]

2. Define the term rancidity.
[TERM 1, 2014]

3. Which of the statements about the reaction below are incorrect?
$2PbO_{(s)} + C_{(s)} \rightarrow 2Pb_{(s)} + CO_{2(g)}$
(i) Lead is getting reduced.
(ii) Carbon dioxide is getting oxidized.
(iii) Carbon is getting oxidized.
(iv) Lead oxide is getting reduced.
(a) (i) and (ii)
(b) (i) and (iii)
(*c*) (i), (ii) and (iii)
(*d*) All
[TERM 1, 2014]

4. Why decomposition reactions are called the opposite of combination reactions?
[TERM 1, 2015]

5. What happens when $ZnCO_3$ is heated in the absence of air? Give the relevant equation.
[TERM 1, 2017]

2 Marks Questions

6 When an iron nail rubbed with sand paper is dipped in copper sulphate solution, we observe that copper gets deposited
(a) first on the lower part of the nail and proceeds to the upper part.
(b) first on the upper part of the nail and proceeds to the lower part.
(c) on the entire surface of the nail.
(d) on the nail in small patches
[TERM 1, 2011]

7. Give an example each for thermal decomposition and photo chemical decomposition reactions. Write relevant balanced chemical equations also. **[TERM 1, 2011]**

8. Burning of candle is accompanied by both physical and chemical change. Mention the observations which help to deduce that both physical and chemical changes are taking place.
[TERM 1, 2014]

9. A solution of potassium chloride when mixed with silver nitrate solution, an insoluble white substance is formed. Write the chemical reaction involved and also mention the type of the chemical reaction?
[TERM 1, 2015]

10. Write observation with reaction for the following: Granulated zinc reacts with dil. sulphuric acid.
[TERM 1, 2017]

3 Marks Questions

11. (a) What happens when a strip of lead metal is placed in a solution of copper chloride? Write the balanced chemical equation for the reaction along with the colour changes observed during the reaction.
(b) What are precipitation reactions? Give one example of precipitation reaction
[TERM 1, 2015]

12. Explain why:
(a) Digestion of food is a decomposition reaction.
(b) All decomposition reactions are endothermic reactions.
(c) A popping sound is produced when a burning candle is brought near mouth of a test tube used in electrolysis of water.
[TERM 1, 2015]

13. Describe the use of aluminium as reducing agent for reduction of metal oxides. Give the equations involved. **[TERM 1, 2015]**

14. 2 ml of sodium hydroxide solution is added to a few pieces of granulated zinc metal taken in a test tube. When the contents are warmed, a gas evolves which is bubbled through a soap solution before testing. Write the equation of the chemical reaction involved and the test to detect the gas. Name the gas which will be evolved when the same metal reacts with dilute solution of a strong acid.
[TERM 1, 2018]

15. Decomposition reactions require energy either in the form of heat or light or electricity for breaking down the reactants. Write one equation each for decomposition reactions where energy is supplied in the form of heat, light and electricity.
[TERM 1, 2018]

5 Marks Questions

16. (a) Name and describe giving chemical equation of the process used for producing sodium hydroxide. Why is this process so named?

(b) Give one use of each of any two products obtained in this process.

[TERM 1, 2016]

Solutions

1. The following will be the reaction when an iron nail rubbed with sand paper is dipped in copper sulphate solution:

$CuSO_4$ *(blue) (aq)* + *Fe (gray) (s)* → $FeSO_4$ *(green) (aq)* + *Cu (brown) (s)* [½]

When a piece of more reactive metal is immersed in an aqueous salt solution of a less reactive metal, a displacement reaction takes place, in which the less reactive metal precipitates out in its original solid form and the more reactive metal forms the aqueous salt solution. Hence, the copper being less reactive than iron deposits on the entire surface of iron nail because complete surface of iron is exposed simultaneously into the solution for reaction. [½]

Hence, option (c) is correct.

2. The correct option is (a) reddish brown in colour After heating strongly iron oxide is formed which is reddish-brown in colour. (1 mark question, so the reaction is not required). [1]

3. The correct option is (c)

When iron nails are kept in the copper sulphate solution which is blue in colour, the displacement reaction takes place and copper being less reactive than iron gets coated on iron nail.

$CuSO_4 + Fe \rightarrow Cu + FeSO_4$ [1]

4. Rancidity is defined as Oxidation of oils and fats present in the food item. It spoils the food materials that makes it difficult for consumption. Nitrogen act as an antioxidant that is added to foods containing fats and oil. [1]

5. Chemical reaction of Zinc metal and NaOH is

$Zn + 2NaOH \rightarrow Na_2ZnO_2 + H_2$ [½]

From above reaction we can see that H_2 gas evolved in the reaction. [½]

Hence (d) is the correct answer.

6. When sodium sulphate solution and barium chloride solution are mixed together, a white precipitate is formed due to the formation of barium sulphate and sodium chloride (Double displacement Reaction) [2]

7. Those reactions in which a chemical compound decomposes by the action of sunlight are called photo chemical decomposition reactions. For example, silver chloride in the presence of light decomposes to give silver and chlorine gas.

$2AgCl\,(s) \xrightarrow{Light} 2Ag(s) + Cl_2(g)$ [1]

Thermal decomposition is a chemical decomposition caused by heat.

For example, when baking soda is heated, we get sodium carbonate along with carbon dioxide and water.

$2NaHCO_3 \xrightarrow{Heat} CO_2 + H_2O + Na_2CO_3$ [1]

8. Physical change: When a candle burns, the wax melts. The state of wax changes from solid to liquid hence, it is a physical change. [1]

Chemical change: The wax near the wick is composed of carbon. When the wax burns its chemical composition changes and due to which carbon dioxide and water is released. A black residue called soot is also produced. This shows that a chemical change takes place while the candle is burning. [1]

9.

$KCl(aq) + AgNO_3(aq) \rightarrow AgCl(s) + KNO_3(aq)$

Potassium chloride	*Silver nitrate*	*Silver cloride* (*white ppt.*)	*Potassium nitrate*

It is a "Double displacement reaction" as well as a "Precipitation reaction" as AgCl forms a white precipitate. [1]

10. The gas produced in the reaction with a pop up sound is hydrogen. Zinc reacts with dilute sulphuric acid to produce hydrogen gas and zinc sulphate. [1]

$Zn(s) + dil.H_2SO_4(l) \rightarrow ZnSO_4(s) + H_2(g)$ [1]

This is an example of dispacement reaction.

11. (a) Lead is more reactive than copper and therefore, it displaces it from its solution. When a strip of lead metal is placed in a solution of copper chloride, then lead chloride solution and copper metal are formed. The chemical reaction is given below:

$Pb_{(3)} + CuCl_{2(aq)} \rightarrow PbCl_{2(aq)} + Cu_{(3)}$

The green colour of copper chloride fades to give a colourless solution. [1]

(b) Precipitation reaction is a chemical reaction in which insoluble, known as a precipitate, is formed when 2 solutions containing soluble salts are combined. [1]

For example:

$AgNO_3(aq) + KCl(aq) \rightarrow AgCl$ *(precipitate)* $+ KNO_3(aq)$

In the above reaction, Silver Chloride is formed as a precipitate. [1]

12. (a) Decomposition reaction is a type of chemical reaction in which single compound splits into two or more simpler substances. Digestion is process where large chunks of nutrient molecules break down into smaller molecules and provide energy to the body. Therefore, digestion of food involves decomposition reaction. [1]

(b) All the decomposition reactions are endothermic reaction because decomposition requires energy. These reactions often involve an energy source in some form and it breaks apart the bonds of compounds. This energy can be either in the form of light, heat or electricity. [1]

(c) Hydrogen gas is produced during the electrolysis of water. A popping sound is produced when a burning candle is brought near mouth of a test tube used in electrolysis of water because Hydrogen is a combustible gas and when it comes in contact of fire, it explodes with a popping sound [1]

13. Carbon is used as a reducing agent for less reactive metals. For metal oxides of a comparatively more reactive metal than zinc, aluminium is used as a reducing agent. [1]

For example, aluminium powder is used as a reducing agent when we have to reduce manganese dioxide. [1]

$3MnO_2(s) + 4Al(s) \rightarrow 2Al_2O_3(s) + 3Mn + Heat$

In this exothermic reaction, aluminium powder reduces the metal oxide to metal and itself gets oxidized to aluminium oxide. [1]

14. The equation of the chemical reaction is as follows:

$Zn + 2NaOH \rightarrow Na_2ZnO_2 + H_2\uparrow$ [1½]

The equation shows that hydrogen gas is liberated. It can be detected by putting a burning matchstick at the opening of a test tube. It is observed that there is a pop-sound and a blue colored flame.

When zinc reacts with dilute hydrochloric acid, hydrogen gas is evolved.

$Zn + 2HCl \rightarrow ZnCl_2 + H_2\uparrow$ [1½]

15. Thermal decomposition reaction where energy is supplied as heat.

$$CaCO_3 \xrightarrow{\Delta} CaO + CO_2$$ [1]

Photo decomposition reaction where energy is supplied as light.

$$2AgCl \xrightarrow{sunlight} 2Ag + Cl_2$$ [1]

Electrolytic decomposition reaction where energy is supplied as electricity

$$2H_2O \xrightarrow{electricity} 2H_2 + O_2$$ [1]

16. (a) The process used to produce sodium chloride is known as Chloroalkali process. Chlorine and sodium hydroxide are used as commodity chemicals in the industries. These chemicals are produced by Chloroalkali process. When electricity is passed through an aqueous solution sodium chloride (called brine) it decomposes to form sodium hydroxide,chlorine gas and hydrogen gas.

The chemical equation for producing sodium hydroxide is [2]

$2NaCl(aq) + 2H_2O\ (l) \rightarrow 2NaOH + Cl_2(g) + H_2(g)$

The process is named as chlor-alkali because the term chlor-alkali refers to the two chemicals i.e. chlorine and an alkali which are produced simultaneously because of electrolysis of a saltwater. [2]

(b) Sodium hydroxide (NaOH) is used to manufacture soaps and chlorine is used as an antiseptic and is used to make drinking water safe. [1]

Smart Notes .....

CHAPTER 2

Acids, Bases and Salts

Chapter Analysis with respect to Last 3 Years' Board Exams

List of Topics	**2016**	**2017**	**2018**
Their definitions in terms of furnishing of H+ and OH- ions, General properties, examples and uses	3Q (1 mark), 1Q (2 marks)	1Q (1 mark), 1Q (3 marks)	
Concept of pH scale, importance of pH in everyday life	1Q (1 mark), 1Q (2 marks)	1Q (1 mark)	1Q (3 marks)
Preparation and uses of sodium hydroxide, Bleaching powder, Baking soda, Washing soda and Plaster of Paris.	2Q (1 mark), 1Q (3 marks)	1Q (3 marks), 2Q (1 mark)	

On the basis of above analysis, it can be said that from exam point of view, concept of pH and different applications of bases and salts in general life are the most important topics of the chapter.

Summary

Knowing your Chapter at Glance:

Acid

- The term 'acid' has been derived from the Latin word 'acidus' which means sour.

  Characteristics of acids

  * They are sour in taste.
  * They give H^+ ions in aqueous solution.
  * They turn blue litmus red.
  * The aqueous solution of acid conducts electricity.
  * Most acids are corrosive in nature. They produce a burning sensation on the skin and make holes on surfaces on which they fall.
- Acids produce H^+ ions when dissolved in water. H^+ ions cannot exist alone. They combine with water molecule to form H_3O^+.Acids when dissolved in water release a large amount of heat. Hence it is advised to add acid to water drop by drop with constant stirring.

Acids are of 2 types

* Strong acids
* Weak acids
* Strong acids dissociate completely in water and thus produces a large amount of H^+, while weak acids do not dissociate completely and thus produces small amount of H^+ (aq) ions.

Example of strong acids

HCl, H_2SO_4

Example of weak acids

CH_3COOH, HNO_3

- The acids obtained from minerals are called **mineral acids**. Those acids which are obtained from plants and animals are called **organic acids**. Those acids which contain minimum amount of water are called **concentrated.**

  Reaction involving acids

  Reaction with metals

  Acid + Metal → Salt + Hydrogen gas

  e.g., $2HCl + Zn \rightarrow ZnCl_2 + H_2$

Reaction with metal carbonates

Acid + Metal carbonate → Salt + CO_2 + H_2O

e.g., $2HCl + Na_2CO_3 \rightarrow 2NaCl + CO_2 + H_2O$

Reaction with metal hydrogen carbonates

Acid + Metal hydrogen carbonate Salt + CO_2 + H_2O

e.g. $HCl + NaHCO_3 \rightarrow NaCl + H_2O + CO_2$

Reaction with metallic oxide

Acid + Metal oxide → Salt + Water

e.g. $2HCl + CuO \rightarrow CuCl_2 + H_2O$

Strength of an acid ∝ Degree of ionization

Bases

Characteristics of base

- Bases are substances that, in aqueous solution, release hydroxide (OH^-) ions
- They are slippery to the touch
- They taste bitter
- They turn red litmus paper blue

Types of bases

- **Strong base**

  Strong base is a base that is completely dissociated in an aqueous solution.

  These compounds ionize in water to yield one or more hydroxide ion (OH^-) per molecule of base.

  Eg:- NaOH, KOH
- **Weak base**

  a weak base is a base that does not ionize fully in an aqueous solution.

  Eg:- NH_3, NH_4OH

Reaction involving base

Reaction with metal

Base + Metal → Salt + H_2 gas

e.g., $2NaOH + Zn \rightarrow Na_2ZnO_2 + H_2$

Reaction with non metallic oxide

Base + Non-metallic oxide → Salt + H_2O

- **Salt:** The ionic compound consisting of two parts, one containing a positive charge (cation) and the other carrying a negative charge (anion)
- Salt of strong acid and strong base: NaCl, KCl

- Salt of strong acid and weak base: NH_4Cl.
- Salt of weak acid and strong base: CH_3COONa.
- Salt of weak acid and weak base: CH_2COONH_4.
- **Indicators**

  Indicators are those substances which change their colour (or odour) in acidic or basic solutions.
- Natural indicator: Litmus solution, turmeric
- Synthetic indicator: Phenolphthalein, methyl orange
- Olfactory indicator: Onion, clove oil, vanilla extract.

	Indicator	Acids	Bases
1.	Red litmus	remains red	turns blue
2.	Blue litmus	turns red	remains blue
3.	Phenolphthalein	colourless	pink
4.	Methyl orange	red	yellow

- A **universal indicator** with the mixture of many different indicators which show graduate but well marks series of colour changes over a very wide range of change in concentration of H^+ ion.
- pH is the scale for measuring hydrogen ion concentration. The concentration of H^+ are generally small. The concentration of H^+ are expressed in terms of pH. pH is defined as negative logarithm of H^+ concentration

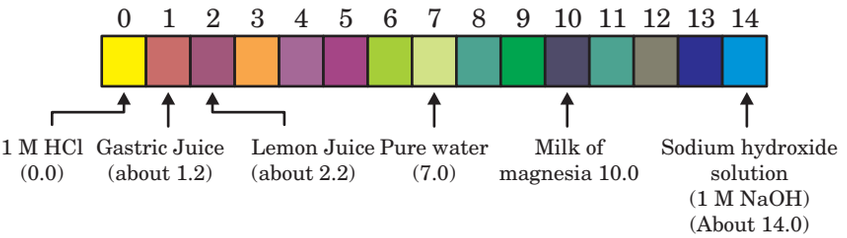
  or H_3O^+ concentration.

  $pH = -\log[H^+]$ or $pH = -\log[H_3O^+]$
- For a neutral solution

  $[H^+] = [OH^-] = 10\text{-}7$ mol/L; pH = 7
- For an acidic solution

  $[H^+] > [OH^-]$; pH < 7
- For a basic solution

  $[H^+] < [OH^-]$; pH > 7



PREVIOUS YEARS' EXAMINATION QUESTIONS

1 Mark Questions

1. A student tested the pH of distilled water using pH paper and observed green colour. After adding a few drops of dilute NaOH solution, the pH was tested again. The colour change now observed would be:
(a) Blue
(b) Green
(c) red
(d) orange **[TERM 1, 2011, 2015]**

2. Four solutions I, II III and IV were given to a student to test their acidic or basic nature by using pH papers. He observed that the colour of pH paper turned to red, blue, green and orange respectively when dipped in four solutions. The correct conclusion made by the student would be
(a) I, II and III are acidic
(b) I and IV are acidic
(c) II, III, and IV are acidic
(d) II and IV are acidic **[TERM 1, 2011]**

3. A metal powder was added to dil. HCl and dil. NaOH solutions taken in separate test tubes. On mixing the contents react in both the test tubes. Hydrogen gas was formed in both the cases. The metal used will be:
(a) Cu
(b) Zn
(c) Fe
(d) Pb **[TERM 1, 2011]**

4. Acetic acid reacts with solid sodium hydrogen carbonate
(a) Slowly forming no gas.
(b) Vigorously with effervescence.
(c) Slowly without effervescence.
(d) Vigorously without gas formation.
[TERM 1, 2011, 2012, 2017]

5. Which one of the following are the correct observations about acetic acid?
(a) It turns blue litmus red and smells like vinegar
(b) It turns blue litmus red and smells like burning sulphur
(c) It turns red litmus blue and smells like vinegar
(d) It turns red litmus blue and has a fruity smell
[TERM 1, 2012]

6. In an experiment to study the properties of acetic acid a student takes about 2 ml of acetic acid in a dry test tube. He adds about 2 ml of water to it and shakes the test tube well. He is likely to observe that:
(a) The acetic acid dissolves readily in water
(b) The solution becomes light orange
(*c*) Water floats over the surface of acetic acid
(*d*) Acetic acid floats over the surface of water
[TERM 1, 2013]

7. Rahul took some zinc granules in a test tube and added dilute HCl to it. He observed that the colour of the zinc granules changed to
(a) Yellow
(b) Brown
(c) Black
(d) White **[TERM 1, 2013]**

8. A colourless and odourless gas is liberated when hydrochloric acid is added to a solution of washing soda. The name of the gas is:
(a) Carbon dioxide
(b) Nitrogen dioxide
(c) Sulphur dioxide
(d) Sulphur trioxide
[TERM 1, 2013]

9. Two colours seen at the extreme ends of pH chart are
(a) Red and blue
(b) Red and green
(c) Green and blue
(d) Orange and black
[TERM 1, 2017]

10. Read the following statements:
I. When a red litmus paper is dipped into reaction mixture of a saponification reaction, it turns blue and the reaction is exothermic.
II. When a blue litmus paper is dipped into reaction mixture of a saponification reaction, its colour does not change and the reaction is exothermic.
III. When a red litmus paper is dipped into reaction mixture of a saponification reaction, its colour does not change and the reaction is endothermic.
IV. When a blue litmus paper is dipped into reaction mixture of a saponification reaction, its colour does not change and the reaction is endothermic.
Which of the above statements are correct?
(a) I and II
(b) II and III
(c) III and IV
(d) I and IV **[TERM 1, 2013]**

11. Why is it advised not to use copper or brass vessels to store pickles or curd?
[TERM 1, 2013]

12. The colour of the pH paper strip turned red when it was dipped into a sample. The sample could be:
(a) Dilute sodium bicarbonate
(b) Tap water
(c) Dilute sodium hydroxide
(d) Dilute hydrochloric acid
[TERM 1, 2014]

13. Which one of the following cannot be used to find the pH of a solution?
(a) pH paper
(b) Litmus paper
(c) Universal indicator
(d) Standard pH value chart
[TERM 1, 2014]

14. Dil. HCl is added to solid sodium carbonate. It is observed that:
(a) No change takes place
(b) A loud sound is produced immediately
(c) Immediately a brisk effervescence is produced
(d) The solution turns blue black
[TERM 1, 2014]

15. We need 20% aqueous solution of sodium hydroxide for the study of saponification reaction. When we open the lid of the bottle containing solid sodium hydroxide we observe it in which form?
(a) Colourless transparent beads
(b) Small white beads
(c) White pellets/ flakes
(d) Fine white powder
[TERM 1, 2014]

16. In locality, hard water, required for an experiment, is not available. However, the following salts are available in the school laboratory:
1. Sodium sulphate
2. Calcium sulphate
3. Magnesium chloride
4. Sodium chloride
5. Calcium chloride
6. Potassium sulphate
Which of the above salts may be dissolved in water to obtain hard water for the experiment?
(a) 2,3 and 5
(b) 1,2 and 5
(c) 1,2,4 and 6
(d) 3 and 5 only
[TERM 1, 2014]

17. A student adds a few drops of universal indicator to an aqueous solution of sodium hydroxide. He would observe that the colour of the solution changes from:
(a) Colourless to red
(b) Colourless to blue
(c) Red to blue
(d) Blue to red

[TERM 1, 2015]

18. A colourless sample was tested with a strip of pH paper. The colour of the strip changed to green. The sample should be:
(a) Tap water
(b) Distilled water
(c) Sodium hydroxide
(d) Lemon juice

[TERM 1, 2015]

19. An iron nail was kept immersed in aluminum sulphate. After about an hour, it was observed that:
(a) The colourless solution changed to light green.
(b) The solution becomes warm.
(c) Grey metal is deposited on the iron nail.
(d) The solution remains colourless and no deposition is observed on iron nail

[TERM 1, 2015]

20. A student was given four samples of water in four different test tubes. These were of distilled water, lemon water, water having dil. HCl in it, water having NaOH in it. For which sample pH value will be 7
(a) Lemon water
(b) Distilled water
(c) Water with HCl in it
(d) Water with NaOH in it

[TERM 1, 2016]

21. If pH of solution changes from 3 to 4, the solution becomes
(a) Less acidic
(b) Basic
(c) More acidic
(d) Strongly basic

[TERM 1, 2016]

22. Name the scientist who proposed acid- Base theory
(a) Arrhenius
(b) Newton
(c) Dalton
(d) Einstein

[TERM 1, 2016]

23. Name the gas evolved when Zinc metal reacts with HCl acid
(a) CO
(b) CO_2
(c) SO_2
(d) H_2

[TERM 1, 2016, 2017]

24. What is the important property of an acid?
(a) Sour taste
(b) Soapy touch
(c) Bitter Taste
(d) No odour

[TERM 1, 2016]

25. A blue litmus paper was first dipped in dil. HCl and then in dil. NaOH solution. It was observed that the colour of the litmus paper
(a) Changed to red
(b) Changed first to red and then to blue
(c) Changed blue to colourless
(d) Remained blue in both the solutions

[TERM 1, 2016]

26. When a drop of an unknown solution X is placed on a strip of pH paper, a deep blue colour is produced. This solution should be -
(a) NaOH
(b) Lemon juice
(c) Water
(d) HCl

[TERM 1, 2017]

27. Write the chemical formula of baking soda. How is baking soda prepared? Write the reaction which takes place when it is heated during cooking?

[TERM 1, 2011]

2 Mark Questions

28. Fill in the blanks with appropriate words.
(a) Acetic acid turns _____ litmus solution or paper into _____.
(b) Acetic acid is miscible in _____ in all proportions and form _____ solutions.

[TERM 1, 2015]

29. On diluting an acid, it is advised to add acid to water and not water to acid. Explain why it is so advised?

[TERM 1, 2016]

30. A student adds a spoon full of powdered sodium hydrogen carbonate to a flask containing ethanoic acid. List two main observations, he must note in his note book, about the reaction takes place. Also write chemical equation for the reaction.

[TERM 1, 2016]

3 Mark Questions

31. A solution of a substance 'X' is used for white washing.

[TERM 1, 2011]

32. (a) A white powder is an active ingredient of antacids and is used in preparation of cakes. Name the compound and state how is it manufactured? Give chemical equation.

(b) Write an equation to show the effect of heat on this compound

[TERM 1, 2011, 2013, 2017]

33. (a) Define 'water of crystallization'.

(b) Give two examples of substances having water of crystallization. Write their chemical formula.

[TERM 1, 2013]

34. (i) Write the chemical name and formula of "Plaster of Paris".

(ii) How is it prepared?

(iii) Write chemical equations of the reaction.

[TERM 1, 2014]

35. You are provided with three test tubes A, B, C which contain distilled water, Acidic and basic solutions. If you are given blue litmus paper only, how will you identify the nature of the solutions in three test tubes?

[TERM 1, 2014]

36. A Compound P forms the enamel of teeth. It is the hardest substance of the body. It doesn't dissolve in water but gets corroded when the pH is lowered below

(a) Identify the compound P

(b) How does it undergo damage due to eating chocolate and sweets? What should we do to prevent tooth decay?

[TERM 1, 2016]

37. A blue colour salt becomes white on heating. Give reason for the above observation. What happens when we add water to the salt which is obtained after heating? Also write its

[TERM 1, 2017]

38. The pH of a salt used to make tasty and crispy pakoras is 14. Identify the salt and write a chemical equation for its formation. List its two uses.

[TERM 1, 2018]

5 Mark Questions

39. (a) A milkman adds a very small amount of baking soda to fresh milk.

(i) Why does he shift the pH of the fresh milk from 6 to slightly alkaline?

(ii) Why does this milk take a long time to set as curd?

(b) What is a neutralization reaction? Give two examples.

[TERM 1, 2013]

40. (a) Name the process by which sodium hydroxide is prepared from sodium chloride? Why it is called so process and write down the balanced chemical equation.

(b) What will be the pH of the following salts?

(i) Salt made of strong acid and strong base.

(ii) Salt made of strong acid and weak base.

[TERM 1, 2013]

41. (a) Five solutions A, B, C, D and E when tested with universal indicator showed pH as respectively. Which solution is:

(i) Neutral?

(ii) Strongly alkaline?

(iii) Strongly acidic?

(iv) Weakly acidic?

(v) Weakly alkaline?

Arrange the pH in increasing order of hydrogen-ion concentration.

(b) Equal lengths of magnesium ribbons are taken in test tubes A and B.Hydrochloric acid (HCl) is added to test tube A, while acetic acid is added to test tube B. In which test tube will the fizzing occur more vigorously and why?

[TERM 1, 2014]

42. (a) Write the chemical name and formula of washing soda. How is it prepared? Write the chemical equation of the reaction.

(b) Why does distilled water not conduct electricity, whereas rain water does?

[TERM 1, 2014]

43. (a) Write an equation to show the reaction between Plaster of Paris and water.

(b) Name the substance which on treatment with chlorine yields bleaching powder.

(c) Name the sodium compound which is used for softening hard water.

(d) What will happen if a solution of sodium hydrogen carbonate is heated? Give the equation of the reaction involved.

[TERM 1, 2015]

44. A sanitary worker uses a white chemical having strong smell of chlorine gas to disinfect the water tank.

(a) Identify the chemical compound.

(b) Write the chemical formula.

(c) Write chemical equation for preparing it.

(d) Write it's any two uses.

[TERM 1, 2015]

Solutions

1. We know that pH paper shows red color for acids, and blue color for bases. More basic the solution, more blue is the paper and more acidic the solution, more red will be the color of the paper. As, distilled water is neutral in nature, so its color on pH paper is green.

Also, we know that NaOH is basic in nature. So, the color of pH paper will turn blue. [1]

2. We know that pH paper shows red color for acids, and blue color for bases and green color for neutral solutions. More basic the solution, more blue is the paper and more acidic the solution, more red will be the color of the paper. [½]

Solutions I and IV show the red and orange color respectively. Therefore, solutions I and IV will be acidic.

Solution II shows blue color. So, it will be basic and solution III shows green color, so it will be neutral in nature. [½]

Hence, option (b) is correct.

3. We know that zinc is the metal that reacts with both HCl and NaOH to liberate hydrogen gas. The reaction can be explained as:

1. With HCl

$Zn + 2HCl \rightarrow ZnCl_2 + H_2$ [½]

2. With NaOH

$Zn + 2\,NaOH \rightarrow Na_2ZnO_2 + H_2$ [½]

Hence, option (b) is correct.

4. Vigorously with effervescence.

When acetic acid reacts with sodium hydrogen carbonate, is released, this causes brisk effervescence. [½]

$CH_3COOH(aq) + NaHCO_3(s) \rightarrow CH3COONa\ (aq) + CO_2(g) + H_2O$ [½]

5. Acetic acid turns blue litmus red and smells like vinegar. [½]

When a blue litmus paper comes in contact of acid, it turns red and when a red litmus paper comes in contact of basic solution it turns blue. As acetic acid is acidic in nature so it turns blue litmus paper red. Acetic acid smells like vinegar because main component of vinegar is acetic acid. Vinegar has 3-9% acetic acid by volume in its composition. [½]

6. He is likely to observe that the acetic acid dissolves readily in water as acetic acid is extremely soluble in water. Hence option (A) is correct. [½]

7. The correct option is (d).

When dilute HCl is added to zinc granules, the reaction produces a white chemical compound $ZnCl_2$ and hydrogen gas. [½]

$Zn + 2HCl \rightarrow ZnCl_2 + H_2\,(g)$

So, the zinc chloride produced in the reaction is white in colour. [½]

8. The correct option is (a) carbon dioxide

The reason is that the washing soda (sodium carbonate) is a basic salt. It reacts with HCl acid to give sodium chloride with water and CO_2. Carbon dioxide is a colourless and odourless gas.

$Na_2CO_3 + 2HCl \rightarrow 2NaCl + H_2O + CO_2$ [1]

9. The correct option is (a) red and blue

In the pH scale, red is at the top and blue at the bottom. Red represents the strong acidic solution while blue is for strong base. [1]

10. I and II

Soap solution is basic in nature and saponification is an exothermic reaction. Therefore, the redlitmus paper is turned to blue. [½]

The blue litmus paper does not change its colour when it is dipped in the soap solution. [½]

11. The curd and pickles are acidic in nature, so when they are kept in copper or brass vessels which are metals, they react with them and make harmful elements. [1]

12. The pH paper turns red when it is dipped in any acidic solution. Hence, the sample could be dilute hydrochloric acid. Therefore, the correct answer is option D. [1]

13. Litmus paper cannot be used to find the pH of a solution this is because it indicates whether the given substance is either an acid or a base. It does not tell the pH of the substance. Hence, the correct answer is option B. [1]

14. When dilute HCL is added to solid sodium carbonate, immediately a brisk effervescence is produced because HCL is an acid and sodium carbonate is basic. A neutralization reaction will take place to form Sodium chloride salt and CO_2 is released which causes brisk effervescence.

$Na_2\,CO_3 + 2HCl \rightarrow 2NaCl + H_2O + CO_2$ [1]

Hence, the correct answer is option (c).

15. We observe it in the form of White pellets/ flakes when we open the lid of the bottle containing solid sodium hydroxide. So the correct option is (c). [1]

16. (a) 2,3 and 5

Hard water comprises of salts of Calcium and Magnesium. The salts are mainly bicarbonates, chlorides and sulphates of Calcium and Magnesium. [1]

17. Sodium hydroxide has a pH close to 14 and it is a very strong base. When few drops of universal indicator are added to an aqueous solution of sodium hydroxide, which is colorless, its color changes to blue. [1]

18. A colourless sample was tested with a strip of pH paper. The colour of strip changed to green. This can only happen when the pH of the sample is 7. Thus, the sample should be distilled water. [1]

19. An iron nail was kept immersed in aluminum sulphate. After about an hour, it was observed that the solution remains colourless and no deposition is observed on iron nail. This is because iron cannot displace aluminium from its salt solution since Al is more reactive than iron. [1]

20. Lemon contains citric acid, HCl is an acid and NaOH is a base. Distilled water is neither base nor acid, so distilled water will have pH value of 7.Therefore, the correct answer is option (b). [1]

21. If pH of solution changes from 3 to 4, the solution will become less acidic. Hence option (a) is correct. [1]

22. Arrhenius proposed acid-base theory. Hence option(a) is correct. [1]

23. $Zn + HCl \rightarrow H_2 + ZnCl_2$

From the above chemical reaction we can see that H_2 evolve when Zinc reacts with HCl. Hence option (d) is correct. [1]

24. The important property of acid is that they are sour in taste. Hence option(a) is correct. [1]

25. Blue litmus paper changes into red when it dipped indil. acid and it changes into blue when dipped into dil. *NaOH* solution. Hence option(b) is correct. [1]

26. *NaOH* is a highly reactive base which turns pH paper into a deep blue colour. [1]

27. The chemical name of Baking soda is sodium hydrogen carbonate, and its chemical formula $NaHCO_3$ is. It is produced by using sodium chloride as one of the raw materials. [½]

$NaCl + H_2O + CO_2 + NH_3 \rightarrow NH_4Cl + NaHCO_3$

When it is heated during cooking the following reaction takes place [½]

$$2NaHCO_3 \xrightarrow{heat} Na_2CO_3 + H_2O + CO_2$$
$$\begin{pmatrix} Sodium \\ Carbonate \end{pmatrix}$$

28. (a) Acetic acid turns blue litmus paper into red. [1]

(b) Acetic acid is miscible in water in all proportions and form homogeneous solution. [1]

29. On diluting an acid, it is advised to add acid to water and not water to acid mixing of water and acid is a highly exothermic process. When water is added to acid, due to small amount of water, evolved heat will change it to vapour and acid will spill out and may cause injury. So it is advised to mix acid in to water and not water to acid. [1 + 1]

30. Sodium hydrogen carbonate on reacting with ethanoic acid, gives brisk effervescence with a colorless and odorless gas and that a sodium salt is formed.

The chemical equation for the reaction is:

$CH_3COOH + NaHCO_3 \rightarrow CH_3COONa + H_2O + CO_2$ [1 + 1]

31. The strengths of acids and bases depend on the number of H^+ ions and OH produced, respectively. If we take hydrochloric acid and acetic acid of the same concentration, then these produce different amounts of hydrogen ions. Acids that give rise to more H^+ ions are said to be strong acids and acids that give less H^+ ions are said to be weak acids. Acetic acid is a weak acid and sulphuric acid is a strong acid. [1 + 1 + 1]

32. (a) The white powder that is an active ingredient of antacids is 'Baking Soda' or Sodium hydrogen Carbonate . It is produced using Sodium Chloride as one of the raw materials

$$NaCl + H_2O + CO_2 + NH_3 \longrightarrow NH_4Cl + NaHCO_3$$
$$\begin{pmatrix} Ammonium \\ Chloride \end{pmatrix} \begin{pmatrix} Sodium \\ hydrogen \\ carbonate \end{pmatrix}$$

[1½]

(b) The following reaction takes place when it is heated during cooking.

$$2NaHCO_3 \xrightarrow{heat} Na_2CO_3 + H_2O + CO_2$$
$$\begin{pmatrix} Sodium \\ carbonate \end{pmatrix}$$

[1½]

33. (a) The number of water molecules which exist in one formula unit of a salt is known as Water of Crystallization. [1½]

(b) The two substances which have water of crystallization are copper sulphate and gypsum. In copper sulphate, there are 5 water molecules present. Its formula is $CuSO_4.5H_2O$. Gypsum has 2 water molecules in its one formula unit. The formula of gypsum is $CaSO_4.2H_2O$. [1½]

34. (i) Calcium sulphate hemihydrate is the chemical name of "Plaster of Paris" is. Its chemical formula is given by

$$CaSO_4.\frac{1}{2}H_2O$$ [1]

(ii) Plaster of Paris is produced when gypsum is heated at 373 K. [1]

(iii) The chemical equation of the reaction is given by:

$$CaSO_4.2H_2O \xrightarrow{373K} CaSO_4.\frac{1}{2}H_2O + \frac{3}{2}H_2O$$

[1]

35. Blue litmus paper will turn red when it is dipped in an acidic solution. Dip the blue litmus paper in each of the three test tubes, the one which turns the litmus paper red is the acidic solution. Now you have a red litmus paper and two remaining test tubes. Dip the red litmus paper in the remaining two test tubes, the one with the basic solution will turn the litmus paper back to blue. Hence, that test tube contains basic solution and the remaining test tube contains distilled water. [1 + 1 + 1]

36. (a) The compound P is calcium phosphate. [1]

(b) Acid is produced in mouth because of the leftover food particles and the presence of bacteria in our mouth. Bacteria present in the mouth work on the leftover food particles and produce acid. [1]

Toothpastes (basic) are used to prevent tooth decay. Toothpastes neutralize the excess acid. [1]

37. A blue colour salt becomes white on heating due to the loss of water of crystallization. If we add water to the salt which is obtained after heating then the blue colour of the salt will reappear. [2]

The chemical formula for the salt is $CuSO_4.5H_2O$ [1]

38. The salt used to make pakoras with a pH of 14 is $NaHCO_3$. The chemical equation for the formation of sodium hydrogen carbonate is as follows:

$$Na2CO_3 + H_2O + CO_2 \rightarrow 2NaHCO_3$$ [1½]

Two uses of $NaHCO_3$ are:

(i) It is used as an antacid in medicines.

(ii) It is used to make cakes as it makes them fluffier. [1½]

39. (a) (i) The pH of pure milk is approximately 6 which is slightly acidic in nature. If the pure milk is left for some time, the lactic acid is formed and the milk is converted to curd. The milkman adds small amount of baking soda to the fresh milk and the pH of the milk is shifted to slightly alkaline so that the milk can be used for longer time. After adding baking soda, as the pH of the milk becomes greater than 7, so it takes time to form acid and the milk can be used for longer time. [2]

(ii) After adding baking soda to the fresh milk, it has now become slightly basic in nature and the acid formed gets neutralizes by the base. That is why this milk takes time to set as curd than the pure milk. [1]

(b) The reaction in which acid and base react together to form salt and water is known as neutralization reaction.

Acid Base → Salt + Water [1]

The examples of neutralization reaction are :

$$HCl + NaOH \rightarrow NaCl + H_2O$$

$$NHO_3 + KOH \rightarrow KNO_3 + H_2O$$ [1]

40. (a) The process by which sodium hydroxide is prepared from sodium chloride is called the chlor-alkali process. In this process, through the aqueous solution of sodium chloride which is also called as brine, the electricity is made to pass. The products formed in this process are chlorine and sodium hydroxide which is an alkali. Therefore, this process is called as chlor-alkali process. [2]

$$2NaCl + 2H_2O \rightarrow 2NaOH + Cl_2 + H_2$$ [1]

(b) (i) The pH of a salt which is made of strong acid and strong base remains 7 as this type of salts remain neutral. [1]

(ii) The pH of a salt which is made of strong acid and weak base is always less than 7. [1]

41. (a) (i) Solution D is neutral because its pH is .

(ii) Solution C is strongly alkaline.

(iii) Solution B is strongly acidic.

(iv) Solution A is weakly acidic.

(v) Solution E is weakly alkaline.

The pH in increasing order of hydrogen-ion concentration is:

$11 < 9 < 7 < 4 < 1$ [2½]

(b) Since, HCl is a stronger acid than the acetic acid, it will react more vigorously with magnesium than the acetic acid because it has more hydrogen ions therefore, the fizzing will occur more vigorously in test tube A. [2½]

42. (a) The chemical name of washing soda is Sodium carbonate decahydrate. Its chemical formula is $Na_2CO_3.10H_2O$. [½]

It is prepared in three steps. In the first step baking soda is obtained from sodium chloride as one of the raw materials. After heating the baking soda, sodium carbonate is formed. The re-crystallization of sodium carbonate gives washing soda. Following are the involved chemical reactions: [½]

$$NaCl + H_2O + CO_2 + NH_3 \longrightarrow \underset{(Ammonium\ chloride)}{NH_4Cl} + \underset{(Sodium\ Hydrogen\ carbonate)}{NaHCO_3}$$

[½]

$$\underset{(Sodium\ Hydrogen\ carbonate)}{NaHCO_3} \xrightarrow{Heat} \underset{(Sodium\ carbonate)}{Na_2CO_3} + H_2O + CO_2$$

[½]

$$\underset{(Sodium\ carbonate)}{Na_2CO_3} + 10H_2O \longrightarrow Na_2CO_3.10H_2O$$

[½]

(b) Any material conducts electricity because of the presence ofions. Distilled water contains no ionic impurities in it because it has been purified with distillation. Whereas in rain water there are some ions present as impurities for conduction of electricity. So, distilled water doesn't conduct electricity, whereas rain water does. [2½]

43. (a)

$$\underset{(Plaster\ of\ Paris)}{CaSO_4\ \ \frac{1}{2}H_2O} + 1\frac{1}{2}H_2O \longrightarrow \underset{(Gypsum)}{CaSO_4\ \ 2H_2O}$$

[1]

Gypsum is produced when Plaster of Paris reacts with water.

(b) Bleaching powder is yielded when Calcium Hydroxide is treated with chlorine gas. [1]

$Ca(OH)_2\,(s) + Cl_2\,(g) \rightarrow CaOCl_2\,(s) + H_2O\,(l)$

(c) Hydrated sodium carbonate, also known as washing soda is used for softening of hard water. Chemical formula for washing soda is $Na_2CO_3.10H_2O$ [1]

(d) Heating of sodium hydrogen carbonate produces carbon dioxide gas and the products formed are sodium carbonate and water. [1]

$$2NaHCO_3 \xrightarrow{heat} Na_2CO_3 + H_2O + CO_2$$

This is an endothermic reaction as heat is absorbed in the reaction. [1]

44. A white chemical compound having strong smell of chlorine gas is often used to disinfect the water tank.

(a) The chemical compound is Calcium-oxychloride. [1]

(b) Its chemical formula is $CaOCl_2$ [1]

(c) The chemical equation for preparing this chemical compound is:

$$Ca(OH)_2 + Cl_2 \longrightarrow CaOCl_2 + H_20$$

[1]

(d) Use of calcium oxychloride: [1]

It is used as a strong oxidizing agent.

It is also used in textile industries for bleaching of linen and cotton. [1]

Smart Notes .....

Smart Notes .....

CHAPTER 3

Metals and Non-metals

Chapter Analysis with respect to Last 3 Years' Board Exams

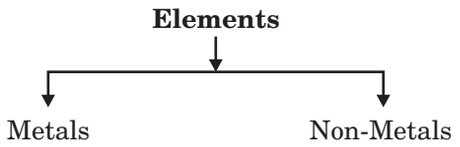
List of Topics	**2016**	**2017**	**2018**
Properties of Metals and Non-metals	1Q (2 marks)		
Reactivity series, formation and properties of ionic compounds	1Q (3 marks)		
Basic metallurgical processes, corrosion and its prevention	1Q (3 marks)	1Q (2 marks), 1Q (5 marks)	1Q (5 marks)

On the basis of above analysis, it can be said that from exam point of view, metallurgical processes and corrosion related concepts are the most important topics of the chapter.

Topic 1: Metal, Non-metals & Their Properties

Summary

Knowing your Chapter at Glance:



Physical properties

Metal	Non-metal
Mostly Solid	Solid, liquid and gas.
Lustrous and sonorous	Non-lustrous.
Malleable and ductile	Non-malleable and non ductile.
Hard and have high density	Varying hardness and have low density.
Good conductors of heat and electricity	Poor conductors of heat and electricity.
High melting and boiling point	Low melting and boiling points.

- Substances that can be beaten into thin sheets are called malleable.
- Substances that can be drawn into thin wires are called ductile.

Exception in physical properties

- Graphite a non metal is a good conductor of electricity
- Iodine is a lustrous non metal
- Diamond is allotrope of carbon which is a non metal is the hardest substance while Sodium and potassium being metal are soft enough to be cut by knife
- Mercury is the metal, is liquid at room temperature while rest are solids.
- Sodium, Potassium, mercury, caesium and gallium are metals with low melting and boiling point
- Diamond is a non metal with the high melting and boiling point
- Sodium, Potassium and lithium are metals with low density.

Chemical properties of metals

- React with dilute acids to liberate hydrogen gas.

  Metal + Dilute acid $\longrightarrow$ Salt + Hydrogen

  $2Na + 2HCl \longrightarrow 2NaCl + H_2$

  $Mg + 2HCl \longrightarrow MgCl_2 + H_2$

  $2Al + 6HCl \longrightarrow 2AlCl_3 + 3H_2$

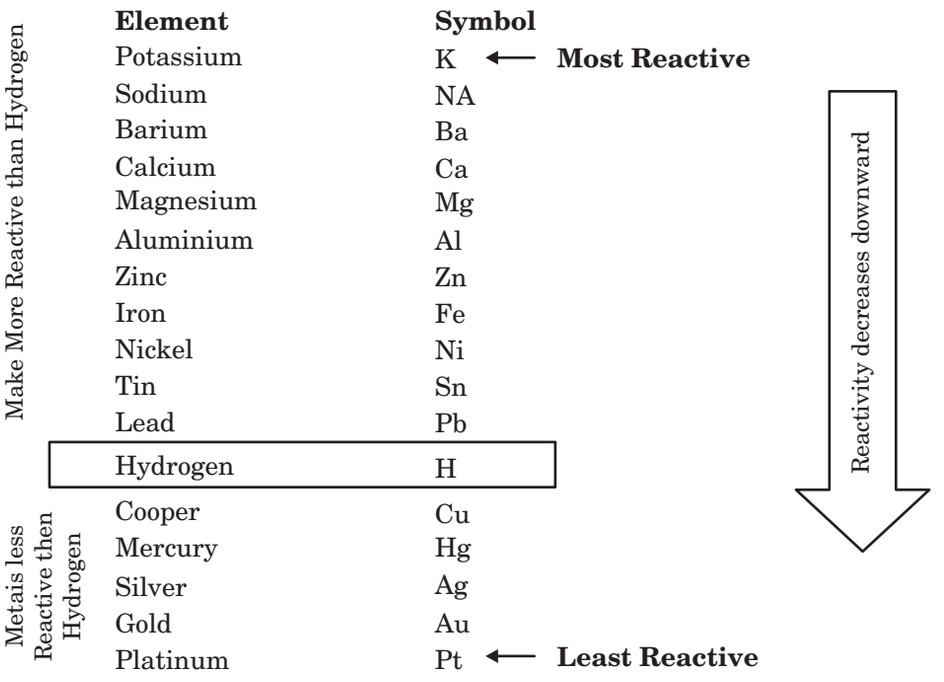
  $2Na(s) + H_2SO_4\,(aq) \longrightarrow Na_2SO_4(aq) + H_2(g)$

  $Mg(s) + H_2SO_4(aq) \longrightarrow MgSO_4(aq) + H_2(g)$

  $2Al(s) + 3H_2SO_4(aq) \longrightarrow Al_2(SO_4)_3(aq) + 3H_2(g)$

- Those metals which are more reactive than hydrogen, displace hydrogen from dilute acids to produce hydrogen gas. This is due to the fact that the more reactive metals give electrons easily and those electrons reduce hydrogen ions of acids to hydrogen gas.

  The metals like copper and silver which are less reactive than hydrogen, do not displace hydrogen from dilute acids. Only high reactive metals displace the least reactive metals in accordance to the following series:



Activity series of metals

- **Aqua regia, (Latin for 'royal water') is a freshly prepared mixture of concentrated hydrochloric acid and concentrated nitric acid in the ratio of 3 : 1. It can dissolve gold, even though neither of these acids can do so alone. Aqua regia is a highly corrosive, fuming liquid. It is one of the few reagents that is able to dissolve gold and platinum.**
- Reacts with oxygen to form basic oxides.

  Metal + Oxygen $\longrightarrow$ Metal oxide

  Metal oxides are basic in nature.

  Sodium and potassium react with oxygen at room temperature to form basic oxides.

  $4Na + O_2 \longrightarrow 2Na_2O$

  $4K + O_2 \longrightarrow 2K_2O$
- Most of the metals do not react with hydrogen. A few reactive metals such as sodium, potassium and calcium react with hydrogen to form ionic hydride.

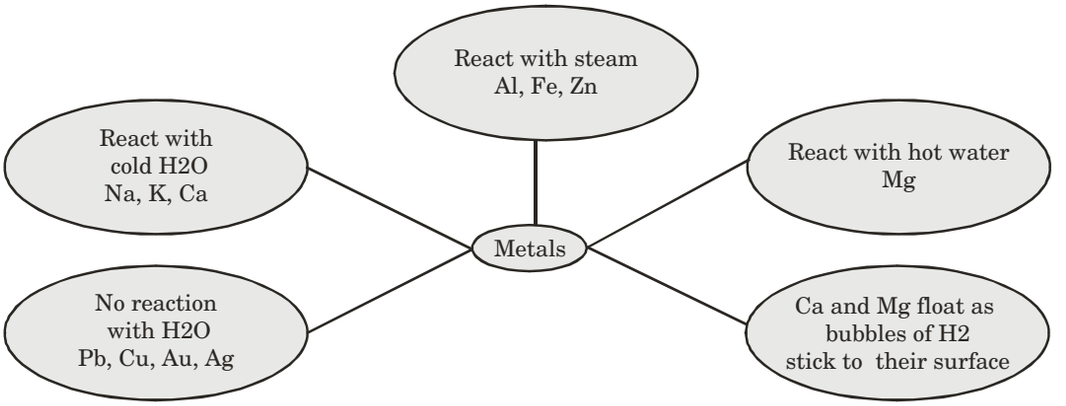
  $2Na + H_2 \longrightarrow 2NaH$

  $2K + H_2 \longrightarrow 2KH$

  $Ca + H_2 \longrightarrow CaH_2$
- React with water to form metal oxides or metal hydroxides.

  Metal + Water $\longrightarrow$ Metal oxide + Hydrogen

  Metal oxide + Water $\longrightarrow$ Metal hydroxide



- Electropositive i.e. form positive ions by losing electrons.

$$M \longrightarrow Mn^{+} + ne^{-}$$

For example:

$$Na \longrightarrow Na^{+} + e^{-}$$

$$Mg \longrightarrow Mg^{2+} + 2e^{-}$$

The characteristic chemical properties of metals are due to their electropositive character.

- Reducing agents.

Chemical properties of non-metal

- Do not displace hydrogen on reaction with dilute acids. For the liberation of hydrogen the non-metals should be able to reduce H^{+} ions to H_2 gas by supplying electrons. However, non-metals are electronegative elements and hence have more tendency to accept electrons rather than donating. Hence, non-metals do not produce hydrogen gas on reaction with acids.
- React with oxygen to form acidic or neutral oxides.

$$S + O_2 \longrightarrow SO_2$$

$$P_4 + 5O_2 \longrightarrow 2P_2O_5$$

On the other hand, certain oxides of non-metals are neutral. Some examples are nitrous oxide (N_2O), carbon monoxide (CO), etc. These oxides do not have any effect on litmus paper.

- Combine with hydrogen to form stable hydrides.
- Do not react with water .
- Electronegative i.e. form negative ions by gaining electrons.

$$\frac{1}{2}Cl_2 + e^{-} \rightarrow Cl^{-}$$

- Oxidising agents.

PREVIOUS YEARS' EXAMINATION QUESTIONS

TOPIC 1

1 Mark Questions

1. Iron nails were dipped in an aqueous solution of copper sulphate. After about 30 minutes, it was observed that the colour of the solution changed from
(a) Colourless to light green
(b) Blue to light green
(c) Blue to colourless
(d) Green to blue

[TERM 1, 2011, 2014]

2. A cleaned aluminium foil was placed in an aqueous solution of zinc sulphate. When the aluminium foil was taken out of the zinc sulphate solution after 15 minutes, its surface was found to be coated with a silvery grey deposit. From the above observation it can be concluded that
(a) Aluminium is more reactive than zinc
(b) Zinc is more reactive than aluminium
(c) Zinc and aluminium both are equally reactive
(d) Zinc and aluminium both are non-reactive

[TERM 1, 2011]

3. Solutions of copper sulphate, iron sulphate and zinc sulphate are prepared and marked I, II and III respectively. Few pieces of aluminium are added to each solution. After some time a change will be observed in
(a) I and II
(b) II and III
(c) III and I
(d) All the three

[TERM 1, 2012]

2 Marks Questions

4. (a) If an iron nail is immersed in the aqueous solution of copper sulphate, what are the changes happening to the nail and to the solution?
(b) Write the balanced chemical equation for the reaction between iron metal and aqueous copper sulphate solution.

[TERM 1, 2011]

5. Write the balance chemical equation for the chemical reaction between Manganese dioxide and Aluminum powder. What happens if Manganese powder is heated with Aluminum oxide?

[TERM 1, 2013]

3 Marks Questions

6. (a) Using a simple experiment, how can you prove that Magnesium is placed above Zinc in the reactivity series?

(b) Why copper metal cannot liberate Hydrogen when reacting with dil. HCl?

[TERM 1, 2013]

7. (a) What happens when copper is burned in air? Give the equation. What type of a reaction is it?

(b) What happens when hydrogen gas is passed over the product obtained in step above? Give the equation also.

[TERM 1, 2014]

8. (a) Aluminium is a reactive metal but is still used for packing food articles. Explain.

(b) Calcium starts floating when water is added to it. Explain.

[TERM 1, 2016]

9. (i) Carbonate of metal 'X' is abundant in earth crust and its hydroxide is used in 'white washing'. Identify metal 'X'.

(ii) How will you convert this carbonate into its oxide? Name the process and write its equation.

[TERM 1, 2016]

5 Marks Questions

10. Answer the following:

(a) How do we find whether a given element is a non metal, if we know its electronic configuration?

(b) With the help of a reaction show that zinc is more reactive than iron.

(c) In nature aluminium is found in combined state whereas silver is found in free state. Give reason.

(d) Why should we not throw small pieces of sodium into a sink in the laboratory?

(e) Name any two amphoteric oxides.

[TERM 1, 2011]

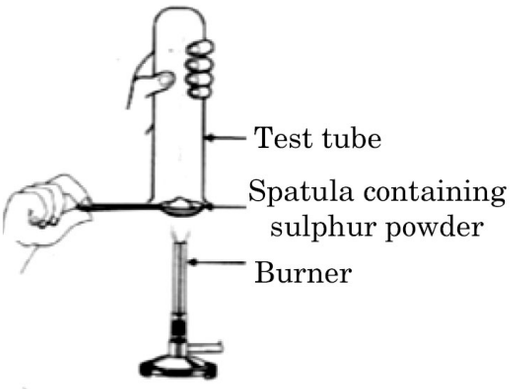
11. (a) A student took sulphur powder on a spatula and heated it. Then he collected the gas evolved by inverting a test tube over it as shown in the figure. Write a balanced chemical equation for the reaction taking place.

What will be the action of the gas on :

(i) Dry litmus paper and

(ii) Moist litmus paper.

(b) What is Thermit reaction? Mention its application.



[TERM 1, 2011]

12. (a) What are amphoteric oxides? Give two examples.

(b) Metals such as Sodium and Potassium are kept immersed in Kerosene, why?

(c) Give the balanced chemical equation for the reaction between Al and steam.

(d) Name a non-metal:

(i) Which is a liquid at room temperature?

(ii) Which is lustrous?

[TERM 1, 2013]

Solutions

1. Blue to light green.

Iron is more reactive than cooper. Thus displacement reaction will take place. So, iron displaces Cu to form Iron Sulphate which is light green in colour. [1]

2. Aluminum is more reactive than zinc.

Zinc is getting deposited on surface and aluminum is getting dissolved in solution. Thus displacement reaction takes place where aluminum gets deposited and forms silvery grey deposit. [1]

3. The changes will be observed in all of the three as aluminum is comparatively highly reactive than iron, copper and zinc. [1]

4. (a) When an iron nail is immersed in the aqueous solution of copper sulphate a displacement reaction will occur. Fe displaces Cu from copper sulphate solution and it results in the formation of ferrous sulphate along with deposition of copper in the iron nail. The blue solution turns pale green and reddish brown copper metal will deposit over the iron nail. [1]

(b) $Fe + CuSO_4 \longrightarrow \underset{\text{Sulphate}}{\underset{\text{Ferrous}}{FeSO_4}} + Cu$ [1]

5. $3MnO_2 + 4Al \rightarrow 3Mn + 2Al_2O_3$ gives the chemical equation of reaction between Manganese dioxide and Aluminum. The balanced equation for the same is as follows:

$O_2 + 4Al \rightarrow 3Mn + 2Al_2O_3 + Heat$ [1]

If manganese powder is heated with aluminum oxide, no reaction takes place as aluminum is more reactive than manganese and so cannot be displaced by manganese. [1]

6. (a) To prove that magnesium is more reactive than zinc, we can take the help of displacement reaction. Taking magnesium and zinc sulphate solution, we can see that magnesium replaces zinc and magnesium sulphate is produced in the experiment.

$Mg + ZnSO_4 \rightarrow MgSO_4 + Zn$ [1]

But if zinc is taken with magnesium sulphate, no reaction takes place. It confirms that magnesium is more reactive than zinc or magnesium is placed above zinc in the reactivity series. [1]

(b) In the reactivity series, copper is placed below the hydrogen. It means that hydrogen is more reactive than copper and cannot be replaced by it. Therefore, copper cannot liberate hydrogen when reacting with dil. HCl. [1]

7. (a) When copper is heated in air, it combines with oxygen to form copper (II) oxide, a black oxide.

$2Cu + O_2 \rightarrow 2CuO$ [1½]

It is an oxidation reaction.

(b) When hydrogen gas is passed over heated copper (II) oxide, red brown copper metal is obtained. The reaction can be shown as:

$CuO + H_2 \rightarrow Cu + H_2O$ [1½]

8. (a) Aluminium is used for packing food articles because the upper surface of the metal get converted into its oxide called aluminium oxide which is non-reactive and acts as a coating on the surface of the metal. [1½]

(b) The hydrogen bubble formed when water is added to the calcium. The bubble sticks to the surface of the metal which makes the calcium float on water. [1½]

9. (i) $Ca(OH)_2$ is used in white washing, which is hydroxide of Ca. So, the metal X is calcium(Ca). [1]

(ii) We can convert calcium carbonate ($CaCO_3$) into its oxide by heating the material above 825°C. This process is called calcinations or lime burning. The chemical equation for this process is: [1]

$CaCO_3(s) \xrightarrow{heat} CaO(s) + CO_2(g)$ [1]

10. (a) There are 1,2 or 3 electrons in the outermost shell of the metals whereas the outermost shell of the nonmetals consists of 5,6 or 7 electrons. Hence, electronic configuration helps to find whether the given element is metal or a non metal. [1]

(b) Zinc displaces iron from ferrous sulphate solution, the color changes from green to colorless. The reaction is as follows:

$Zn + FeSO_4 \rightarrow ZnSO_4 + Fe$

This reaction shows that zinc is more reactive than iron. [1]

(c) Aluminium is highly reactive as compared to silver. Hence aluminium reacts easily with moisture or any other elements and thus it is always found in combined state whereas because of low reactivity of silver it is found in its elemental form in its ores. [1]

(d) The sink in the laboratory has water and sodium reacts vigorously with water which results in an exothermic reaction such that hydrogen gas is released. The hydrogen gas so released catches fire. Thus, we should not throw small pieces of sodium in the sink of the laboratory. [1]

(e) Amphoteric oxides are oxides that can act as both as acids and bases. For example, Al_2O_3. It reacts with acids to form the corresponding aluminium salt and with bases to form aluminates. [1]

$Al_2O_3 + 6\,HCl \rightarrow 2AlCl_3 + 3H_2O$

$Al_2O_3 + 2\,NaOH \rightarrow Na_2Al_2O_4 + H_2O$

11. (i) Dry litmus paper will have no action on it due to the gas released. [1]

(ii) The gas released is SO_2 or sulphur dioxide it turns moist blue litmus paper to red because sulphur dioxide reacts with moisture to form sulphurous acid H_2SO_3. [1]

$S + O_2 \rightarrow SO_2$

$SO_2 + H_2O \rightarrow H_2SO_2$ [1]

(b) When a metal oxide reacts with aluminum, such a reaction is called thermite reaction. The aluminum acts as a reducing agent

and the reaction between a metal oxide and aluminum is highly exothermic. Such highly exothermic reaction is called a thermite reaction. For example:- [1]

$Fe_2O_3 + 2Al \rightarrow 2Fe + Al_2O_3$

It is used in joining railway tracks and filling gaps of machineries. [1]

12. (a) The amphoteric oxides are those metal oxides which behave as both the acidic as well as basic oxides. For example, aluminium oxide (Al_2O_3) and zinc oxide (ZnO). [1]

(b) Sodium and potassium both are the highly reactive metals. They can easily react with oxygen and catch fire if kept out in air. Therefore they are kept immersed in kerosene so that this type of destruction can be avoided. [1]

(c) The balanced chemical equation for the reaction between Al and steam is given below:

$2Al\ (s) + 3H_2O\ (g) \rightarrow Al_2O_3(s) + 3H_2(g)$ [1]

(d) (i) Bromine (Br) is a non-metal which is liquid at room temperature. [1]

(ii) Iodine (I) is a non-metal which is lustrous. [1]

Topic 2: Ionic Compound & Metallurgy

Summary

Formation of ionic compound

In chemistry, an ionic compound is a chemical compound composed of ions held together by electrostatic forces termed ionic bonding.

Properties of ionic compound

- **Physical nature**

  Ionic compounds are hard and brittle. The ions are held by the strong electrostatic forces.
- **Melting and Boiling points**

  The ionic compounds have high melting and boiling points due to the strong inter-ionic attraction.
- **Solubility**

  Electrovalent compounds are generally soluble in water and insoluble in solvents such as kerosene and petrol.
- **Conduction of electricity**

  It conducts electricity due to the movement of ions in molten state or in aqueous solution but behaves as insulator in solid state as there are no free ions for movement to conduct electricity.

Occurrence of metals

- Minerals : Most of the elements occur in nature as in combined states as minerals. The chemical composition of minerals is fixed.
- Ore : Minerals from which metals can be extracted profitably are known as ores.
- Gangue : The impurities like sands,salt,soil etc present in the ore are called gangue.

  Metals can be divided into 3 categories
  - * Metals of low reactivity
  - * Metals of medium reactivity
  - * Metals with high reactivity

Extraction of low reactivity metals

These metals are generally unreactive and these can be reduced to metals by heating alone.

$$2HgS(s) + 3O_2(g) \longrightarrow 2HgO(s) + 2SO_2(g)$$

Extraction of middle reactivity metals

- Roasting is a process of converting suphide ores into oxides by heating strongly in the presence of excess of air reaction.

- Calcination is the process of converting carbonte ore into oxides by heating strongly in presence of air.

$$\underset{\text{Zinc sulphide (Zinc blende-ore of Zn)}}{2\,ZnS(s)} + \underset{\text{From air}}{3O_2(g)} \xrightarrow[\text{Presence of excess of air}]{\text{Heat}} \underset{\text{Zinc oxide}}{2ZnO(s)} + \underset{\text{Sulphur dioxide}}{2SO_2(g)}$$

Thermit reaction

The reaction of iron oxide with aluminium used to join railway tracks or damaged machine parts.

$$\underset{\text{Iron (III) oxide}}{Fe_2O_3(s)} + \underset{\text{Aluminium}}{2\,Al(s)} \xrightarrow{\text{Ignited}} \underset{\text{Iron (melt)}}{2\,Fe\,(l)} + \underset{\text{Aluminium oxide}}{Al_2O_3\,(s)}$$

Extraction of high reactivity metals

These metals are obtained by electrolytic refining as they are quite reactive. They are obtained by electrolysis of their molten chlorides.

During electrolysis, the metal ions, being positive are liberated at the cathode (the negatively charged electrode), whereas the chlorine is liberated at the anode (the positively charged electrode).

The reactions taking place are as follows :

At Cathode :
$$\underset{\text{Sodium ion}}{Na^+(l)} + \underset{\text{Electron}}{e^-} \xrightarrow{\text{Reduction}} \underset{\text{Sodium metal}}{Na(s)}$$

At Anode :
$$\underset{\text{Chloride ion}}{Cl^-(l)} \xrightarrow{\text{Oxidation}} \underset{\text{Chlorine atom}}{Cl(g)} + e^-$$

$$\underset{\text{Chloride atoms}}{Cl\,(g)} + Cl(g) \longrightarrow \underset{\text{Chlorine gas}}{Cl_2\,(g)}$$

Thus, sodium metal is obtained at the cathode whereas chlorine gas is liberated at the anode.

Refining of metals

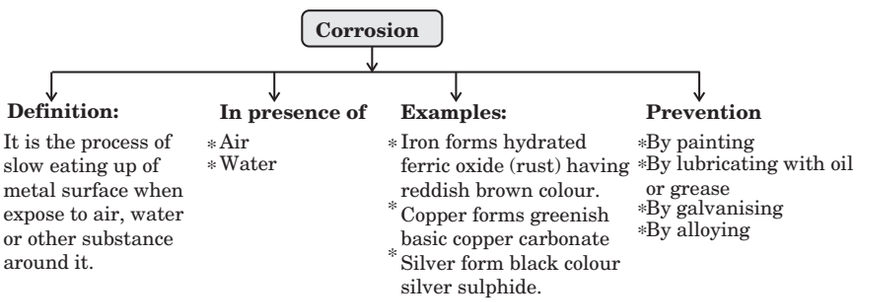
Electrolytic Refining

This is the most widely used method for refining impure metals. Many metals, such as copper, zinc, tin, nickel, silver, gold, etc., are refined electrolytically. In this process, the impure metal is made as anode and a thin strip of pure metal is made as cathode. A solution of the metal salt is used as an electrolyte. On passing the current through the electrolyte, the pure metal from the anode dissolves into the electrolyte. An equivalent amount of pure metal from the electrolyte is deposited on the cathode

The following reactions take place :

At Anode :
$$\underset{\text{Copper atom}}{Cu(s)} \xrightarrow{\text{oxidation}} \underset{\text{Copper ions}}{Cu^{2+}(aq)} + 2e^-$$

At Cathode :
$$\underset{\text{Copper ions (from solution)}}{Cu^{2+}(aq) + 2e^-} \xrightarrow{\text{reduction}} \underset{\text{Copper atom}}{Cu}$$



An alloy is a homogeneous mixture of two or more metals or a metal and a non-metal.

An alloy containing mercury as one of the metals is known as an amalgam.

Some examples of common alloys are :

(a) Brass containing copper and zinc metals.

(b) Bronze containing copper and tin metals.

(c) Stainless steel containing iron, carbon and chromium.

PREVIOUS YEARS' EXAMINATION QUESTIONS

TOPIC 2

2 Marks Questions

1. Give reason:
(i) Ionic compounds have high melting point
(ii) Ionic compounds are hard crystalline solids
[TERM 1, 2014]

2. Name first discovered alloy. Give its composition also.
[TERM 1, 2016]

3 Marks Question

3. What is the main ore of mercury? Explain, how mercury is obtained from this ore? Also write the reaction involved in the extraction.
[TERM 1, 2013, 2017]

5 Marks Questions

4. (a) What are the main two allotropes of carbon? Distinguish these two allotropes on the basis of hardness and electrical conduction.
(b) Why Aluminium articles have a longer life and attractive finish compared to many other metals?
(c) Explain the following terms:
(i) Ore
(ii) Gangue
(d) What is common feature in the electronic configuration of metal atom?
[TERM 1, 2013]

5. What are alloys? How are they made? Name the constituents and uses of brass,bronze and solder.
[TERM 1, 2014]

6. A metal E is stored under kerosene. When a small piece of it is left open in the air, it catches fire. When the product formed is dissolved in water, it turns red litmus to blue:
(i) Name the metal E.
(ii) Write the chemical equation for the reaction when it is exposed to air and when the product is dissolved in water.
(iii) Explain the process by which the metal is obtained from its molten chloride.
[TERM 1, 2014]

7. Define corrosion. Name a metal which corrodes and one metal which does not. Write any three methods of prevention of corrosion.
[TERM 1, 2015]

8. (i) What causes rusting of iron? Design an activity to show the conditions needed for iron nails to rust.
(ii) Why do we paint iron articles?
[TERM 1, 2017]

9. (a) Write the steps involved in the extraction of pure metals in the middle of the activity series from their carbonate ores.
(b) How is copper extracted from its sulphide ore? Explain the various steps supported by chemical equations. Draw labeled diagram for the electrolytic refining of copper.
[TERM 1, 2018]

Solutions

1. (i) Ionic compounds have high melting point and boiling point temperature. These compounds have strong inter ionic attraction, hence a considerable amount of energy is required to break the strong inter ionic attraction, resulting in high melting and boiling points. [1]

(ii) Ionic compounds are hard crystalline solids because of the strong force of attraction between the positive and negative ions. These compounds are generally brittle and break into pieces when pressure is applied. [1]

2. Alloy is formed by combination of various metals or metals with some other elements. The first discovered alloy is bronze. Its composition is: Copper 90% and Tin 10%. [2]

3. Cinnabar or mercury sulphide is the main ore of mercury. Its formula is HgS. To obtain mercury from its ore, first mercury sulphide is converted into its oxide which is mercuric oxide (HgO) by heating it in air. Afterwards, it is further heated more and the mercuric oxide is reduced to mercury. In this way, the mercury is obtained from its ore. The following reaction explains the extraction of the mercury: [2]

$$2HgS + 3O_2 \xrightarrow{Heat} 2HgO + 2SO_2$$

$$2HgO \xrightarrow{Heat} 2Hg + O_2$$ [1]

4. (a) Diamond and graphite are the two main allotropes of carbon. Diamond is the hardest allotrope while graphite is soft. On the other hand, graphite is a very good conductor of electricity while diamond is not. [1]

(b) Aluminium is highly reactive metal. It reacts with oxygen and creates a thick layer of aluminium oxide. This layer protects the aluminium from corrosion. This is the process of anodizing. Also, this layer is lustrous in nature and it makes the metal shiny. That is why aluminium articles have a longer life and attractive finish as compared to other metals. [1]

(c) (i) Ore: Ores are the minerals which contain a large amount of a specific metal. Those metals can be extracted from their respective ores through various scientific processes. [1]

(ii) Gangue: When the ores are mined from the earth, they contain some impurities like rock, soil, sand etc. There impurities are called gangue. [1]

(d) The metals have a nature to lose electrons. It means they have electropositive character. So, all the metals get positive charge on them after losing electrons. [1]

5. An alloy is a homogeneous mixture of two or more metals, or a metal and a non-metal. [1]

It is prepared by first melting the primary metal, and then, dissolving the other elements in it in definite proportions. It is then allowed to cool at the room temperature. [1]

Brass is an alloy of zinc (Zn) and copper (Cu). Brass is often used in artificial jewelry and stamp dies. [1]

Bronze is an alloy of tin (Sn) and copper (Cu). Bronze was used to make coins and utensils. [1]

Solder is an alloy of lead (Pb) and tin (Sn). Solder is generally used to join two metal pieces together. [1]

6. (i) The metal E can either be Sodium (Na) or Potassium (K). This is because both sodium and potassium are highly reactive, so they catch fire if kept in the open. Hence, to prevent accidental fires, these metals are kept immersed in kerosene oil. [1]

(ii) When sodium is exposed to air the following reaction takes place:

$4Na + O_2 \rightarrow 2Na_2O$

The product formed is Sodium oxide. When sodium oxide is dissolved in water, sodium hydroxide is produced.

$Na_2O + H_2O \rightarrow 2NaOH$ [1]

When Potassium is exposed to air the following reaction takes place:

$4K + O_2 \rightarrow 2K_2O$

The product formed is potassium oxide. When potassium oxide is dissolved in water, potassium hydroxide is produced.

$K_2O + H_2O \rightarrow 2KOH$ [1]

(iii) Highly reactive metals such as sodium and potassium are obtained by electrolytic reduction from the electrolysis of their molten chlorides. The metals are deposited at the cathode (the negatively charged electrode), whereas, chlorine is liberated at the anode (the positively charged electrode). [1]

Electrolysis of NaCl:

At cathode $Na^+ + e^- \rightarrow Na$

At anode $2Cl^- \rightarrow Cl_2 + 2e^-$

Electrolysis of KCl:

At cathode $K^+ + e^- \rightarrow K$

At anode $2Cl^- \rightarrow Cl_2 + 2e^-$ [1]

7. The deterioration caused on the surface of a metal when it is exposed to the surrounding atmosphere (water and oxygen) is known as corrosion. Almost all the metals are prone to corrosion but the type of metal and the surrounding atmosphere determines the rate of corrosion. [1]

Nobel metals like Gold, Platinum does not corrode easily whereas Iron corrodes very quickly due to its properties. [1]

Three methods to prevent corrosion are:

(a) **Coating of the metal surface** can prevent corrosion. Coating can be achieved by painting and plating the metal surface. [1]

(b) **Anodization** is also used as a protective measure against corrosion. [1]

(c) **Galvanization** is used to protect the metals by **coating a thin layer of zinc** over the surface of the metal. [1]

8. (i) Iron oxide is formed when iron and oxygen molecules react with each other in the presence of water or moisture in atmosphere. Thus this presence of moisture causes rusting of iron. [1]

To show the conditions needed for iron nails to rust, take three test tubes and label them A, B and C. Pour some water in test tube A with a nail in it and close it with a cork. Next, pour boiled water in test tube B with the nail inside it. Add some oil to it so that it makes a layer above the water to prevent air from dissolving in water and close it with

a cork. Now put some anhydrous calcium chloride in test tube C with a nail in it and close it with a cork. Leave these test tubes for some days and then observe. You will observe that rusting occurs in the nail of test tube A as oxygen and water are both present in test tube A. [3]

(ii) Painting iron provides an extra layer for iron articles as it prevents iron from making a direct contact with air and moisture. [1]

9. (a) Pure metals are extracted from the carbonate ores by following these steps:

Here zinc is extracted from zinc carbonate.

(i) The ore is concentrated by gravity separation method. [1]

(ii) The ore is calcined which converts it into oxide.

$$ZnCO_3 \xrightarrow{\Delta} ZnO + CO_2 \uparrow$$ [1]

(iii) Reduction of the oxide takes place in presence of coke.

$ZnO + C \rightarrow Zn + CO$ [1]

(iv) Electrolysis process is used to purify the metal. [1]

(b) Copper is extracted from its sulphide ore using the following steps: [1]

Sulphide ore is heated in air to extract copper. The following reactions take place:

$$2Cu_2S + 3O_2 \xrightarrow{\Delta} 2Cu_2O + 2SO_2$$

$$2Cu_2O + Cu_2S \xrightarrow{\Delta} 6Cu + SO_2$$

Electrolytic refining of copper takes place as follows:

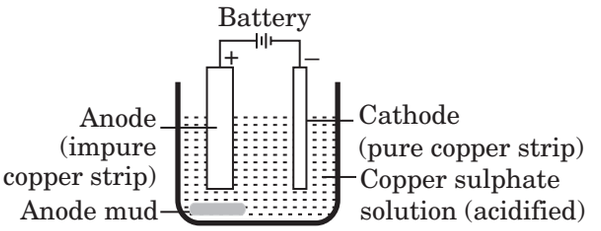


Fig.: Electrolytic Refining of Copper

Smart Notes .....

CHAPTER 4

Carbon and its Compounds

Chapter Analysis with respect to Last 3 Years' Board Exams

List of Topics	**2016**	**2017**	**2018**
Covalent bonding in carbon compounds. Versatile nature of carbon			1Q (3 marks)
Homologous series Nomenclature of carbon compounds containing functional groups (halogens, alcohol, ketones, aldehydes, alkanes and alkynes)	1Q (1 mark), 1Q (3 marks)	1Q (1 mark), 1Q (2 mark), 1Q (5 marks)	1Q (2 marks)
Difference between saturated hydrocarbons and unsaturated hydrocarbons	2Q (1 mark), 1Q (5 marks)	1Q (3 marks)	
Chemical properties of carbon compounds (combustion, oxidation, addition and substitution reaction)	1Q (3 marks)	1Q (1 mark)	
Ethanol and Ethanoic acid (only properties and uses), soaps and detergents	1Q (1 mark)	1Q (1 mark)	

On the basis of above analysis, it can be said that from exam point of view, homologous series and chemical properties of carbon compounds are the most important topics of the chapter.

Topic 1: Carbon and Its Properties

Summary

Knowing your Chapter at Glance:

Characteristics of Carbon

Carbon is a non-metallic element.

Symbolic Representation : $^{12}_{6}C$ where, atomic number is 6 and atomic mass is 12

- Always forms covalent bonds
- Tetravalent
- 3 all otropes - diamond, graphite and fullerenes
- Catenation - Unique property of self-linking of carbon atoms
- Steps for writing the Lewis Dot Structures of a Covalent Compound

(a) Write the electronic configuration of all the atoms present in the molecule.

(b) Identify how many electrons are needed by each atom to attain noble gas configuration.

(c) Share the electrons between atoms in such a way that all the atoms in a molecule have noble gas configuration.

(d) Keep in mind that the shared electrons are counted in the valence shell of both the atoms sharing it.

Types of chemical bonding

1. Ionic bond
2. Covalent bond

Ionic bond

The chemical bond formed by the transfer of electrons from one atom to another is known as an ionic bond. The ionic bond is called so because it is a chemical bond between oppositely charged ions i.e. one positive and one negative ion.

Sodium (with electronic configuration 2, 8, 1) has only one electron in the valence shell. It loses this electron to acquire the stable electronic configuration 2, 8 (similar to that of neon) and form sodium ion (Na^+).

$$\underset{\text{Sodium atom}}{\underset{(2,8,1)}{Na}} \longrightarrow \underset{\text{Sodium ion}}{\underset{(2,8)}{Na^+}} + e^-$$

Chlorine(with electronic configuration (2, 8, 7) has seven electrons in the valence shell. It gains one electron to acquire the stable electronic configuration 2, 8, 8 (similar to that of argon) and form chloride ion (Cl^-)

$$\underset{\text{Chlorine atom}}{\underset{(2,8,7)}{:\ddot{Cl}: + e^-}} \longrightarrow \underset{\text{Chloride ion}}{\underset{(2,8,8)}{[:\ddot{Cl}:]^-}}$$

Sodium loses one electron to form Na^+ ion and chlorine gains that electron to form Cl^- ion. As a result, both acquire the stable nearest noble gas configuration. These oppositely charged ions are then held together by electrostatic forces of attraction forming the compound Na^+Cl^- or simply written as NaCl. The transfer of electron may be represented in one step as follows:

$$\underset{\text{Sodium atom}}{Na^{\times}} + \underset{\text{Chlorine atom}}{\cdot\ddot{Cl}:} \longrightarrow Na^+ \; [\overset{\times}{\cdot}\ddot{Cl}:]^- \text{ or } NaCl$$

Sodium chloride

Covalent bonds

The chemical bond formed by the sharing of electrons between two atoms is known as a covalent bond.

Covalent bonds are of three types :

(i) Single covalent bond

(ii) Double covalent bond

(iii) Triple covalent bond

(i) Single covalent Bond

A single covalent bond is formed by the sharing of two electrons between the atoms, each atom contributing one electron for sharing.

For example, a hydrogen molecule H_2

(ii) Double covalent Bond

A double covalent bond is formed by the sharing of four electrons between two atoms, each atom contributing two electrons for sharing. It is represented by putting two short line (=) between the two atoms. For example, oxygen molecule, O_2, contains a double bond between two atoms and it can be written as O = O.

(iii) Triple covalent Bond

A triple bond is formed by the sharing of six electrons between two atoms, each atom contributing three electrons for sharing. It is represented by putting three short line () between the two atoms. Nitrogen molecule, N_2, contains a triple bond, so it can be written as NN.

Properties of covalent bond

(a) Physical states: They are generally liquid or gases. Some covalent compounds may exist as solid.

(b) Solubility: They are generally insoluble in water and other polar solvents but soluble in organic solvents such as benzene, toluene etc.

(c) Melting and boiling points: They do not conduct electrical current.

(d) Electrical conductivity: They do not conduct electrical current.

Versatile nature of carbon

- Carbon is tetravalent, it does not form ionic bond by either losing four electrons (C^{4+}) or gaining four electrons (C^{4-}). It is because it is difficult to hold four extra electrons and would require large amount of energy to remove four electrons. So, carbon can form bond by sharing of its electron with the electrons of other carbon atom or with other element and attain gas configuration.
- Carbon atoms have a unique ability to combine with one another to form chains. This property is called catenation.
- Due to small size, carbon also forms multiple (double and triple) bonds with other carbon atoms, oxygen, and nitrogen.

Hydrocarbons

- Carbon and Hydrogen combine in different proportions to form a large number of compounds called hydrocarbons.
- There are two types of hydrocarbons : saturated and unsaturated.

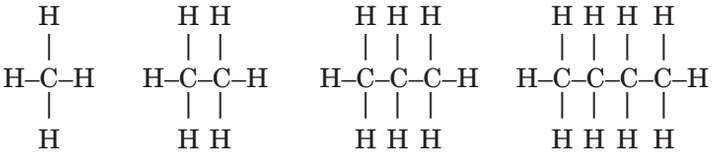
(a) Saturated Hydrocarbons (Alkanes)

Saturated hydrocarbons are also called paraffins or alkanes. They are represented by the general formula

C_nH_{2n+2}, where n = number of carbon atoms in a molecule of the alkane.

When n = 1, the alkane is methane (CH_4).

When n = 2, the alkane is ethane (C_2H_6) and so on.

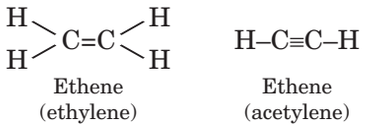


(b) Unsaturated hydrocarbons

(i) Alkenes

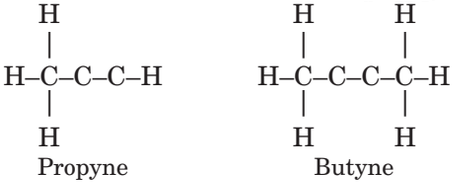
Hydrocarbons in which two carbon atoms in the molecule are joined by a double (=) or triple () bond, are called unsaturated hydrocarbons. For example,

Alkenes are represented by the general formula, C_nH_{2n}, where n = number of carbon atoms in a molecule. When n = 2, the alkene is ethene or ethylene (C_2H_4), when n = 3, the alkene is propene or propylene (C_3H_6), and so on.



(ii) Alkynes

The molecules of hydrocarbons containing a triple bond between two carbon atoms are called alkynes. They are represented by general formula C_nH_{2n-2}.



PREVIOUS YEARS' EXAMINATION QUESTIONS

TOPIC 1

1 Mark Questions

1. Draw the structure for Ethanoic acid molecule CH_3COOH.

[TERM 2, 2011]

2. Vapors of acetic acid smell
(a) Pungent like vinegar
(b) Sweet like rose
(c) suffocating likes sulphur dioxide
(d) suffocating like sulphur dioxide

[TERM 2, 2011]

3. Write the name and formula of the second member of the carbon compounds having functional group - OH.

[TERM 2, 2012]

4. A student takes 2mL acetic acid in a dry test tube and adds a pinch of sodium hydrogen carbonate to it. He makes the following observations:
I. A colourless and odourless gas evolves with a brisk of effervescence.
II. The gas turns lime water milky when passed through it.
III. The gas burns with an explosion when a burning splinter is brought near it.
IV. The gas extinguishes the burning splinter that is brought near it.
The correct observations are:
(a) I, II and III
(b) II, III and IV
(c) III, IV and I
(d) IV, I and II **[TERM 2, 2012, 2014]**

5. In an experiment to study the properties of acetic acid a student takes about 2mL of acetic acid in a dry test tube. He adds about 2mL of water to it and shakes the test tube well. He is likely to observe that:
(a) the acetic acid dissolves readily in water
(b) the solution becomes light orange
(c) water floats over the surface of acetic acid
(d) acetic acid floats over the surface of water

[TERM 2, 2012, 2014]

6. A student prepared 20% sodium hydroxide solution in a beaker containing water. The observations noted by him are given below:
I Sodium hydroxide is in the form of pellets.
II. It dissolves in water readily.
III. The beaker appears cold when touched from outside.
IV. The red litmus paper turns blue when dipped into the solution.
The correct observations are:
(a) I, II and III
(b) II, III and IV
(c) III,IV and I
(d) I, II and IV

[TERM 2, 2013]

7. Read the following statements:
I. When a red litmus paper is dipped into reaction mixture of a saponification reaction, it turns blue and the reaction is exothermic.
II. When a blue litmus paper is dipped into reaction mixture of a saponification reaction, its colour does not change and the reaction is exothermic.
III. When a red litmus paper is dipped into reaction mixture of a saponification reaction, its colour does not change and the reaction is endothermic.
IV. When a blue litmus paper is dipped into reaction mixture of a saponification reaction, its colour does not change and the reaction is endothermic.
Which of the above statements are correct:
(a) I and II
(b) II and III
(c) III and IV
(d) I and IV

[TERM 2, 2013, 2016]

8. Hard water required for an experiment is not available in a school laboratory. However, following salts are available in the laboratory. Select the salts which may be dissolved in water to make it hard for the experiment.
(1) Calcium Sulphate
(2) Sodium Sulphate
(3) Calcium Chloride
(4) Potassium Sulphate
(5) Sodium Hydrogen Carbonate
(6) Magnesium Chloride
(a) 1, 2 and 4
(b) 1, 3 and 6
(c) 3, 5 and 6
(d) 2, 4 and 5

[TERM 2, 2013]

9. While studying saponification reaction, a student measures the temperature of the reaction mixture and also finds its nature using blue/red litmus paper. On the basis of his observations the correct conclusion would be:
(a) The reaction is exothermic and the reaction mixture is acidic.

(b) The reaction is endothermic and the reaction mixture is acidic.
(c) The reaction is endothermic and the reaction mixture is basic.
(d) The reaction is exothermic and the reaction mixture is basic.

[TERM 2, 2014]

10. Write the name and the structure of an alcohol with four carbon atoms in its molecule.

[TERM 2, 2016]

11. In the neighbourhood of your school, hard water required for an experiment is not available. Select from the following groups of salts available in your school, a group each member of which, if dissolved in distilled water, will make it hard:
(a) Sodium chloride, calcium chloride
(b) Potassium chloride, sodium chloride
(c) Sodium chloride, magnesium chloride
(d) Calcium chloride, magnesium chloride

[TERM 2, 2016, 2017]

12. Write the molecular formula of the 2nd and 3rd member of the homologous series whose first member is methane.

[TERM 2, 2017]

2 Marks Questions

13. Why homologous series of carbon compounds are so called? Write chemical formula of two consecutive members of a homologous series and state the part of these compounds that determines their
(i) physical properties, and
(ii) chemical properties.

[TERM 2, 2013, 2014]

3 Marks Questions

14. An organic compound with molecular formula forms three structural arrangements of atoms. Draw these structures and name them.

[TERM 2, 2015]

15. An aldehyde as well as a ketone can be represented by the same molecular formula, say C_3H_6O. Write their structure and name them. State the relation between the two in the language of science.

[TERM 2, 2016]

16. (a) Why are most carbon compounds poor conductors of electricity?
(b) Write the name and structure of a saturated compound in which the carbon atoms are arranged in a ring. Give the number of single bonds present in this compound.

[TERM 2, 2018]

5 Marks Questions

17. (a) State two properties of carbon which lead to a very large number of carbon compounds.
(b) Why does micelle formation take place when soap is added to water? Why are micelles not formed when soap is added to ethanol?

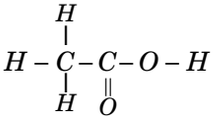
[TERM 2, 2011]

18. Elements forming ionic compounds attain noble gas configuration by either gaining or losing electrons from their outermost shells. Give reason to explain why carbon cannot attain noble gas configuration in this manner to form its compounds. Name the type of bonds formed in ionic compounds and in the compounds formed by carbon. Also give reason why carbon compounds are generally poor conductors of electricity.

[TERM 2, 2014]

Solutions

1. The structure for ethanoic acid molecule is



[1]

2. Pungent like vinegar [1]

3. Ethanol C_2H_5OH [1]

4. When acetic acid is reacted with sodium hydrogen carbonate, a colourless and odourless gas evolves with a brisk of effervescence.

$$CH_3COOH + NaHCO_3 \rightarrow CH_3COONa + H_2O + CO_2$$

[½]

When CO_2 is passed through lime water, it turns milky.

CO_2 extinguishes the burning splinter that is brought near it. [½]

5. Acetic acid dissolves readily in water because acetic acid gets disassociated into its ions. [1]

6. Sodium hydroxide is present in the form of pellets which react with water readily because it is a base. Due to its basic nature it will turn red litmus into blue. When beaker touched from outside, it will be hot as it is an exothermic reaction. [1]

7. Saponification is an exothermic reaction and soap solution is basic in nature. Therefore, it turns red litmus into blue and there will be no change of colour when a blue litmus paper is dipped in the solution. [1]

8. 1, 3 and 6

Hard water contains Ca^{2+} and Mg^{2+} ions. So, the salts that can be added to water to make it hard are calcium sulphate, calcium chloride and magnesium chloride. [1]

9. On the basis of his observations the correct conclusion would be the reaction is exothermic and the reaction mixture is basic.

Hence the option (d)is correct. [1]

10. Butan-1-ol [1]

$CH_3 - CH_2 - CH_2 - CH_2 - OH$

11. The common salts like calcium and magnesium salts make the water hard. [1]

Thus, the correct answer is (d).

12. The molecular formula of the 2nd and 3rd member of the homologous series:

Using the formula C_nH_{2n+2} [1]

For $n = 2$; $C_2H_{(2\times2)+2} = C_2H_6$, ethane

For $n = 3$; $C_3H_{(2\times2)+2} = C_3H_8$, propane

13. In homologous series of carbon compounds, the same functional group dictates the properties of the compounds regardless of the length of the carbon chain. This is the reason they are known as homologous series of carbon compounds. [1]

The two consecutive members of a homologous series are CH_3OH and C_2H_5OH belonging to the group alcohol.

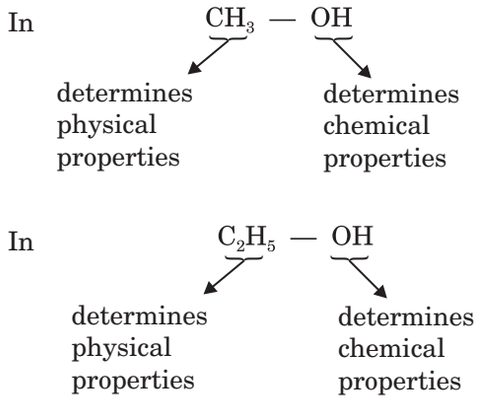
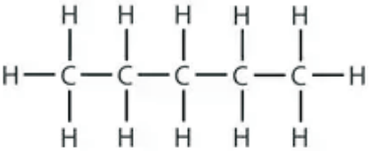


Fig.: Members of Homologous Series [1]

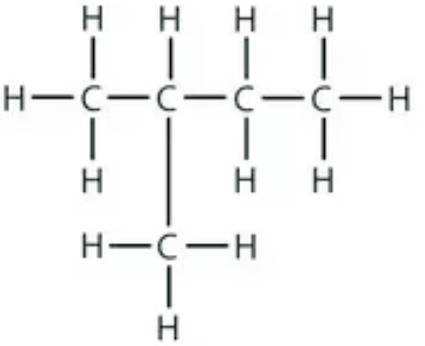
14. The organic compound having molecular formula is pentane. Its three structural arrangements are as follows:

(i) n-pentane



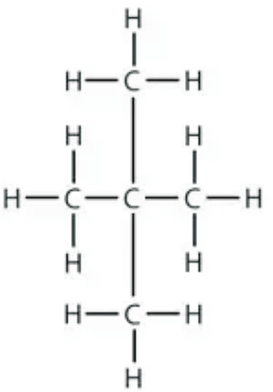
[1]

(ii) Isopentane or methylbutane



[1]

(iii) Neopentane (dimethylpropane)



[1]

15. $C_6H_6O \rightarrow (a)$ Aldehyde $\rightarrow CH_3 - CH_2 - CHO$

Propanal

(b) Ketone $\rightarrow CH_3 - C - CH_3$

$\|$

O

Aceton e [1½]

Here, Ketone as well as Aldehyde are functional group isomers as they share same molecular formula. [1½]

16. (a) Carbon compounds are poor conductors of electricity because they are non-metals and do not have as many free electrons as metals. [1]

(b) The figure shown below is cyclohexane having 18 single bonds. [1]

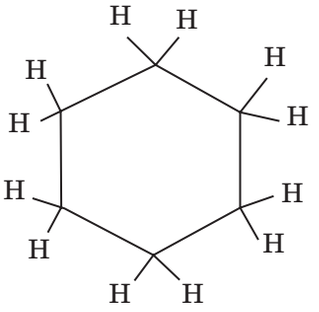


Fig.: Cyclohexane [1]

17. (a) Tetravalency of carbon atom means it has valency four. It is capable of forming bond with other four atoms of some other element or carbon atom. [1]

Catenation is a unique property of carbon atoms to form bonds with other carbon atoms to form large molecules and form chains. [1]

(b) When soap comes in contact with water, each molecule of soap gets ionized. Soap molecule is generally RCOONa; in contact with water after ionization it forms RCOO- and Na+. So each molecule forms a polar head (COO-) and a non-polar tail (R). Polar head gets attracted towards water and non-polar tail towards greasy dirt and oil particles. [1]

When dirty clothes are placed in soap solution the non-polar head gets attached to dirt particle and polar side towards water, this forms a spherical structure with polar part on surface and non-polar with dirt particle inside. This spherical structure is called micelle. This micelle gets attracted towards water and carry dirt particle along with it, making a cloth clean. [1]

Micelles not formed when soap is added to ethanol because the alkyl chain of soap gets dissolved in ethanol. [1]

18. Ionic compounds are formed by transfer of electrons between metals and non-metals. To achieve a noble gas configuration, the number of electrons that are transferred between the atoms corresponds to the number of electrons required to lose or gain. [1]

Now, carbon cannot attain noble gas configuration because it has four electrons in its outermost shell and it needs to lose or gain 4 electrons to attain noble gas configuration. [1]

(i) It could gain four electrons forming C^{4-} anion. But for the nucleus with six protons, it would be difficult to hold on to ten electrons. [1]

(ii) It could lose four electrons forming C^{4-} cation. But large amount of energy would be required to remove four electrons leaving behind a carbon cation with six protons in its nucleus holding onto just two electrons. [1]

The ionic compounds and the compounds formed by carbon make covalent bond and shares electrons. Carbon compounds (covalent compounds) do not conduct electricity because they do not have free electrons or ions. [1]

Topic 2: Carbon Compounds, Soaps & Detergents

Summary

Rules for naming a compound

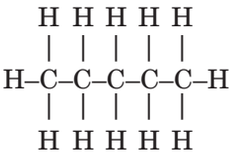
- Select the longest possible chain containing C atoms.
- Numbering of chain is done from the end from which the substituent is closer.
- If there are substituents that have the same number of carbons from either end, start numbering from the end nearest the next substituent.
- The hydrocarbon groups attached to the parent chain are called alkyl groups such as methyl ethyl propyl etc.
- Name the substituent as an alkyl group based on the number of carbon atoms in the chain
- Place the name of the branch substituent preceded by a number indicating the carbon of the parent chain carbon to which it joins.

Types of formula for writing hydrocarbons

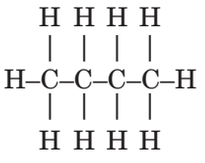
1. Molecular formula - it involves the actual number of each type of atom present in the compound.
2. Structural formula- the actual arrangement of atom is written in structural formula.
3. Condensed formula- it is the shortest form of the structural formula.

Isomerism

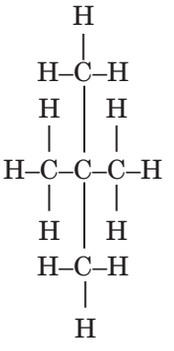
- Organic compounds with the same molecular formula but different structural formulae are known as isomers. This phenomenon is called Isomerism.
- Isomers of pentane : The molecular formula of pentane is C_5H_{12}. Three isomers corresponding to this formula are possible.



Common Name : n-pentane
IUPAC Name : pentane



Common Name : iso pentane
IUPAC Name : 2-methyl butane



Common Name : neo pentane
IUPAC Name : 2,2-dimethyl propane

Functional groups

In hydrocarbon chain one or more hydrogen atom is replaced by other atoms in accordance with their valencies these are called heteroatom.

These heteroatom or group of atoms which make carbon compound reactive and decide its properties are called functional groups.

Various functional groups are given as follows

S. No.	Hetero atom	Functional Group	Formula of a Functional Group	Class of Compounds
1.	O	Hydroxyl	–OH–	Alcohols, R–OH
2.	O	Aldehydic	–CHO or $-\overset{\overset{O}{\|\|}}{C}-H$	Aldehydes, R–CHO

3.	O	Keto	$-\overset{\overset{O}{\|\|}}{C}-$ or –CO–	Ketones, R–CO–R
4.	O	Carboxyl	$-\overset{\overset{O}{\|\|}}{C}-OH$ or –COOH	Carboxylic acids, R–COOH
5.	Cl, Br	Halo (chloro, bromo)	–Cl, –Br	Haloalkanes, R–Cl, R–Br

- **Homologous series**

A homologous series is a group of organic compounds having same general formula, similar structures and similar chemical properties in which the successive compounds differ by CH_2 group. The various organic compounds of a homologous series are called homologues.

Chemical properties of a carbon compounds

- **Combination**

The process of burning of a carbon compound in air to give carbon dioxide, water, heat and light, is known as combustion.

For example,

When methane (natural gas) burns in a sufficient supply of air, then carbon dioxide and water vapour are formed, and a lot of heat is also produced :

$$\underset{\text{Methane (Naturalgas)}}{CH_4} + \underset{\text{Oxygen (from air)}}{2O_2} \xrightarrow{\text{Combustion}} \underset{\text{Carbon dioxide}}{CO_2} + \underset{\text{Water}}{2H_2O} + \text{Heat} + \text{Light}$$

Other example of combustion are

$$\underset{\text{Carbon}}{C} + \underset{\text{Oxygen}}{O_2} \longrightarrow \underset{\text{Carbondioxide}}{CO_2} + \text{Heat and light}$$

$$\underset{\text{Ethanol}}{CH_3CH_2OH} + \underset{\text{Oxygen}}{3O_2} \longrightarrow \underset{\text{Carbondioxide}}{CO_2} + \underset{\text{Water}}{3H_2O} \text{ Heat and light}$$

- **Oxidation**

Addition of oxygen to any substance is called oxidation and the substances which are capable of adding oxygen to other substances are called oxidizing agents.

Alkaline potassium permanganate and acidified potassium dichromate are good oxidizing agents. These can easily oxidize alcohols to carboxylic acids. For example,

$$\underset{\text{Potassium dichromate}}{K_2Cr_2O_7} + \underset{\text{Sulphuric acid}}{4H_2SO_4} \longrightarrow \underset{\text{Potassium sulphate}}{K_2SO_4} + \underset{\text{Chromium sulphate}}{Cr_2(SO_4)_3} + 4H_2O + 3[O]$$

- **Substitution reaction**

Reactions which involve the direct replacement (displacement or substitution) of an atom or a group of atoms in an organic molecule by another atom or group of atoms without any change in the rest of the molecule are called substitution reactions.

$$\underset{\text{Methane}}{CH_4} + \underset{\text{Chlorine}}{Cl} \xrightarrow[\text{or 520–670 K}]{\text{Sunlight}} \underset{\text{Chloromethane (Substitution product)}}{CH_3Cl} + \underset{\text{Hydrogen chloride}}{HCl}$$

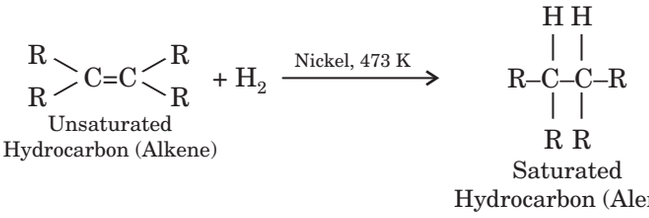
$$\underset{\text{Chloromethane (Methyl chloride)}}{CH_3Cl} + Cl_2 \xrightarrow[\text{or 520 – 670 K}]{\text{Sunlight}} \underset{\text{Dichloromethane (Methylene chloride)}}{CH_2Cl_2} + HCl$$

$$\underset{\text{Dichloromethane (Methylene chloride)}}{CH_2Cl_2} + Cl_2 \xrightarrow[\text{or 520–670 K}]{\text{Sunlight}} \underset{\text{Trichloromethane (Chloroform)}}{CHCl_3} + HCl$$

$$\underset{\text{Trichloromet hane}}{CHCl_2} + Cl_2 \xrightarrow[\text{or 520–670 K}]{\text{Sunlight}} \underset{\substack{\text{Tetrachloro methane}\\ \text{(Carbon tetra chloride)}}}{CCl_4} + HCl$$

- **Addition**

  Reactions which involve addition of two reactants to form a single product are called addition reactions.



Unsaturated Hydrocarbon (Alkene)

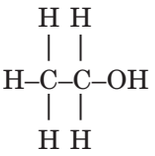
Saturated Hydrocarbon (Alene)

The addition of hydrogen to an unsaturated hydrocarbon to obtain a saturated hydrocarbon is called hydrogenation. It is used to prepare vegetable ghee from vegetable oils.

Some important compounds of carbon-

1. Ethanol

The structural formula of ethanol is



Formula : CH_3CH_2OH

IUPAC Name : Ethanol

Common Name : Ethyl alcohol

Ethanol is a colourless liquid at room temperature. Its freezing point is 156 K while its boiling point is 351K.

Ethanol is commonly called alcohol. It is an active ingredient of all alcoholic drinks such as beer, rum, whisky, brandy, etc. Consumption of small quantities of dilute ethanol causes drunkenness. However, intake of even a small quantity of pure alcohol (absolute alcohol) can be lethal.

Ethanol reacts with sodium in the cold to form sodium ethoxide with the evolution of hydrogen gas

$$\underset{\text{Ethanol}}{2\,CH_3CH_2OH} + \underset{\text{Sodium}}{2Na} \xrightarrow{\text{Cold}} \underset{\text{Sodium ethoxide}}{2\,CH_3CH_2ONa} + H_2$$

When ethanol is heated with excess of concentrated sulphuric acid at 170°C (443 K), it gets dehydrated to form ethene (which is an unsaturated hydrocarbon) :

$$\underset{\substack{\text{Ethanol}\\ \text{(Ethyl alcohol)}}}{CH_3 — CH_2OH} \xrightarrow[\text{(Dehydration)}]{\text{Conc. } H_2SO_4 \text{ ; } 170°C} \underset{\text{Ethene}}{CH_2 = CH_2} + \underset{\text{Water}}{H_2O}$$

Ethanoic acid is the second member of homologous series of carboxylic acids

Formula : CH_3COOH

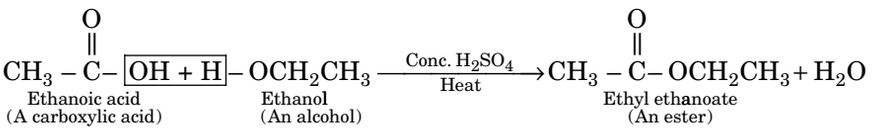
IUPAC Name : Ethanoic Acid

Common Name : Acetic Acid

Ethanoic acid is a colourless, pungent smelling liquid. When pure ethanoic acid is cooled, it freezes (m.p. 290 K) forming glacier like crystals. Therefore, 100% acetic acid, obtained by melting these crystals, is called glacial acetic acid

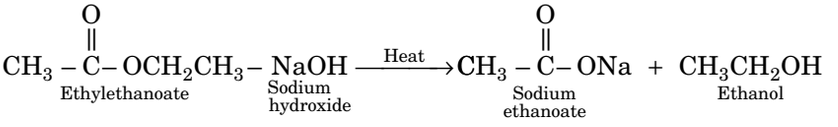
Esterification

Carboxylic acids react with alcohols to form esters For example, when ethanoic acid is warmed with ethnol in presence of a few drops of concentrated sulphuric acid as catalyst, an ester (ethyl ethanoate, commonly called ethyl acetate) and water are formed



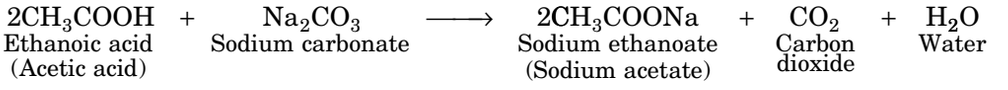
Saponification

Alkaline hydrolysis of an ester to give the salt of the corresponding carboxylic acid and the alcohol is called saponification. It is reverse of esterification, therefore also called as De-esterification.



Reaction with Sodium Carbonate

Ethanoic acid reacts with sodium carbonate to form sodium ethanoate and carbon dioxide gas.



When sodium carbonate is added to a solution of ethanoic acid, brisk effervescence of carbon dioxide is given off.

Soaps

These are sodium or potassium salt of long chain fatty acids. These work well in soft water but in hard water it form scum.

Detergents are ammonium salt of long chain carboxylic acid. It works well in soft as well as hard water.

Cleansing Action of soap

The long hydrocarbon chain is hydrophobic i.e. water repelling, so the hydrocarbon part of soap molecule is insoluble in water but soluble in oil and grease, so it can attach to the oil and grease particles present on dirty clothes.

The ionic portion of soap molecule is hydrophilic i.e. water attracting due to the polar nature of water molecules. So it can attach to the water particles.

When the surface of the cloth is mechanically scrubbed or beaten or agitated in a washing machine, the loosened oily dirt particles are removed from the dirty surface and the cloth is cleaned. Since detergents lower the surface tension of water to a greater extent than soaps, therefore, the cleansing power of detergents is much higher than those of soaps.

A spherical aggregate of soap molecule in soap solution in the water is called 'micelle'.

PREVIOUS YEARS' EXAMINATION QUESTIONS TOPIC 2

1 Mark Questions

1. The correct general equation for saponification reaction is:
(a) Easter of fatty acid + alkali → soap + glycol
(b) Easter of fatty acid + alkali → soap glycol
(c) Easter of fatty acid + acid → soap + glycerol
(d) Easter of fatty acid + acid → soap glycol
[TERM 2, 2015, 2016]

2. Water containing magnesium ion is called:
(a) polluted water
(b) soft water
(c) heavy water
(d) hard water **[TERM 2, 2015]**

3. While studying the saponification reaction, what do you observe when you mix an equal amount of colourless vegetable oil with aqueous solution of in a beaker?
(a) The colour of the mixture has become dark brown.
(b) A brisk effervescence is taking place in the beaker.
(c) The outer surface of the beaker has become hot.
(d) The outer surface of the beaker has become cold. **[TERM 2, 2017]**

2 Marks Questions

4. Write the name and the structural formula of the compound formed when ethanol is heated at with excess of conc. H_2SO_4 . State the role of conc. H_2SO_4 in this reaction. Write the chemical equation for the reaction.

[TERM 2, 2012]

5. A compound 'X' on heating with excess conc. sulphuric acid at 443 K gives an unsaturated compound 'Y'. 'X' also reacts with sodium metal to evolve a colorless gas 'Z'. Identify 'X', 'Y' and 'Z'. Write the equation of the chemical reaction of formation of 'Y' and also write the role of sulphuric acid in the reaction.

[TERM 2, 2012, 2017, 2018]

3 Marks Questions

6. Write chemical equations for what happens when

(i) Sodium metal is added to ethanoic acid.

(ii) Solid sodium carbonate is added to ethanoic acid.

(iii) Ethanoic acid reacts with a dilute solution of sodium hydroxide

[TERM 2, 2011]

7. A carboxylic acid (molecular formula $C_2H_4O_2$ reacts with an alcohol in the presence of an acid catalyst to form a compound 'X'. The alcohol on oxidation with alkaline $KMnO_4$ followed by acidification gives the same carboxylic acid $C_2H_4O_2$. Write the name and structure of (i) carboxylic acid, (ii) alcohol and (iii) the compound 'X'.

[TERM 2, 2014]

8. On dropping a small piece of sodium in a test tube containing carbon compound 'X' with molecular formula C_2H_6O, a brisk effervescence is observed and a gas 'Y' is produced. On bringing a burning splinter at the mouth of the test tube the gas evolved burns with a pop sound. Identify 'X' and 'Y'. Also write the chemical equation of the reaction. Write the name and structure of the product formed, when you heat 'X' with excess conc. sulphuric acid.

[TERM 2, 2016]

9. Distinguish between esterification and saponification reactions with the help of the chemical equations for each.

State one use of each

(i) esters and

(ii) saponification process

[TERM 2, 2017]

5 Marks Questions

10. What are detergents chemically? List two merits and two demerits of using detergents for cleaning. State the reason for the suitability of detergents for washing, even in the case of water having calcium and magnesium ions.

[TERM 2, 2012]

11. Why are certain compounds called hydrocarbons? Write the general formula for homologous series of alkanes, alkenes and alkynes and also draw the structure of the first member of each series. Write the name of the reaction that converts alkenes into alkanes and also write a chemical equation to show the necessary conditions for the reaction to occur.

[TERM 2, 2012, 2017]

12. (a) Define the term 'isomers'.

(b) Draw two possible isomers of the compound with molecular formula and write their names.

(c) Give the electron dot structures of the above two compounds

[TERM 2, 2013]

13. Name the process and write the complete reaction involved in the following conversions:

(i) Ethanol to ethene

(ii) Ethanoic acid to ester

(iii) Estertoethanol

[TERM 2, 2015]

14. A carbon compound 'P' on heating with excess conc. H_2SO_4 forms another carbon compound 'Q' which on addition of hydrogen in the presence of nickel catalyst forms a saturated carbon compound 'R'. One molecule of 'R' on combustion forms two molecules of carbon dioxide and three molecules of water. Identify P, Q and R and write chemical equations for the reactions involved.

[TERM 2, 2016]

Solutions

1. The correct option is (b).

In saponification reaction, soap and glycerol are formed after the reaction of fat/oil and $NaOH$/ KOH (Alkali). [1]

2. The correct option is (d).

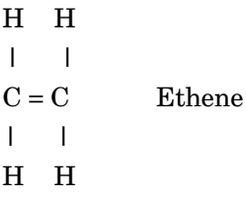
The water containing high calcium and magnesium ions is considered as hard water. [1]

3. The outer surface of the beaker becomes hot.

Since saponification reaction is an exothermic reaction, when an equal amount of colourless

vegetable oil and aqueous solution of are mixed in a beaker, the beaker becomes hot due to the release of heat. [1]

4. When ethanol is heated at 443*K* with excess of conc. H_2SO_4 then ethene ($CH_2 = CH_2$) is formed.



Ethene [1]

$$C_2H_5OH \xrightarrow[443K]{conc.H_2SO_4} CH_2 = CH_2 + H_2O$$

H_2SO_4 acts as a dehydrating agent, that removes water molecule from ethanol. [1]

5. Consider that compound X is a saturated alcohol.

$$H_3 - CH_2 - OH + H_2SO_4 \xrightarrow{443K} CH_2$$

$$= CH_2 + H_2O$$ [1]

It is observed that Ethanol when heated with excess conc. sulphuric acid at 443 K gives ethene as an unsaturated compound and water.

Now, $CH_3 — CH_2 — OH + Na \rightarrow CH_3 — CH_2 — ONa + H_2$

It is observed that Ethanol reacts with sodium metal to evolve hydrogen gas.

Thus $X \rightarrow C_2H_6O$ H, $Y \rightarrow C_2H_4$, $Z \rightarrow H_2$ and concentrated sulphuric acid acts as a dehydrating agent in the first step. [1]

6. (i) $2CH_3COOH + 2Na \longrightarrow 2CH_3COONa + H_2$

(Ethanoic Acid) (Sodium Metal) (Sodium Ethanoate) [1]

(ii)

$$2CH_3COOH + Na_2CO_3 \longrightarrow 2CH_3COONa + H_2O + CO_2$$

(Ethanoic Acid) (Sodium Carbonate) (Sodium Ethanoate)

[1]

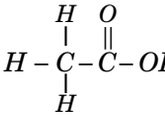
(iii) $CH_3COOH + NaOH \longrightarrow CH_3COONa + H_2O$

(Ethanoic Acid) (Sodium Hydroxide) (Sodium Ethanoate)

[1]

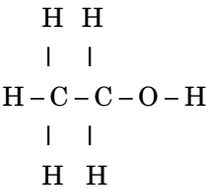
7. $CH_3 — COOH + C_2H_5OH \rightarrow CH_3 - COOC_2H_5$

(i) The carboxylic acid with molecular formula $C_2H_4O_2$ is Acetic acid $CH_3 — COOH$



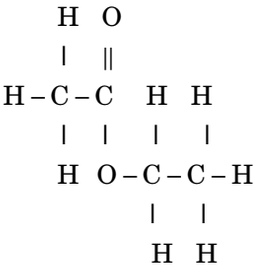
[1]

(ii) The name of the alcohol is Ethyl alcohol with structure C_2H_5OH



[1]

(iii) The organic acid X is Ethyl Ethanoate and its structure is $CH_3 — COOC_2H_5$



[1]

8. Chemical Equation-

$$2CH_3 - CH_2 - OH + 2Na \rightarrow 2CH_3 - CH_2 - ONa + H_2$$

Ethanol 'X' Sodium Ethoxide 'Y'

[1½]

$$CH_3 - CH_2 - OH \xrightarrow{Conc.H_2SO_4} CH_2 = CH_2 + H_2O$$

X Ethene

[1½]

Hence, 'X' = Ethanol and 'Y' = Sodium Ethoxide

9. **Esterification:** In Esterification, carboxylic acid reacts with alcohols in the presence of a little concentrated sulphuric acid to form esters.

Equation: Ethanoic acid reacts with ethanol in the presence of conc. H_2SO_4 to form esters.

$$C_2H_5OH + CH_3COOH \xrightarrow{Conc.H_2SO_4}$$

$$CH_3COOC_2H_5 + H_2O$$ [1]

Saponification Reaction: Reaction of an ester with a base such as NaOH, it is converted back to alcohol and sodium salt of carboxylic acid.

Equation: Reaction of ethyl ethanoate and NaOH gives ethanol and sodium ethanoate. [1]

$CH_3COOC_2H_5 + NaOH \rightarrow C_2H_5OH + CH_3COONa$

Use of:

(i) Esters: They are used in synthetic flavours, perfumes, cosmetics.

(ii) Saponification process: It can be used in soap preparation. [1]

10. Detergents are ammonium or sodium salts of long chain sulphonic acids, which has cleansing properties in water. [1]

Merits:

(i) It cleans dirt in hard water.

(ii) More than soaps, detergents are soluble in water. [1½]

Demerits:

(i) Non bio-degradable.

(ii) Detergents cause water pollution.

(iii) They are harmful for skin. [1½]

Suitability:

Calcium and magnesium salts of detergents are the reason for the suitability of detergents for washing, as they are soluble in water and therefore, can be used in hard water. [1]

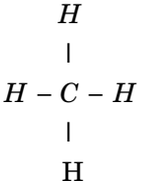
11. Certain compounds contain only carbon(C) and hydrogen (H) atoms. Such types of compounds are called hydrocarbons.

There are three kinds of homologous families of hydrocarbons classified on the basis on number of bonds between two carbon atoms. These are [1]

(a) **Alkanes:** Alkanes are the simplest kind of hydrocarbons containing single bond between any two carbon atoms. The general formula of compounds in this family is CnH_{2n+2}

The first member of this series is Methane -

$C_1H_{2\times1+2} = CH_4$

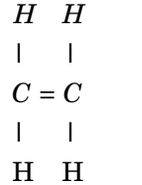


[1]

(b) Alkenes: Alkanes are the kind of hydrocarbons containing at least one double bond between any two carbon atoms. The general formula of compounds in this family is CnH_{2n}

The first member of this series is Ethene -

$C_2H_{2\times2} = C_2H_4$



[1]

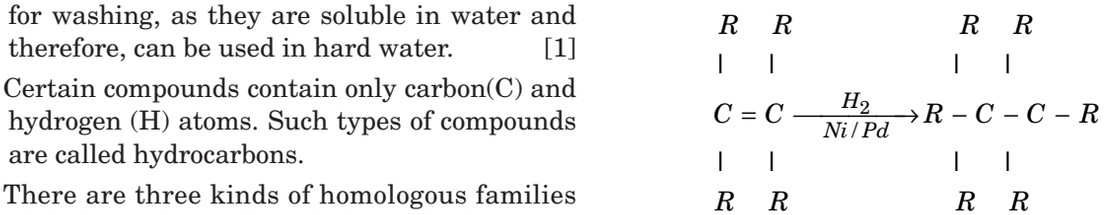
(b) Alkenes: Alkanes are the kind of hydrocarbons containing at least one double bond between any two carbon atoms. The general formula of compounds in this family is CnH_{2n-2}

The first member of this series is Ethene -

$C_2H_{2\times2-2} = C_2H_2$

H – C ≡ C – H [1]

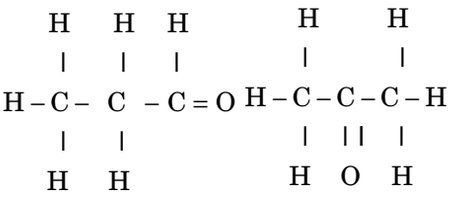
Alkenes are converted into Alkanes by hydrogenation reaction. This is an addition reaction in which unsaturated hydrocarbons are added with hydrogen in the presence of palladium and nickel catalysts to give saturated hydrocarbons.



[1]

12. (a) Isomers are the molecules having same molecular formula but different structural formula. [1]

(b) Two possible isomers of the compound with molecular formula C_3H_6O are acetone and propanal:



Propanal Propanone (Acetone) [2]

(c) Electron dot structure of these compounds is:

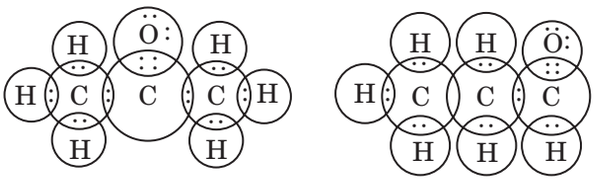


Fig.: Electron dot Structure of Propanol & Acetone [2]

13. (i) Ethanol to ethene: Heating ethanol at 443 K with excess concentrated sulphuric acid results in the dehydration of ethanol to given ethene

$CH_3\ CH_2OH \xrightarrow{(Hot\ Conc.H_2SO_4)} CH_2 = CH_2 + H_2O$

[1 + 1]

(ii) Ethanoic acid to ester: Reaction of Ethanoic acid to ester is called Esterification.

$$CH_3COOH + CH_3CH_2OH \xrightleftharpoons{\text{Acid}} CH_3 - \underset{\underset{O}{\|}}{C} - CH_2 - CH_3 + H_2O$$

Ethanoic Acid Ethanol Ester

[1½]

(iii) Ester to ethanol: The reaction named as Saponification because it is used in the preparation of soap.

$$CH_3COOC_2H_5 \xrightarrow{NaOH} C_2H_5OH + CH_3COONa$$

[1½]

14. Carbon compound 'P' is ethanol on reacting in presence of excess conc. H_2SO_4 gives another carbon compound 'Q' which is ethene and water.

$$C_2H_5OH \xrightarrow{Conc.H_2SO_4} \rightarrow CH_2 = CH_2 + H_2O$$

[2]

Ethene reacts with hydrogen in the presence of nickel catalyst to form a saturated compound 'R', i.e. ethane.

$$CH_2 = CH_2 + H_2 \xrightarrow{Ni/Pd} \rightarrow C_2H_6$$

[1]

Combustion reaction of ethane takes place and the equation is as follows:

$$C_2H_6 + \frac{7}{2}O_2 \rightarrow 2CO_2 + 3H_2O$$

[1]

So, $P = C_2H_5OH$, $Q = C_2H_4$, $R = C_2H_5$ [1]

Smart Notes .....

CHAPTER 5

Periodic Classification of Elements

Chapter Analysis with respect to Last 3 Years' Board Exams

List of Topics	**2016**	**2017**	**2018**
Need for classification, Modern periodic table	1Q (3 marks)	1Q (3 marks)	1Q (5 marks)
Gradation in properties, valency, atomic number	1Q (3 marks)	1Q (3 marks)	
Metallic and non-metallic properties	1Q (5 marks)		

On the basis of above analysis, it can be said that from exam point of view, different periodic tables, their pros and cons, metallic and non metallic properties are the most important topics of the chapter.

Summary

Knowing your Chapter at Glance:

Necessity for classification of elements

- For easy study of elements, elements were classified into certain groups in such a way that they share common properties.
- Dobereiner was first to classify elements with similar properties together in increasing order in such a way that the atomic mass of the middle element of the triad was roughly the average of the atomic masses of the other two elements.

Element	Symbol	Atomic Mass	
Lithium	Li	6.9 u	$\frac{6.9+39.0}{2} = 22.950$ u
Sodium	Na	23.0 u	
Potassium	K	39.0 u	

The major drawback of the dobereiner triad was that it was applicable to only few elements.

There were only three triads known they are:

Li	Na	K
Ca	Sr	Ba
Cl	Br	I

- Dobereiner's attempt encouraged other scientists to correlate the atomic masses of the elements with their properties.
- In 1866, Newlands arranged the elements in order of increasing atomic masses in such a way that the properties of every 8th element was similar to the 1st one.

Therefore, he called it as "Newlands' law of octaves"

sa (do)	**re (re)**	**ga (mi)**	**ma (fa)**	**pa (so)**	**da (la)**	**ni (ti)**
H	Li	Be	B	C	N	O
F	Na	Mg	Al	Si	P	S
Cl	K	Ca	Cr	Ti	Mn	Fe
Co and Ni	Cu	Zn	Y	In	As	Se
Br	Rb	Sr	Ce and La	Zr	–	–

Limitaion:

- It was found that the law of octaves was applicable only upto Ca or only for the lighter elements.
- It was assumed by Newland that only 56 elements existed in nature and no more elements would be discovered in the future. But later on many more elements were discovered whose properties did not fit into the law of octaves.
- In order to fit elements into his table, Newlands not only adjusted two elements into the same slot, but also put some unlike elements under the same note.

- Mendeleev was the most successful in developing the peroidic table where he arranged elements on the basis of atomic mass and chemical properties.

  Mendeleev's periodic law states that the physical and chemical properties of elements are the periodic functions of atomic masses.

Characteristics of mendeleev's periodic table

- He arranged the elements in the increasing order of atomic masses in horizontal rows known as periods and vertical columns known as groups.
- There were 8 groups designated as I, II, III, IV, V, VI, VII, and VIII and 7 periods. The group I to VII are subdivided into subgroups A and B. Group VIII don't have any subgroup.
- In some cases Mendeleev had to place an element with a slightly greater atomic mass before an element which has slightly lower atomic mass. Example, cobalt (atomic mass 58.9 u) appeared before Nickel (atomic mass = 58.71 u) and tellurium (atomic mass 127.6 u) was placed before Iodine (126.9 u).
- Mendeleev also left some gaps in his periodic table for those elements which were not known or discovered at that time. Example, scandium, gallium and germanium discovered later have properties similar to Eka-boron, Eka-aluminium and Eka-silicon.

Limitations

Anomalous position of hydrogen

Hydrogen resembles in its electronic configuration with alkali metals as it has only one electron in its valence shell.On the other hand hydrogen has many properties similar to that of halogens like both have one electron less than the nearest noble gas. For example, like halogens (F_2, Cl_2, Br_2, I_2) hydrogen (H_2) also exist as diatomic molecules. Also it combines with alkali metals to form covalent compounds like halogens.

Position of isotopes

Isotopes are the atoms of the same atomic number but having different atomic masses.

Since in the Mendeleev's periodic table elements are arranged in order of their increasing atomic masses so isotopes should be placed at different positions in the periodic table. As there is no provision for them in Mendeleev's periodic table, so these can not be placed at separate positions.

Uncertainty in prediction of new elements

As in Mendeleev's periodic table atomic mass does not increase in a regular manner in going from one element to another, so it was not possible to predict new elements.

Modern periodic table

Henry Moseley gas a new property of elements,'atomic numbers' and this was adopted as the basis of modern periodic table.

Periodic table

Modern periodic law states that the physical and the chemical properties of elements are the periodic function of atomic number.

Characteristics of modern periodic table

It has 7 periods and 18 groups.

Elements in the same group shares common chemical properties due to the same number of valence electrons.

Elements present in the same period contains same number of shells.

Atomic Number

Atomic number is defined as the total number of protons present in the nucleus of an atom. It is denoted by 'Z'.

Atoms of two different elements will always have different number of protons.

Electron Distribution in Orbits

It is arrangement of electrons in atomic orbitals.

Diagram

Rules:

1. An orbit can have a maximum of $2n^2$ electrons table
2. Orbits are filled from inside to outside. First, n = 1 shell is filled, then n = 2 shell, and so on...
3. The outermost shell of an atom cannot accommodate more than 8 electrons.

This is a very important rule is also called the Octet rule. The presence of 8 electrons in the outermost shell makes the atom very stable.

Valency:

Valence Electrons: Valence electrons are the electrons in the outermost orbit of an atom. Outermost orbit is also called valence shell.

Trends in modern periodic table:

1. Valence electron and valence shell
   (a) Across a period:
   • Valence electrons increases from left to right.
   • Valence shell is constant.
   (b) Down the group:
   • Valence electrons remains constant.
   • Valence shell increase.
2. Valency
   (a) Across the period:
   • Valence increases till group 14 and decreases till 18.
   (b) Down the group:
   • Valency remains constant.
3. Size of atom:
   (a) Across period:

- As we move to right, positive charge on nucleus increases, so attraction of outer electron increases. Therefore, electron comes close to nucleus. Thus size of atom decreases from left to right.

   (b) Down the group:

- As we go down, number of shells increases, so size of atom also increases.

4. Metallic character
   (a) Across the period:
   • Decreases from left to right.
   (b) Down the group:
   • Increases down the group.
5. Electro positivity
   It is ability of an atom to lose electron.
   • If electropositivity is high, it is easy to lose electron.

- If electropositivity is low, it is difficult to lose electron.

   (a) Across the period:

- As we move to right, size of atom decreases and therefore more attraction on electrons. So it is difficult to take electron. Thus electropositivity decreases from left to right.

   (b) Down the group:

- As we move down in a group, size of atom increase so less attraction on electrons. So it is easy to take electron. Thus electropositivity increases down the group.

6. Chemical reactivity
   (a) Across the period:

- First decreases as it is more difficult to loose more electron and then increases from left to right as it is easier to gain lesser number of electron.

   (b) Down the group:

- As we move down in a group, chemical reactivity increases for metals and increases for non-metals.

   Metallic and non-metallic character: Group 1 to 12 are metals. Group 13 to 18 comprises non-metals, metalloids and metals.

Metal	**Non-metal**
Mostly Solid	Solid, liquid and gas.
Lustrous and sonorous	Non-lustrous.
They have generally 1 to 3 valence electrons	They have generally 4 to 8 valence electrons
Malleable and ductile	Non-malleable and non ductile.
Hard and have high density	Varying hardness and have low density.
Good conductors of heat and electricity	Poor conductors of heat and electricity.
High melting and boiling point	Low melting and boiling points.

PREVIOUS YEARS' EXAMINATION QUESTIONS

1 Mark Questions

1. List any two properties of the elements belonging to the first group of the modern periodic table.

[TERM 2, 2014]

2. Justify the statement that the elements having atomic number 3 and 11 will belong to the same group of periodic table.

[TERM 2, 2015]

2 Marks Questions

3. How does the valency of elements vary

(i) in going down a group, and

(ii) In going from left to right in a period of the periodic table ?

[TERM 2, 2011]

4. In the modern periodic table, the element Calcium (atomic number = 20) is surrounded by elements with atomic numbers 12, 19, 21 and 38.

Which of these elements has physical and chemical properties resembling those of Calcium and why?

[TERM 2, 2011]

5. Choose from the following

$_{6}C$, $_{8}O$, $_{10}Ne$, $_{11}Na$, $_{14}Si$

(i) Elements that should be in the same period.

(ii) Elements that should be in the same group.

State reason for your selection in each case.

[TERM 2, 2012]

6. An element 'X' belongs to 3rd period and group 17 of the Periodic Table. State its (i) electronic configuration, (ii) Valency. Justify your answer with reason.

[TERM 2, 2012]

3 Marks Questions

7. The atomic number of an element is 16. Predict

(i) the number of valence electrons in its atom

(ii) its valency

(iii) its group number

(iv) whether it is a metal or a non-metal

(v) the nature of oxide formed by it

(vi) the formula of its chloride

[TERM 2, 2011]

8. Write the number of periods and groups in the Modern Periodic Table. How does the metallic character of elements vary on moving (i) from left to right in a period, and (ii) down a group? Give reason to justify your answer.

[TERM 2, 2012, 2017]

9. Na, Mg and Al are the elements having one, two and three valence electrons respectively. Which of these elements (i) has the largest atomic radius, (ii) is least reactive? Justify your answer stating reason for each.

[TERM 2, 2012]

10. Given below are some elements of the modern periodic table:

$_{4}Be$, $_{9}F$, $_{14}Si$, $_{19}K$, $_{20}Ca$

(i) Select the element that has one electron in the outermost shell and write its electronic configuration.

(ii) Select two elements that belong to the same group. Give reason for your answer.

(iii) Select two elements that belong to the same period. Which one of the two has bigger atomic size?

[TERM 2, 2012]

11. Write the number of periods the modern periodic table has. How do the valency and metallic character of elements vary on moving from left to right in a period? How do the valency and atomic size of elements vary down a group?

[TERM 2, 2012, 2013]

12. The electrons in the atoms of four elements A, B, C,and D are distributed in three shells having 1,3,5 and 7 electrons in the outermost shell respectively. State the period in which these elements can be placed in the modern periodic table. Write the electronic configuration of the atoms of A and D and the molecular formula of the compound formed when A and D combine.

[TERM 2, 2014]

13. Study the following table in which positions of six elements A, B, C, D, E and F are shown as they are in the modern periodic table:

Group → Period ↓	1	2	3-12	13	14	15	16	17	18
2	A					B			C
3				D	E				F

On the basis of the above table, answer the following questions:

(i) Name the element which forms only covalent compounds.

(ii) Name the element which is a metal with valency three.

(iii) Name the element which is a non-metal with valency three.

(iv) Out of D and E, which is bigger in size and why?

(v) Write the common name for the family to which the elements C and F belong.

[TERM 2, 2014]

14. Atom of an element contains five electrons in its valence shell. This element is major component of air. It exists as a diatomic molecule.

(i) Identify the element.

(ii) Show the bond formed between two atoms of this element.

(iii) Write the nature of the bond between the two atoms

[TERM 2, 2015]

15. (a) Amongst the following elements which would form cations - K, C, Li, O, Mg, S, Ca, F.

(b) Write the electronic configuration of any two cations identified from above

[TERM 2, 2015]

16. (a) Identify the elements amongst the following that would belong to the same group, H, He, Li, B, C.

(b) State the group number of the above elements identified.

(c) Name another element belonging to the same group. **[TERM 2, 2015]**

17. An element 'X' belongs to 3rd period and group 16 of the Modern Periodic Table.

(a) Determine the number of valence electrons and the valency of 'X'.

(b) Molecular formula of the compound when 'X' reacts with hydrogen and write its electron dot structure.

(c) Name the element 'X' and state whether it is metallic or non-metallic.

[TERM 2, 2016]

18. Three elements 'X', 'Y' and 'Z' have atomic numbers 7, 8 and 9 respectively.

(a) State their positions (Group number and periodic number both) in the Modern Periodic Table.

(b) Arrange these elements in the decreasing order of their atomic radii.

(c) Write the formula of the compound formed when 'X' combines with 'Z'.

[TERM 2, 2016]

19. Na, Mg and Al are the elements of the 3rd period of the Modern Periodic Table have group number 1, 2 and 13 respectively. Which one of these elements has the (a) highest valency, (b) largest atomic radius and (c) maximum chemical reactivity? Justify your answer stating the reasons for each.

[TERM 2, 2017]

5 Marks Questions

20. (i) Write down the electronic configuration of Magnesium and Oxygen.

(ii) Give two general properties of the compound formed by combination of magnesium and oxygen.

(iii) Show the formation of this compound by the transfer of electrons.

[TERM 2, 2016]

21. (a) The modern periodic table has been evolved through the early attempts of Dobereiner, Newland and Mendeleev. List one advantage and one limitation of all the three attempts.

(b) Name the scientist who first of all showed that atomic number of an element is a more fundamental property than its atomic mass.

(c) State Modern periodic law.

[TERM 2, 2018]

Solutions

1. Two properties of the elements belonging to the first group of the modern periodic table are:

(i) They all belong to alkali metal group that release hydrogen on reacting with acids.[½]

(ii) They all have their valency as 1. [½]

2. The element having atomic number 3 will have electronic configuration as 2, 1. Here the number of valence electron (electrons in the outermost shell) is 1. [½]

The element having atomic number 11 will have electronic configuration as 2, 8, 1.Here also the number of valence electron is 1.

As both the elements have same number of valence electrons, so they belong to the same group. [½]

3. (i) Valency will remain same when we go down the group as the number of electrons in the outermost shell remains the same. [1]

(ii) Valency will first increase from 1 to 4, then it will decrease from 4 to 0 as we move from left to right. [1]

4. Physical and chemical property of elements resemble if they have same number of valence electrons. The valency of calcium is 2 as it is having electronic configuration of (20 = 2, 8, 8, 2). [1]

The valency of other atoms around calcium is,

Atomic number (12) = 2, 8, 2

Atomic number (19) = 2, 8, 8, 1

Atomic number (21) = 2, 8, 8, 3

Atomic number (38) = 2 8, 18, 8, 2

Elements of atomic number 12 and 38 are having same valency(i.e. 2 in there outermost shell) thus they will have same physical and chemical properties. [1]

5. (i) Electronic configuration:

C - 2, 4

O - 2, 6

Ne - 2, 8

Na - 2, 8,1

Si - 2, 8, 4

C, O and Ne have same number of shells i.e. 2 as electrons are filled in first 2 shells so these elements lie in the same period. Also Na and Si have same number of shells i.e. 3 as electrons are filled in first 3 shells. So these elements lie in the same period. [1]

(ii) C and Si have same number of valence electrons i.e. 4. So, these elements lie in the same group. [1]

6. As the element belongs to 3rd period It means it has 3 shells. The group number is 17. The group number tells about number of valence electrons. The element has 7 valence electrons. Therefore it's electronic configuration = 2,8,7 and valency = 1 (8 – 7). It will gain 1 electron to reach the nearest noble gas configuration. [1 + 1]

7. (i) The atomic number of element is 16, so electronic configuration will be 16 = 2,8,6. Therefore the number of valence electrons are 6. [½]

(ii) The valency of this atom is 8 – 6 = 2 [½]

(iii) The group number of this atom is 16. [½]

(iv) It is non-metal as it is having deficiency of electron in outermost shell. [½]

(v) The oxide formed by this atom will be acidic in nature. [½]

(vi) The valency of chloride is 1 and valency of this atom(= 16) is 2. The formula for its oxide will be XCl_2 [½]

8. There are 7 periods and 18 groups in the modern periodic table.

(i) From moving left to right in a period, metallic character of elements decreases because effective nuclear charge increases on the valence electrons and hence the tendency to lose the electrons decreases. [1½]

(ii) Moving down a group metallic character increases because effective nuclear charge experienced by valence electrons decreases and hence the tendency to lose the electrons increases. [1½]

9. (i) Na has the largest atomic radius compared to Mg and Al .Due to an increase in nuclear charge, the atomic radius decreases when moving from left to right along a period as it tends to pull the electrons closer to the nucleus and thus, reduces the size of the atom. [1½]

(ii) Al is least reactive as it is smaller in size compared to Na and Mg so, it has lesser tendency to lose electron due to high effective nuclear charge. [1½]

10. (i) Potassium (K) is the element that has one electron in the outermost shell. [1]

Electronic configuration: 2, 8, 8, 1

(ii) Beryllium (Be) and Calcium (Ca) are the elements belongs to same group-2 as both of them has two valence electrons. [1]

(iii) Beryllium (Be) and Fluorine (F) are the elements belong to same 2nd period as both of them have 2 shells. We know that on moving from left to right in the periodic table atomic radius decreases due to increase in effective nuclear charge, thus,Beryllium(Be) will have bigger atomic radius. [1]

11. Modern periodic table has 7 periods.

As we move along left to right, valency increases from 1 to 4 and then decrease from 4 to 0 as the valency of an element is determined by the number of valence electrons present in the outermost shell of the atom. The valence electrons increases in s and p blocks as one move from left to right. [1]

The metallic character decreases as we move from left to right because the nuclear charge on valence shell electron increases. So, tendency to lose electrons decreases. [1]

On moving down the group, the valence shell electrons remain the same. Therefore, valency of the atom does not change in a group.

As we go down the group, a new shell is added. So, the atomic size increases. [1]

12. As the elements A, B, C, and D are filled with three shells so they all belong to period 3. Electronic configuration of the all the four elements is written below:

A : 2, 8, 1

B : 2, 8, 3

C : 2, 8, 5

D : 2, 8, 7 [1½]

Now, here A has 1 valence electron and D has 7 valence electrons. To achieve inert gas configuration element A has to lose one valence electron and element D has to gain 1 electron. So, the molecular formula when both the elements combine is "AD". [1½]

13. (i) Element E can only form covalent compounds because it has 4 electrons in its outermost shell (i.e. 2, 8, 4). [½]

(ii) The metal is element D with valency 3 as it can donate its 3 electrons in the outermost shell. [½]

(iii) Then on metallic element B with valency 3 as it can easily gain 3 electrons to complete its outermost shell. [½]

(iv) Out of E and D, the size of D is large than E because atomic size decreases across the period. [½]

(v) The name of the family to which the elements C and F belong is 'Noble gases or 'inert gases' as their outermost shell is complete.[½+½]

14. (i) The element which has 5 electrons in its valence shell and is a major component of air is nitrogen (N). It exists as a diatomic molecule. [1]

(ii) The nitrogen atoms form covalent bond by sharing 3 electrons. It means two atoms of nitrogen make triple bond. The structural formula of nitrogen is as follows:

$N \equiv N$ [1]

(iii) The triple bond between nitrogen atoms is very strong and as the electrons are shared and no ion is present so the molecule formed is very stable or unreactive. [1]

15. (a) The elements which would form cations are K, Li, Mg and Ca because these elements have the tendency to lose electron to attain inert gas configuration. [1½]

(b) Atomic number of potassium is 19.

K = 2,8,8,1

Atomic number of magnesium is 12.

Mg = 2, 8, 2 [1½]

16. (a) H and Li belong to the same group. [1]

(b) They belong to the group 1 as they have 1 valence electron. [1]

(c) The other element that belongs to the same group is sodium (Na). [1]

17. (a) As this element belongs to group 16, therefore it got 6 electrons in its outermost shell. [1]

Valency= 2

Number of Valence electrons = 6

(b) The compound $= H_2X$

Electron dot structure = $H \bullet\bullet \underset{\bullet\bullet}{\overset{\bullet\bullet}{X}} \bullet\bullet H$ [1]

(c) The element 'X' is Sulphur and it is non metallic as it will gain 2 electrons to complete its octet. [1]

18. (a)

Element	Atomic No.	Group No.	Periodic No.
X	7	15^{th}	2^{nd}
Y	8	16^{th}	2^{nd}
Z	9	17^{th}	2^{nd}

[1½]

(b) The decreasing order of atomic radii-

This is so because the new electron enters in to same shell increasing the force of attraction and decreased radii.

(c) ${}_7X$ = 2, 5 valency = 3

${}_9Z$ = 2, 7 valency = 1

The compound formed is XZ_3. [1½]

19. (a) Valency of an element is determined by the number of valence electrons.

The valency of Sodium (Na) is 1, Magnesium (Mg) is 2 and Aluminium (Al) is 3.

Thus, Aluminium has the highest valency of 3. [1]

(b) As we move from left to right across a period, electrons are added one at a time to the outer energy shell. This increases the nuclear charge which tends to pull the electrons closer to the nucleus and reduces the size of the atom. Thus, Sodium (Na) has the largest atomic radius. [1]

(c) As we move from left to right across a period, the tendency to lose the electrons to participate in any reaction decreases due to increasing nuclear charge which pulls the electrons close to the nucleus. Thus, Sodium (Na) will have the maximum chemical reactivity. [1]

20. (i) The atomic number of magnesium is 12 therefore its electronic configuration is2, 8, 2.

The atomic number of oxygen is 8 therefore its electronic configuration is 2, 6. [1]

(ii) General properties of the compound formed by combination of magnesium and oxygen are:

(a) It has high pH of 10.3,that means it is very basic. [1]

(b) It will be an ionic compound. The compound will have extremely high melting point of 5,072 degree Fahrenheit. [1]

(iii) Atomic number of Magnesium (Mg) – 12

Electronic configuration of Magnesium – 2, 8, 2

It has two valence electrons, it will lose two electrons to get octet configuration

Atomic number of Oxygen (O) – 8

Electronic configuration of Oxygen – 2, 6

It is two electrons short of octet configuration, thus it will gain two electrons.

During the bond formation between Magnesium and Oxygen, one Magnesium atom loses two electrons to Oxygen atom.

$Mg \rightarrow Mg^{2+} + 2e^-$

$O + 2e \rightarrow O^{2-}$

$Mg^{+2} + O^{-2} \rightarrow MgO$ [2]

21. (a) Advantage of Dobereiner triad's attempt was that the three elements in the triad had similar properties.

While the limitation was that its classification was applicable to few elements. [1]

Advantage of Newland octave attempt was that if the elements were arranged in the increasing order of atomic weights, the properties of every eighth element were similar to the properties of the first one.

It was applicable upto only calcium. [1]

Advantage of the attempt made by Mendeleev was that the physical and chemical properties of elements are periodic functions of their atomic weights.

While the position of rare earth metals was not clear so they were placed in group 3A which was a limitation. [1]

(b) Henry Moseley was the first scientist who showed that atomic number of an element is a more fundamental property than its atomic mass. [1]

(c) The modern periodic law states that the physical and chemical properties of the elements are periodic functions of their atomic number. [1]

Smart Notes .....

CHAPTER 6

Life Processes

Chapter Analysis with respect to Last 3 Years' Board Exams

List of Topics	**2016**	**2017**	**2018**
Basic concept of nutrition	1Q (1 mark)	4Q (1 mark), 1Q (3 marks)	1Q (5 marks)
Respiration, transport and excretion in plants and animals	1Q (3 marks), 1Q (5 marks)	3Q (5 marks), 3Q (1 marks)	2Q (5 marks)

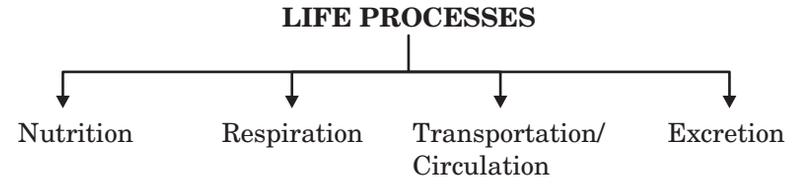
On the basis of above analysis, it can be said that from exam point of view, nutrition and respiratory systems are the most important topics of the chapter.

Topic 1: Nutrition

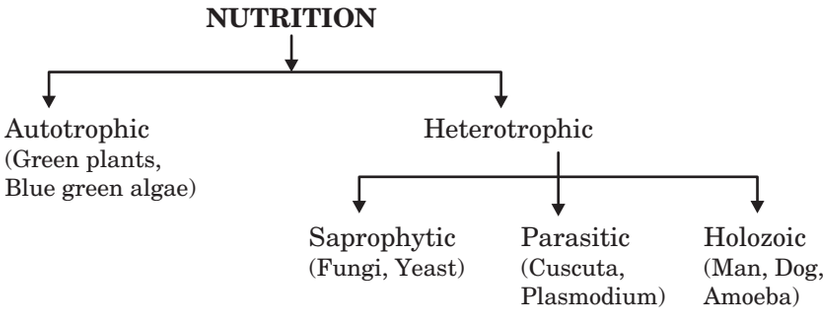
Summary

Knowing your Chapter at Glance:

- The various basic functions performed by living organisms to maintain their life on this earth are called life processes.



The process of obtaining food from the surroundings and using it for various metabolic activities by an organism is called nutrition.



Autotrophic Nutrition

Green plants are capable of manufacturing their own food in the form of carbohydrate in presence of light by using water and carbon-dioxide, this process is called photosynthesis.

Heterotrophic Nutrition

The type of nutrition in which organisms derive their food (nutrients) from other living organism is called heterotrophic nutrition. Heterotrophic mode of nutrition is of different types :

(a) **Saprotrophic Nutrition** : It refers to the mode of nutrition in which organisms obtain nutrients from the dead and decaying organic matter e.g. fungi (yeast) and some bacteria. These organisms are called saprophytes.

(b) **Parasitic Nutrition** : It refers to the mode of obtaining food synthesized by other animals. The organism which obtains food is called the parasite and the organism from which the food is obtained is called 'host'. This nutrition is observed in fungi, bacteria, few plants like Cuscuta, orchids and some animals like Plasmodium, roundworm, ticks, lick, leeches etc.

(c) **Holozoic Nutrition** : it refers to the mode of nutrition in which the complex organic matter in the form of solid food is ingested, digested and then absorbed into the cells and utilized e.g. Amoeba, frog, human being etc. In single-celled organisms, the food may be taken in by the entire surface.

Photosynthesis: It is the process by which green parts of the plant synthesise organic food in the form of carbohydrates from CO_2 and water in the presence of sunlight.

$$6CO_2 + 6H_2O \xrightarrow[\text{Chlorophyll}]{\text{Light}} \underset{\text{(Glucose)}}{C_6H_{12}O_6} + 6O_2$$

Steps of photosynthesis

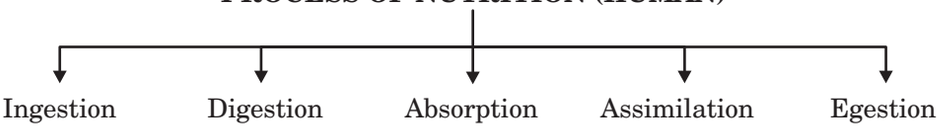
- Absorption of light energy by chlorophyll.
- Conversion of light energy to chemical energy and splitting of water molecules into hydrogen and oxygen.
- Reduction of carbon-dioxide to carbohydrates. This is also known as dark reaction as it does not require light.

- Plants carry out gaseous exchange with surrounding through stomata.
- The mode of nutrition in Amoeba is holozoic and it is omnivorous.

Nutrition in Amoeba

- When Amoeba comes in contact with food particles, it sends out temporary finger-like extensions of the cell surface called pseudopodia which engulf the prey by forming a food cup. This process is ingestion.
- When the tips of encircling pseudopodia touch each other, the food is encaptured into a bag called food vacuole. This step is digestion.
- The food vacuole serves as a temporary stomach secreting digestive juice.
- The digested food gets absorbed and diffuses into the cytoplasm and then assimilated.
- The process of elimination of undigested food is called egestion. Egestion of undigested food takes place at any point on the surface of the body .
- However in Paramoecium, which is also a unicellular organism the cell has a definite shape and food in taken in at a specific spot. Food is moved to this spot by the movement of cilia which covers the entire surface of the cell.

PROCESS OF NUTRITION (HUMAN)

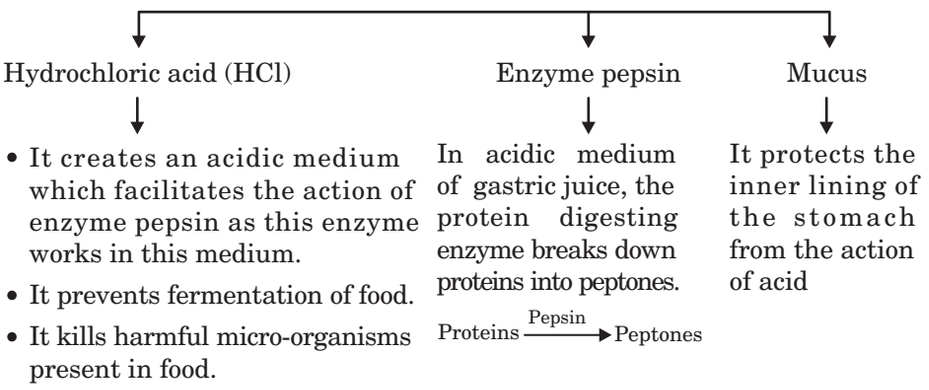


- In humans, digestion of food takes place in alimentary canal.

  The various organs of human alimentary canal in sequence are: Mouth ⟶ Buccal Cavity ⟶ Pharynx ⟶ Oesophagus ⟶ Stomach ⟶ Small Intestine ⟶ Large Intestine ⟶ Anus

1. **Mouth**: It is bound by two soft, movable lips, the upper lips and lower lip. Mouth opens into a chamber or cavity called buccal cavity. This cavity contains:
   (a) Teeth: In man, there are 16 teeth in each jaw (upper and lower). These are used for the purpose of chewing and grinding of food.
   (b) Tongue: It is a muscular, sensory organ, which forms the floor of buccal cavity. It bears taste buds and hence helps in tasting the food.
   (c) Salivary glands: The buccal cavity receives the secretion (saliva) of three pairs of salivary glands through their ducts. Saliva contains water, salts and an enzyme ptyalin or salivary amylase, which breaks starch into maltose. Thus, the digestion of carbohydrate begins in mouth itself.
2. **Pharynx**: The buccal cavity opens into a funnel shaped vertical canal. It is the common passage for food and air. It opens into oesophagus.
3. **Oesophagus**: It is muscular tube about 10 inches long and carries the food from pharynx to the stomach. No digestion occurs here. The lining of the food pipe has muscles that contract rhythmically in order to push the food forward. These movements are called peristaltic movements.
4. **Stomach**: The stomach has branched and tubular glands present on its wall (gastric glands). The secretions of these glands are collectively called gastric juice.

LIFE PROCESSES



- The small intestine is the site of complete digestion of carbohydrates, proteins and fats. It is distinctly divided into three regions - duodenum, jejunum and ileum.
- Duodenum, the first part of small intestine is U-shaped. It receives the secretions of liver and pancreas. Liver secretes bile, which contains bile pigments and bile salts.

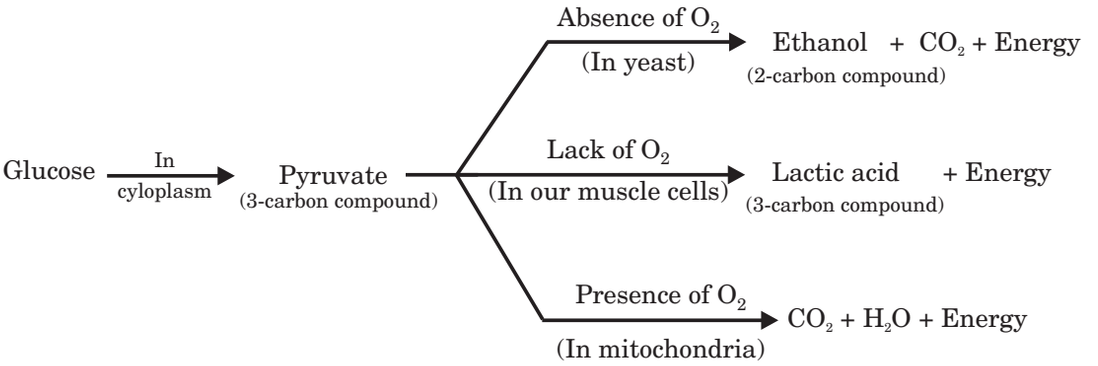
  The following steps of digestion takes place in the duodenum :

  1. Bile juice makes the medium alkaline in small intestine as the food coming from the stomach is acidic.
  2. Bile emulsifies fat present in the food. Emulsification means breaking of fat molecules into small globules increasing the efficiency of enzyme action.
  3. Pancreatic juice contains :
     - Trypsin for digesting proteins,
     - Pancreatic amylase for breakdown of starch and
     - Pancreatic lipase for breaking down emulsified fats.

     The partially digested proteins, carbohydrates and emulsified fats enter jejunum and ileum, where intestinal juice called succus entericus completes the digestion of proteins into amino acid, carbohydrates into glucose, and fats into fatty acids and glycerol.

     Internally, the wall of the small intestine is provided with numerous long finger-like projections called villi, which increase the surface area of the inner lining of intestine.
- Large intestine: The undigested and unabsorbed food is sent to the large intestine. It is about 1.5 - 1.8m long and about 6.5 cm in diameter. It consists of three parts - caecum, colon and rectum. The walls of large intestine absorb most of the water from this undigested food making the contents in semi-solid form.
- Anus: The undigested waste is passed out through the anus. This is called egestion or defecation. The exit of this waste material is regulated by anal sphincter.

  Break-down of food in cells to release energy is called cellular-respiration.



PREVIOUS YEARS' EXAMINATION QUESTIONS

TOPIC 1

1 Mark Questions

1. Following are the steps involved in the experiment to determine the percentage of water absorbed by raisins. They are not in proper sequence.

I. Soak the raisins in fresh water.
II. Weigh dry raisins.
III. Weigh soaked raisins.
IV. Wipe out soaked raisins.

The correct sequence of steps is
(a) I, II, III, IV
(b) II, I, IV, III
(c) II, I, III, IV
(d) I, II, IV, III

[TERM 1, 2011]

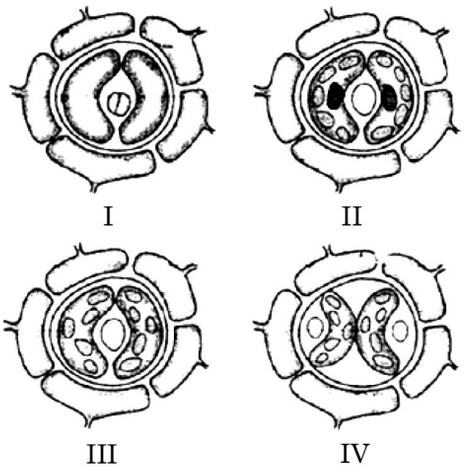
2. In an experiment to show that sunlight is necessary for photosynthesis, the leaf is boiled in alcohol for a few minutes using a water-bath. It is essential to use water-bath because:
(a) Alcohol is highly volatile
(b) Steam from the water bath heats the leaf rapidly
(c) Steam from the water bath dissolves the chlorophyll
(d) Alcohol is inflammable

[TERM 1, 2011]

3. Which one of the following is the combination of relevant materials required for setting up an experiment to show that light is necessary for photosynthesis?
(a) Destarched leaves, strips of black paper, starch solution and iodine crystals
(b) A potted plant, strips of colored paper, starch solution, iodine and potassium iodide
(c) Strips of black paper, starch solution, destarched leaves and potassium iodide
(d) Strips of black paper, destarched leaves and iodine solution

[TERM 1, 2011, 2013]

4. Four students observed the epidermal peel of leaf under a high power microscope and made the sketches as below. The correct sketch would be:



(a) I
(b) II
(c) III
(d) IV

[TERM 1, 2011, 2014, 2015]

5. A student was asked to prepare temporary mount of stomata from a leaf. He should select
(a) Tip of the leaf
(b) Mid-rib of the leaf
(c) Upper epidermis
(d) Lower epidermis

[TERM 1, 2011]

6. A student weighed some raisins and recorded the weight as 'x'. She then soaked the raisins in distilled water. After about 2 hours she removed the raisins, wiped them dry and weighed again and recorded that as 'y'. The percentage of water absorbed by raisins may be determined using the relationship

(a) $\frac{y-x}{y}\times 100$

(b) $\frac{y-x}{x}\times 100$

(c) $\frac{y-x}{x}\times\frac{1}{100}$

(d) $(y-x)\times 100$

[TERM 1, 2012]

7. In the experiment for determining the percentage of water absorbed by raisins, we do the final weighing of the raisins after keeping them dipped in water for about one hour. For the accuracy of the result, the extra water from the surface of the soaked raisins is removed by
(a) Rubbing with cotton cloth
(b) Hot air blower
(c) Dry cotton wool
(d) Filter paper **[TERM 1, 2012]**

8. Sequence in preparing a temporary mount is
(a) Staining, mounting, putting cover slide
(b) Staining, putting coverslip, mounting
(c) Putting coverslip, staining, mounting
(d) Mounting, staining, putting cover slip
[TERM 1, 2013]

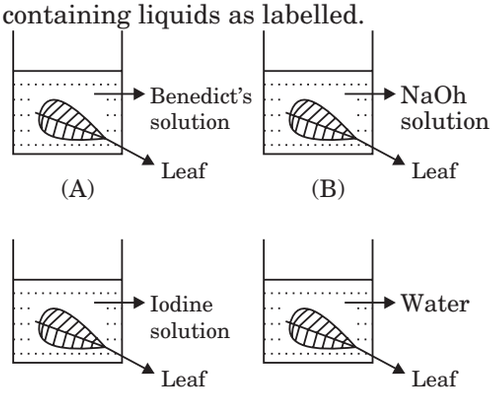
9. Stomata plays an important role in
(a) Respiration
(b) Photosynthesis
(c) Transpiration
(d) All of the above **[TERM 1, 2013]**

10. We test for starch and not glucose to prove that photosynthesis has taken place because
(a) Glucose is not produced during photosynthesis in variegated leaves
(b) Glucose formed during photosynthesis gets stored as sucrose
(c) Glucose formed during photosynthesis gets stored as starch
(d) Glucose is a stable product and cannot be tested **[TERM 1, 2013]**

11. For the experiment "light is necessary for photosynthesis", the potted plant is first kept in darkness for a day. This is to
(a) Deactivate the chloroplast
(b) De-starch leaves
(c) Activate chloroplast
(d) Prepare leaves for photosynthesis
[TERM 1, 2013, 2014]

12. A well stained leaf peel preparation when focused under the high power of a microscope would show:
(a) Epidermal cells, stomata and guard cells, each with one nucleus and many chloroplasts.
(b) Epidermal cells, stomata and guard cells, each with many nuclei but one chloroplast.
(c) Stomata and guard cells without nuclei or chloroplast.
(d) Stomata but no guard cells or epidermal cells
[TERM 1, 2014]

13. Figures A, B, C and D show leaves that has been boiled in alcohol, placed in four beakers containing liquids as labelled.



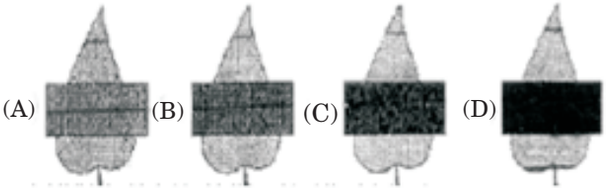
In which one of the above a positive test for presence of starch would be obtained?
(a) A
(b) B
(c) C
(d) D
[TERM 1, 2014]

14. A temporary slide of leaf peel is mounted in:
(a) Iodine
(b) Glycerin
(c) Safranin
(d) Methylene blue
[TERM 1, 2014, 2015]

15. Which of the following pairs of two vegetables represents the correct homologous structures?
(a) Sweet potato and potato
(b) Sweet potato and tomato
(c) Carrot and potato
(d) Radish and carrot
[TERM 1, 2014]

16. To determine that light is essential for photosynthesis, following are the steps, but not in sequence:
(i) Pluck the leaf and do the starch test.
(ii) Keep the selected plant in sunlight.
(iii) De-starch the plant for 48 - 72 hours.
(iv) Cover the leaf with black paper strip.
The correct sequence is:
(a) (iii), (i), (ii), (iv)
(b) (iii), (ii), (iv), (i)
(c) (iii), (iv), (ii), (i)
(d) (i), (ii), (iv), (iii)
[TERM 1, 2015]

17. In an experiment on photosynthesis students were instructed to cover a portion of a leaf of a destarched potted plant with opaque paper as shown:



"A" covered one of the leaves with red strip, "B" with green, "C" with blue, "D" with black. When the starch test was done on the leaves after 4 hours, the result showed no starch in:
(a) The portion covered with red, green and blue strips
(b) The portion covered with green strips
(c) The portion covered with black and blue strips
(d) Any of the covered portions
[TERM 1, 2015]

18. A leaf is boiled in alcohol before using iodine for starch test in order to
(a) Dissolve starch
(b) Dissolve chlorophyll
(c) Softening the leave
(d) To kill the enzymes

[TERM 1, 2017]

19. To make the plant free of starch, it is kept:
(a) In darkness for 72 hours
(b) In a room, but with lights on at night only
(c) Under the shade of a tree
(d) Covered with coloured polythene in a shady placed

[TERM 1, 2017]

20. During the experiment to show that plants do photosynthesis, the destarched leaf is boiled in alcohol. Once boiling is completed
(a) Alcohol remains colourless
(b) Leaf remains greenish
(c) Alcohol turns greenish and leaf becomes colourless
(d) No visible change occur

[TERM 1, 2017]

21. While preparing a temporary stained mount of a leaf epidermal peel, the extra stain is removed by:
(a) Washing with water
(b) Washing with calcium chloride
(c) Soaking with filter paper
(d) Absorbing with cotton wool

[TERM 1, 2017]

22. A student focused the leaf epidermal peel under a low power microscope, but he could not see all the parts. He should:
(a) Use the coarse adjustment knob again to focus the slide
(b) Use the fine adjustment knob to increase magnification
(c) Focus under high power using coarse adjustment knob
(d) Focus under high power using fine adjustment knob

[TERM 1, 2017]

5 Marks Questions

23. List the steps of preparation of temporary mount of a leaf peel to observe stomata.

[TERM 1, 2018]

Solutions

1. The steps involved in the experiment 'to determine the percentage of water absorbed by raisins, in proper sequence is II, I, IV, III. Therefore, option (b) is correct. [1]

2. Alcohol is highly inflammable, it may catch fire if boiled directly over the flame, and so, we use the water bath for boiling it.

Hence, option (d)is correct. [1]

3. Strips of black paper are necessary so as to make sure that covered part of the plant does not receive any light.

Destarched leaves are necessary so that the photosynthesis could be confirmed on the non-covered part of leaf to make starch on further exposure to sunlight. [½]

Iodine is necessary to confirm the presence of starch, because iodine turns starch solution to blue-black.

Hence, option (d) is correct. [½]

4. Stomata are tiny pores present on the surface of the leaves. Though they are found on both upper and lower epidermis of leaf but they are more in number on the lower epidermis. Each stoma is bounded by two kidney-shaped guard cells. These guard cells possess a nucleus and a number of chloroplasts. [½]

Option (b) shows leaf peel with open stomata. The dark spots on the guard cells are the nucleus and the other lighter spots show the chloroplasts.

Hence, option (b) is correct. [½]

5. In monocots, the number of stomata on lower surface of leaf is almost similar to the number of stomata on the upper surface whereas in dicots number of stomata present on the lower surface is more than the upper surface. Hence, lower epidermis is being preferred.

Hence, option (d) is correct. [1]

6. The percentage of water absorbed by raisins may be determined using the relationship $\frac{y-x}{x} \times 100$
Therefore, option (b) is correct. [1]

7. The extra water from the surface of the soaked raisins is removed by filter paper. Therefore, option (d) is correct. [1]

8. In order to prepare a temporary mount, first staining is done followed by mounting and at last the cover slide is to be put. Therefore, the correct option is (a). [1]

9. Stomata plays important role in respiration, photosynthesis as well as transpiration. Therefore, the correct option is (d). [1]

10. The reason is that glucose converts rapidly into starch in the leaf. Therefore, the correct option is (c). [1]

11. It is done so that the leaves get destarched after using all the starch produced in the process of photosynthesis. Therefore, the correct option is (b). [1]

12. When focused under the high power of a microscope, a well stained leaf peel preparation would show epidermal cells, stomata and guard cells, each with one nucleus and many chloroplasts. Hence, the correct answer is option A. [1]

13. Putting the leaf in the Iodine solution is a positive test for the presence of starch. Hence, the correct answer is option C. [1]

14. A temporary slide of leaf peel is mounted in Safranin. Hence, the correct answer is option C. [1]

15. Two vegetables represents the correct homologous structures are Radish and Carrot because they both are modified roots. [1]

Hence the correct option is (D).

16. The correct sequence to determine that light is essential for photosynthesis is to first de-starch the plant for 48 - 72 hours. Later covering the leaf with black paper strip and keeping the selected plant in sunlight. After that pluck the leaf and do the starch test. [1]

Therefore, option C is correct.

17. The portion covered with black and blue strips will show no starch when the starch test is done. Therefore, option C is correct. [1]

18. A leaf is boiled in alcohol before using iodine for starch test in order to decolorize the leaf and dissolve the chlorophyll. [1]

Hence, option B is correct.

19. (a) To make the plant free of starch, it is kept in darkness for 72 hours. Hence, option (a) is correct. [1]

20. (c) Alcohol turns greenish as it removes the chlorophyll from the leaf and the leaf becomes colourless. [1]

21. The extra stain is removed by soaking with filter paper. [1]

22. He should focus under high power using fine adjustment knob. [1]

23. Following are the steps for the preparation of temporary mount of a leaf peel to observe stomata:

(i) Healthy leaf from a potted plant is to be taken.

(ii) Fold the leaf and gently remove the part of the peel from the lower surface using forceps and then put few drops of Safranin in a watch glass. [1]

(iii) Place the peel in a clean glass slide after 2-3 minutes and put a drop of glycerin over the peel. [1]

(iv) Cover it with a clean cover slip. [1]

(v) Using blotting paper glycerin and excess of stain is removed. [1]

(vi) Using magnifications of Low-power and High-power observe the slides under compound microscope. [1]

Topic 2: Respiration, Circulation & Excretion

Summary

TYPES OF RESPIRATION

Aerobic Respiration

Anaerobic Respiration

S. No.	Aerobic Respiration	Anaerobic Respiration
1	Takes place in presence of oxygen	Takes place in absence of oxygen
2	Complete breakdown of food takes place	Partial breakdown of food takes place
3	Food gets converted into CO_2 and water.	Food can be converted into either ethanol and CO_2 (as in yeast) or in lactic acid (as in animal muscles)
4	38 molecules of ATP are produced	2 molecules of ATP are produced.

RESPIRATION IN PLANTS

Exchange of gases CO_2 and O_2 in Plants:

At Night ⟶ No Photosynthesis only Respiration ⟶ CO_2 is given out

At Daytime ⟶ Photosynthesis and Respiration ⟶ O_2 is given out

↓

CO_2 is used up in photosynthesis.

RESPIRATION IN ANIMALS

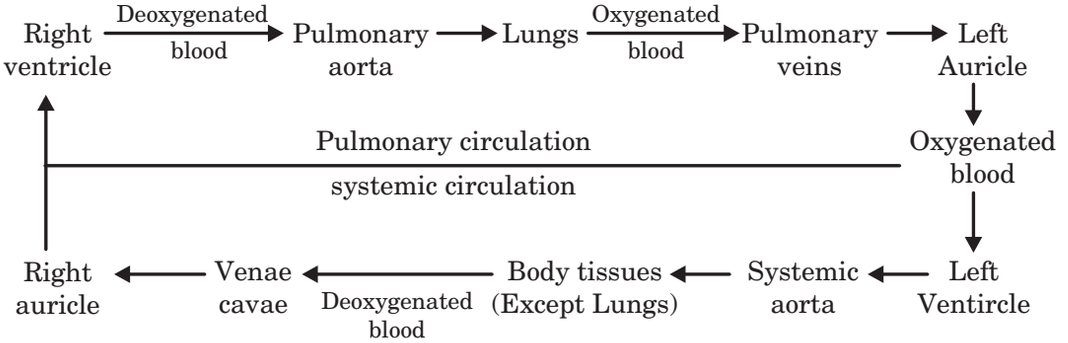
Respiratory system

The various parts of the respiratory system are :

$$\underbrace{\text{Nasal Passage} \rightarrow \text{Pharynx} \rightarrow \text{Larynx} \rightarrow \text{Trachea}}_{\text{Respiratory tract}} \rightarrow \underbrace{\text{Bronchi} \rightarrow \text{Bronchioles} \rightarrow \text{Terminal Bronchioles} \rightarrow \text{Alveoli}}_{\text{Respiratory organ}}$$

Breathing : It is a physical process in which there is intake of fresh air from the environment and removal of foul air (having more CO_2) from the body.

- In humans, the respiratory pigment haemoglobin, carry oxygen from lungs to different tissues of the body.
- Human heart has 4 chambers-2 atria(right and left) and 2 ventricles(right and left).Right half of the heart receives deoxygenated blood whereas the left half receives oxygenated blood.
- Blood travels twice through the heart in one complete cycle of the body.



- Blood vessels

S. No.	Arteries	Veins
1	Always carry blood away from the heart.	Always bring back blood to the heart.
2	They carry oxygenated blood except pulmonary artery.	They carry deoxygenated blood except pulmonary vein.
3	Blood flows under high pressure.	Blood flows at lower pressure.
4	More thick and elastic.	Thin walled.
5	Have no valves.	Have valves to ensure unidirectional flow of blood.

Capillaries: Each artery divides into smaller and smaller vessels on reaching organ or tissue to bring the blood in contact with all the individual cells. These smallest vessels are known as capillaries. Capillaries have walls which are one-cell thick to allow exchange of material between the blood and surrounding cells.

The transport system in highly organized plants consists of -

(a) Xylem - Transports water. Consists of tracheids and vessels

(b) Phloem - Transports food. Consists of sieve tubes and companion cells.

Transpiration is the process of loss of water as vapour from aerial parts of the body.'

Excretion

It is the biological process of elimination of harmful metabolic waste products from the body of an organism.

During excretion, the harmful metabolic nitrogenous wastes generated are removed from the body.

Formation of Urine

1. The waste material is brought to kidneys by the renal arteries.
2. Blood is filtered, from the blood capillaries into Bowman's capsule.
3. As this filtrate passes through the tubular parts of nephron, some useful products, such as glucose, amino acids, salts and major amount of water are selectively reabsorbed by blood capillaries surrounding the nephron.
4. The nephrons drain the remaining liquid waste (urine) into the collecting duct which eventually enters a long tube, the ureter. Human urine contains water and nitrogenous substances, most of which is urea.

- From the ureter, urine passes into the urinary bladder. Urine is stored in the urinary bladder until the pressure of the expanded bladder leads to the urge to pass it out through the urethra. The bladder is muscular, so it is under nervous control. As a result, we can usually control the urge to urinate.
- Dialysis is the procedure used in artificial kidney to do the work of a non-functional or damaged kidney. In the process blood of the patient is allowed to pass through the long cellulose tubes dipped in a tank containing dialysing solution having same ionic concentration as plasma. The waste substances diffuse out of blood into the tank and the cleansed blood is returned back into the patient through a vein. This procedure is also known as haemodialysis.
- Blood pressure: It is the force that blood exerts against the wall of a vessel. This pressure is much greater in arteries than in veins.
- The normal systolic blood pressure is about 120 mm of Hg and diastolic blood pressure is 80 mm of Hg.
- Blood pressure is measured using an instrument called sphygmomanometer.
- Abnormally high blood pressure is called hypertension and it can lead to rupture of an artery.

Lymph

It is another type of fluid which also helps in transportation.

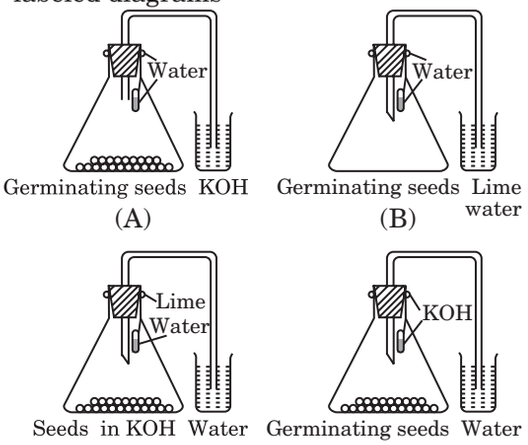
The major functions of lymph are:

1. It carries digested and absorbed fat from intestine into blood.
2. It drains excess fluid from extra cellular space back into the blood.
3. It provides immunity to the body.

PREVIOUS YEARS' EXAMINATION QUESTIONS TOPIC 2

1 Mark Questions

1. After performing the experiment to show that germinating seeds give out carbon dioxide during respiration, students drew the following labeled diagrams



The correct labeled diagram is:
(a) A
(b) B
(*c*) C
(*d*) D

[TERM 1, 2011, 2014, 2015, 2016, 2017]

2. In the following food chain 100 J of energy is available to the Lion. How much energy was available to the producer?
Plants → Deer → Lion

[TERM 1, 2017]

2 Marks Questions

3. What are the final products of carbohydrates, proteins and fats after their digestion?

[TERM 1, 2011]

4. Any two causes that may damage the kidney of a person.

[TERM 1, 2013]

5. Explain the significance of peristaltic movement that occurs all along the gut during digestion.

[TERM 1, 2013]

6. What are the two vital functions of the human kidneys?

[TERM 1, 2015]

3 Marks Questions

7. Write one feature which is common to each of the following pairs of terms:
(i) Glycogen and starch
(ii) Chlorophyll and hemoglobin
(iii) Arteries and veins

[TERM 1, 2013]

8. List in tabular form three differences between arteries and veins.

[TERM 1, 2016]

9. Which is the internal energy reserve in plants? Do the animals have the same energy reserve? Justify your answer.

[TERM 1, 2017]

5 Marks Questions

10. (a) Name the enzyme present in saliva. Why is it important?
(b) What is emulsification?
(c) Name the substance that is oxidized in the body during respiration.
(d) Why are lungs divided into small sac like structures?

[TERM 1, 2011, 2017]

11. (a) Draw a neat diagram of human excretory system and label the parts that:
(i) Produces urine
(ii) Releases urine to outside.
(b) What are the end products of digestion of fat and proteins in human beings?

[TERM 1, 2011]

12. (a) Draw diagram of respiratory system and label the following:
(i) Part through which air is taken in.
(ii) Part which protects the lungs.
(iii) Part which carry the air into the lungs.
(b) What are alveoli? Mention their role in respiration.
(c) Differentiate between aerobic and anaerobic respiration

[TERM 1, 2013, 2015]

13. (a) Draw diagram of human alimentary canal and label the following
(i) Part in which starch digestion starts
(ii) Part in which bile is stored
(iii) Part in which nutrients are absorbed
(iv) Part in which water is absorbed
(b) Mention the role of hydrochloric acid in the stomach.
(c) What function is served by the following:
(i) Gastric sphincter
(ii) Anal sphincter

[TERM 1, 2013, 2014]

14. (a) Draw a neat diagram of excretory system of human beings and label the following:
(i) Kidney
(ii) Ureter
(iii) Urinary Bladder
(iv) Urethra
(b) How is urine produced?
(c) Name two excretory products other than in plants

[TERM 1, 2014, 2017]

15. (a) Draw a sectional view of the human heart and label on it the following parts:
(i) Aorta (ii) Pulmonary arteries (iii) Vena cava from upper body (iv) Left ventricle
(b Why is double circulation of blood necessary in human beings?

[TERM 1, 2015]

16. (i) Describe the process of starch digestion. Specifying site, glands and enzymes used and end products produced.
(ii) Draw the structure of human digestive system and label
(a) Pancreas (b) small intestine.

[TERM 1, 2016]

17. (a) Draw diagram to show the nutrition in amoeba and label the part used for this purpose. Mention any other purpose served by this part other than nutrition.
(b) Name the glands associated with digestion of starch in human digestive tract and mention their role.
(c) How is required pH maintained in the stomach and small intestine?

[TERM 1, 2011]

18. (a) Draw a neat diagram of human respiratory system and label the parts and label 9 parts in it.
(b) What are the end products of digestion of fat and protein in human beings?

[TERM 1, 2017]

19. (a) Define excretion.
(b) Name the basic filtration unit present in the kidney.
(c) Draw excretory system in human beings and label the following organs of excretory system which perform following functions:
(i) form urine
(ii) is a long tube which collects urine from kidney
(iii) store urine until it is passed out.

[TERM 1, 2018]

20. (a) Mention any two components of blood.
(b) Trace the movement of oxygenated blood in the body.
(c) Write the function of valves present in between atria and ventricles.
(d) Write one structural difference between the composition of artery and veins

[TERM 1, 2018]

Solutions

1. CO_2 is produced and respired by the germinating seed that is absorbed by *KOH* solution. The vacuum is being created by the *KOH* present inside the flask containing seeds. The water is pull up in the bent tube as the air in the bent glass tube moves into the flask.

Hence, option (d) is correct. [1]

2. In a food chain, According to 10% Law, only 10% of the total energy is transferred to the next tropic level.

If the energy available to the Lion is 100J

The deer must have x Joule of energy. Then

10% of $x = 100$ [½]

$x = 1000$ J

The plants must have x Joule of energy. Then

10% of $x = 1000$

$x = 10, 000$ J [½]

Thus energy available to the producer is 10, 000J.

3. The walls of the small intestine contain glands which secrete intestinal juice. The enzymes present in it finally convert the proteins to amino acids, complex carbohydrates into glucose and fats into fatty acids and glycerol. [2]

4. The two causes that may damage the kidney of a person are:

(a) If the blood flow is restricted to the kidney.[1]

(b) Any injury or infection in the kidney. [1]

5. In the peristaltic movement, the food is carried away in a regulated manner along the digestive tube in order to process it properly in each part. In order to push the food in forward direction, there are muscles that get contracted rhythmically. This is the significance of peristaltic movement. [2]

6. The two vital functions of the human kidneys are:

(1) They remove toxic wastes such as urea from the body. [1]

(2) They help to control water balance and level of mineral ions in the body. [1]

7. (i) Glycogen and starch both are the polymers of glucose and are used to store it. To store

the glucose in animals, glycogen is used. While in plants, starch is used to store the glucose. [1]

(ii) Chlorophyll is the green pigment present in the leaves because of which the leaves get the green colour. On the other hand, hemoglobin is the red pigment present in the blood. Because of the presence of hemoglobin, the colour of the blood is red. [1]

(iii) Both the arteries and veins carry the blood between heart and tissues. [1]

8.

Arteries	Veins
Arteries carry pure blood from the heart to supply all the tissues except for pulmonary artery.	Veins carry deoxygenated blood to the heart except for pulmonary veins.
Arteries branch out to form capillaries which supply oxygenated blood to all the organs.	Veins are formed by many capillaries joining together to dump the deoxygenated blood from different tissues.
Arteries have thick walls as blood in them flows under great pressure.	Veins have thin muscular walls as blood in them flows under less pressure.

[1 + 1 + 1]

9. Carbohydrates are stored in the form of starch and are utilized for providing energy to the plants, which acts as the internal energy reserve in plants. Whereas, Carbohydrates are reserved in the form of glycogen in animals as internal energy reserve. Starch and glycogen are polymers of glucose and their hydrolysis provides glucose molecules to provide energy at the time of need. [3]

10. (a) Salivary amylase or ptyalin is the enzyme present in saliva. It helps break down the starch into simpler sugars such as maltose and dextrin that can be further broken down in the small intestine. [1]

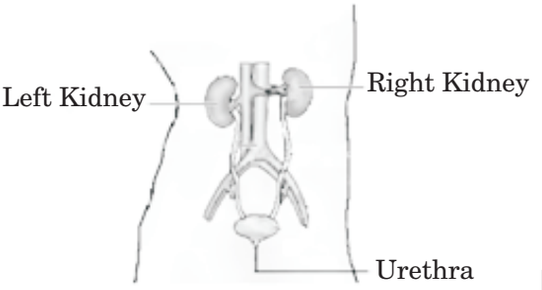
(b) The breaking of complex fat molecules into simpler fat molecules is called emulsification. It provides a larger surface area on which the enzyme pancreatic lipase can act to digest the fats into fatty acids and glycerol. [2]

(c) Glucose is oxidized in the body during respiration. [1]

(d) The lungs are divided into small sac like structures called alveoli. It helps increase surface area for the exchange of gases. [1]

11. (a) (i) Produces Urine- Kidney [1]

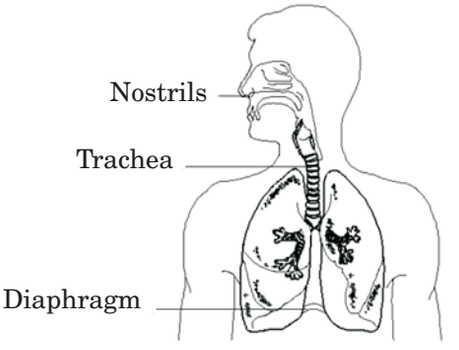
(ii) Releases urine to outside- Urethra [1]



[2]

(b) Fatty acids and glycerol are the end products after digestion of fats whereas for the digestion of proteins, it is amino acids. [1]

12. (a) Diagram of respiratory system



[1]

1. A nostril is the part through which air is taken in.
2. A Rib Cage is the part that protects the lungs.
3. A trachea is the part which carries air into the lungs. [1½]

(b) Alveoli are the tiny Bulb like structures present in the lungs that help the parts of our body to get oxygen that we breathe through nostrils and get rid of the carbon dioxide that is not required by the body.[1½]

Alveoli are an indispensable part for human respiration. The air we breathe in is rich in oxygen and needs to be delivered to various parts of the body through bloodstream. This oxygen is supplied to the blood by the help of alveoli and thus it plays an important role in respiration.[1]

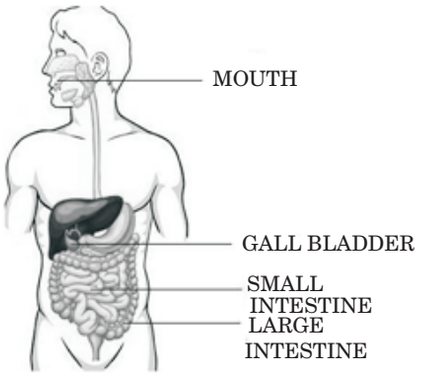
13. (a) Following is the diagram of human alimentary canal with different labeled parts:

(i) Part in which starch digestion starts – Mouth

(ii) Part in which bile is stored – Gall bladder [1]

(iii) Part in which nutrients are absorbed – Small Intestine

(iv) Part in which water is absorbed – Large Intestine [1]



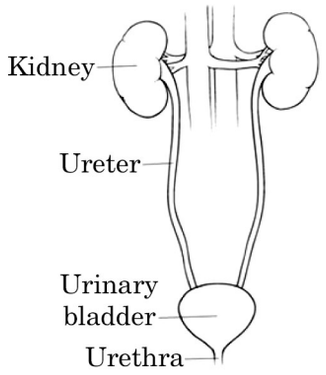
[1]

(b) The hydrochloric acid (HCl) formed in the stomach kills the bacteria. It also provides the acidic medium for the action of pepsin (An enzyme). [1]

(c) (i) Gastric sphincter controls the release of food from the stomach to small intestine.[½]

(ii) Anal sphincter controls the release of undigested waste from the rectum through the anus. [½]

14. (a) The diagram of excretory system of human beings is shown below:

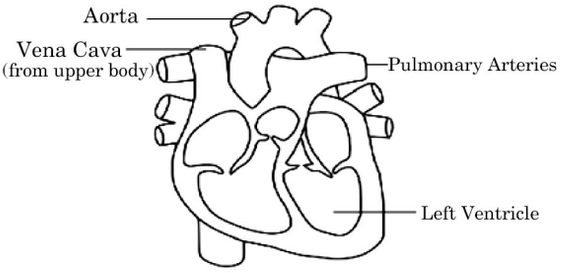


[2]

(b) Urine is formed by the nephrons inside the kidney. The dirty blood containing wastes is being filtered by the glomerulus. Substances in the blood like glucose, amino acids, salts, urea and water are passed in the Bowman's capsule during the filtration and then passed to the tubule of nephron. When the filtrate containing useful substances like glucose, amino acids, most salts and water are reabsorbed into the blood through blood capillaries surrounding the tubule. Only the waste substances like urea, some unwanted salts and excess water remains behind in the tubule. Urine is the yellowish liquid. [2]

(c) Water and urea are two excretory products other than in plants. [1]

15. (a) **Sectional view of the human heart**

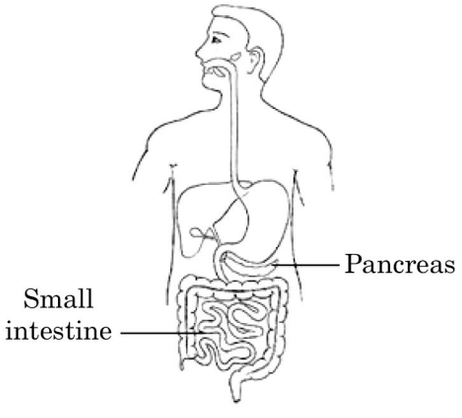


[2½]

(b) Blood goes twice to the heart during a single cycle. This is known as Double circulation. Double circulation of blood is necessary for human beings because it separates oxygenated and deoxygenated blood and helps to maintain constant body temperature. It also makes the circulatory system more efficient. [2½]

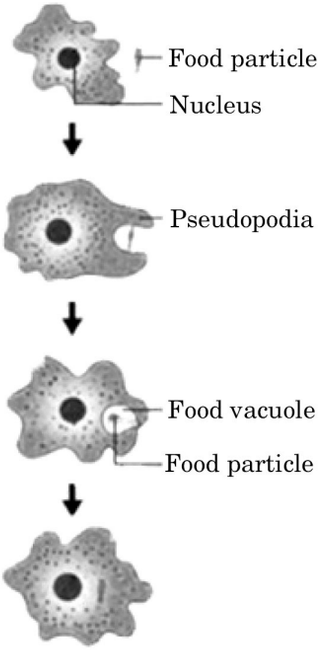
16. The digestion of starch begins in the mouth. The salivary glands present in the mouthsecrete saliva. Saliva contains enzymes like salivary amylase, lysozyme and electrolytes. Upto 30 % of starch is digested in the mouth in the presence of the enzyme called Salivaryamylase. After that food reaches to the stomach where little digestion of starch takes place due to acidic medium. Now food reaches to the duodenum of small intestine in the form of chyme where remaining starch is broken down into disaccharides by the help of amylase enzyme present in pancreatic juice. The disaccharides are further broken down into monomers of glucose by the help of enzymes like maltase and lactase secreted by walls of small intestine. The completely digested starch is then absorbed in the jejunumand ileum of small intestine. After the work of Amylase hydrolyzes starch, with the primary end product being maltose, maltotriose, and a-dextrine and some glucose is also produced. [3]

(ii) The structure of human digestive system:



[2]

17. (a) The following diagram shows the nutrition in amoeba:-



[2]

Other than nutrition, pseudopodia also serve for the purpose of locomotion.

(b) The glands which are associated with digestion of starch in human digestive tract are as follows:-

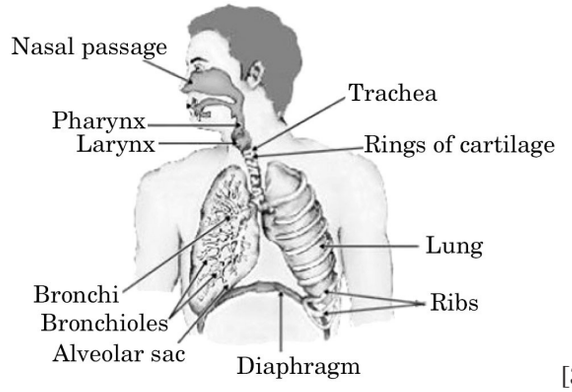
Salivary gland: It secretes enzyme amylase which breakdown starch into sugar. [1]

Pancreas: Pancreatic amylase converts starch into disaccharides.

Small intestine: Lactase maltase and sucrose convert disaccharides into monosaccharide. [1]

(c) HCl is secreted by inner wall of stomach which helps in maintaining the acidic pH in the stomach. The bile produced by the liver and stored by the gall bladder is alkaline which helps in maintaining the alkaline pH in the small intestine. [1]

18. (a) The following is a diagram of human respiratory system:-



[3]

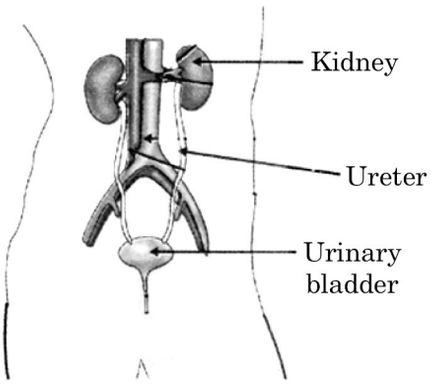
(b) Fats are broken down by enzymes into fatty acids and glycerol. [2]

Enzymes break down proteins into amino acids.

19. (a) Excretion can be termed as a biological process in which the removal of harmful metabolic waste from the body takes place. [2]

(b) The filtration unit present in the kidney is nephron. [1]

(c) Excretory system in human beings is shown below:



[2]

20. (a) Blood cells and blood plasma are two components of blood. [1]

(b) Oxygen-rich blood enters the left atrium of the heart from the lungs. It contracts so that the blood enters the left ventricle. The left ventricle contracts to pump the blood out to the body. [1]

Pulmonary veins → Left a trium → Left ventricle → Ststemic aorta → Body parts.

(c) The valves present in between atria and ventricles prevent the backflow of blood.[1]

(d) Arteries carry blood away from the heart to various organs of the body and as the blood is under high pressure, they have thick, elastic walls. [1]

Veins collect the blood from different parts of the body and bring it back to the heart so they do not need thick walls. [1]

Smart Notes .....

CHAPTER 7

Control and Coordination

Chapter Analysis with respect to Last 3 Years' Board Exams

List of Topics	**2016**	**2017**	**2018**
Plant Hormones and movement	1Q (1 mark), 1Q (3 marks)		
Nervous System in humans and animals	1Q (1 mark), 1Q (3 marks)	2Q (3 marks)	1Q (2 marks), 1Q (3 marks)

On the basis of above analysis, it can be said that from exam point of view, nervous system is the most important topic of the chapter.

Topic 1: Plant Hormones and Movement

Summary

PLANT HORMONES (PHYTOHORMONES)

S. No.	Hormone	Functions
1.	Auxin	• Promotes cell enlargement and cell differentiation (e.g. growth of stem). • Promotes fruit growth.
2.	Gibberellins	• Promotes cell enlargement and cell differentiation in presence of auxin.
3.	Cytokinin	• Promotes cell division i.e. cytokinesis (e.g. in fruits and seeds). • Helps in breaking the dormancy of seeds and buds. • Promotes opening of stomata.
4.	Abscisic Acid (A growth inhibitor)	• Promotes the dormancy in seeds and buds. • Promotes the closing of stomata. • Promotes the wilting and falling of leaves.

PLANT MOVEMENT

Plant movement can be divided into two heads on the basis of direction :

1. Tropism or Tropic movement

   Tropic movement is the directional movement of the part of plant in response to external stimuli.

Similarly, the types of tropisms are

S. No.	Receptor	Types of Stimulus	Sense organ
1	Photo receptors	Detects light	Eye
2	Phono receptors	Detects sound	Ear
3	Olfactory receptors	Detects smell	Nose
4	Gustatory receptors	Detects taste	Tongue
5	Thermo receptors	Detects heat or cold	Skin

2. Nasties or Nastic movement

   The movement of plant part in response to an external stimuli in which the direction of response is not determined by the direction of stimulus

(a) Types of nastic movement

   (i) Thigmonasty: Thigmonasty is the nastic movement of a plant part in response to touch. For example - Mimosa pudica responds to touch by folding its leaves.

   (ii) Photonasty: Photonasty is the movement of plant part in response to light. In case of dandelion flower it opens in the morning with the rising sun and as the sun sets lower also closes The stimulus here is light.

PREVIOUS YEARS' EXAMINATION QUESTIONS

TOPIC 1

1 Mark Question

1. Other than light, what else is necessary for photosynthesis?

(a) Carbon dioxide

(b) Water

(c) Oxygen

(d) Both (a) and (b)

[TERM 1, 2016]

3 Marks Questions

2. What is chemotropism? Give one example. Name any two plant hormones and mention their functions.

[TERM 1, 2013]

3. How do auxins help in bending of stem towards light? Explain

[TERM 1, 2016]

5 Marks Questions

4. (a) (i) Which plant hormone is present in greater concentration in the areas of rapid cell division?

(ii) Give one example of a plant growth promoter and a plant growth inhibitor

(b) What is the role of plant hormone 'cytokinin'?

[TERM 1, 2014]

Solutions

1. Photosynthesis is the process by which the green plants synthesize their own food using carbon dioxide and water as raw materials in presence of sunlight and chlorophyll. Hence (d) is the correct option. [1]

2. The growth of a plant or its part because of chemical stimulus is known as chemotropism. The growth of pollen tube towards the ovule is an example of chemotropism. The two plant hormones along with their functions are as follows: [1]

(i) **Auxin:** It is a plant hormone that stimulates growth. It promotes cell elongation. Auxin hormone stimulates the enlargement and differentiation of cells in plant. It also suppresses the growth of lateral buds. [1]

(ii) **Abscisic Acid:** This is a plant hormone which retards the growth due to the season changes. It keeps the dormancy in leaf buds and seeds. It also controls the closing of stomata in dry conditions. [1]

3. Auxin is a plant growth hormone which helps in regulating shoot growth. During normal light auxin is evenly spread throughout the shoot. As auxin is photo sensitive so they move towards shadier side of shoot when light falls on it. Due to which the plant cells on the shady side of the plants grow longer than the cells on the sunny side and so bend towards light. [3]

4. (a) (i) **Cytokinin** is present in greater concentration in the areas of rapid cell division. [1½]

(ii) Plant growth promoter - **auxin**. Plant growth inhibitator - **abscisic acid**. [1½]

(b) The role of cytokinin is to **promote cell division**. Therefore, they are present in greater concentration in those areas of the plants where rapid cell division occurs. [2]

Topic 2: Nervous System in Animals

Summary

Knowing your Chapter at Glance:

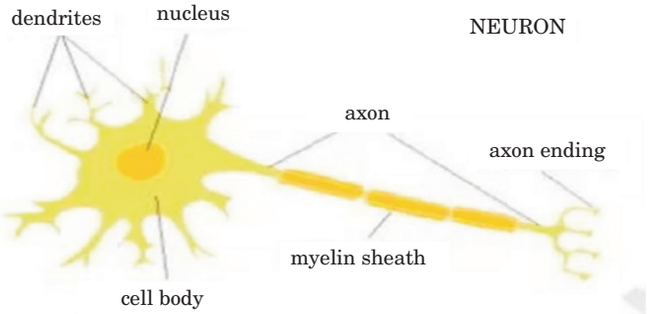
- Stimuli are the changes in the environment to which an organism reacts. For e.g. light, heat, cold, sound, smell, etc.
- The control and coordination in higher animals (Human) takes place through combination of nervous system and hormonal system, i.e. neuro-endocrine system.

NERVOUS SYSTEM IN ANIMALS

Nervous system is the system of conducting tissues the stimulus and transmits it to other parts of the body forming a network of nerves.

Nerve cells are the fundamental unit of nervous system.

Parts of Neuron



1. Dendrite: It receives information.
2. Cell body: The information acquired travels through it as an electrical impulse.
3. Axon: It is the longest fibre on the cell body is called axon. It transmits electrical impulse from cell body to dendrite of next neuron.

- Synapse is the gap between the nerve ending of one neuron and dendrite of the other neuron.

Functioning of neuron

- The information from receptors is acquired at the end of the dendritic tip of nerve cell as chemical reaction that creates an electrical impulse.
- This impulse travels from the dendrite to the cell body and at the end of axon.
- At the end of the axon, the electrical impulse sets off the release of the neurotransmitter which crosses the synapse and undergoes a chemical reaction resulting in initiation of a similar impulse in the next neuron.
- This impulse is again transmitted to the terminal endings of the next neuron and the process continues till it reaches the relay neuron in spinal cord and brain.
- From the brain and spinal cord arises a set of motor neurons which transmits electrical impulses in the similar way to the effectors like muscles and glands.

Receptor and Effector

- There are five sense organs in our body: eyes, ears, nose, tongue and skin. In a sense organ a receptor is present, which is a cell or group of cells sensitive to a particular type of stimulus (change in environment) such as light, heat, sound etc.

S. No.	Receptor	Types of Stimulus	Sense organ
1.	Photo receptors	Detects sound	Eye
2.	Phono receptors	Detects smell	Ear
3.	Olfactory receptors	Detects smell	Nose
4.	Gustatory receptors	Detects taste	Tongue
5.	Thermo receptors	Detects heat or cold	Skin

- The part of a body which can respond to stimulus according to the instruction sent from the nervous system is called effector. Effectors are mainly muscles and glands.
- Neuromuscular junction: It is the point where a muscle fibres comes in contact with the motor neuron carrying nerve impulses from the central nervous system.

Reflex Action

- It is a spontaneous, involuntary and unconscious (without will) response of the effectors to a stimulus.

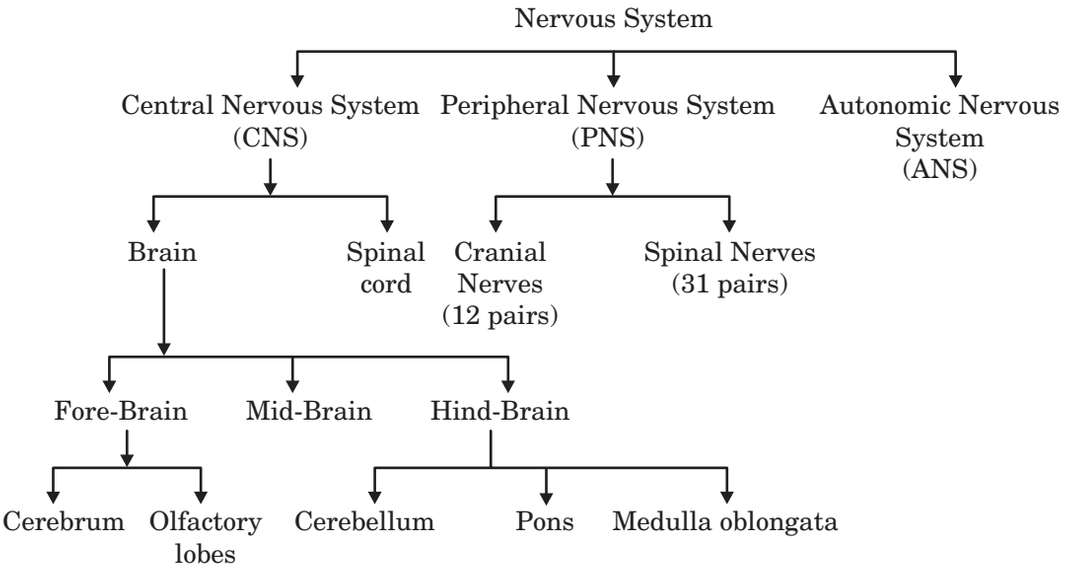
Reflex arc is the path taken by nerve impulses in a reflex action.

Responses are of three main types

1. Voluntary :Controlled by fore brain. E.g., talking, writing.
2. Involuntary: Controlled by mid and hind brain. E.g., vomiting, respiration.
3. Reflex action: Controlled by spinal cord. E.g., withdrawal of hand on touching a hot object.

How muscles work?

Muscles are made up of muscle cells which have special proteins. These proteins can change their arrangement on receiving message from brain due to which it can contract or expand. This contraction and expansion cause movement in body parts.



Human brain

The brain is broadly divided into three regions :

1. Fore Brain: It consists of Olfactory lobes: A pair of bodies covered by cerebrum. It is concerned with olfaction (smell).

   Cerebrum: It forms about two-third of the brain. Different areas of cerebrum perform different functions. Association areas control learning, reasoning, intelligence, personality, thinking, memory, etc. Sensory areas give us sensation by receiving information from eyes, ears, nose, tongue, skin. Motor areas give instructions to muscles for various voluntary actions.
2. Midbrain

   It controls reflex movements of the head, neck, eye muscles, etc. in response to visual or auditory stimuli.
3. Hind brain: It is further sub divided into :

Pons: It takes part in regulating respiration.

Cerebellum: It helps in maintaining posture and balance. It also coordinates smooth body movements like walking in a straight line, riding a bicycle, picking up a pencil etc.

Medulla Oblongata: It controls various involuntary actions such as heart beat, blood pressure, salivation, breathing, peristaltic movements, etc. Medulla also controls reflex actions like, swallowing, sneezing, vomiting, etc.

Spinal Cord is rod-like structure extending downwards in continuation with medulla. It is enclosed in a bony cage called vertebral column and is also surrounded by meninges.

- Glands are organs in our body which excrete a liquid substance having some different chemicals. This liquid is called secretion of the gland.
- Glands are of 2 types
  1. Exocrine Glands

     Glands that have ducts are called exocrine glands. Some examples of exocrine glands are sweat glands and salivary glands.
  2. Endocrine Glands

     The endocrine glands do not have ducts to carry their product to a surface. They are called ductless glands.

- Hormones are the chemical substances produced by endocrine glands.

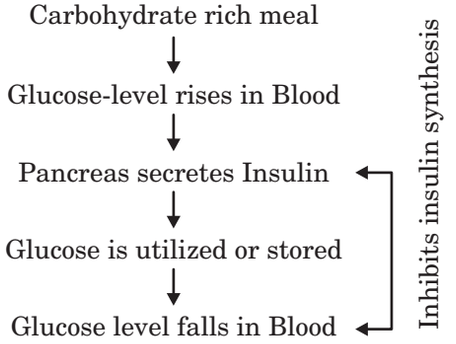
Endocrine gland	Hormones	Location	Function
Hypothalamus	Releasing Hormones	Below mid brain	Regulates the secretion of hormones from the pituitary.
Pituitary Gland	Growth Hormone	Below hypothal-amus in brain	Controls growth-dwarfism & gigantism
Thyroid Gland	Thyroxin (iodine is necessary for the secretion of thyroxine)	Around windpipe in neck	Regulates metabolism of carbohy-drates, fats & proteins
Adrenal Gland	Adrenaline	On top of kidneys	Regulates heart rate, breathing rate, blood pressure and carbohydrate metabolism.
Parathyroid	Parathormone	On the thyroid gland	Regulates calcium and phosphorus balance in the blood.
Pancreas	Insulin	Below stomach	Lowers the blood sugar level
	Glucagon		Increases the blood sugar level
Testes	Testosterone	In scortum	Regulates the development of male reproductive organs and accessory sexual characters like beard, moustache, etc.
Ovaries	Estrogen and Progesterone	In the pelvis	Regulates the development of female reproductive organs and accessory sexual characters like development of mammary gland. Maintenance of Pregnancy.

Feedback Mechanism

It is important that hormones should be secreted in precise quantities because both excess and deficiency of hormones has a harmful effect on the body. So, we need a mechanism through which this is to be done. The timing and amount of hormone released by various glands are controlled by 'Feedback mechanism' which is inbuilt in our body.

E.g. if the blood sugar level falls below normal, insulin secretion by pancreas decreases automatically.

FEEDBACK CONTROL OF BLOOD GLUCOSE LEVEL



PREVIOUS YEARS' EXAMINATION QUESTIONS TOPIC 2

1 Mark Questions

1. Name the hormone that controls the rate of respiration. Also name the part of the brain responsible for controlling respiration.

[TERM 1, 2013]

2. Which system facilitates the communication between central nervous system and other parts of the body?

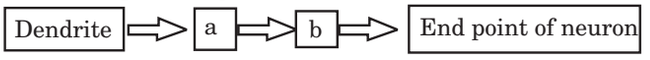
[TERM 1, 2016]

2 Marks Question

3. (a) Name one gustatory receptor and one olfactory receptor present in human beings.

(b) Write '*a*' and '*b*' in the given flow chart of neuron through which information travels as an electrical impulse.

(b) Identify the nature of the radioactive radiations emitted in each step of the decay process given below.



[TERM 1, 2018]

3 Marks Questions

4. Draw a labeled diagram of a neuron. List its functions.

[TERM 1, 2011]

5. What is endocrine gland? Name any two endocrine glands present in a human body and write hormones secreted by them.

[TERM 1, 2018]

6. Draw a diagram of human brain and label any four parts. Write one function each of any two parts.

[TERM 1, 2013]

7. Give a reason to explain why:

(i) Adrenaline helps in dealing emergency situations?

(ii) Secretions of growth hormone should be specific in the human body?

(iii) Some patients of diabetes are treated by giving injections of insulin

[TERM 1, 2014]

8. How are involuntary actions different from reflex actions?

[TERM 1, 2015]

9. What are nephrons? How is nephron involved in the filtration of blood and formation of urine?

[TERM 1, 2016]

10. (a) Which hormone is responsible for the changes noticed in males at puberty?

(b) Deficiency of which hormone leads to dwarfism?

(c) Name the hormone which is injected to a diabetic patient.

[TERM 1, 2017]

11. (a) What is reflex arc?

(b) How do muscle cells move?

[TERM 1, 20157]

5 Marks Questions

12. (a) (i) Why should we use iodized salt in our diet?

(ii) If iodine is insufficient in one's diet, what might be the deficiency disease?

(b) How does feedback mechanism regulate the hormone secretion?

[TERM 1, 2014]

13. (a) Draw the structure of a neuron and label the following on it:

Nucleus, Dendrite, cell body and Axon.

(b) Name the part of neuron.

(i) Where information is acquired.

(ii) Through which information travels as an electrical impulse.

[TERM 1, 2015]

14. (a) Mention any three important functions of fore brain.

(b) What are the functions of spinal cord?

[TERM 1, 2015]

Solutions

1. The adrenalin hormone controls the rate of respiration in the human body. Pons and medulla are responsible to control the respiration. [1]

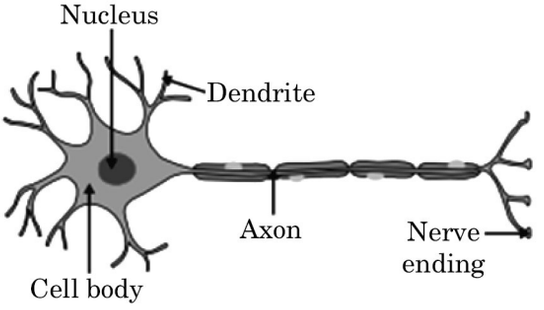
2. Peripheral nervous system passes information between central nervous system and other parts of the body. [1]

3. (a) Gustatory receptor present in human beings is tongue and olfactory receptor present in human beings is nose. [1]

(b) A neuron consists of dendrite followed by cell body (cyton or soma), axon and then the end point of neuron. [1]

Therefore in the flowchart a is Cell body and b is axon.

4.



Functions of neuron include:

1. Neuron receives signal or information from other neurons or external source. [1]
2. It processes all the information collected from all the input sources and decides whether it will send an output signal or not. [1]
3. They send signals to other neurons or to a muscle or gland. [1]

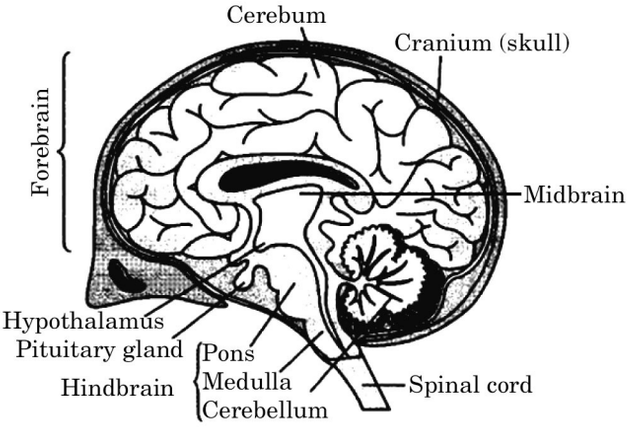
5. **Endocrine glands** are glands of the endocrine system that secrete hormones, directly into the blood without a duct or a tube, that is why they are also known as ductless glands. Some of the endocrine glands are Pituitary gland, pineal gland, thyroid gland and hypothalamus. [1]

Pituitary gland – Hormones secreted by pituitary gland are 'Thyroid stimulating hormone' and 'Growth hormone'. Thyroid stimulating hormone stimulates the growth and function of the thyroid gland and growth hormone stimulates the growth and development of body. [1]

Thyroid gland – The hormone secreted by thyroid gland is 'Thyroxine'. Thyroxine regulates the body temperature and plays an important role in growth and development. Absence of thyroxine in the body may result in a disease named as 'Goitre'. [1]

Pancreas – It secretes insulin hormone which regulates the blood sugar level.

6. The following diagram shows a human brain with its different parts.



Functions of parts of human brain: [1]

Medulla oblongata: This part of brain is responsible for controlling the involuntary actions and regulating the reflex responses. It also responsible for controlling the blood pressure, vomiting and salivation. [1]

Cerebellum: This is one of the parts of human brain which is responsible for controlling and coordinating the different muscular actions. Also, it maintains the equilibrium of the body at the time of walking, drinking and catching. [1]

7. (i) Adrenaline is known as the emergency hormone. It acts by increasing alertness, pupillary dilation, piloerection (rising of hair), increasing heartbeat, respiration rate, stimulating the breakdown of glucose, lipids and proteins. Thus, prepares the body to deal with the emergency situations. [1]

(ii) The secretion of the growth hormone should be specific, because the excess and deficiency both result in the abnormalities. For example, the over secretion of the growth hormone can cause acromegaly (excess thickening of the bones) or the gigantism (excessive growth). The under secretion of the growth hormone can result in the growth failure and short stature known as Dwarfism. [1]

(iii) Some patients of diabetes are treated by giving injections of insulin because it lowers the blood sugar level by controlling the metabolism of sugar. [1]

8. Involuntary actions are the actions or set of muscle movement which do not require thinking and are completely controlled by the brain. For example, beating of a heart beat. [1]

On the other hand, reflex actions are caused in response of any external stimulus. Reflex actions are very quick as they are rapid response to an emergency situation. For example, removing of hand when it comes in contact of a hot surface. [1]

9. Filtration unit of kidney is called nephron. Nephrons consist of a tubule which is connected to collecting duct on one end and a cup-shaped structure at the other end. [1]

Cup shaped structure in nephron is Known as Bowman's capsule and on the top, it possesses a mass of capillaries called as glomerulus which is the site of blood filtration. Urine is formed because of glomerular filtration in which the blood flows through the glomerulus and due to the pressure of blood, water and unwanted salts and chemicals are pushed from the capillaries into the capsule through a filtration membrane and this begins the urine formation process. [2]

10. (a) Testosterone hormone is responsible for the changes noticed in males at puberty. [1]

(b) Growth hormone deficiency leads to dwarfism. [1]

(c) Insulin is the hormone which is injected to a diabetic patient. [1]

11. (a) The neural pathway which manages a reflex is called reflex arc. This pathway includes a sensory nerve which receives the signal from the external stimulus and a motor nerve which responds to the signal with a synapse in between where the signal is processed. E.g. closing of eyes when flashed with high intensity of light or removing hand when you touch something hot. [1½]

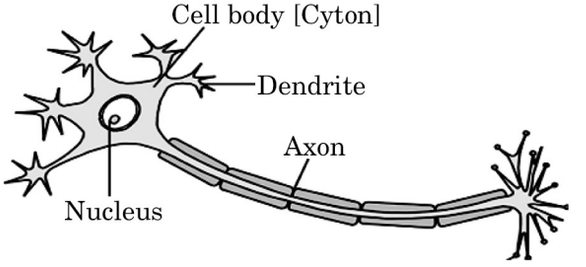
(b) Muscle cells have special proteins called ATP that change their shape and arrangement in the cell in response to electrical impulse. This forces the muscle cells to contract and relax. [1½]

12. (a) (i) As thyroid gland needs iodine to produce thyroxin hormone which we get from iodized salt, so it's necessary to use iodized salt in our diet. Thyroxine helps in metabolizing carbohydrate, protein and fat in the body and provides the best balance for growth. Iodine is essential for the synthesis of thyroxine. [1 + 1]

(ii) In case iodine is deficient in our diet, there is a possibility that we might suffer from goitre. One of the symptoms in this disease is a swollen neck. It can cause difficulty in breathing and pain while swallowing. [½ + 1]

(b) The amount of hormone secreted should be in an accurate amount. The feedback mechanisms regulates timing and amount of hormone released. The feedback mechanism works in two ways. For a positive feedback, the effect is further intensified but for a negative feedback, a reverse response is created. For example, if the sugar levels in blood rise, they are detected by the cells of the pancreas which respond by producing more insulin. Insulin secretion is reduced as the blood sugar level falls. [1½]

13. (a) Structure of a neuron is given below



[1½ + 1]

(b) (i) **Dendrite** is the part where information is acquired. [½ + ½]

(ii) **Axon** is the part through which information travels as an electrical impulse. [1 + ½]

14. (a) Main thinking part of the brain is fore brain. Important functions of fore brain are:

- There are separate areas in the fore brain that are specialized for hearing, smelling, seeing and several general sensations like pain, touch, taste etc. [1]
- Cerebrum is the largest part of the fore brain and it helps in controlling intelligence, learning, thinking etc. [1]
- Thalamus is one another part of fore brain that helps regulate the sleeping and wakefulness. It also helps the brain to process sensory movements. [½]

(b) Main functions of spinal cord are:

- When there is motion in the body, spinal cord carries message signals from our brain to the body parts. [1]
- It returns sensory signals from body parts to our brain. [1]
- It helps to perform various reflexive actions. [½]

Smart Notes .....

CHAPTER 8

How do Organisms Reproduce

Chapter Analysis with respect to Last 3 Years' Board Exams

List of Topics	**2016**	**2017**	**2018**
Reproduction in animal and plants (asexual and sexual)	2Q (1 mark), 1Q (2 marks), 3Q (3 marks)	3Q (1 mark), 2Q (3 marks)	2Q (2 marks), 1Q (3 marks)
Reproductive health-need for and methods of family planning. safe sex vs HIV/AIDS			
Child bearing and women's health	1Q (5 marks)	1Q (3 marks), 1Q (5 marks)	

On the basis of above analysis, it can be said that from exam point of view, reproduction in animals and plants are the most important topic of the chapter.

Topic 1: Basics of Reproduction

Summary

Knowing your Chapter at Glance:

- Reproduction is defined as the production of new generation of individuals similar to themselves.

TYPES OF REPRODUCTION

There are two main types of Reproduction in living organisms :

(a) Asexual Reproduction

(b) Sexual Reproduction

Asexual Reproduction	Sexual reproduction
A single individual give rise to new individual	Two individuals i.e., one male and one female are needed to give rise to new individual
Gametes are not formed	Gametes are formed
New individual are identical to parent	New individual is genetically similar but not identical to parents.

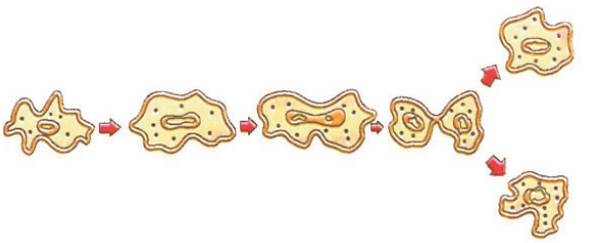
Types of asexual reproduction

Fission

It is defined as the splitting of a unicellular organism into two or more separate daughter cells.

(a) Binary fission: In binary fission, the parent organism splits to form two new organisms.

During binary fission, the DNA molecules replicate. The nuclear division is followed by the appearance of constriction in cell membrane. The membrane then grows centripetally from near the middle of dividing cell which separates the cytoplasm into two equal parts, each with one nucleus, e.g. Amoeba, Paramecium, Leishmania etc.



(b) Multiple fission: In multiple fission, the parent organism splits to form many new organisms at the same time. During multiple fission, the nucleus of parent cell divides several times into many daughter nuclei. The daughter nuclei then get arranged along the periphery of the parent cell followed by division of cytoplasm into as many pieces as the number of nuclei e.g. Plasmodium.

Budding in Hydra: A bulge appears on the body as a result of repeated mitotic division in the cells resulting in the formation of out-growth called bud. This bud enlarges in size by further division of cells and attains the shape of parent. It then separates from the parent body and starts behaving as new Hydra.

Spore formation

Spore formation takes place mostly in bacteria and fungi. Spores are formed in a sac-like structure called sporangium at the tips of fungal hyphae. The nucleus divides inside the sporangium and gets surrounded by a small mass of cytoplasm forming a spore. After attaining maturity, the sporangial wall ruptures releasing the spores. The spores are covered with thick walls that protect them until they come in contact with another moist surface and can begin to grow.

Regeneration

It is the ability of a fully differentiated organism to give rise to new individual organisms from its body parts. Small cut or broken parts of the organism's body grow or regenerate into separate individuals.

For example:Planaria and Hydra

Fragmentation

Spirogyra (algae) breaks up into smaller pieces upon maturation. These pieces (fragments) grow into new individuals.

PREVIOUS YEARS' EXAMINATION QUESTIONS

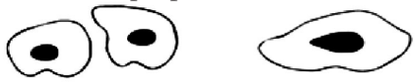
TOPIC 1

1 Mark Questions

1. The shape of yeast cell is:
(a) Only spherical
(b) Only oval
(c) irregular
(d) Both oval and spherical **[TERM 2, 2011]**

2. The steps involved in observing a slide under a microscope are given below. They are not in proper sequence.
I. Focus the object under high power of the microscope.
II. Place the slide on the stage of the microscope.
III. Arrange the mirror to reflect maximum light to the slide.
IV. Focus the object under low power of the microscope.
The proper sequence of steps is
(a) II, III, IV, I (b) I, II, III, IV
(c) IV, III, II, I (d) III, I, II, IV
[TERM 2, 2011]

3. The given figures illustrate binary fission in Amoeba in improper order.

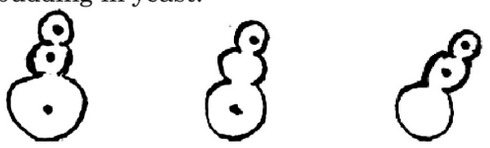


I II

III IV

The correct order is
(a) III, IV, II, I
(b) IV, III, II, I
(c) II, III, IV, I
(d) I, III, IV, II **[TERM 2, 2011]**

4. Following diagrams were drawn by different students on having seen prepared slides of budding in yeast.



I II III

IV V

Correct diagrams are
(a) I, II, III
(b) II, III, IV
(c) III, IV, V
(d) I, IV, V **[TERM 2, 2012]**

5. In which of the following figures is budding not shown?

I II

III IV

(a) I
(b) II
(c) III
(d) IV **[TERM 2, 2012]**

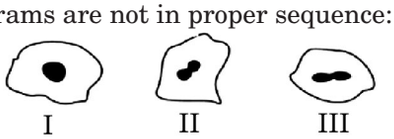
6. From the following diagrams, select the correct ones showing stages of binary fission in amoeba

I II III

IV V

(a) I, II, III
(b) IV, II, III
(c) V, II, III
(d) IV, I, III **[TERM 2, 2012]**

7. A student after observing a slide showing different stages of binary fission in Amoeba draws the following diagrams. However these diagrams are not in proper sequence:

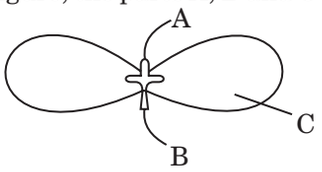


I II III

IV V

The correct sequence is:
(a) I, V, IV, III, II
(b) I, III, IV, V, II
(c) I, V, III, IV, II
(d) I, IV, V, III, II **[TERM 2, 2012]**

8. In the figure, the parts A, B and C sequentially:



(a) Plumule, Radicle and Cotyledon
(b) Radicle, Plumule and Cotyledon
(c) Plumule, Cotyledon and Radicle
(d) Radicle, Cotyledon and Plumule

[TERM 2, 2014]

9. A student was asked to focus a permanent slide under the high power of a microscope. This involved the following steps which have not been written in a correct sequence:
(A) Place the slide on the stage
(B) Clean the microscope and lenses
(C) Focus the material with coarse adjustment
(D) Place the low power objective lens above the slide
(E) Sharpen the focus with fine adjustment
(F) Bring high power objective lens over the slide
Which one of the following is the correct sequence of steps for focusing the slide under high power?
(a) B, A, C, E, D, F
(b) B, A, C, D, E, F
(c) A, B, F, C, D, E
(d) B, A, D, C, F, E

[TERM 2, 2013]

3 Marks Questions

10. (a) Explain the process of regeneration in Planaria.
(b) How is regeneration different from reproduction?

[TERM 2, 2012, 2013, 2014]

Solutions

1. The shape of yeast cell is only oval. [1]

2. (a) II, III, IV, I
Place the slide on the stage of the microscope and then arrange the mirror to reflect maximum light to the slide. Then, focus the object under low power of the microscope and after that focus the object under high power of the microscope. [1]

3. The correct order that illustrate binary fission in Amoeba is (c) II, III, IV, I [1]

4. (d) The correct diagrams are: I, IV and V
This is so because each bud has a nucleus of its own in budding of yeast. In budding, a new organism is formed from a bud of an existing organism. The nucleus of parent cells splits and a part of it enter inside the newly formed bud. [1]

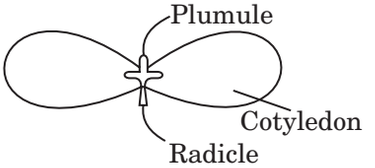
5. (a) In the first figure, budding is not shown. In budding, a new organism is formed from a bud of an existing organism. The nucleus of parent cells splits and a part of it enter inside the newly formed bud. [1]

I

6. None of these sequences are showing binary fission. The correct sequence is I, II, III, IV, V [1]

7. (a) None of these sequences are showing binary fission. The correct sequence is I, II, III, IV, V

8.



[1]

9. The correct option is (d).
Clean the microscope and lenses and then place the slide on the stage. Place the low power objective lens above the slide and focus the material with coarse adjustment. Bring high power objective lens over the slide and then sharpen the focus with fine adjustment.
This is the correct sequence of steps to focus the slide under a high power of a microscope. [1]

10. (a) The ability of the organisms to replace or develop the lost part by cell division is called regeneration. Regeneration is carried out by specialized cells. These cells proliferate and make large number of cells; different cells undergo changes to become various cell types and tissues. On being cut into pieces, Planaria can regenerate into a complete organism. These changes take place in an organized sequence referred to as developed. [1½]
(b) Regeneration is different from reproduction since most organisms would not normally depend on being cut up to be able to reproduce. It occurs when the organism is accidentally cut so it does not depend upon the will or age of the organism, for example, Planaria. Reproduction occurs either asexually or sexually when the organism gets into reproductive age, for example, humans and amoeba. [1½]

Topic 2: Sexual Reproduction in Plants

Summary

Vegetative propagation in plants

Types of vegetative propagation

Natural vegetative propagation	**Artificial vegetative propagation**
1. Through leaf buds (Eg. Bryophyllum)	1. Stem cutting (Eg. rose)
2. Through stem (Eg. potato, onion, ginger)	2. Micro propagation (Eg. Orchids, Dahlia)
3. Through roots (Eg. guava, sweet potato)	3. Layering (Eg. rose, jasmine)
	4. Grafting (Eg. lemon, orange, mango)

- The production of plants from a small piece of plant tissue removed from the growing tips of a plant in a suitable growth medium (culture solution). It is called tissue culture. This technique is used for the production of ornamental plants like orchids, dahlia, etc.

Advantages of micropropagation (tissue culture)

- It is a fast technique producing many plantlets from a small plant tissue in few weeks and using very little space. In other words, it is quite economical.
- The plants produced by tissue culture are disease free.

Types of flower based on reproductive organs

(a) Unisexual: In such flower, only one reproductive part is present, either male (stamen) or female (pistil) e.g. cucurbits, mulberry, papaya, watermelon, etc.

(b) Bisexual: When stamens and carpel are found in the same flower, it is called bisexual, e.g. Hibiscus (chinarose), mustard, rose, pea, cotton, etc.

- Stamens and carpels are the reproductive parts of a flower which contain the germ cells. The male organ of a flower called 'stamen' makes the male gamete which are present in the pollen grain. The female organ of a female called 'carpel' or 'pistil' make the female gamete, which are present in ovules of the plant.
- A flower which bear only stamen is called staminate flower and one in which only carpel is present is called a pistillate flower.

Pollination : The transfer of pollen grain from the anther of a stamen to the stigma of a carpel.

Pollination (Transfer of pollens from anther to the stigma)

Self pollination	**Cross polination**
(Transfer of pollens from anther to stigm a of the same flower or different flower of the same plant) e.g. rice, pea, wheat, etc.	(Transfer of pollens from anther to stigma of another flower of same species e.g. rose, mango, etc.

Embryo is the stage of development between the zygote or fertilized egg and the newly formed offstring.

Fertilization: The fusion of male gamete with the female gamete to form a diploid zygote within the embryo sac is called fertilization.

- The part of the baby plant that develops into shoot is called plumule and the part which develops into root is called radicle.
- The part of the seed which contains stored food for the baby plant is called cotyledon.
- The baby plant inside the seed develops into a seedling under suitable conditions like water, air, temperature, etc. This is called germination.

PREVIOUS YEARS' EXAMINATION QUESTIONS

TOPIC 2

1 Mark Questions

1. "The chromosomes number of the sexually reproducing parents and their offspring is the same." Justify this statement.

[TERM 2, 2013]

2. Potato is analogous to:
(a) Onion
(b) Turmeric
(c) Ginger
(d) Radish

[TERM 2, 2015]

3. The part of a dicotyledonous seed on the embryonic axis above the level of cotyledon is:
(a) Embryo
(b) Epicotyl
(c) Hypocotyle
(d) Plumule

[TERM 2, 2015]

4. What are those organisms called which bear both the sex organs in the same individual. Give one example of such organism.

[TERM 2, 2016]

5. If you are asked to select a group of two vegetables, out of the following, having homologous structures which one would you select?
(a) Carrot and radish
(b) Potato and sweet potato
(c) Potato and tomato
(d) Lady finger and potato

[TERM 2, 2016, 2017]

6. A student while observing an embryo of a pea seed in the laboratory listed various parts of the embryo as given below:
Testa, Tegmen, Radicle, Plumule, Micropyle, Cotyledon
On examining the list the teacher remarked that only three parts are correct. Select three correct parts from the above list:
(a) Testa, Radicle, Cotyledon
(b) Tegmen, Radicle, Micropyle
(c) Cotyledon, Plumule, Testa
(d) Radicle, Cotyledon, Plumule

[TERM 2, 2016]

7. To perform an experiment to identify the different parts of an embryo of a dicot seed. Select dicot seeds from the following groups:
Wheat, Gram, Maize, Pea, Barley, Ground-nut
(a) Wheat, Gram and Pea
(b) Gram, Pea and Ground-Nut
(c) Maize, Pea and Barley
(d) Gram, Maize and Ground-nut.

[TERM 2, 2017]

2 Marks Questions

8. List any four reasons for vegetative propagation being practiced in the growth of some type of plants.

[TERM 2, 2011]

9. Name an organism which reproduces by spore formation. List three conditions favorable for spores to germinate and grow.

[TERM 2, 2012]

10. State the role of placenta in the development of embryo.

[TERM 2, 2012]

11. Mention the observations of the process of binary fission in amoeba.

[TERM 2, 2015]

12. A student is observing a permanent slide showing sequentially the different stages of asexual reproduction taking place in yeast. Name this process and draw diagrams, of what he observes, in a proper sequence.

[TERM 2, 2018]

13. Draw in sequence (showing the four stages), the process of binary fission in Amoeba.

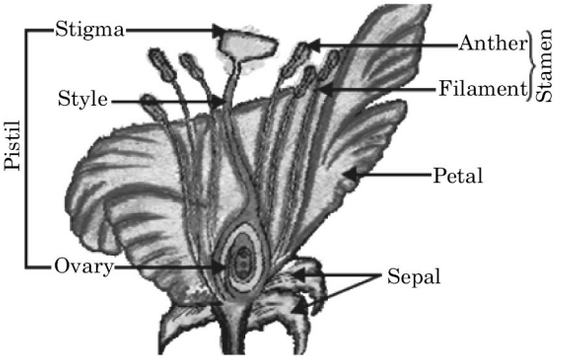
[TERM 2, 2018]

3 Marks Questions

14. Explain the term "Regeneration" as used in the relation to reproduction of organisms. Describe briefly how regeneration is carried out in multi-cellular organism like Hydra.

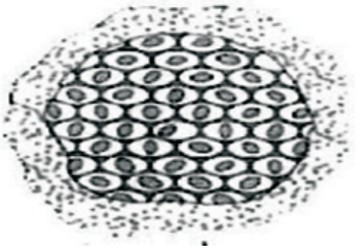
[TERM 2, 2016]

15. Identify the incorrectly labeled part and correct it.



[TERM 2, 2015]

16. The picture given below depicts the process of asexual reproduction in Plasmodium,



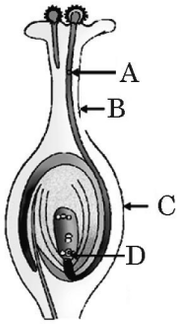
(a) Name the process depicted above and define it.
(b) What is meant by asexual reproduction?[

[TERM 2, 2015]

17. In the context of reproduction of species state the main difference between fission and fragmentation. Also give one example for each.

[TERM 2, 2016]

18. (a) List two reasons for the appearance of variations among the progeny formed by sexual reproduction.
(b)



(i) Name the part 'A' in the diagram.
(ii) How does 'A' reaches part 'B"?
(iii) State the importance of the part 'C'.
(iv) What happens to the part marked 'D' after fertilization is over?

[TERM 2, 2016]

19. Reproduction is one of the most important characteristics of living beings. Give three reasons in support of the statement.

[TERM 2, 2017]

20. What is vegetative propagation? State two advantages and two disadvantages of this method

[TERM 2, 2017]

21. Write one main difference between asexual and sexual mode of reproduction. Which species is likely to have comparatively better chances of survival- the one reproducing asexually or the one reproducing sexually? Give reason to justify your answer.

[TERM 2, 2018]

5 Marks Questions

22. With the help of suitable diagrams, explain the various steps of budding in Hydra.

[TERM 2, 2011]

23. What is binary fission in organisms? With the help of suitable diagrams, describe the mode of reproduction in Amoeba.

[TERM 2, 2011]

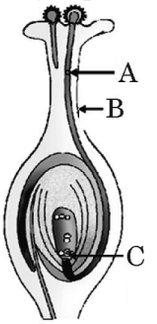
24. Distinguish between unisexual and bisexual flowers giving one example of each. Draw a diagram showing process of germination of pollen grains on stigma and label the following parts
(i) Female germ cell
(ii) Male germ cell
(iii) Ovary

[TERM 2, 2012]

25. (a) List three distinguishing features between sexual and asexual types of reproduction.
(b) Explain why variations are observed in the off springs of sexually reproducing organisms?

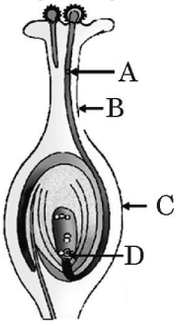
[TERM 2, 2013]

26. (a) Identify A, B and C in the given diagram and write their functions.
(b) Mention the role of gamete and zygote in sexually reproducing organisms.



[TERM 2, 2013]

27. (a) Name the parts labeled as A, B, C and D in the diagram given below:



(b) What is pollination? State its significance.
(c) How does fertilisation occur in flowers? Name the parts of the flower that develop into (i) seed, and (ii) fruit after fertilisation.

[TERM 2, 2014]

28. Define the following processes:
(a) Fertilization
(b) Vegetative propagation
(c) Menstruation
(d) Regeneration
(e) Binary fission

[TERM 2, 2015]

Solutions

1. In sexually reproducing parents, the gametes have half the number of chromosomes and DNA that is they are haploid. These gametes i.e. sperms and ova fuse at the time of fertilization to form zygote and thus restore the chromosome number or the diploid condition. Thus the parents and the offspring have the same number of chromosomes. [1]

2. The correct option is (a).

Potato and onion both are modified stems and also their functions are same as they both perform the function of food storage. [1]

3. The correct option is (b).

The part of a dicotyledonous seed on the embryonic axis above the level of cotyledon is epicotyl. [1]

4. Organisms which bear both the sex organs in the same individual are called bisexual. For example, earthworm. [1]

5. Vegetables having homologous structures will have similar structures but perform different functions. [½]

Carrot and radish have similar structure and same origin. [½]

Thus, the correct answer is (a).

6. The embryo consists of epicotyl, hypocotyl, radicle and cotyledons. The growing tip of epicotyl is plumule. [1]

Therefore, the correct answer is (d).

7. (b) Gram, Pea. Ground-Nut Dicots have two cotyledons, thus Gram, Pea and Ground-nut are dicots and rest are monocots or single cotyledon. [1]

8. Vegetative propagation is being practiced in the growth of some type of plants because:

(i) Vegetative propagation is used when genetically similar plants need to be produced, thus we can keep their characteristics and traits similar. [½]

(ii) It can be used even for those plants which don't produce any seeds. [½]

(iii) It is also a quick and cheap method for a rapid production. [½]

(iv) It can used for plants which bear fruit after long time thus by using vegetative propagation. They can bear fruits faster, by planting them using layering and grafting. [½]

9. An organism which reproduces by spore formation is Rhizopus. [½]

The three conditions favorable for spores to germinate and grow are as follows:

(i) Moist temperature [½]

(ii) Warm temperature [½]

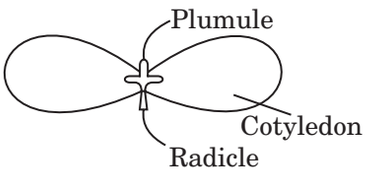
(iii) Enough nutrition [½]

10. The exchange of materials between the mother's blood and the blood of foetus takes place through placenta. It's a special umbilical duct that develops in the fourth week of embryo development. It establishes an intimate connection between the fetal membrane and the uterine wall of mother and serves as a nutritive respiratory and excretory organ of the foetus. [2]

11. In most of the single celled organisms like amoeba, cell division and reproduction is done by binary fission method. In this process, one parent cell is involved and as a result two daughter cells are formed. The amoeba cell is first reproduced into two nuclei and then those nuclei get divided and start moving to opposite directions. After that, proteins and nutrients are produced by the cell for the preparation of binary fission. When the environmental conditions are suitable, the process of binary fission occurs and in that stage, two daughter cells are formed. [2]

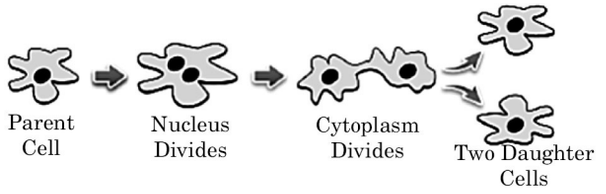
12. The process by which asexual reproduction takes place in yeast is known as budding. [1]

It is explained using diagram below:



[1]

13. The four steps of binary fission in Amoeba are shown in the following figures:



[2]

14. Regeneration-The ability of living organism to repair themselves or restore their lost part is called regeneration. [1½]

Regeneration of Hydra: All the body column cells of Hydra constantly undergo mitosis. If Hydra is cut into two parts, the upper as well as the lower parts regenerate and form two new organisms. As a result, the Hydra is constantly regenerating. [1½]

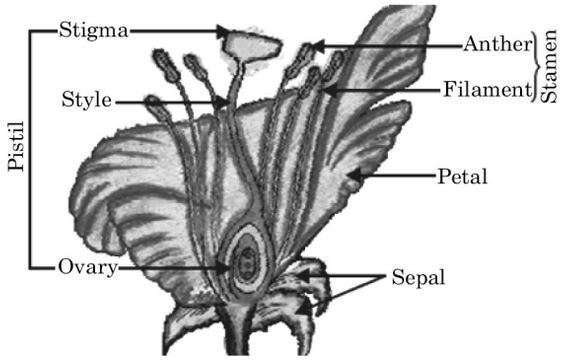
15. The (b), (e) and (f) parts are labeled incorrectly. The correct parts are: [1]

(b) Style

(e) Anther

(f) Filament [1]

The following diagram shows the correct labeling of all these parts:



[1]

16. (a) The above depicted process is called multiple fission. In this process, a single cell organism is divided into many daughter cells concurrently. [1½]

(b) Asexual reproduction is a form of reproduction in which a single parent takes part in asexual reproduction and as a result a new generation is created from that. [1½]

17.

Fragmentation	**Fission**
Cells do not have same shape and size.	Cells are same in shape and size.
It is observed in multi-cellular organisms.	It is observed in uni-cellular organisms.
The division produces two or more cells depending on the number of fragments.	The division produces two or more identical cells.
e.g.: Spirogyra	e.g.: Amoeba

[1 + 1 + 1]

18. (a) Two reasons for the appearance of variations are:

(i) The progeny formed by the sexual reproduction occurs when the genetic material of two different individuals is combined.

(ii) Crossing over is the result during gamete production in which the DNA gets exchanged. [1½]

(b) (i) Pollen grain

(ii) A reaches B by the process of pollination.

(iii) It is the pathway to the pollen tube.

(iv) The embryo is formed. [1½]

19. The biological process of producing new offspring in living organisms is called reproduction. It is one of the most important characteristics of living beings because

(a) It ensures the continuity of the life form of a species and saves the species from the loss of cellular degeneration, leading finally to extinction. [1]

(b) It ensures passing down the genetics and characteristic traits of a species to the new generation. [1]

(c) It provides genetic variance with better traits through mutation and evolution to help build new species having better survival instincts. [1]

20. It is the process of production of plants from the vegetative parts of the plant like stem, root, leaf in which a portion is detached from the body of the parent plant and is grown independently.

Advantages:

(a) It is a faster and simple process of creating genetically identical offspring wherein only one parent is required.

(b) It is a beneficial process to produce those plants which produce no or very less viable seeds. [1½]

Disadvantages:

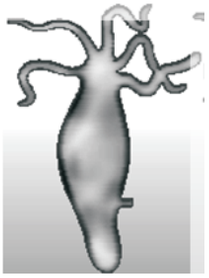
(a) This process creates genetically identical offspring, thus reduces the chances of increasing on genetic variance through mutation and evolution.

(b) Genetically identical offspring lack betterment of traits through mutation and evolution, thus they are more prone to diseases specific to the species. [1½]

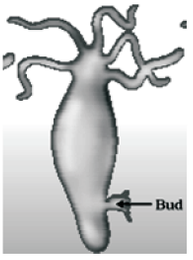
21. Sexual reproduction involves both male and female parent while asexual reproduction includes one individual to produce new generation. [1]

Sexual mode of reproduction have better chances of survival because the new generation is produced by combining DNA from two different gametes of female and male parents. Therefore the process involving two individuals have better chances of survival. [1]

22.

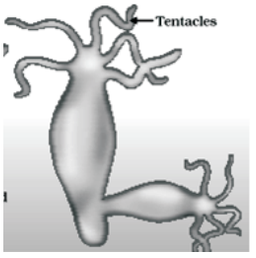


Hydra reproduce with budding process. Initially, a bud is formed after repeated cell division.[1 + 1]



[1]

After formation of the buds, they further develop into tiny individuals further.



[1]

Once they develop fully mature they get detached from parent's body and become new independent individual. [1]

23. Binary fission is a process of reproduction used by single celled organisms. It is an asexual method of reproduction. In it each single cell gets further divided into two similar daughter cells. It can be seen mostly in prokaryotes, eukaryotes, amoeba, etc. [1½]

[1½]

Amoeba reproduces using binary fission. These are various stages:

(i) Parent cell gets enlarged and nucleus starts getting elongated.

(ii) The nucleus further gets divided into two parts.

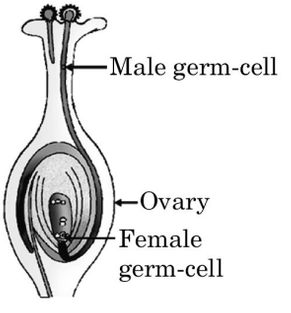
(iii) Further that nucleus starts to move apart further.

(iv) Further cytoplast gets divided and two daughter cells are released. [2]

24. **Unisexual flowers -** The flower has either male reproductive organs (stamens) or the female reproductive organs (pistil). For example - papaya and watermelon. [1½]

Bisexual flowers- The flower has both the male reproductive organs (stamens) and the female reproductive organs (pistil) in a single flower. For example- Hibiscus, rose etc. [1½]

The process of combining pollen from male flowers with female flowers to form seeds and set fruit is called pollination. When the pollen grain gets deposited on the stigma, it starts to germinate and the pollen tube grows up through the pistil of the female flower until it reaches the ovary and fertilization occurs. [1]



[1]

25. (a)

Sexual reproduction	Asexual reproduction
Requires involvement of both the parent.	Involves only a single parent.
Fusion of male and females gametes.	Does not involve fusion, in fact gamete of single parent undergoes division and give rise to a new individual.
New born individuals are not the exact copies of the parent	New born individuals are identical to their parents.

[1 + 1 + 1]

26. In the diagram given above:

(a) A is the Stigma. Function: The stigma is a sticky surface where the pollen lands and later germinates. [1]

(b) B is the Pollen tube. Function: It carries the pollen from stigma to the egg cell in the ovary for fertilization. C is the Egg cell. Function: It fuses with the male gamete and leads to the formation of zygote. [1]

(b) The gametes play an important role in the sexually reproducing organisms as they carry genetic instructions that is a haploid set of chromosomes that the new organism needs to grow, develop and complete its life cycle. These gametes upon fusion result in the formation of zygote, which develops into a new individual. [1]

Zygote is the diploid cell formed by the fusion of male and female gametes during fertilization in sexual reproduction. Zygote is the first stage in the development process of an organism and it contains the complete set of genetic information of both the parents, essential for the growth of the new organism. [2]

27. (a) A- Pollen grain ; B- Pollen tube; C- Ovary; D- Female germ cell [1]

(b) Pollination is the transfer of pollen grains from anther to stigma. It helps in fertilization. [1]

(c) As the pollen lands on the suitable stigma a pollen tube grows through the style carrying the male germ cell. It reaches the ovary and the male germ cell fuses with the female germ cell and thus fertilization takes place. [1]

The parts that develop into seed and fruits after fertilization are:

(i) Ovule develops into seed. [1]

(ii) Ovary develops into fruits. [1]

28. (a) **Fertilization-** It is a process of sexual reproduction in which fusion of male and female gametes takes place. It happens in animals and plants both. Zygote is formed after successful fertilization. [1]

(b) **Vegetative propagation-** Vegetative propagation is a type of asexual reproduction in plants, in which a fragment of parent plant can grow entirely new plant. New plants can be grown from stem, root or leaf of parent plant. [1]

(c) **Menstruation-** When the monthly released egg by ovary doesn't fertilize then the blood comes out through the vagina and mucous. The cycle takes place roughly every month and is known as menstruation. It usually lasts for about two to eight days. [1]

(d) **Regeneration-** It is an ability of an organism to produce new individual organism from their body parts. If the individual is cut into pieces, these pieces grow into separate individual. [1]

(e) **Binary fission:** In unicellular organism, cell division, or fission, leads to the creation of new individual. During cell division some bacteria and protozoa split into two equal halves. [1]

Topic 3: Reproduction in Human Beings

Summary

(i) Puberty in males: It is attained at the age of 13 - 14 years. It is triggered by the secretion of testosterone from the testes which brings about the development of secondary sexual characters during puberty and maintains throughout life.

(ii) Puberty in females: It is attained at the age between 10 - 12 years. It is triggered by the hormone estrogen from the ovaries. This hormone causes growth, maturation of reproductive tracts and development of secondary sexual characters.

Changes at puberty

(i) In human males

- Enlargement of penis and scrotum.
- Broadening of shoulders.
- Growth of the body hair and facial hair.
- Deepening of the voice due to enlargement of larynx and thickening of vocal cords.
- Increase in the development of musculature and bones.
- Increase in height.

(ii) In human females

- Growth of breast and external genitalia.
- Growth of pubic hair and extra hair in the armpits.
- Broadening of pelvis.
- Initiation of menstruation and ovulation.
- Increase in fat particularly in thighs, shoulders, buttocks and face.

Male reproductive system

(a) Scrotum: The scrotum is a pouch of pigmented skin from the lower abdominal wall and hanging between the legs. The scrotum acts as a thermoregulator and maintains a temperature of 2 C less than the body and provides an optimal temperature for the formation of sperms. The life of the sperm is reduced if the temperature is higher.

(b) Testis : Testes are the primary sex organs lying in the scrotum outside the abdominal cavity. Testes are the sites where sperms are produced. It also produces sex hormone testosterone.

(c) Vas deferens : This is a straight tube about 40 cm long which carries the sperms to seminal vesicles. It temporarily stores the sperms.

(d) Urethra: It is 20 cm long tube that arises from urinary bladder to carry urine. It carries sperms from vasa deferentia through the penis. Thus urethra forms a common passage for both urine and sperms.

(e) Penis: It is a long and thick muscular organ made up of mostly erectile tissue. It opens outside the body. It passes the sperms from the man's body into the vagina of the women's body during mating.

Associated glands

Seminal vesicles and prostate glands add their secretion to the sperms. This fluid provides nourishment to sperms and make their transport easy.

Female reproductive system

It consists of a pair of ovaries, a pair of fallopian tubes, uterus and vagina.

(a) Ovaries: They are the primary sex organs located in the lower part of the abdominal cavity near kidney. Each ovary is connected by a ligament to the uterus. It produces gametes (eggs) and hormones like estrogen and progesterone.

When a girl is born, the ovaries already contain thousands of immature eggs. At puberty some of these eggs start maturing. One egg is produced every month by one of the ovaries. The release of egg from the ovary is called ovulation. The force of ejection carries the egg to the fallopian tube.

(b) Fallopian tube (oviducts): A fallopian tube is about 10 to 12 cm long muscular tube which carries egg from the ovary to the uterus and provides suitable environment for fertilization.

(c) Uterus: It is a large, elastic sac specialized for the development of embryo until birth. It is located between urinary bladder and rectum.

(d) Vagina: The vagina is a large, median elastic muscular tube. It is adapted to receive the male penis during copulation. The vagina is also called "birth canal". It allows the passage of baby at the time of child birth.

Fertilization is the fusion of sperm nucleus with the egg nucleus to form a diploid zygote.

- The sperm penetrates through penis into the vagina during copulation. The sperm moves to the uterus and then to the fallopian tube. The fallopian tube contains an ovum produced during ovulation. Only one sperm fuses with the ovum in the oviduct to form the zygote.
- The zygote divides and forms a hollow ball of hundred of cells called embryo which gets embedded in the thick lining of uterus. The lining thickens and is richly supplied with blood to nourish the growing embryo.
- A disc-like special tissue embedded in the uterine wall called placenta develops between the uterus wall and the embryo. The placenta contains villi on the embryo's side of the tissue. On the mother's side are blood spaces which surround the villi. It provides large surface area for exchange of oxygen, nutrients and waste products between the embryo and the mother.
- The complete development of the embryo (foetus) from the initial stage of conception till the birth of young ones is called gestation. It is also termed as pregnancy.

Sexual cycle in females

(a) Menstruation: When the egg released during ovulation is not fertilized by the sperm it lives for about one day, then the thick and soft uterus lining having lot of blood capillaries is not required. The unfertilized ovum dies and the uterus lining breaks down which produces blood along with other tissues. The blood and other tissues come out of vagina in the form of bleeding called menstruation.

(b) Menstrual cycle: The cycle of events taking place in female reproductive organs (ovaries and uterus) under the control of sex hormones, in every 28 days and marked by bleeding or menstrual flow is called menstrual cycle.

At puberty, the commencement of menstruation is termed menarche. Stoppage of menstrual cycle at the age of 45 - 55 is called menopause.

BIRTH CONTROL METHODS

The prevention of pregnancy in a woman is called contraception. Any device or chemical which prevents pregnancy is called a contraceptive. All the birth control methods are divided into:

- Barrier methods
- Chemical methods
- Intra uterine contraceptive device (IUCD)
- Surgical methods

Chemical methods

(a) Oral pills: They act by changing the hormonal balance of the body, so that eggs are not released & fertilization cannot occur. They are taken orally, therefore commonly called oral contraceptives (OC). These pills can cause side effects.

(b) Vaginal pills: They contain spermicides and therefore they kill the sperms.

Intra-uterine contraceptive device (IUCD)

They are contraceptives such as a loop or the copper-T placed in the uterus. They prevent implantation in the uterus. They can cause side effects due to irritation of the uterus.

Surgical methods

(a) Vasectomy: In males, a small portion of vas deferens (sperm duct) is cut and the cut ends are then ligated (tied). This prevents the sperms from coming out.

(b) Tubectomy: In females, a small portion of fallopian tubes is cut & the cut ends are then ligated (tied). This prevents the egg to enter the fallopian tube.

Surgical methods are the permanent methods of contraception.

There are some diseases which are spread by sexual contact with an infected person. Such diseases are called sexually transmitted diseases (STD).

For example:

- Gonorrhoea (bacterial disease)
- Syphilis (bacterial disease)
- Warts (viral infection)
- AIDS (viral infection)

PREVIOUS YEARS' EXAMINATION QUESTIONS TOPIC 3

1 Mark Questions

1. Give a way to prevent sexually transmitted diseases.

[TERM 2, 2015]

2. When a cell reproduces, what happens to its DNA?

[TERM 2, 2017]

2 Marks Questions

3. Describe the role of fallopian tubes in the female reproductive system.

[TERM 2, 2011]

4. What is the main difference between sperms and eggs of humans? Write the importance of this difference.

[TERM 2, 2014]

3 Marks Questions

5. What does HIV stand for? Is AIDS an infectious disease? List any four modes of spreading AIDS.

[TERM 2, 2011]

6. List and explain in brief three methods of contraception.

[TERM 2, 2012]

7. Write two examples each of sexually transmitted diseases caused by (i) virus, (ii) bacteria. Explain how the transmission of such diseases be prevented?

[TERM 2, 2012, 2013]

8. "The sex of a newborn child is a matter of chance and none of the parents may be considered responsible for it". Justify this statement with the help of flow chart showing determination of sex of a newborn.

[TERM 2, 2012]

9. What is placenta? State its function in the human female.

[TERM 2, 2014]

10. List three techniques that have been developed to prevent pregnancy. Which one of these techniques is not meant for males? How does the use of these techniques have a direct impact on the health and prosperity of a family?

[TERM 2, 2017]

5 Marks Questions

11. Draw a diagram of human female reproductive system and label the part
(i) That produces eggs.
(ii) Where fusion of egg and sperm takes place.
(iii) Where zygote is implanted.
What happens to human egg when it is not fertilized?

[TERM 2, 2012, 2014]

12. What is placenta? Describe its structure. State its functions in case of a pregnant human female.

[TERM 2, 2016]

13. (a) Write the functions of each of the following parts in a human female reproductive system:
(i) Ovary
(ii) Uterus
(iii) Fallopian Tube
(b) Write the structure and functions of placenta in a human female.

[TERM 2, 2017]

Solutions

1. A way to prevent sexually transmitted diseases is to avoid unprotected sexual intercourse. [1]

2. When a cell reproduces, DNA is copied from parents DNA. The DNA replicates making copies during cell division. [1]

3. The fallopian tubes are found in female reproductive organ there are two fallopian tubes. It is a tube like structure connecting between ovary and uterus which is responsible for transportation of egg from ovary to uterus. The fimbria of the fallopian tube reaches into pelvic cavity and there it picks released egg. It is also the part in where sperm meets the egg cell for fertilization. [2]

4. Difference between sperm and egg:

Sperm	Egg
Sperm is produced by male reproductive Organ. It is produced in testes.	The egg is produced by female reproductive organ. It is produced in ovary.
It has a head, middle part, and a tail.	It has membrane
It has X and Y chromosomes	It has X and X chromosomes

[2]

5. HIV stands for Human Immunodeficiency Virus.

Yes, AIDS (Acquired Immunodeficiency Syndrome) is an infectious disease which is caused by HIV. [1½]

The various modes of spreading HIV are:

(i) Sexual intercourse with a person who is carrier of HIV or infected by it.

(ii) If infected needle and syringe by HIV are used.

(iii) It can be transmitted from pregnant mother to child during pregnancy.

(iv) If the person is transfused with HIV infected blood during transfusion of blood from infected person. [1½]

6. Contraceptive methods are used to avoid unplanned pregnancy. The three methods are explained below :

(i) Mechanical barrier: Condoms on the penis or similar coverings worn in the vagina as they do not allow sperms to reach the egg. [1]

(ii) Contraceptive pills: These pills help by changing the hormonal balances, which makes sure that the eggs are not released and thus tops fertilization. [1]

(iii) Contraceptive devices: Loop or copper – T are placed in the uterus to prevent pregnancy.[1]

7. (i) Viral infection: Warts and AIDS [½]

(ii) Bacterial diseases: Gonorrhea and Syphilis [½]

The transmission of sexually transmitted diseases can be prevented in following ways:

(i) Using protection or condoms during sexual intercourse. [½]

(ii) Prohibiting the sharing of needles, syringes etc. [½]

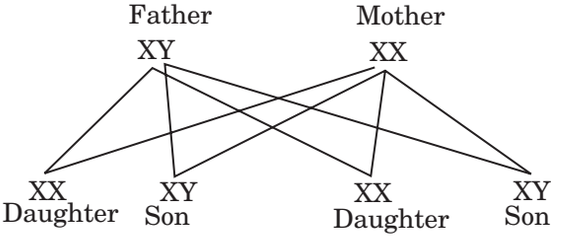
(iii) Testing of blood before transfusion. [½ + ½]

8. "The sex of a newborn child is a matter of chance and none of the parents may be considered responsible for it". The statement can be justified as:

The females comprises of two X chromosomes and the males have one each of X and Y chromosome. Males produce two gametes namely X and Y and the females produce two similar X gametes. Fertilization is the process when the male and female gametes fuse together. [1]

If sperm having X chromosome fuses with egg, the progeny will be a female and if sperm having Y chromosome fuses with the egg, the progeny will be a male. X or Y chromosome have equal chances to fuse with the egg so we can say that the sex of new born child is a matter of chance and none of the parent is responsible for it. [1]

The following flow chart shows determination of sex of a newborn:



[1]

9. A special umbilical cord that develops in the fourth week is called placenta. It establishes a very close connection between the membrane of the foetus and the uterine wall. [1½]

The function of placenta: The material between the mother's blood and the blood of foetus is exchanged by the placenta. Placenta serves as excretory organ, respiratory, nutritive of the foetus. Foetus develops waste while it is growing and placenta removes this waste by transferring it to mother's blood. [1½]

10. The three techniques that have been developed to prevent pregnancy are:

(a) Use of barrier methods such as condoms and contraceptive pills. [½]

(b) Use of IUD (Intra-uterine devices) such as Copper T. [½]

(c) Surgical methods such as tubectomy and vasectomy. [½]

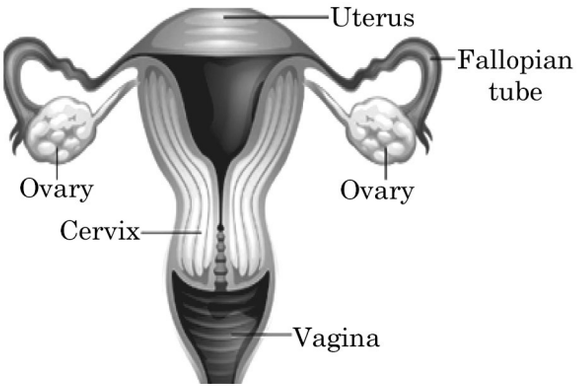
Usage of Intra-uterine devices is not meant for males.

These modern methods to prevent unwanted pregnancy are very beneficial for the over-all health of a woman and prevent the complications of being pregnant and its related consequences. A couple can use these methods to have optimum birth control to plan when to welcome an offspring in the family. This helps them to prepare to have resources required to provide stable financial and healthy lifestyle to the family as a whole. [1½]

11. (i) The part that produces eggs- Ovary [½]

(ii) Fusion of egg and sperm takes place in fallopian tubes [½]

(iii) Zygote is implanted in the Uterus. [½]



[1½]

When the egg is not fertilized, it lives for one day. Ovary releases one egg per month and the uterus is prepared to receive a fertilized egg every month. When the fertilization does not takes place the lining slowly break; discharging blood and mucous through vagina. This cycle takes place after every 28 days and is known as menstruation. [1½ + ½]

12. A physical barrier connecting the embryo from the mother womb to the uterine wall is called placenta. It helps in nutrient uptake, waste removal, etc. [1]

Placenta is dark reddish – blue or crimson coloured with a length of 22 cm and thickness of 2 – 2.5 cm. Placenta is discoidal in shape. [1]

The functions of the embryo are as follows:

(i) It helps in the removal of the waste produced by the embryo. [1]

(ii) Placenta is used to provide nutrition to the embryo. [1]

(iii) It provides immunity to the foetus as well.[1]

13. (a) The functions of each of the following parts in a human female reproductive system:

(i) Ovary: Ovary is a ductless gland that mainly functions in the production of female reproductive cells (eggs or ovum). It also secretes sex hormones, i.e., estrogen and progesterone. [1]

(ii) Uterus: The embryo gets developed in the Uterus into a foetus. It gives nutrition and protects the embryo. [1]

(iii) Fallopian tube: It carries egg (ovum) or fertilized egg (zygote) towards the uterus. Fertilisation takes place inside the fallopian tube. [1]

(b) Structure and Function of Placenta:

The Placenta is embedded in the uterus wall. It is a disc shaped organ. It contains villi on the embryo side. [1]

It basically functions to provide oxygen and nutrients to the growing baby and also helps in waste elimination and thermo-regulation. [1]

Smart Notes .....

Smart Notes .....

CHAPTER 9

Heredity and Evolution

Chapter Analysis with respect to Last 3 Years' Board Exams

List of Topics	**2016**	**2017**	**2018**
Heredity			
Mendel's contribution- Laws for inheritance of traits		1Q (5 marks)	1Q (2 marks)
Sex determination: brief introduction			
Basic concepts of evolution	1Q (5 marks)	1Q (3 marks)	

On the basis of above analysis, it can be said that from exam point of view Mendel experiment and concept of evolution are the most important topics of the chapter.

Topic 1: Heredity & Mendel's Contribution

Summary

Knowing your Chapter at Glance:

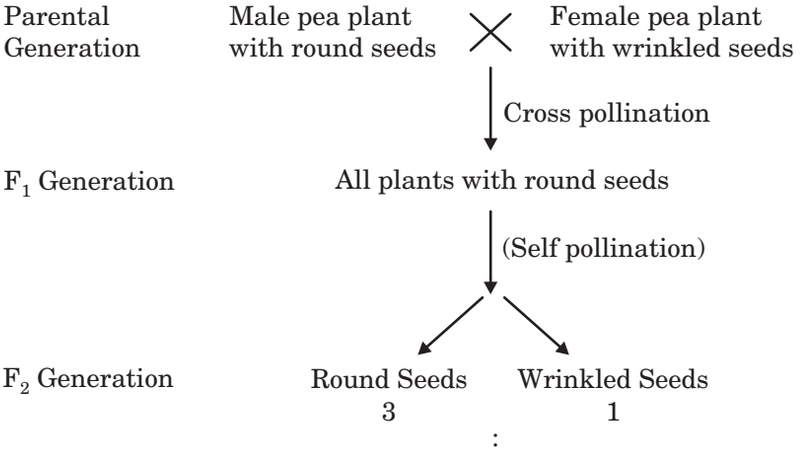
- **HEREDITY**
  Transmission of characters (resemblances as well as variations) from parents to the offsprings, i.e., from one generation to the next is called heredity.
- Trait is any characteristic that is transferred from parent to offspring. E.g. height and colour.
- Evolution is the process of development of new type of living organism from an old one due to gradual change.
- **VARIATION**
  The differences shown by the individuals of a species, and also by the offsprings (siblings) of the same parents are referred to as variations.
- Genetics is the study of heredity and variations. Genetics is to help our understanding of heredity by knowing how offspring inherit characteristics from their parents.
- Variation may occurs due to different combinations of genetic material or due to some positive gene mutations or due to interaction of genes with environmental changes.
- Importance of variations
  1. Different individuals would have different kinds of advantage.
  2. It forms the basis of heredity.
  3. Accumulation of variations forms the basis of evolution.
- Asexual reproduction involves single parent. When a single individual reproduces asexually, the resultant two individuals again after sometime reproduce to form four individuals. All these individuals would be exactly similar (carbon copies).
  On the other hand,Sexual reproduction, generates even greater diversity. This is so because sexual reproduction involves two parents (father and mother) and every offspring receive some characters of father and some characters of mother. Since, different offsprings receive different combination of characters of their parents, they show distinct differences (variations) among themselves as well as from their parents.
  Hence,Sexual mode of reproduction is considered better than asexual mode of reproduction.
- Gregor Johann Mendel carried out several experiments on pea plants. He carried out large number of monohydrid and dihydrid crosses using many constrasting characteristics and put forward several important conclusion.

MENDEL AND ITS CONTRIBUTION

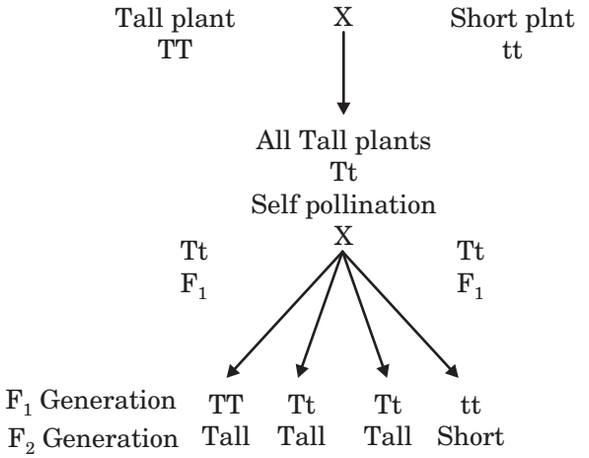
He studied the inheritance of contrasting characters (traits).Plant selected by Mnedel was Pisum sativum(pea plant)

Characters of pea plant studied by Mendel

- Plant height - Tall/short
- Flower colour - Violet/white
- Pod colour - Green/yellow
- Pod shape - Smooth/wrinkled
- Seed colour - Green/yellow
- Seed shape - Round/wrinkled
- Mendel was known as **Father of Genetics**
- In case of monohybrid cross with pure variety of plants, the phenotypic ratio obtained in F_2 generation is 3:1.
- In case of dihybrid cross involving two pairs of contrasting characters, the phenotypic ratio obtained in F_2 generation is 9:3:3:1.



Monohybrid cross : Cross between 2 pea plants with one pair of contrasting characters Tall/short (monohybrid cross)



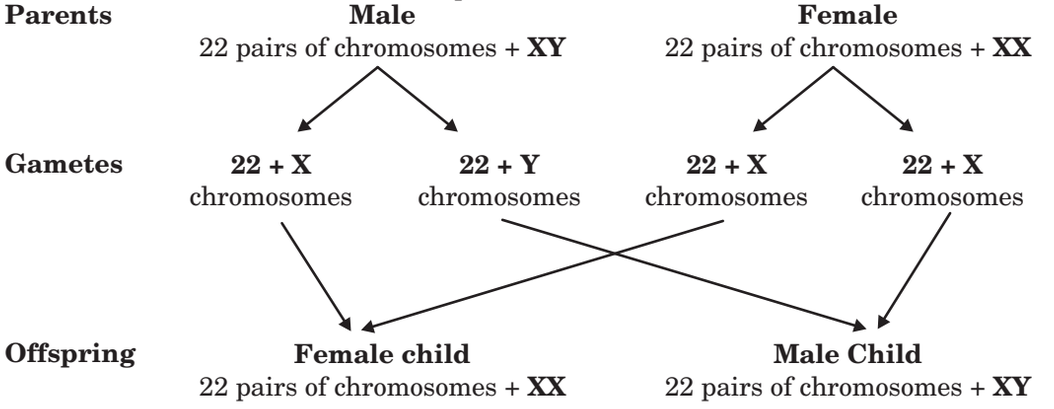
Mendel's Dihybrid Cross

A breeding experiment dealing with two characters at the same time is called a dihybrid cross.

	RY	Ry	rY	ry
RY	RRYY Round, yellow	RRYy Round, yellow	RrYY Round, yellow	RrYy Round, yellow
Ry	RRYy Round, yellow	RRyy Round, green	RrYy Round, yellow	Rryy Round, green
rY	RrYY Round, yellow	RrYy Round, yellow	rrYY Krinkled, yellow	rrYy Wrinkled, yellow
ry	RrYy Round, yellow	Rryy Round, green	rrYy Wrinkled, yellow	rryy Wrinkled, green

F_2 Generation	Plants with round and yellow coloured seeds		Plants with round and green coloured seeds		Plants with wrinkled and yellow coloured seeds		Plants with wrinkled and green coloured seeds
	9	:	3	:	3	:	1

- Genes carry information for producing proteins,which in turn control the various body characteristics.
- Phenotype is the appearance of an individual.
- Genotype is the genetic constitution of an organism which determines the character.
- The combination of male and female germ cells gives a diploid zygote.
- Sex is determined genetically in human beings by sex chromosomes. Male child has one pair of dissimilar sex chromosomes - XY. Female child has one pair of similar sex chromosomes - XX.



PREVIOUS YEARS' EXAMINATION QUESTIONS

TOPIC 1

1 Mark Questions

1. What is speciation?

[TERM 2, 2012, 2013]

2. Study the different conclusions drawn by students of a class on the basis of observations of preserved/available specimens of plants and animals.

I. Potato and sweet potato are analogous organs in plants.

II. Wings of insects and wings of birds are homologous organs in animals.

III. Wings of insects and wings of bats are analogous organs in animals.

IV. Thorns of citrus and tendrils of cucurbita are analogous organs in plants.

The correct conclusions are:

(a) I and II
(b) II and IV
(c) I and III
(d) III and IV

[TERM 2, 2012, 2013]

3. You have potato, carrot, radish, sweet potato, tomato and ginger bought from the market in your jute bag. Identify two vegetables to represent the correct homologous structures.

(a) Potato and tomato
(b) Carrot and tomato
(c) Potato and sweet potato
(d) Carrot and radish

[TERM 2, 2012, 2013]

4. Study the following statements:

I. Wings of birds and wings of bats are homologous organs.

II. Wings of birds and wings of insects are modified forelimbs.

III. Wings of birds and wings of insects are analogous organs.

IV. Wings of birds and forelimbs of horse are homologous organs.

The correct statements are

(a) I and II
(b) II and III
(c) III and IV
(d) I and IV

[TERM 2, 2014]

5. A Mendelian experiment consisted of breeding pea plants bearing violet flowers with pea plants bearing white flowers. What will be the result in F_1 progeny?

[TERM 2, 2018]

3 Marks Questions

6. If we cross pure-bred tall (dominant) pea plant with pure-bred dwarf (recessive) pea plant we will get pea plants of F_1 generation. If we now self-cross the pea plant of F_1 generation, then we obtain pea plants of F_2 generation.

(a) What do the plants of F_1 generation look like?

(b) State the ratio of tall plants to dwarf plants in F_2 generation.

(c) State the type of plants not found in F_1 generation but appeared in F_2 generation, mentioning the reason for the same.

[TERM 2, 2012]

7. The sex of a newborn child is a matter of chance and none of the parents may be considered responsible for it." Justify this statement with the help of flow chart showing determination of sex of a newborn.

[TERM 2, 2013]

8. A particular character is selected, whereas another is rejected. This is decided by nature. How nature does this?

[TERM 2, 2015]

9. (a) When a sperm bearing Y chromosome fertilizes with egg, then why the child born will not be like his father?

(b) What will be the % of ab gametes produced by Aa and Bb?

[TERM 2, 2015]

Solutions

1. Speciation can be described as an event that splits a population into two independent species which cannot reproduce among them. Speciation occurs when a population exhibits a continuous change due to changes in the environment. These unit changes get accumulated over a period of time. The levels of gene flow between them decrease which slowly results on alteration of the individual's structure and functions to give rise to a new species. [1]

2. Analogous organs are those which do not share a common ancestor but perform a common function. Here, wings of bat and insects have the same function but they do have different origin and it is same for potato and sweet potato. [1]

3. Carrot and radish

Homologous structures perform different functions but have the same origin. Both carrot and radish are underground roots and that's why they represent homologous structures. [1]

4. The correct statements are III and IV.

Analogous organs are those which do not share a common ancestor but perform a common function. Wings of insects and bats both perform the same function of flight but do not have a common origin. Hence, wings of insects and wings of bats are analogous organs in animals. [½]

Wings of birds and forelimbs of horse are homologous organs, because they have a common source of origin, or common ancestry but serve different purposes for birds and horse. [½]

Hence, the correct answer is option (c).

5. In peas, plant bearing violet flower is dominant trait over plant bearing white flower so the cross- breeding between plant bearing violet flowers with plant bearing white flowers will result in plant with all violet coloured flower as F_1 progeny. [1]

6. (a) All of the plants in the F_1 generation are tall. [1]

(b) The ratio is 3:1. [1]

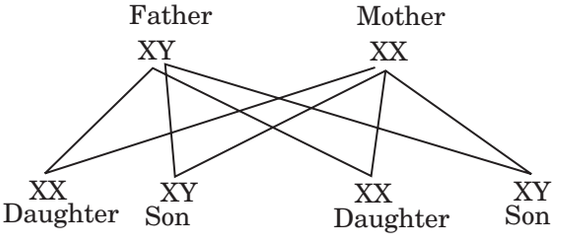
(c) The dwarf plants are not found in the F_1 generation but appear in the F_2 generation and the trait for dwarfness is recessive, as always the dominant trait dominated the short recessive trait. [1]

7. In humans, a male has one X and one Y chromosome whereas a female has two X chromosomes. Therefore, the females are XX and the males are XY. The male produces two different gametes X and Y while the female produces two same gametes that are X and X. The process of fusion between a male with the female gamete inside the uterus is known as fertilization. [1½]

Therefore during fertilization, if sperm carrying Y chromosome fuses with egg (X) the child will be male(XY)and if sperm carrying X chromosome fuses with the egg (X) the child will be female(XX).

There is an equal chance (that is 50 %- 50%) chance of fusion of either X or Y chromosome with the egg so we can say that the sex of the newborn child is a matter of chance and none of the parents is responsible for it.

Sex determination in human is shown below:



[1½]

8. The capable species with variants which can survive in a distinct environment are selected by nature. This process is called natural selection. As an example, if there is a group of red beetles which are living with crows in an area then crows can see the beetles and can feed on them. But after sometime as the variation arises , among the population of red beetle a green beetle appeared. Now these green beetle can camouflage on green leaves the crows will not be able to see them . So the green beetle survives better than the red beetles. [3]

9. (a) The Y chromosome comes from male and the other chromosome that comes from female is X. In sexual reproduction, this X chromosome also has effect on the fertilized egg. That is why the child born will not be like his father exactly. [1½]

(b) The gametes produced by Aa and Bb parent will be AB, Ab, aB and ab. It means 4 gametes will be produced. That is why the percentage of ab gamete will be 25%. This can be further understood by the following table:

	B	b
A	AB	Ab
a	aB	ab

[1½]

Topic 2: Evolution

Evolution

Evolution is the sequence of gradual changes which takes place in the primitive organisms,over millions of years,in which new species are produced.

Charles Darwin proposed that evolution of species occurred by natural selection, but he did not know the underlying mechanism.

Natural selection,genetic drift and geographical isolation can lead to speciation in sexually reproducing organisms.

Gene flow between the members of a population prevents speciation.

SPECIATION

Origin of new species from the existing one is called speciation.

KINDS OF TRAITS

(i) **Inherited traits** : These traits are controlled by specific genes and are passed on from one generation to another. Any alteration in the DNA will be passed on, through germ cells, to the progeny resulting in variations in them.

(ii) **Acquired traits** : Certain traits are acquired by organisms in their life time. For instance, decrease in the body weight of beetles due to starvation is an acquired trait by the beetles during their lifetime. It will not bring any change in the DNA. Therefore, even if some of the generations of beetles are low in weight because of starvation, this trait cannot be inherited by the progeny over generations.

Basis for classifying organisms are:

1. presence of prokaryotic or eukaryotic.
2. whether the organism is unicellular or multicellular
3. ability to perform photosynthesis
4. presence of endoskeleton or exoskeleton in heterotrophic organisms.

EVOLUTION AND CLASSIFICATION

Characteristics of organisms refer to the details of external and internal appearance or behaviour that distinguish them from one another. These characteristics of organisms also form the basis of the classification of organisms. The more characteristics two species have in common, the more closely they are related. Also, the more they are related, the more recently they will have had a common ancestor.

(a) Homologous organs

The organs, which perform different functions in different species but have similar basic structure, are called homologous organs.

Forelimbs of a frog, a lizard, a bird and human being are, therefore, homologous organs.

(b) Analogous organs

The organs, which are quite different in fundamental structure but perform same function are called analogous organs.

The wings of an insect and a bird are analogous organs.

It is so because both these organs in entirely different animals perform similar functions, i.e., they are used for flying in the air. However, they are very different in structure.

- Fossils are the remains or impressions of the dead animals and plants that lived in the remote past.

  How do we know the age of fossils?

  1. First way is relative. If we dig the earth to locate fossils, the fossils we find closer to the surface are more recent than the fossils we find in deeper layers.
  2. Second way is to date the rocks or fossils. Dating the rocks or fossils is done by working out the ratio of uranium to lead in a rock or fossil.

- Artificial selection is the process by which man selects trait(s) useful to him for improving the qualities of domesticated plants and animals.

  Humans have carried out artificial selection for various features of cabbage and produced different vegetables.

  1. Cabbage : with short distances between leaves.
  2. Broccoli : with arrested flower development.
  3. Cauliflower : with sterile flowers.
  4. Kohlrabi : with swollen parts.
  5. Kale : with larger leaves.

- Molecular phylogeny is the branch of science, which is used to trace the changes in DNA.
- **Human evolution**

  Tools for studying human evolution are:

  1. Excavating.
  2. Time dating.
  3. Studying fossils.
  4. Determining DNA sequences.
- All human beings,whether fair skinned or dark skinned,belong to the same species i.e., Homosapiens that originated in Africa.
- The human ancestors gradually migrated from Africa to various parts of the world such as Asia,Europe,Australia and America. Thus they spread to different parts of the earth.

PREVIOUS YEARS' EXAMINATION QUESTIONS

TOPIC 2

1 Mark Questions

1. What is a gene? **[TERM 2, 2014]**

2 Marks Questions

2. Describe any three ways in which individuals with a particular trait may increase in population. **[TERM 2, 2011]**

3. State the evidence we have for the origin of life from inanimate matter. **[TERM 2, 2011]**

4. What are fossils? What do they tell us about the process of evolution? **[TERM 2, 2011]**

5. List in tabular form two distinguishing features between acquired traits and inherited traits, with one example of each. **[TERM 2, 2012, 2013]**

6. How are fossils formed? Describe, in brief, two methods of determining the age of fossils. **[TERM 2, 2012]**

7. With the help of suitable examples, explain why certain traits cannot be passed on to the next generation. What are such traits called? **[TERM 2, 2014]**

8. "A trait may be inherited, but may not be expressed." Justify this statement with the help of a suitable example. **[TERM 2, 2014]**

9. An organ like a wing in birds is an advantage to the organism. Did they appear in different stages or were formed due to a single sudden change in them? **[TERM 2, 2015]**

10. "Evolution and classification of organisms are interlinked". Give reasons to justify the statement. **[TERM 2, 2017]**

5 Mark Questions

11. An angiosperm plant having red coloured flowers when crossed with the other having the same colour produced 40 progenies, out of which 30 plants were with red coloured flowers, 10 plants were with white coloured flowers. Find out:

(a) What is the possible genotype of parent plants?

(b) Which trait is dominant and recessive?

(c) What is this cross called as and what is its phenotypic ratio? **[TERM 2, 2015]**

12. Define evolution. How does it occur? Describe how fossils provide us evidences in support of evolution. **[TERM 2, 2016]**

13. With the help of one example each, distinguish between the acquired traits and the inherited traits. Why are the traits/experiences acquired during the entire lifetime of an individual not inherited in the next generation? Explain the reason of this fact with an example. **[TERM 2, 2017]**

Solutions

1. The basic functional and physical unit of heredity is called a gene. There are two copies of gene in every person, one inherited from each parent.[1]

2. The ways in which particular trait may increase in population are as follows:

(i) **Genetic Drift:** When there is some accident or disaster with some part of the population with some trait. The remaining population undergoes a genetic drift in which accumulation of particular trait of the remaining population takes place. It does not give any survival advantage but brings variation. [1]

(ii) **Natural Selection:** Organisms with certain traits are selected by nature on basis of their traits which they possess. The selection is done naturally for traits which give natural advantage for that particular species to increase its population. [1]

(iii) **Geographical Isolation:** It is caused when there is some barrier or isolation of some population of that particular species. Due to this reproductive isolation some particular trait which gets increased among that isolated population. [1]

3. Let us consider following experiments to state the evidence for the origin of life from inanimate matters.

(i) **J.B.S. Haldane** conducted an experiment in which he speculated that the conditions on earth at time of origin were far from the conditions we see today which could have given rise to more complex organic molecules that were necessary for life. [1]

(ii) In 1953 an experiment was conducted by **Stanley L. Miller and Harold C. Urey** to simulate the conditions of Earth's early atmosphere. They tried to simulate the atmosphere in a specially designed apparatus having a mixture of gases like methane, ammonia, carbon dioxide, and hydrogen sulphide over a pool of water. No oxygen gas is used in the mixture of gases. Temperature below 100°C was maintained to simulate the weather conditions. Also, to simulate the atmospheric conditions of lightning, they used electrodes and passed sparks through the mixture of gases. This experiment carried for one week and after one week it was found that in the liquid pool there were several amino acids. Also, more than 14% of carbon had been converted from methane to simple compounds of carbon. [2]

4. (i) Most of the time when organisms die, the body decomposes. But sometimes the body or some part of the body comes in an environment which does not allow the body to decompose completely. For example, if a dead mosquito gets caught in the sap of a tree, the sap will not allow the body to decompose quickly. The sap will harden before the complete decomposition of the body. Also, the hardened sap will retain the impressions of the body parts of the mosquito. These retained and preserved impressions of living organisms are known as fossils. [1½]

(ii) The process of evolution can be studied using these fossils. It can be said that a common ancestral design evolved in very dissimilar looking structures. Fossils also allow us to analyze the organ structure and to make a guess of how far back evolutionary relationships go. How simple structure turned into a complex structure. Further telling us, how these species are related and evolved in different phases. [1½]

5.

Acquired traits	Inherited traits
Traits which are experienced by an individual during his lifetime.	Traits or qualities which an individual acquires from ancestors.
Do not bring changes in the DNA.	Bring changes in the DNA.
Cannot undergo direct evolution.	Can undergo direct evolution.
Cannot be passed on to the progeny.	Can be passed on the progeny.
For example: Cut marks, low weight etc	For example: height, eye, skin color etc.

[3]

6. Fossils are formed in the following way:

Usually, when the organisms die, their bodies decompose, but sometimes the body or at least some parts may be trapped in an environment that does not let it decompose completely and eventually harden and retains the impression of the body parts. All such preserved traces of living organisms form fossils. [1]

The age of the fossil can be determined:

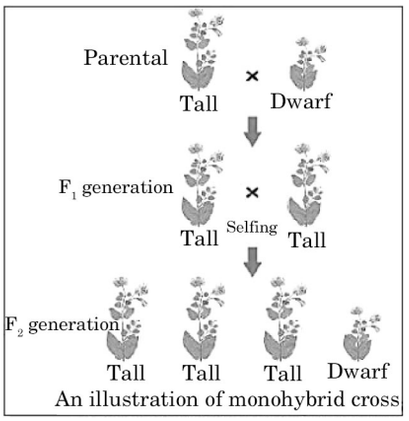
(i) By determining the layer in which the fossil is found. The fossils which we find closer to the surface are comparatively more recent than those we find in deeper layers.

(ii) Other method to determine the age of fossil is Radio-carbon dating

(iii) Detecting the ratios of different isotopes of the same material. [2]

7. Some traits are acquired during the lifetime of a person. There is no change in the reproductive cells of a person by these traits, that's why they are not inherited to the next generation. For example, if we cut the tail of rat and then allow it to reproduce, then the next generation will have a tail, as this change is acquired by the rat will not follow to its next generation. As human acquire changes like learning skills i.e. swimming, dancing, cooking but these changes will not pass on to next generation. These types of traits are called acquired traits. [3]

8. When a short plant was crossed with a tall plant, it was observed that the first (F_1) generation plants were all tall.



An illustration of monohybrid cross

[1½]

Now when the First (F_1) generation plants were crossed, not every second (F_2) generation plants were tall. Some of them were tall and some of them were short, as the character of dwarfness which was hidden, came into existence.

This shows that a trait may be inherited but it may not be expressed. [1½]

9. The wings in birds do not form due to a single sudden change in them. In fact, they appear in different stages of evolution. They first appeared in dinosaurs but they did not use them to fly instead they were used to keep them warm. But later as a result of evolution, they evolved as birds and started using those wings to fly. [3]

10. Evolution among living organisms is the slow and sustained change in the characteristic traits over a long period of time that causes the formation of evolved features in the newer species. The life forms which still exist, have gone through the process of evolution to adapt to the changes in surroundings for survival. [1½]

Classification deals with the grouping of species based on the similarity or differences. The species having similar characteristic features are classified in one group which helps us to link them to their pre-existing ancestral species. This is done by tracing the evolutionary relationship between organisms in the same group of classification.

Thus, classification and evolution of organisms are interlinked. [1½]

11. (a) Possible genotype of parent plants is heterozygous with a dominant allele of red colour. The dominant is the red flower which is represented by R and the recessive one is the white coloured flower represented by r. [1]

(b) The dominant is red coloured trait and recessive is white colour trait. [1]

(c) The result of the cross section is

RR, RR, Rr and rr [1]

Every offspring with R will have the colour red and the one with small r R will be white. [1]

Hence the percentage of red is 75% and the white is 25% . That means for every 4 offspring 3 offspring will be red and 1 will be while

So the phenotypic ratio is 75:25 or 3:1 [1]

12. Over successive generation, the change in the heritable traits of biological populations is called evolution. The continued mutation of natural selection is the cause of evolution. The gradual change in phenotype with respect to shape and size indicates adaptation with changing environmental condition. [2½]

Fossils are the remains or pre-historic plant or animal embedded in rock. They are preserved in petrified form. The present plants and animals have originated from the existing ones which is a clear evidence of evolution. For example: Fossils of Archaeopetryx shows the characteristics of both reptiles and birds. [2½]

13. Acquired traits are the traits which develop in the response to the environment and cannot be inherited. They are acquired due to changes in lifestyle and happen in the somatic cells. For Example: A person learns to swim or cook. [1]

Inherited traits are those traits that are inherited from the previous generations. They are transferred from one generation to another because these traits are present in the genetic material or DNA of a human being. For example: A child having same eye colour or hair colour as that of parent. [2]

Acquired traits do not get inherited in the next generation as they do not bring any change in the DNA or the genetic material of human cells as they happen in the somatic cells that don't affect the reproducing cells. For example: Starving beetles or surgical removal of tail in mice. [2]

Smart Notes .....

CHAPTER 10

Light-Reflection and Refraction

Chapter Analysis with respect to Last 3 Years' Board Exams

List of Topics	**2016**	**2017**	**2018**
Reflection of light at curved surfaces, Images formed by spherical mirrors, centre of curvature, principal axis, principal focus, focal length, mirror formula, magnification	1Q (2 marks), 1Q (2 marks), 1Q (5 marks)	3Q (1 mark), 1Q (3 marks)	1Q (5 marks)
Refraction: laws of refraction, refractive index	2Q (1 mark), 1Q (3 marks)	1Q (2 marks)	1Q (2 marks)
Refraction of light by spherical lens, Image formed by spherical lenses, Lens formula, Magnification, Power of a lens.	1Q (1 mark), 1Q (3 marks)	1Q (2 marks), 1Q (5 marks)	1Q (1 mark)

On the basis of above analysis, it can be said that from exam point of view applications of spherical mirrors and lenses, reflection and refraction concepts are the most important topic of the chapter. This is important chapter of the subject most.

Topic 1: Reflection of Light, Image formed by Spherical Mirrors

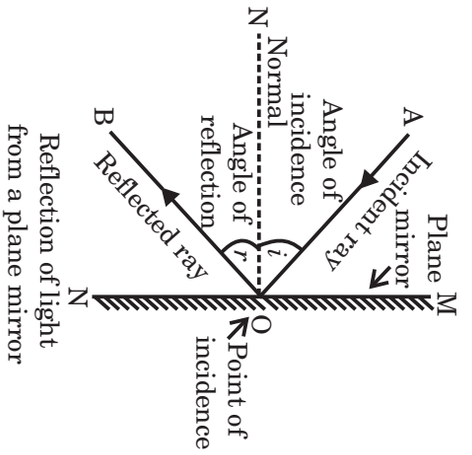
Summary

Knowing your Chapter at Glance:

- Light is a form of energy that produces in us the sensation of sight.

Properties of light

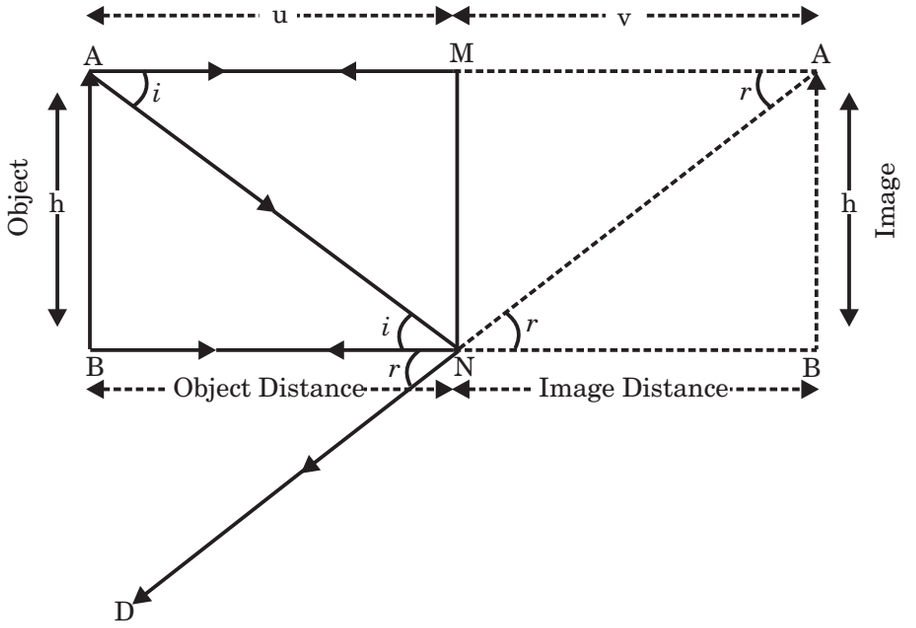
- It's an electromagnetic wave, so does not require any medium to travel.
- Light tends to travel in straight line.
- Light has dual nature: Wave and Particle nature.
- Light casts a shadow.
- Speed of light is maximum in vacuum and its vacuum is 3×10^8.
- When light falls on a surface, following may happen
  1. Reflection
  2. Refraction
  3. Absorption
- A ray of light is the straight line path along which light travels. It is represented by an arrow head, on a straight line ($\underset{\text{(Ray)}}{\longrightarrow}$).
- A group of parallel rays is called a beam of light.
- Reflection of light is the phenomenon of bouncing back of light in the same medium on striking the surface of any object.
- The two laws of reflection are :
  (i) the incident ray, the reflected ray and the normal (at the point of incidence), all lie in the same plane.
  (ii) the angle of reflection (r) is always equal to the angle of incidence (i) $\angle r = \angle i$



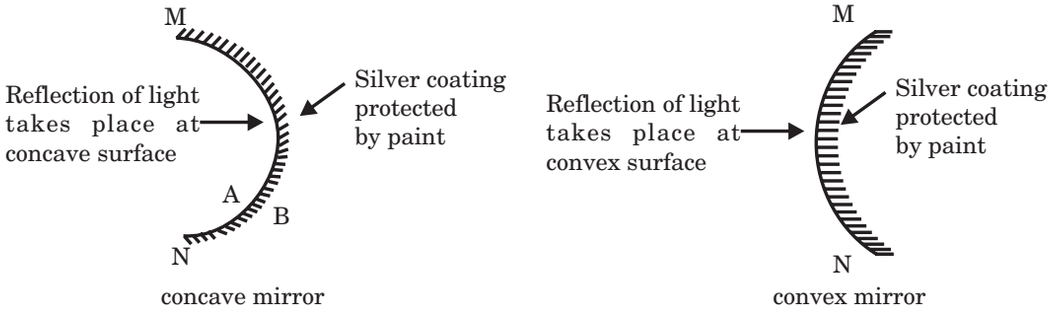
Real image	Virtual image
The real image is formed due to real intersection of reflected or refracted rays.	The virtual image is formed due to apparent intersection of reflected or refracted light rays.
Real images can be obtained on screen.	Virtual images can't be obtained on screen.
Inverted	Erect
e.g. the images formed on a cinema screen are real images.	e.g. The image of our face in a plane mirror is a virtual image

CHARACTERISTICS OF IMAGE FORMED BY PLANE MIRRORS

- Virtual and erect
- Size of image is equal to the size of object
- The image distance is equal to the object distance.
- Laterally inverted.



- A spherical mirror whose reflecting surface is curved inwards and polished on the outer spherical surface is called concave mirror.
- A spherical mirror whose refletcting surface is curved outwards and polished on the inner spherical surface is convex mirror.



DIFFERENTIATING BETWEEN PLANE, CONVEX AND CONCAVE MIRROR

1. If the image formed is erect and of the same size then it is a plane mirror.
2. If the image formed is erect but smaller in size then it is a convex mirror.
3. If the image is erect but magnified when mirror is close to the object then it is a convex mirror.

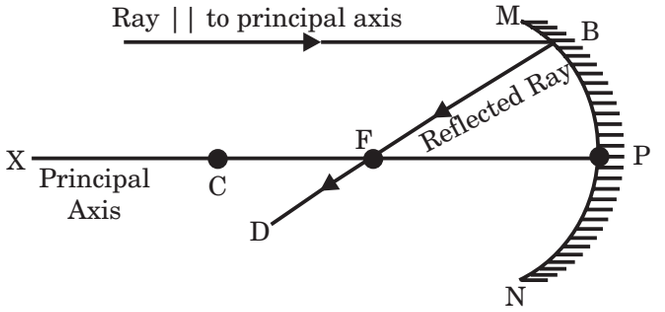
The important terms related to spherical mirrors are -

- The centre of curvature of a spherical mirror is the centre of the imaginary hollow sphere of glass, of which the spherical mirror is a part. It is denoted by 'C'.
- The radius of curvature of a spherical mirror is the radius of the imaginary hollow sphere of glass, of which the spherical mirror is a part. It is denoted by the letter 'R'.
- The centre of the reflecting surface of a spherical mirror is called its pole. It is usually denoted by the letter 'P' .
- The principal axis of a spherical mirror is the straight line passing through the centre of curvature C and pole P of a spherical mirror, produced on both sides.
- The aperture of a spherical mirror is denoted by the diameter of its reflecting surface.

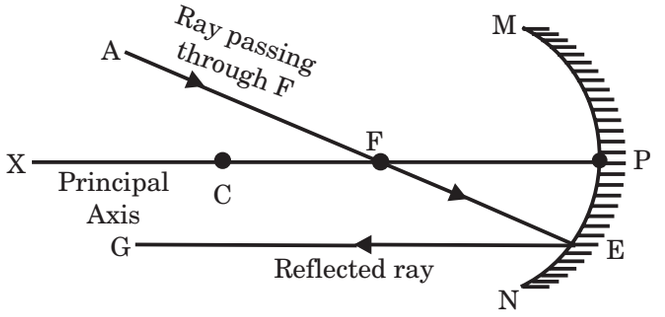
$$f = \frac{R}{2} \Rightarrow R = 2f$$

RULES FOR TRACING IMAGES FORMED BY CONCAVE MIRRORS

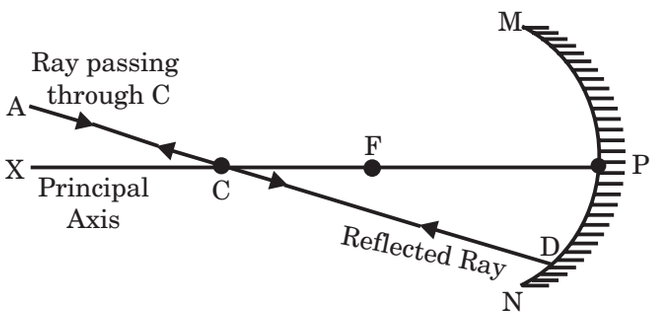
1. A ray parallel to the principal axis will pass through the principal focus,after reflection.



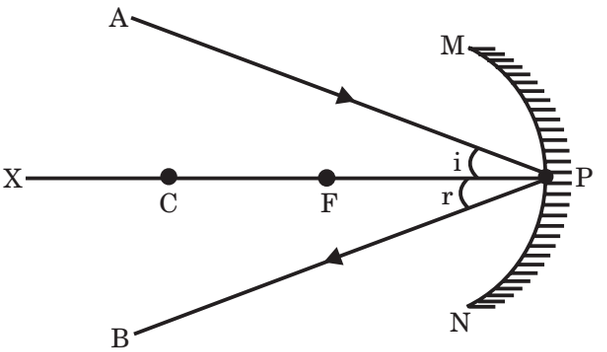
2. A ray passing through the principal focus of concave mirror will emerge parallel to principal axis after reflection.



3. A ray of light passing through the centre of curvature of a concave mirror is reflected back along the same path.



4. A ray incident obliquely to the principal axis of a concave mirror is reflected obliquely making equal angles.



According to New Cartesian Sign Convention, for spherical mirror.

(i) All distances are measured from the pole of the spherical mirror.

(ii) The distances measured in the direction of incidence of light are taken as positive and vice-versa.

(iii) The heights above the principal axis of the mirror are taken as positive and vice-versa.

Images formed by concave and convex mirror at different positions of the object

Lens	Object position	Image position	Image size	Nature of image
CONVEX	At infinity	At focus F	Highly diminished, point sized	Real and inverted
	Beyond C	Between F and C	Diminished	Real and inverted
	At C	At C	Same size	Real and inverted
	Between F and C	Beyond C	Enlarged	Real and inverted
	At focus F	At infinity	Highly enlarged	Real and inverted
	Between focus F and optical centre O	On the same side of the lens as the object	Enlarged	Virtual and erect
CONCAVE	At infinity	At focus F	Highly diminished, point sized	Virtual and erect
	Between infinity and optical centre O of the lens	Between focus F and optical centre O	Diminished	Virtual and erect

- **Mirror Formula**

  The relationship between the image distance (v), object distance (u) and focal length (f) of a spherical mirror is known as the mirror formula.

$$\boxed{\frac{1}{v}+\frac{1}{u}=\frac{1}{f}}$$

- **Linear Magnification**

  It is the ratio of the height of image to the height of the object

$$\text{linear magnification (m)} = \frac{\text{height of the image (h')}}{\text{height of the object (h)}}$$

$$\boxed{m=\frac{h'}{h}=-\frac{v}{u}}$$

- In case of a concave mirror, for the real and inverted images the magnification is always -ve. and for the virtual and erect images the magnification is always +ve.
- In case of a convex mirror, which always forms virtual and erect image, the magnification is always +ve.
- Magnification of plane mirror is always +1.

FOR SPHERICAL MIRRORS IF THE

(i) Linear magnification, $m > 1$, the image is enlarged

(ii) Linear magnification, $m = 1$, the image is of the same size as the object.

(iii) Linear magnification, $m < 1$, the image is diminished

PREVIOUS YEARS' EXAMINATION QUESTIONS

TOPIC 1

1 Mark Questions

1. A student has obtained an image of a well-illuminated distant object on a screen to determine the focal length, F_1 of the given spherical mirror. The teacher then gave him another mirror of focal length, F_2 and asked him to obtain a focused image of the same object on the same screen. The student found that in order to focus the same object using the second mirror, he has to move the mirror away from the screen. From this observation it may be concluded that both the spherical mirrors given to the student were (select the correct option)

(a) Concave and $F_1 < F_2$

(b) Concave and $F_1 > F_2$

(c) Convex and $F_1 < F_2$

(d) Convex and $F_1 > F_2$

[TERM 2, 2014]

2. If the image formed by a spherical mirror for all positions of the object placed in front of it is always small and diminished, what type of mirror is it? Draw a labeled ray diagram to support your answer.

[TERM 2, 2018]

2 Marks Question

3. "The magnification produced by a spherical mirror is -3". List four information you obtain from this statement about the mirror/image.

[TERM 2, 2016]

5 Marks Question

4. List the new Cartesian sign convention for reflection of light by spherical mirrors. Draw a diagram and apply these conventions for calculating the focal length and nature of a spherical mirror which forms a 1/3 times magnified virtual image of an object placed 18 cm in front of it.

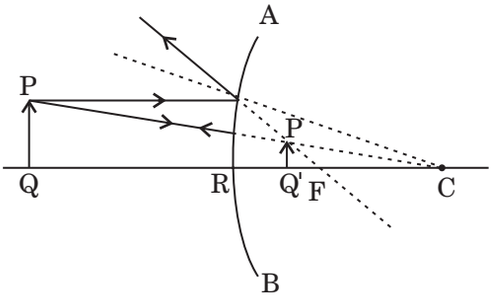
[TERM 2, 2012]

Solutions

1. Both the mirrors have to be concave as the light is converged and focused on the screen from a distant object. Since, the second mirror is moved farther $F_1 < F_2$. [1]

So, the correct option (A) Concave and $F_1 > F_2$.

2. Convex mirror gives small and diminished image.



[½]

Here the object is PQ and the small and diminished image formed by the convex mirror is P'Q'. [½]

3. Magnification = –3

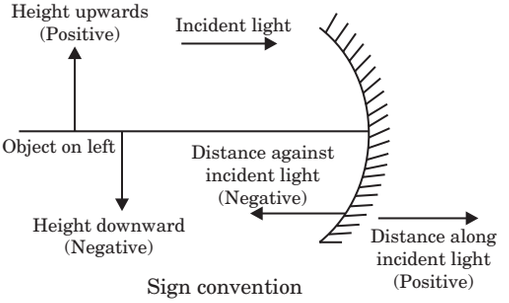
The information obtained is as follows:

Mirror: Concave

Image: Real, Inverted and Magnified. [2]

4. The new Cartesian signs for reflection of light are as follows:

1. The object is placed on to the left mirror side. That is the incident light falls on the object from the left side. [½]
2. All the distance parallel to principal axis is measured from the pole of mirror. [½]
3. All the distances which are measured to the right of the origin (along +x axis) is taken as positive whereas those measured to the left of the origin (along (-)ve x axis) is taken as negative. [½]
4. The distance being measured which is perpendicular to and above principal axis(+y axis) is always being taken as positive. [½]
5. The distance being measured which is perpendicular to and below principal axis ((-)ve y-axis) is taken to be negative. [½]



Sign convention [½]

Given magnification, $m = \frac{1}{3}$

Object distance, $u = -18$cm

We need to calculate the focal length (f) and the image distance (v).

$$m = \frac{v}{u} = \frac{1}{3}$$

According to the formula,

$$\frac{1}{v} + \frac{1}{u} = \frac{1}{f}$$

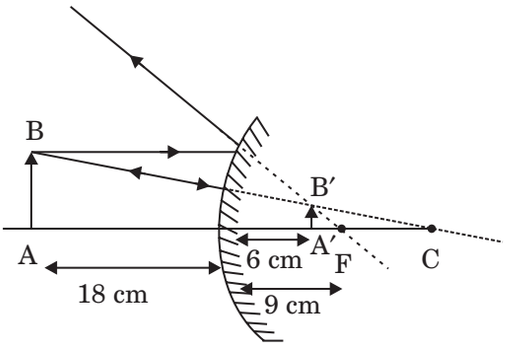
$$\Rightarrow \frac{1}{6} + \frac{1}{-18} = \frac{1}{f}$$

$$\Rightarrow \frac{1}{f} = \frac{2}{18}$$

$f = 9$ cm

As the focal length is positive, it is a convex mirror. [1]

Ray diagram is as follows:



[1]

Topic 2: Refraction, Lenses, Power of Lens

Summary

REFRACTION OF LIGHT

- The phenomenon of bending of light from its original path on passing from one medium to another is known as refraction.

CAUSE OF REFRACTION

- The light travels with different speeds in different media. Therefore when light goes from one medium to another, its speed changes. This change in speed of light on going from one medium to another causes the refraction of light.
- When a ray of light passes from a rarer to a denser medium,it bends towards the normal.
- When a ray of light passes from a denser to a rarer medium, it bends away from the normal.

LAWS OF REFRACTION

1. The incident ray, the refracted ray and the normal to the interface of two transparent media at the point of incidence, all lie in the same plane.
2. The ratio of sine of angle of incidence to the sine of angle of refraction is a constant, for the light of a given colour (wavelength) and for the given pair of media. This law is also known as Snell's law of refraction.

$$\frac{\sin i}{\sin r} = \text{constant}$$

where i = angle of incidence

r = angle of refraction

This constant value is called the refractive index of the second medium with respect to the first.

$$\text{Absolute Refractive Index of a medium} = \frac{\text{speed of light in air (or vacuum)}}{\text{Speed of light in medium}}$$

$$\boxed{n_m = \frac{c}{v}}$$

Relative refractive index of medium 2 with respect to medium 1

$$= \frac{\text{Speed of light in medium 1 (other than vacuum or air)}}{\text{Speed of light in medium 2}}$$

$$\boxed{n_{21} = \frac{v_1}{v_2}}$$

Where n_{21} = Relative refractive index of medium 2 with respect to medium 1.

v_1 = Speed of light in medium 1.

v_2 = Speed of light in medium 2.

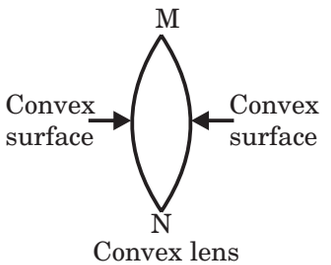
$$\boxed{n_{12} = \frac{v_2}{v_1}}$$

$$\boxed{n_{21} = \frac{1}{v_{12}}}$$

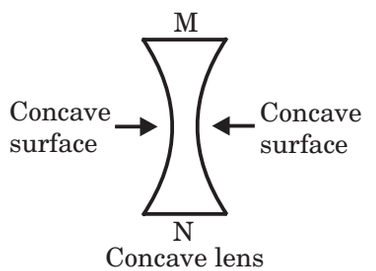
OPTICAL DENSITY VS. MASS DENSITY

Optical density of a substance is different from its mass density. A medium (substance) may have higher optical density than another medium (substance) but its mass density may be less. For example oils (kerosene, mustard etc.) having higher refractive index has a higher optical density than water which has a lower refractive index, but the mass density of oils (Kerosene, mustard etc.) is less than that of water. That is why the oils generally float on the water surface.

Lens



Convex lens



Concave lens

Images formed by concave and convex lenses at different postions of the object

Lens	Object position	Image position	Image size	Nature of image
CONVEX	At infinity	At focus F_2	Highly diminished, point sized	Real and inverted
	Beyond $2F_1$	Between F_2 and $2F_2$	Diminished	Real and inverted
	At $2F_1$	At $2F_2$	Same size	Real and inverted
	Between F_1 and $2F_1$	Beyond $2F_2$	Enlarged	Real and inverted
	At focus F_1	At infinity	Highly enlarged	Real and inverted
	Between focus $F_1$and optical centre O	On the same side of the lens as the object	Enlarged	Virtual and erect

C O N C A V E	At infinity	At focus F_1	Highly diminished, point sized	Virtual and erect
	Between infinity and optical centre O of the lens	Between focus F_1 and optical centre O	Diminished	Virtual and erect

LENS FORMULA

The relationship between the image distance (v), object distance (u) and focal length (f) of a spherical lens is known as the lens formula.

$$\boxed{\frac{1}{v} - \frac{1}{u} = \frac{1}{f}}$$

Linear magnification, $\boxed{m = \frac{h'}{h} = \frac{v}{u}}$

(i) A concave Lens always forms an image smaller than the object. Therefore linear magnification (m) of a concave lens is less than one.

(ii) A convex lens forms an image

(a) equal in size to the object (i.e. m = 1)

(b) less than the size of the object (i.e. m<1) (iii) more than the size of the object (i.e. m > 1). Therefore linear magnification of a convex lens can be one, less than one or more than one.

Power

The power of a lens is the degree of convergence or divergence of light rays achieved by a lens.

$$\boxed{P = \frac{1}{f(\text{in meters})}}$$

where P = power of a lens

and f = focal length of the lens in meters.

The S.I. unit of power is dioptre. It is denoted by the letter 'D'.

One dioptre is the power of a lens whose focal length is 1 metre.

Power of a combination of lenses

$$\boxed{P = p_1 + p_2 + p_3 + ...}$$

Where P = power of combination of lenses.

$p_1, p_2, p_3, \ldots\ldots\ldots\ldots\ldots$ = Powers of individual lens placed close to each other.

- A convex lens has positive focal length so the power of a convex lens is positive.

- A concave lens has a negative focal length, so the power of a concave lens is negative.

PREVIOUS YEARS' EXAMINATION QUESTIONS TOPIC 2

1 Mark Questions

1. To find the focal length of a concave mirror, Sita should choose which one of the following set-ups?
(a) mirror holder and a screen holder
(b) A screen holder and a scale
(c) A mirror holder, a screen holder and a scale
(d) A screen, a mirror, holders for them and a scale

[TERM 2, 2011]

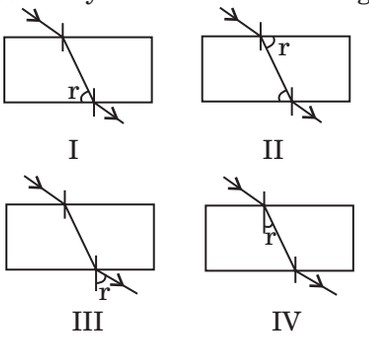
2. By using a convex lens, a student obtained a sharp image of his class-room window grill on a screen. In which direction should he move the lens to focus a distant tree instead of the grill?
(a) Towards the screen
(b) Away from the screen
(c) Very far away from the screen
(d) Behind the screen

[TERM 2, 2011]

3. To determine the focal length of a convex lens by obtaining a sharp image of a distant object, the following steps were suggested which are not in proper sequence
I. Hold the lens between the object and the screen.
II. Adjust the position of the lens to form a sharp image.
III. Select a suitable distant object.
IV. Measure the distance between the lens and the screen.
The correct sequence of steps to determine the focal length of the lens is
(a) III, I, II, IV
(b) III, IV, II, I
(c) III, I, IV, II
(d) I, II, III, IV

[TERM 2, 2011]

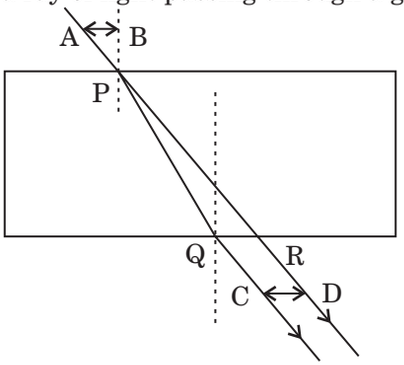
4. In these diagrams, the angle of refraction r has been correctly marked in which diagram?



(a) I
(b) II
(c) III
(d) IV

[TERM 2, 2011]

5. For a ray of light passing through a glass slab

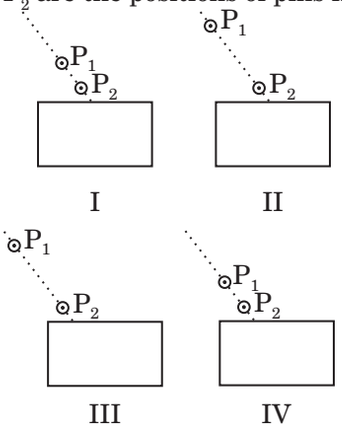


the lateral displacement was correctly measured as
(a) AB
(b) PQ
(c) CD
(d) PR **[TERM 2, 2011]**

6. If you are to determine the focal length of a convex lens, you should have
(a) a convex lens and a screen
(b) a convex lens and a lens holder
(*c*) a lens holder, a screen holder and a scale
(*d*) a convex lens, a screen, holders for them and a scale

[TERM 2, 2012]

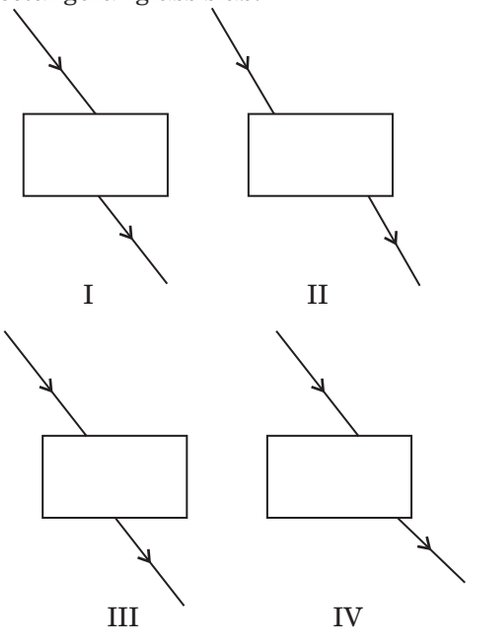
7. While performing the experiment on tracing the path of a ray of light through a rectangular glass slab, in which of the following experimental set-ups is a student likely to get best results?
P_1 and P_2 are the positions of pins fixed by him.



(a) I
(b) II
(c) III
(d) IV

[TERM 2, 2012, 2013]

8. Four students showed the following traces of the path of a ray of light passing through a rectangular glass slab.

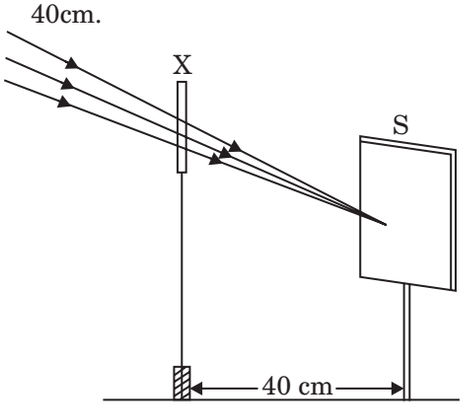


The trace most likely to be correct is that of student

(a) I
(b) II
(c) III
(d) IV **[TERM 2, 2012]**

9. The student focused the image of a distant object using a device 'X' on a white screen 'S' as shown in the figure. If the distance of the screen from the device is 40cm. Select the correct statement about the device.

(a) The device X is a convex lens of focal length 20cm.
(b) The device X is a concave mirror of focal length 40cm.
(c) The device X is a concave mirror of radius of curvature 40cm.
(d) The device X is a convex lens of focal length 40cm.



[TERM 2, 2012, 2013, 2014]

10. A student obtained a sharp image of a burning candle, placed at the farther end of a laboratory table, on a screen using a concave mirror. For getting better value of focal length of the mirror, the subject teacher suggested him for focusing a well illuminated distant object. What should the student do?

(a) He should move the mirror away from the screen
(b) He should move the mirror slightly towards the screen
(c) He should move the mirror as well as the screen towards the newly selected object
(d) He should move only the screen towards the newly selected object.

[TERM 2, 2012, 2013]

11. After tracing the path of rays of light through a glass slab for three different angles of incidence, a student measured the corresponding values angle of refraction r and angle of emergence e and recorded them in the table given below:

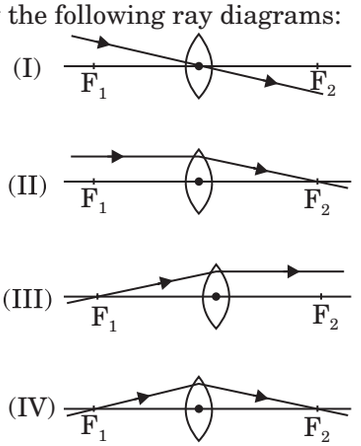
S.No	$\angle i$	$\angle r$	$\angle e$
I	30°	20°	31°
II	40°	25°	40°
III	50°	31°	49°

The correct observations are:

(a) I and II
(b) II and III
(c) I and III
(d) I, II and III

[TERM 2, 2013]

12. Study the following ray diagrams:

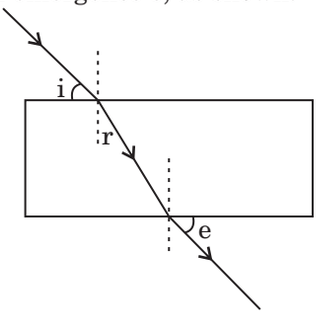


The diagrams showing the correct path of the ray after passing through the lens are:

(a) II and III only
(b) I and II only
(c) I, II and III
(d) I, II and IV

[TERM 2, 2012, 2013]

13. A student traces the path of a ray of light passing through a rectangular glass slab and marks the angle of incidence i, angle of refraction r and angle of emergence e, as shown.



The correctly marked angle(s) is/are
(a) $\angle i$ only
(b) $\angle e$ only
(c) $\angle r$ only
(d) $\angle i$ and $\angle e$

[TERM 2, 2014]

14. A student is using a convex lens of focal length 10*cm* to study the image formation by a convex lens for the various positions of the object. In one of his observations, he may observe that when the object is placed at a distance of 20*cm* from the lens, its image is formed at (select the correct option)
(a) 20*cm* on the other side of the lens and is of the same size, real and erect
(b) 40*cm* on the other side of the lens and is magnified, real and inverted
(c) 20 *cm* on the other side of the lens and is of the same size, real and inverted
(d) 20 *cm* on the other side of the lens and is of the same size, virtual and erect

[TERM 2, 2014]

15. Three students A, B and C followed the procedure given below to find the focal length of a convex lens by measuring the image distance.
A: Kept the lens as well as screen on a horizontal stand and adjusted them to get a sharp image of a distant object.
B: Kept the lens on a stand and held the screen in hand for a sharp image.
C: Kept the lens in hand and moved it to get a sharp focus.
Student (s) performing the experiment most precisely is/are
(a) A
(b) B
(c) C
(d) B and C

[TERM 2, 2015]

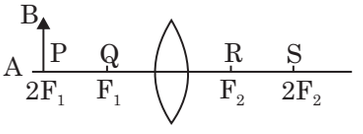
16. Three students X, Y and Z are finding the focal length of the given concave mirror by obtaining the image of the object selected by them. X obtains the image of the grill of the nearest window of the laboratory. Y obtains the image of a white painted building near the laboratory and Z obtains a point size image of the sun. The most correct value of the focal length is obtained by:
(a) X
(b) Y
(c) Z
(d) X and Y Both

[TERM 2, 2015]

17. In the experiment to trace the path of a ray of light through a rectangular glass slab, four students A,B, C and D fixed the pins P3 and P4 in the following manner :
(A) Looked at heads of P1 and P2 while placing P3 and heads of P1, P2 and P3 while placing P4
(B) Looked at feet of P1 and P2 while placing P3 and feet of P1, P2 and P3 while placing P4
(C) Looked at heads of P1 and P2 while placing P3 and feet of all the pins while placing P4
(D) Looked at feet of P1 and P2 while placing P3 and heads of all the pins placing P4
The correct procedure is that of student:
(a) (A)
(b) (B)
(c) (C)
(d) (D)

[TERM 2, 2015]

18. Observe the given ray diagram and answer the following questions:



(a) Complete the ray diagram for image formation by a convex lens.
(b) Mention the size and nature of image formed in above case

[TERM 2, 2015]

19. Suppose you have focused on a screen the image of candle flame placed at the farthest end of the laboratory table using a convex lens. If your teacher suggests you to focus the parallel rays of the sun, reaching your laboratory table, on the same screen, what you are expected to do is to move the:
(a) lens slightly towards the screen
(b) lens slightly away from the screen

(c) lens slightly towards the sun
(d) lens and screen both towards the sun

[TERM 2, 2016]

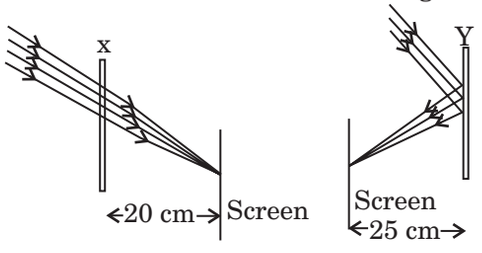
20. To determine the approximate value of the focal length of a given concave mirror, you focus the image of a distant object formed by the mirror on a screen. The image obtained on the screen, as compared to the object is always:
(a) Laterally inverted and diminished
(b) Inverted and diminished
(c) Erect and diminished
(d) Erect and highly diminished

[TERM 2, 2016]

21. In your laboratory you trace the path of light rays through a glass slab for different values of angle of incidence ($\angle i$) and in each case measure the values of the corresponding angle of refraction ($\angle r$) and angle of emergence ($\angle e$). On the basis of your observations your correct conclusion is:
(a) ($\angle i$) is more than ($\angle r$), but nearly equal to ($\angle e$)
(b) ($\angle i$) is less than ($\angle r$), but nearly equal to ($\angle e$)
(c) ($\angle i$) is more than ($\angle e$), but nearly equal to ($\angle r$)
(d) ($\angle i$) is less than ($\angle e$), but nearly equal to ($\angle r$)

[TERM 2, 2016, 2017]

22. Study the given ray diagrams and select the correct statement from the following:



(a) Device X is a concave mirror and device Y is a convex lens, whose focal lengths are 20cm and 25cm respectively.
(b) Device X is a convex lens and device Y is a concave mirror, whose focal lengths are 10cm and 25cm respectively.
(c) Device X is a concave lens and device Y is a convex mirror, whose focal lengths are 20cm and 25cm respectively.
(d) Device X is a convex lens and device Y is a concave mirror, whose focal lengths are 20cm and 25 cm respectively.

[TERM 2, 2017]

23. A student obtains a blurred image of a distant object on a screen using a convex lens. To obtain a distinct image on the screen he should move the lens,
(a) Away from the screen
(b) Towards the screen
(c) To a positive very far away from the screen
(d) Either towards or away from the screen depending upon the position of the object.

[TERM 2, 2017]

2 Mark Questions

24. State any four characteristics of the image of an object formed by a plane mirror.

[TERM 2, 2011]

25. To construct ray diagram we use two light rays which are so chosen that it is easy to know their directions after reflection from the mirror. List these two rays and state the path of these rays after reflection. Use these rays to locate the image of an object placed between centre of curvature and focus of a concave mirror.

[TERM 2, 2012]

26. "A ray of light incident on a rectangular glass slab immersed in any medium emerges parallel to itself". Draw labeled ray diagram to justify the statement.

[TERM 2, 2012, 2013]

27. List two possible ways in which a concave mirror can produce a magnified image of an object placed in front of it. State the difference, if any, between these two images.

[TERM 2, 2014]

28. Briefly describe an activity to find approximate focal length of a convex lens

[TERM 2, 2015]

29. An object of height 2.5 cm is placed at a distance of 15 cm from the optical centre 'O' of a convex lens of focal length 10 cm. Draw a ray diagram to find the position and size of the image formed. Mark optical centre 'O', principal focus F and height of the image on the diagram.

[TERM 2, 2016]

30. A student focuses the image of a candle flame, placed at about 2m from a convex lens of focal length 10 cm, on a screen. After that he moves gradually the flame towards the lens and each time focuses its image on the screen,
(a) In which direction does he move the lens to focus the flame on the screen?
(b) What happens to the size of the image of the flame formed on the screen?

(c) What difference is seen in the intensity (brightness) of the image of the flame on the screen?
(d) What is seen on the screen when the flame is very close (at about 5 cm) to the lens?
[TERM 2, 2017]

31. What is meant by power of lens? Write its SI unit. A student uses a lens of focal length 40 cm and another of -20cm. Write the nature and power of each lens.
[TERM 2, 2017]

32. State the laws of refraction of light. Explain the term 'absolute refractive index of a medium' and write an expression to relate it with the speed of light in vacuum. **[TERM 2, 2018]**

3 Mark Questions

33. An object is placed between infinity and the pole of a convex mirror. Draw a ray diagram and also state the position, the relative size and the nature of the image formed.
[TERM 2, 2011]

34. What is the principle of reversibility of light? Show that the incident ray of light is parallel to the emergent ray of light when light falls obliquely on a side of a rectangular glass slab
[TERM 2, 2011]

35. State the types of mirrors used for (i) headlights and (ii) rear view mirror in cars and motorcycles. Give reason to justify your answer in each case.
[TERM 2, 2012, 2013]

36. A 4 cm tall object is placed perpendicular to the principal axis of a convex lens of focal length 24 cm. The distance of the object from the lens is 16 cm. Find the position, size and nature of the image formed, using the lens formula
[TERM 2, 2012]

37. An object of height 6 cm is placed perpendicular to the principal axis of a concave lens of focal length 5 cm. Use lens formula to determine the position, size and nature of the image if the distance of the object from the lens is 10 cm.
[TERM 2, 2013]

38. A student wants to project the image of a candle flame on a screen 60 cm in front of a mirror by keeping the flame at a distance of 15 cm from its pole.
(a) Write the type of mirror he should use.
(b) Find the linear magnification of the image produced.
(c) What is the distance between the object and its image?
(d) Draw a ray diagram to show the image formation in this case. **[TERM 2, 2014]**

39. Draw a ray diagram to show the path of the refracted ray in each of the following cases:
A ray of light incident on a concave lens is
(i) passing through its optical centre.
(ii) parallel to its principal axis.
(iii) directed towards its principal focus.
[TERM 2, 2014]

40. A convex lens has to be used to produce a real, inverted and magnified image of a given object. Where the object should be placed with respect to the lens? Draw the corresponding ray diagram. Also draw the corresponding ray diagram if a concave mirror were to be used in place of the convex lens for producing the same kind of image. State the formulae relating the object and the image distances in the two cases.
[TERM 2, 2015]

41. The image of an object formed by a lens is of magnification –1. If the distance between the object and its image is 60cm, what is the focal length of the lens? If the object is moved 20 cm towards the lens, where would the image be formed? State reason and also draw a ray diagram in support of your answer.
[TERM 2, 2016]

42. (a) A divergent lens has a focal length of At what distance should an object of height from the optical centre of the lens be placed so that its image is formed away from the lens? Find the size of the image also.
(b) Draw a ray diagram to show the formation of image in the above situation.
[TERM 2, 2016]

43. If the image formed by a lens for all positions of an object placed in front of it is always erect and diminished, what is the nature of this lens? Draw a ray diagram to justify your answer. If the numerical value of the power of this lens is 10D, what is its focal length in the Cartesian system?
[TERM 2, 2017]

5 Mark Questions

44. (a) What is meant by 'power of a lens'?
(b) State and define the S.I. unit of power of a lens.
(c) A convex lens of focal length 25 cm and a concave lens of focal length 10 cm are placed in close contact with each other. Calculate the lens power of this combination.
[TERM 2, 2011]

45. (a) Draw a ray diagram to show the formation of image of an object placed between infinity and the optical centre of a concave lens.

(b) A concave lens of focal length 15 cm forms an image 10 cm from the lens. Calculate
(i) the distance of the object from the lens
(ii) the magnification for the image formed
(iii) the nature of the image formed

[TERM 2, 2011]

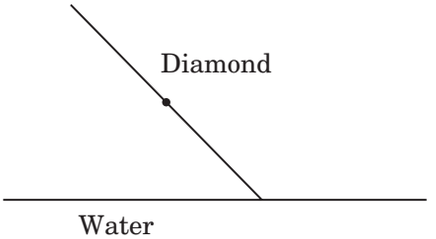
46. With the help of a ray diagram, state what is meant by refraction of light. State Snell's law for refraction of light and also express it mathematically. The refractive index of air with respect to glass is 2/3 and the refractive index of water with respect to air is 4/3. If the speed of light in glass is 2×10^8m/s, find the speed of light in (a) air, (b) water.

[TERM 2, 2012, 2013]

47. (a) Explain the following terms related to spherical lenses:
(i) optical centre
(ii) centres of curvature
(iii) principal axis
(iv) aperture
(v) principal focus
(vi) focal length
(b) A converging lens has focal length of 12 cm. Calculate at what distance should the object be placed from the lens so that it forms an image at 48 cm on the other side of the lens.

[TERM 2, 2014]

48. (a) Differentiate between reflection and refraction.
(b) A ray of light is incident on the interface separating diamond and water. Given that the refractive index of diamond and water with respect to air are 2.42 and 1.33 respectively. Complete the diagram by showing refracted ray and mark angles of incidence and refraction.



(c) Calculate speed of light in water (given that velocity of light in air is $3 \times 10^8 ms^{-1}$).

[TERM 2, 2015]

49. (a) What is meant by power of lens? Give its S.I. unit. When two or more lenses are placed in contact what will be their combined power?
(b) What is meant by power of accommodation of the eye? State the role of ciliary muscles in achieving it.
(c) A person suffering from an eye-defect uses lenses of power –1D. Name the defect he is suffering from and the nature of lens used.

[TERM 2, 2015]

50. It is desired to obtain an erect image of an object, using concave mirror of focal length of 12cm.

[TERM 2, 2016]

51. (a) If the image formed by a mirror for all positions of the object is placed in front of it is always diminished, erect and virtual, state the type of the mirror and also draw a ray diagram to justify your answer. Write one use such mirrors are put to and why.
(b) Define the radius of curvature of spherical mirrors. Find the nature and focal length of a spherical mirror whose radius of curvature is +24cm.

[TERM 2, 2017]

52. An object of height 4.0 cm is placed at a distance of 30 cm from the optical centre 'O' of a convex lens of focal length 20 cm. Draw a ray diagram to find the position and size of the image formed. Mark optical centre 'O' and principal focus 'F' on the diagram. Also find the approximate ratio of size of the image to the size of the object.

[TERM 2, 2018]

Solutions

1. A screen, a mirror, holders for them and a scale [1]

2. Towards the screen [1]

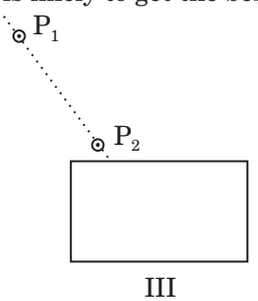
3. III, I, II, IV [1]

4. IV [1]

5. CD [1]

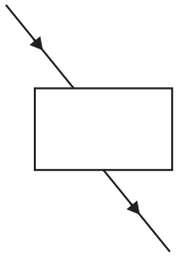
6. To determine the focal length of a convex lens, one should have convex lens, a screen, holders for them and a scale. [1]

7. In the given below experimental set-up, student is likely to get the best results. [½]



III [½]

8. The trace most likely to be correct is that of student III. [½]



III [½]

9. The rays are converging to a particular point on the screen. Therefore, it is a convex lens with a focal length same as the distance between the lens and the screen. [1]

10. As the image distance increases, the object distance would decrease thus the distance between the mirror and the screen should be decreased. So, he should move the mirror slightly towards the screen. [1]

11. The following conditions should satisfy to get the correct observation:-

(i) The angle of incidence must be nearly equal to the angle of emergence.

$\angle i \approx \angle e$ [½]

(ii) The angle of incidence must be more than the angle of refraction.

$\angle i > \angle r$ [½]

All the given observations satisfy these conditions.

12. The light rays passing through the optical centre of lens traces the same path after refraction. When the light rays parallel to the principal axis it passes through the second focus of the lens, and when the light rays passing through the first focus it become parallel to the principal axis after passing through the lens [1]

Hence, option (c) is correct.

13. The correctly marked angle is $\angle r$ only. So option (c) is correct. [1]

14. A student is using a convex lens of focal length 10cm to study the image formation by a convex lens for the various positions of the object. In one of his observations, he may observe that when the object is placed at a distance of 20cm from the lens, its image is formed at 20cm on the other side of the lens and is of the same size, real and inverted. Therefore, option (c) is correct. [1]

15. The correct option is (b).

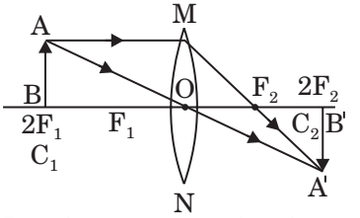
To find the focal length of a convex lens by measuring the image distance, the lens should be kept on a stand and the screen must be held in the hand. [1]

16. The correct option is (c).

While obtaining the point sized image of the sun, the incident rays are parallel to the principal axis of the concave mirror and rays are focused at the focal point of the mirror. Therefore the most correct value of the focal length is obtained by Z. [1]

17. Student B performed the correct procedures. To fix the pins correctly, the right way is to look at the feet of the pins not the head. Therefore, the correct option is (b). [1]

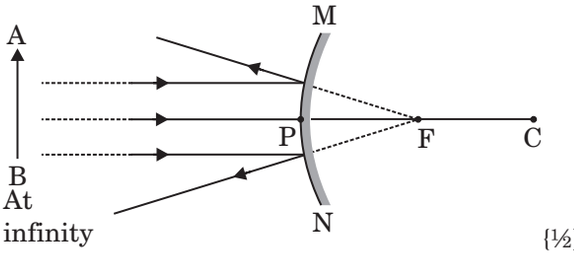
18. (a) The following ray diagram shows the image formation by a convex lens:



[½]

(b) In this case, the object is placed at $2F_1$. So the real and inverted image of same size as the object will be formed at $2F_2$. [½]

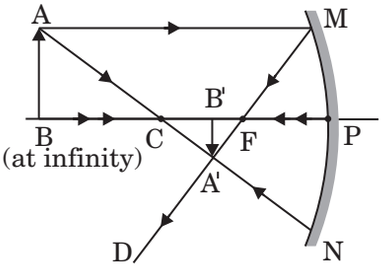
19. When the candle is at a far end of the laboratory, the image formed is highly diminished and the rays of the sun are parallel. To keep the rays parallel the lens is moved slightly towards the sun. If the lens will be shifted away from the screen then the object will be close to the lens and the rays will not be parallel. The ray diagram of the image formed when the object is at infinity is shown below:



{½]

Thus the correct answer is (a).

20. The image formed by the concave mirror for the object at infinity will be real and inverted and the size of the object will be diminished. It can be observed in the diagram below: [½]



[½]

Thus, the correct answer is (b).

21. When a light ray is incident on the glass slab it enters from a rarer to a denser medium, i.e. from air to glass, so the light bends towards the normal. Therefore the angle of incidence is greater than the angle of refraction. When the light ray passes from the denser to the rarer medium, i.e. from glass to air, the light bends away from the normal and is parallel to the incident ray. Therefore the angle of incidence is nearly equal to the angle of emergence. [1]

Thus, the correct answer is (a).

22. Device X is a convex lens and device Y is a concave mirror, whose focal lengths are 20 cm and 25 cm respectively. Therefore, option (d) is correct. [1]

23. Either towards or away from the screen depending upon the position of the object.

As the object position is not given so to move the lens towards or away would depend on the position of object. Therefore, option (d) is correct. [1]

24. The characteristics of image formed by plane mirror are as follows:

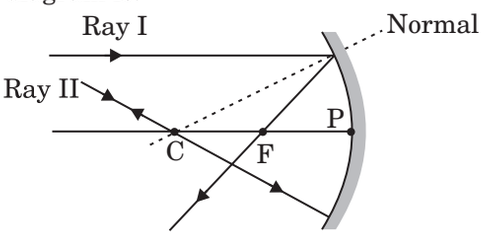
(i) The image which is formed by the plane mirror is same in size, i.e. there is no change in size. [½]

(ii) The image formed by the plane mirror is virtually erect. [½]

(iii) The distance of image shown will be same as that of object in front of the mirror. [½]

(iv) The image after formation is laterally inverted by the plane mirror. [½]

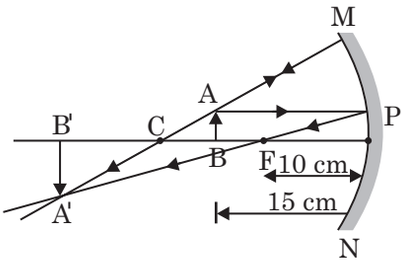
25. The two rays chosen for the construction of ray diagram is:



[½]

Ray 1: When the incident ray is parallel to the principal axis, the reflected ray will pass through the focus of concave mirror or it appears to pass through the focus of convex mirror. [½]

Ray 2: When the incident ray passes through or appears to pass through the centre of curvature, the light, after reflection from the spherical mirror, reflects back along the same path. [½]



[½]

The image formed is real, inverted, magnified and is formed beyond the centre of curvature.

26. "A ray of light incident on a rectangular glass slab immersed in any medium emerges parallel to itself". The statement states that when original path of the incident ray is extended it will be parallel to emergent ray. [2]

27. Magnified image can be produced by the concave mirror in following cases:

(i) When the object is placed at F (focus), then the image will be formed at infinity. This image will be enlarged, inverted and real. [1]

(ii) The image will be formed behind the mirror when the object is placed between F and P. This image will be enlarged, erect and virtual. [1]

The only difference is, in case (i) the image formed will be real and inverted while the image formed in case (ii) will be erect and virtual.

28. In order to find out the focal length of a convex lens, first the lens should be fixed and placed on a long surface facing towards the distant object. The screen, the object and the lens should be adjusted confirming that all of them are on the principal axis. After that to determine the correct position for the bright and clear image, the screen should be moved back and forth. After getting the clear image, measure that distance and repeat the experiment 2-3 times. At last, find the mean of the focal length which will give the approximate value of the focal length. [2]

29. Height of object, $h_0 = 2.5$ cm

Distance from the optical centre, $u = -15$ cm

Focal length, $f = 10$ cm

$$\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$$

$$\frac{1}{10} = \frac{1}{v} - \left(\frac{1}{-15}\right)$$

$$\frac{1}{10} = \frac{1}{v} + \frac{1}{15}$$

$$\frac{1}{v} = \frac{1}{10} - \frac{1}{15}$$

$$\frac{1}{v} = \frac{15-10}{10\times 15}$$

$$\frac{1}{v} = \frac{5}{150}$$

v = 30 cm

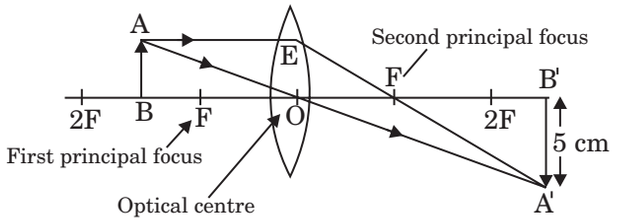
$$\frac{v}{u} = \frac{h_i}{h_o}$$

$$\frac{30}{-15} = \frac{h_i}{2.5}$$

$$h_i = -\frac{30\times 2.5}{15}$$

h_i = –5cm

Thus, a real, inverted and magnified image of size 5 cm is formed by the convex lens at a distance of 30 cm.



[2]

30. (a) He moves the lens towards the object. [½]

(b) The size of the image increases. [½]

(c) Image intensity decreases as the flame moves towards the lens. [½]

(d) Image formed is virtual and thus can't be obtained on the screen. [½]

31. Power of lens is the reciprocal of its focal length which is in meters. It is represented as

$$P \propto \frac{1}{f}$$

SI unit of power of lens is Dioptre (D).

Focal length of first lens is 40 cm or 0.4 m

Power, $P = \frac{1}{f} = \frac{1}{0.4} = \frac{10}{4} = 2.5D$ [1]

As the focal length is positive so the lens is convex.

Focal length of second lens is -20 cm or -0.2 m

Power, $P = \frac{1}{f} = -\frac{1}{0.2} = -\frac{10}{2} = -5D$

As the focal length is negative so the lens is concave. [1]

32. There are two laws of refraction of light:

(i) First law of refraction states that the "incident ray, the refracted ray and the normal to the surface at the point of incidence all lie in the same plane". [½]

(ii) Second law of refraction states that "the ratio of sine of the angle of incidence and the sine of the angle of refraction is called the refractive index". [½]

$$\frac{\sin i}{\sin r} = n$$

n_{21} is the refractive index of second medium with respect to the first medium.

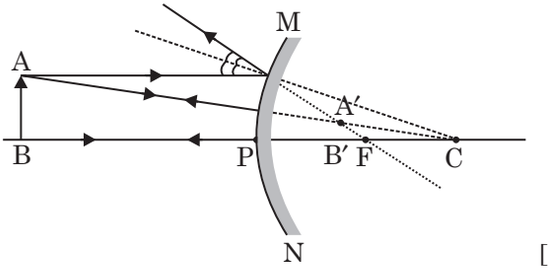
Therefore, $\frac{\sin i}{\sin r} = n_{21}$

This is the Snell's law. [½]

Absolute refractive index is the ratio of the speed of light in vacuum to the speed of light in the medium which is denoted by n.

$$n = \frac{\text{Speed of light in air}}{\text{Speed of light in medium}} = \frac{c}{v}$$ [½]

33.



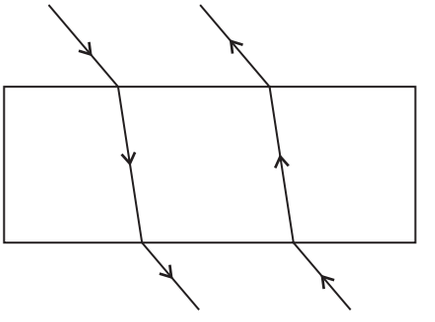
[1]

When the object is between infinity and the pole of a convex mirror, the position of image formed after reflection, would be between pole(P) and focus(F). [1]

The relative size of image is going to get diminished.

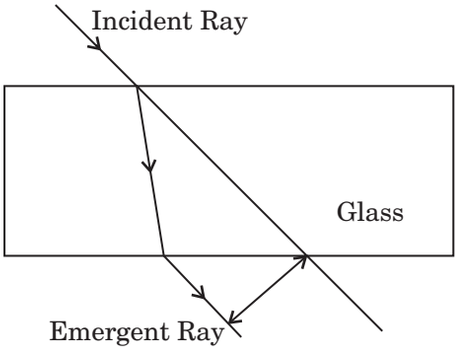
The nature of image is virtual and erect. [1]

34. The principle of reversibility of light states that the light always follow the same path even if the direction of the light is reversed. [1]



[1]

When the incident ray falls obliquely on a side of a rectangular glass slab, it bends. When this ray leaves the glass slab, this emergent ray is parallel to the incident ray. This can be illustrated as follows:



[1]

35. (i) **Headlights:** Concave mirrors are used as it gives a large area of magnification for the light. [1½]

(ii) **Rear view mirrors:** Convex mirrors give a virtual, erect, and diminished image of the objects placed in front of them. They are preferred as a rear-view mirror in vehicles because they give a wider field of view, which allows the driver to see most of the traffic behind him. [1½]

36. Given Information:

Height of the object = 4cm

Focal length = 20cm

Object distance (u) = –16 cm

Now using the lens formula, i.e $\frac{1}{v}-\frac{1}{u}=\frac{1}{f}$

$$\frac{1}{v}=-\frac{1}{u}+\frac{1}{f}$$

[1]

Substituting the values,

$$=\frac{1}{20}+\frac{1}{(-16)}$$

$$=-\frac{1}{80}$$

Hence, v = –48 [1]

The image distance is 48 cm on the same side of the lens as the object.

Now for Magnification,

$$M=\frac{v}{u}=\frac{-80}{-16}=5=\frac{h_i}{h_o}=hi=4$$

$\Rightarrow h_i = 5 \times 4 = 20$ cm

The image formed is erect, virtual and enlarged. The image distance is 80cm from the optical centre on the same side as that of the lens. [1]

37. Height of object, = 6cm

Focal length of lens, f = –5 cm

Object distance, u = –10 cm

Now, using the lens formula,

$$\frac{1}{v}-\frac{1}{u}=\frac{1}{f}$$

$$\Rightarrow \frac{1}{v}-\frac{1}{-10}=\frac{1}{-5}$$

$$\Rightarrow \frac{1}{v}+\frac{1}{10}=-\frac{1}{5}$$

$$\Rightarrow \frac{1}{v}=-\frac{1}{5}-\frac{1}{10}$$

$$\Rightarrow v=-\frac{10}{3}=-3.33cm$$

[1½]

Magnification, M = $\frac{v}{u}=-\frac{10}{3}\times\left(-\frac{1}{10}\right)=\frac{1}{3}$

Also, magnification, M

$$=\frac{v}{u}=\frac{h_2}{h_1}=\frac{h_2}{6}=\frac{1}{3}\Rightarrow h_2=\frac{6}{3}=2cm$$

Thus, the image of size 2 cm will be formed in front of the lens at a distance of 3.33 cm from the lens. The nature of the image is virtual and erect. [1½]

38. (a) Concave mirror [1]

(b) As flame is placed 15cm away from its pole

So, u = – 15cm

And the screen is placed 60cm away from its pole

So, v = –60cm

Now, $\text{magnification}=-\frac{\text{image distance}}{\text{object distance}}$ [½]

$$\Rightarrow -\frac{v}{u}=-\frac{(-60cm)}{(-15cm)}=-4$$

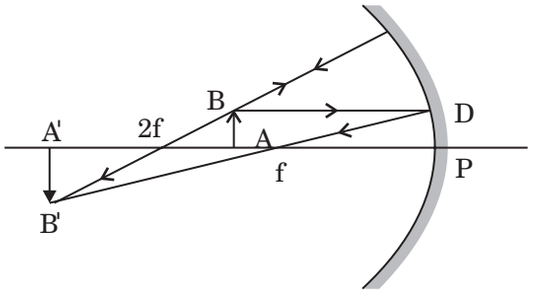
[½]

So, the linear magnification of the image is – 4

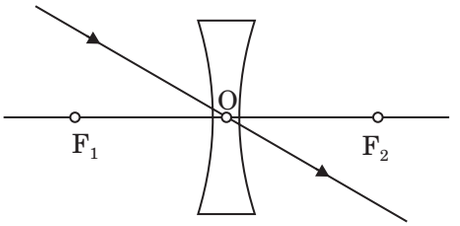
(c) Now, the distance between object and image = distance of screen from pole of mirror – distance of object from pole of mirror [½]

= 60 – 15 = 45 cm. [½]

(d) Object to be placed between F and C. [1]

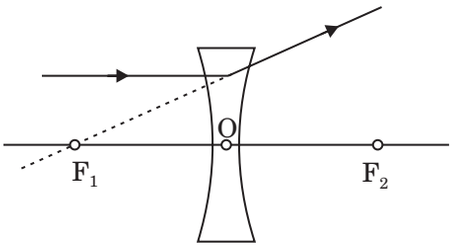


39. (i) The ray of light is passing through optical centre of concave lens.



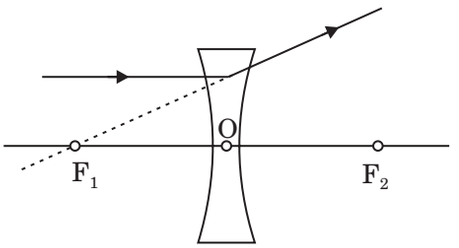
[1]

(ii) The ray of light is parallel to its principal axis.



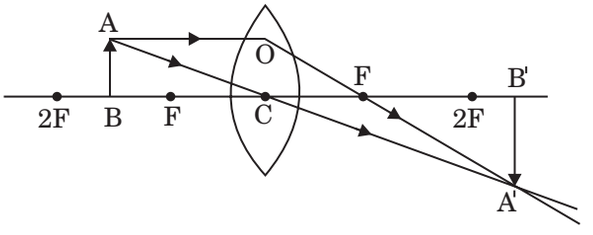
[1]

(iii) The ray of light is directed towards it principal focus



[1]

40. To get the real, inverted and magnified image from a convex lens, object should be placed between F_1 and $2F_1$. This can be shown from the following ray diagram:



[1]

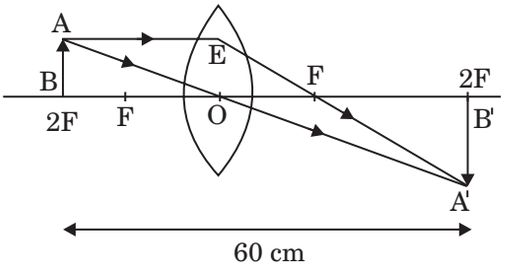
The related formula for the object and image distance is as follows:

$$\frac{1}{f}=\frac{1}{v}-\frac{1}{u}$$

This is known as lens formula and here f = focal length, v = image distance and u = object distance. [1]

To get the same type of image from a concave mirror, the object should be placed between C and F as shown in the following ray diagram.[1]

41.



[1]

We know that magnification or $m = -1$

Hence, $h_i = h_o$, and we know that the image formed is real and inverted.

The object and the image formed is at 2F.

$u = -30\ cm$

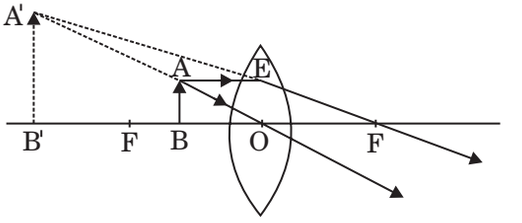
$v = +30\ cm$

Using the focal length formula, i.e. $\frac{1}{f}=\frac{1}{v}-\frac{1}{u}$

Substituting the values,

$$\frac{1}{f}=\frac{1}{30}-\left(-\frac{1}{30}\right)$$

f = 15 cm [1]



According to the question, the object is moved 20 cm towards the lens.

Now, u = –10 cm f = + 15cm

Using the focal length formula again, i.e.

$$\frac{1}{f}=\frac{1}{v}-\frac{1}{u}$$

Substituting the values,

$$\frac{1}{v}=\frac{1}{15}-\frac{1}{10}=\frac{2-3}{30}$$

$\Rightarrow v = -30$ cm [1]

42. Focal length, f = –30cm (Concave lens are divergent)

Height of the object, h_o = 5 cm

Distance between the lens and the image,

$v = -15$ cm

$$\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$$

$$\frac{1}{-30} = -\frac{1}{15} - \frac{1}{u}$$

$$\frac{1}{u} = -\frac{1}{15} + \frac{1}{30}$$

$$\frac{1}{u} = \frac{-30+15}{15\times 30}$$

$$\frac{1}{u} = \frac{-15}{15\times 30}$$

$u = -30$ cm [1]

Distance of the object from the optical centre is 30 cm.

Magnification, $m = \frac{v}{u} = \frac{h_i}{h_o}$

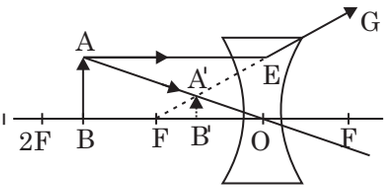
$$\frac{-15}{-30} = \frac{h_i}{5}$$

$$h_i = \frac{5\times 15}{30}$$

$h_i = 2.5$ cm

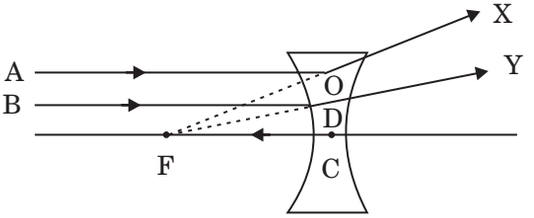
Height of the image is 2.5 cm. [1]

(b) The image in the above situation is formed as follows:



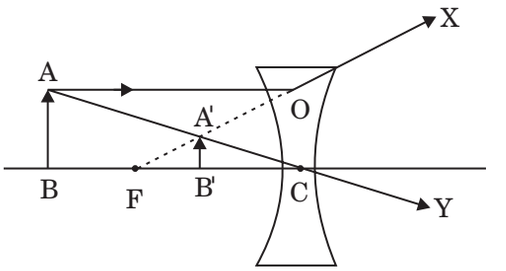
[1]

43. If the image formed by a lens for all positions of an object placed in front of it is always erect and diminished, then it is a concave lens.



[1]

In the above figure, when the object is placed at infinity, the image is formed at the principal focus, highly diminished (point size), virtual and erect.



[1]

In the above figure, when the object is placed between infinity and optical centre, the image is formed at the same side of the lens between focus and optical centre. The image is diminished, virtual and erect,

Power (P) of the lens = 10D

Now, Focal length (f) = $\frac{1}{P}$

$\Rightarrow f = \frac{1}{10}$

$\Rightarrow$ = 0.1 m

$\Rightarrow$ = 10 cm [1]

44. (a) The ability of convergence or divergence of light rays achieved by a lens is called as power of lens.

The power of a lens is the reciprocal of its focal length. The power is given as:

$$P = \frac{1}{f}$$

[1½]

where, f is focal length and P is the power.

(b) The SI unit is "Dioptre". It is denoted by the alphabet D.

If the focal length is being measured in 'metres', then the power of a lens is given in 'dioptre'. [1½]

(c) Focus of lens$_1$ $= f_1 = +25cm = +\left(\frac{25}{100}\right)m$

Power of lens$_1$ $= P_1 = \frac{1}{f_1} = \frac{1}{+\left(\frac{25}{100}\right)} = +4\text{D}$

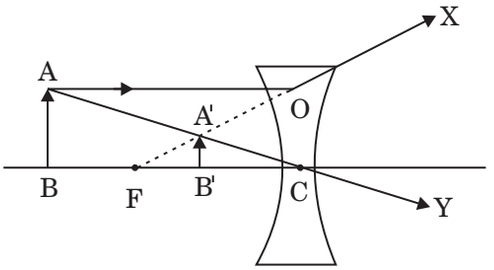
Focus of lens$_2$ $= f_2 = -10cm = -\left(\frac{10}{100}\right)m$

Power of lens$_1$ $= P_1 = \frac{1}{f_1} = \frac{1}{-\left(\frac{10}{100}\right)} = -10\text{D}$

The lens power of this combination

$= P_1 + P_2 = +4 - 10 = -6D$ [2]

45. (a)



When an object is placed between the infinity and the optical centre, the image formed between optical centre and focus. [1½]

(b)

(i) Focal length of lens, $f = -15$ cm, focus is negative for concave lens

Image is formed at, $v = -10$ cm , image formation is in front of lens so it is negative.

Lens formula = $\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$

$$\frac{1}{-15} = \frac{1}{-10} - \frac{1}{u}$$

$$\frac{1}{u} = \frac{1}{-10} - \frac{1}{-15}$$

$$\frac{1}{u} = \frac{-3+2}{30}$$

$$\frac{1}{u} = \frac{-1}{30}$$

u = – 30 [1½]

Object is placed at 30cm in front of lens.

(ii) Magnification formula,

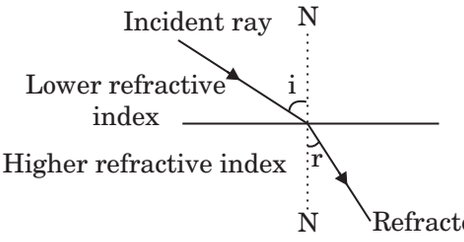
$$m = \frac{h'}{h} = \frac{v}{u}$$

$$m = \frac{-10\text{cm}}{-30\text{cm}}$$

m = +0.33 [1]

(iii) The positive sign shows that image is virtual and erect as the image formation is in front of lens. The image is one-third of the size of the object. [1]

46. When a ray of light travels from one transparent medium to another, it bends at the surface. This happens because different media have different optical densities. The phenomenon of bending of light as it travels from one medium to the other is termed as refraction of light. When a ray of light moves from optically rarer medium to an optically denser medium, it bends towards the normal at the point of incidence. Therefore, angle of incidence (i) is greater than the angle of refraction (r). [1]



[1]

According to Snell's law, the ratio of the sine of angle of incidence to the sine of angle of refraction is constant.

Mathematically, it is given as,

$$\frac{\sin i}{\sin r} = \text{constant} = {}^{a}\propto_{b}$$

Here,

$$g\mu_{\alpha} = \frac{2}{3} = \frac{\mu_{\alpha}}{\mu_{g}}$$

$${}^{\alpha}\mu_{w} = \frac{4}{3} = \frac{\mu_{w}}{\mu_{a}}$$

$V_g = 2 \times 10^8$ m/s [1]

$$\propto = \frac{c}{v}$$

where ,

μ is the absolute refractive index of a medium w.r.t vacuum

c is the speed of light in vacuum

V is the speed of light in medium

(a) Now,

$$\mu_{\alpha} = \frac{c}{v_{\alpha}}$$

$$\propto_{g} = \frac{c}{v_{g}}$$

Dividing, $\frac{\mu_{\alpha}}{\mu g} = \frac{v_g}{v_a} = \frac{2}{3}$

$$v_{\alpha} = \frac{3}{2} \times v_g$$

$$v_{\alpha} = \frac{3}{2} \times 2 \times 10^8 \text{ m/s}$$

$\Rightarrow 3 \times 10^8$m/s [1]

(b) We have,

$$\mu_\alpha = \frac{c}{v_\alpha}$$

$$\mu_\alpha = \frac{c}{v_\alpha}$$

$$\frac{\mu_w}{\mu_\alpha} = \frac{v_\alpha}{v_w} = \frac{4}{3}$$

$$v_w = \frac{3}{4} \times 3 \times 10^8$$

$$= \frac{9}{4} \times 10^8$$

$= 2.25 \times 10^8$ m/s [1]

47. (i) **Optical centre:** It is the centre point of the spherical lens. It is represented by O. When a ray of light passes through the optical centre it goes straight. [½]

(ii) **Centre of curvature:** The centre of the sphere of which a part of lens is formed is called as centre of curvature of lens. [½]

(iii) **Principal axis:** The line passing through the optical centre of the lens and perpendicular to both faces of the lens is known as the principal axis. [½]

(iv) **Aperture:** It is the diameter of the sphere from which a lens is formed. [½]

(v) **Principal focus:** The point at which an incident ray after refraction or reflection appears to diverge on the principal axis in a concave lens and concave mirror is known as principal focus.

Also, the point at which a ray after refraction or reflection converges in a convex lens and mirror respectively is known as principal focus. [½]

(vi) **Focal length:** The distance between the optical centre and principal focus of the lens is known as the focal length. [½]

(b)

Focal length, $F = +12$cm (Given)

Image distance, $V = +48$cm (Given)

Let, the object distance be U

By using the lens formula

$$\frac{1}{F} = \frac{1}{V} - \frac{1}{U}$$

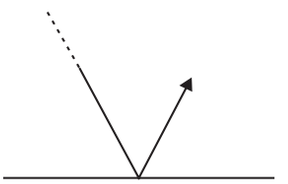
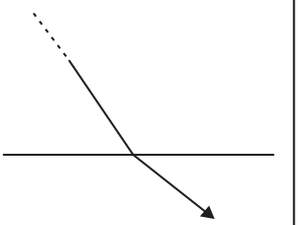
$$\frac{1}{12} = \frac{1}{48} - \frac{1}{U}$$

$$\frac{1}{U} = -\frac{1}{24}$$

U = – 16

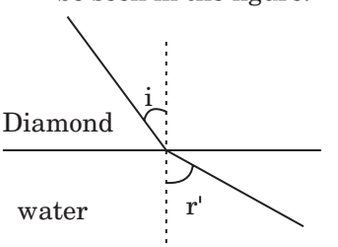
Hence, the object should be placed at a distance of 16 cm from the convex lens. [2]

48. (a)

Reflection	Refraction
It is the phenomenon in which light waves bounce back off the surface to same medium. It occurs in mirrors.	In refraction, light waves pass through boundary between two medium and it changes its path or bends as it enters another medium. It happens in lenses.
In refection, the angle of reflection is same as angle of incidence.	Whereas, in refraction, angle of incidence and angle of refraction are different.
 Reflection	 Refraction

[1 + 1 + 1]

(b) As the refractive index of water is less than that of diamond, so the ray of light will move away from normal after refraction, as it can be seen in the figure.



[1]

(c) Velocity of light in air 3×10^8 ms^{-1}

Refractive index of water = 1.33

$$\text{Refractive index of water} = \frac{\text{Speed of light in air}}{\text{Speed of light in water}}$$

$$\Rightarrow \text{Speed of light in water} = \frac{\text{Speed of light in air}}{\text{Refractive index of water}}$$

$\Rightarrow$ Speed of light in water $= \dfrac{3\times10^{8} ms^{-1}}{1.33}$

$\Rightarrow$ Speed of light in water = 2.25 $ms^{-1} \approx 2.3\ ms^{-1}$ [1]

49. (a) The ability of lens to converge diverge the rays of light falling on it is called power of lens.

$\Rightarrow P = \dfrac{1}{f}$ [1]

S.I. unit of power of lens is dioptres (D). Combined power of two or more lenses is the sum of powers of those lenses

i.e. $P = P_1 + P_2 + P_3$ [1]

(b) The ability of the eye lens to focus near and far objects by adjusting its focal length is called power of accommodation of the eye. Role of ciliary muscles is to alter the focal length of the lens depending on how far or near the object is from eye. [1]

(c) The person using lens of –1D suffers from defect of vision called myopia and the nature of his lens used is concave lens. [1]

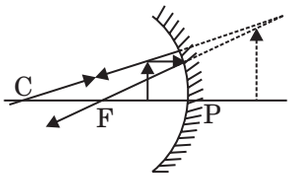
$$Power = \frac{1}{focal\,length} = -1$$

$\Rightarrow$ Focal length h = – 1m = – 100 cm [1]

50. (i) $f = -12$ cm

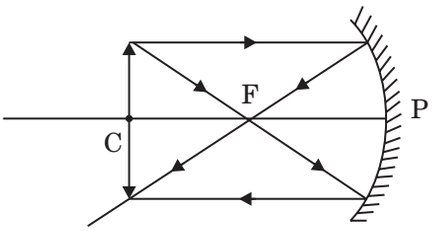
Range to obtain an erect image: $0 < u < 12$ [1]

(ii) The image formed will be larger than the object. [1]



[1]

(iii)



[1]

We know that,

$f = -12$ cm, and $u = -24$cm

Using the focal length formula i.e. $\dfrac{1}{f} = \dfrac{1}{v} + \dfrac{1}{u}$

Substituting the values,

$$-\frac{1}{12} = \frac{1}{v} + \left(-\frac{1}{24}\right)$$ [1]

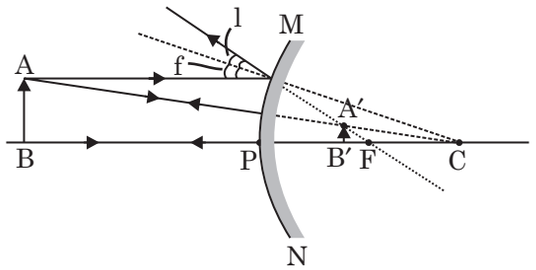
$\Rightarrow v = -24$ cm

51. (a) A convex mirror always forms a diminished, virtual and erect image of the object placed in front of it.

Position of object	Position of image	Size of image	Nature of Image
Between infinity and the pole of the mirror	Between P and F behind the mirror	Diminished	Virtual and erect

[1½]

Fig: Ray Diagram:



[1]

Uses of convex mirror are commonly seen in the rear view mirrors in vehicles. They are preferred as they give an erect image, although diminished. They enable the driver to view a much larger view than the plane mirror.

(b) Radius of curvature

The radius of curvature of a spherical mirror is the radius of the sphere of which the reflecting surface of the spherical mirror is a part and represented by R. [1]

R = 24 cm

Also, R = 2f

$24 = 2 \times f$

$$f = \frac{24}{2}$$

f = 12 cm [1½]

52. It is given that, $u = -30$ cm,

f = 20 cm, h_o = 4 cm

Use $\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$ [1]

Substitute the values of f and u

$\Rightarrow \frac{1}{20} = \frac{1}{v} - \frac{1}{(-30)}$

$\Rightarrow \frac{1}{20} = \frac{1}{v} + \frac{1}{30}$

$\Rightarrow \frac{1}{v} = \frac{1}{20} - \frac{1}{30}$

$\Rightarrow \frac{1}{v} = \frac{30-20}{20\times 30}$

$\Rightarrow \frac{1}{v} = \frac{10}{600}$

$\Rightarrow v = 60$ cm [1]

Magnification ratio $= \frac{\text{Size of the image}}{\text{Size of the object}}$ [1]

Magnification ratio $= \frac{v}{u} = \frac{h_i}{h_o}$

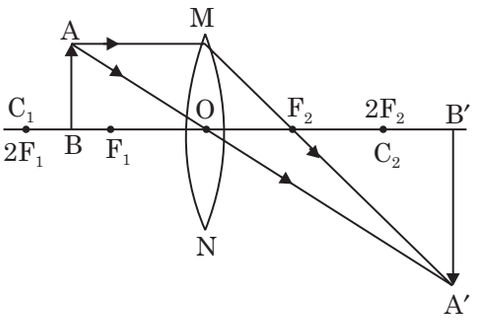
$\Rightarrow \frac{60 \text{ cm}}{30 \text{ cm}} = \frac{h_i}{4 \text{ cm}}$

$\Rightarrow h_i = \frac{60 \text{ cm} \times 4 \text{ cm}}{30 \text{ cm}}$

$\Rightarrow h_i = 8$ cm [1]

Ratio of size of the image to the size of the object

$= \frac{h_i}{h_o} = \frac{8}{4} = 2$



[1]

Smart Notes .....

CHAPTER 11

Human Eye and Colourful World

Chapter Analysis with respect to Last 3 Years' Board Exams

List of Topics	**2016**	**2017**	**2018**
Eye and it defects	—	1Q (5 marks)	1Q (3 marks), 1Q (3 marks)
Dispersion and scattering	1Q (1 mark), 1Q (3 marks), 1Q (5 marks)	1Q (1 mark), 1Q (3 marks)	

On the basis of above analysis, it can be said that from exam point of view, eye its defects and scattering are the most important topics of the chapter..

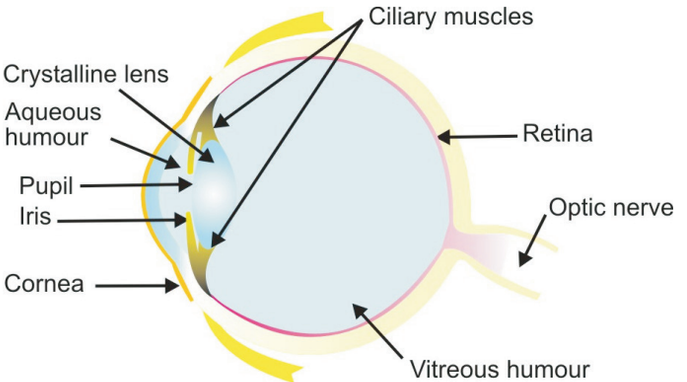
Topic 1: Structure of Eye & Eye Defects

Summary

Knowing your Chapter at Glance:

- Eye is a natural optical device using which man could see objects around him. It forms an inverted, real image on a light sensitive surface called retina.

STRUCTURE OF THE EYE



- The front part of the eye, which is transparent and bulging outwards is called as **cornea**.
- Cornea serves as a window of the eye as the light coming from objects enters the eye through the cornea.
- Behind the cornea, is a circular diaphragm called **iris**. There is a hole in the middle of the iris which is called **pupil** of the eye.
- Behind the pupil, is a convex lens called eye lens. It is composed of transparent, fibrous jelly like material. It is held in position by ciliary muscles. The converging power of eye len can be changed by changing its shape by the action of ciliary muscles.
- The eye lens forms an inverted real image of the object on the screen called retina. The retina is behind the eye lens. The retina is a delicate membrane having enormous number of light sensitive cells- Rods and Cones.
- The Rods respond to the intensity of light and the cones respond to colour of light. These cells get activated upon illumination and send electric signals to brain through optic nerve.
- **Far point**

  The maximum distance at which object can be seen clearly is far point of the eye. For a normal adult eye, its value is infinity.
- **Near point or Least distance of distinct vision**

  The minimum distance at which objects can be seen most distinctively without strain.

  For normal adult eye, its value is 25cm.
- The ability of an eye to focus both near and distant objects by adjusting its focal length is called the power of accommodation of an eye.

DEFECTS OF VISION AND THEIR CORRECTION

Following are the four common defects of vision:

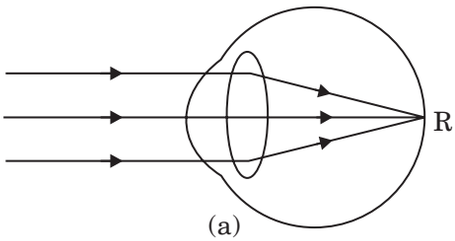
(i) Myopia or short-sightedness
(ii) Hypermetropia or long-sightedness
(iii) Presbyopia

- **Myopia or short-sightedness**

  Myopia or near-sightedness is the defect of an eye due to which a person can see nearby objects clearly but he cannot see far away (distant) objects clearly and distinctly.

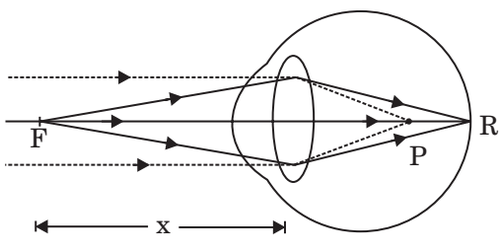
  A person with this defect has the far point nearer than infinity.

- **Causes of Defect**
  (a) Excessive curvature of the eye lens or due to the high converging power of eye lens
  (b) Elongation of the eye ball.
- **Corrective Measures**
  This defect can be corrected by using spectacles with concave lens of suitable focal length or power.



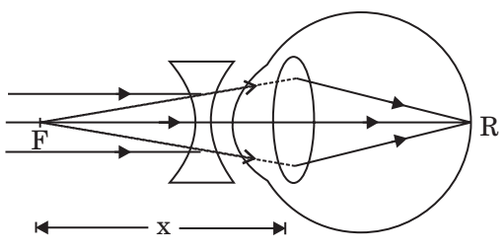
Normal Eye
(Sharp image of object at infinity)

(a)



Myopic Eye
[Blurred image of object at infinity
and sharp image of object at F (far point)]

(b)



Corrected
myopic eye
(Sharp image of object at infinity)

(C)

Hypermetropia or Long-sightedness

It is the defect of an eye due to which a person can see far away (distant) objects clearly but cannot see nearby objects clearly and distinctly.

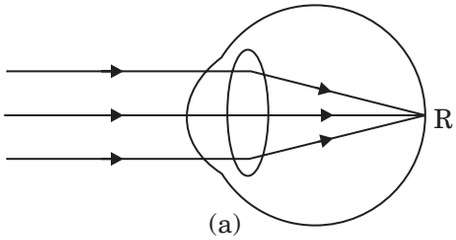
A person with this defect has the near point farther away from the normal point (25 cm).

Causes of Defect

(a) Excessive curvature of the eye lens or due to the high converging power of eye lens
(b) Elongation of the eye ball.

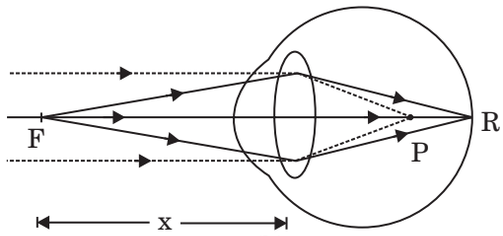
Corrective Measures

This defect can be corrected by using spectacles with concave lens of suitable focal length or power.



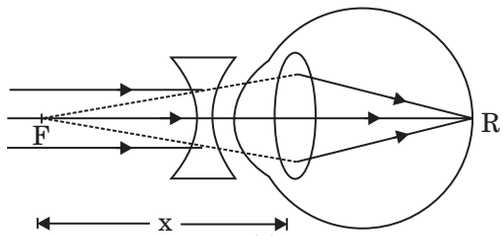
Normal Eye
(Sharp image of object at infinity)

(a)



Myopic Eye
[Blurred image of object at infinity
and sharp image of object at F (far point)]

(b)



Corrected
myopic eye
(Sharp image of object at infinity)

(c)

- **Presbyopia or old sight**

  It is the defect of the eye due to which an old person cannot see the nearby objects clearly. The near point of the old person having presbyopia gradually recedes and becomes much more than 25 cm.

Cause of Defect

Presbyopia arises due to the gradual weakening of the ciliary muscles and diminishing flexibility of the eye lens with age.

Corrective Measures

Presbyopia defect is corrected in the same way as hypermetropia i.e. by using spectacles having convex lenses.

PREVIOUS YEARS' EXAMINATION QUESTIONS

TOPIC 1

1 Mark Question

1. State one function of iris in human eye.

[TERM 2, 2012]

3 Marks Questions

2. (a) A student is unable to see clearly the words written on the black board placed at a distance of approximately 3 m from him. Name the defect of vision the boy is suffering from. State the possible causes of this defect and explain the method of correcting it.

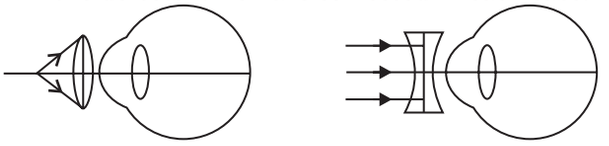
(b) Why do stars twinkle? Explain.

[TERM 2, 2011, 2013,2018]

3. An old man cannot see objects closer than 1 m from the eye clearly. Name the defect of vision he is suffering from. How can it be corrected? Draw ray diagram for the (i) defect of vision and also (ii) for its correction.

[TERM 2, 2012]

4. Given below are incomplete diagrams for correction of eye defects. Complete these diagrams to show the image formation and name the defects which are corrected in each case.



(i) (ii)

[TERM 2, 2015]

5. (a) Write the function of each of the following parts of human eye:

(i) Cornea

(ii) Iris

(iii) Crystalline lens

(iv) Ciliary muscles

(b) Why does the sun appear reddish early in the morning? Will this phenomenon be observed by an astronaut on the Moon? Give reason to justify your answer.

[TERM 2, 2018]

5 Marks Questions

6. (a) A person cannot read newspaper placed nearer than 50cm from his eyes. Name the defect of vision he is suffering from. Draw a ray diagram to illustrate this defect. List its two possible causes. Draw a ray diagram to show how this defect may be corrected using a lens of appropriate focal length.

(b) We see advertisements for eye donation on television or in newspapers. Write the importance of such advertisements.

[TERM 2, 2012, 2013]

7. (a) List the parts of the human eye that control the amount of light entering into it. Explain how they perform this function.

(b) Write the function of retina in human eye.

(c) Do you know that the corneal-impairment can be cured by replacing the defective cornea with the cornea of the donated eye? How and why should we organize groups to motivate the community members to donate their eyes after death? **[TERM 2, 2014]**

8. (a) A student suffering from myopia is not able to see distinctly the objects placed beyond 5m. List two possible reasons due to which this defect of vision may have arisen. With the help of ray diagrams, explain

(i) Why the student is unable to see distinctly the objects placed beyond 5m from his eyes.

(ii) The type of the corrective lens used to restore proper vision and how this defect is corrected by the use of this lens.

If, in this case, the numerical value of the focal length of the corrective lens is 5m, find the power of the lens as per the new Cartesian sign convention.

[TERM 2, 2017]

Solutions

1. The function of the iris is to **control the amount of size of the pupil** and thus regulates the amount of light entering the eye. Iris increases the size of the pupil when the light around is low i.e. of low intensity, to gather more light and decreases the size of the pupil when the light around is bright i.e. of high intensity, to let small amount of light onto the retina to avoid the stress. [1]

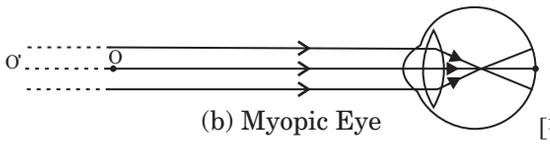
2. (a) As the student cannot see the words on the black board present far away from him, he is suffering from myopia.

There are two possible causes of myopia:

(i) It is caused due to increase in the distance of retina from the eye lens which results in increase in the length of eyeball. [½]

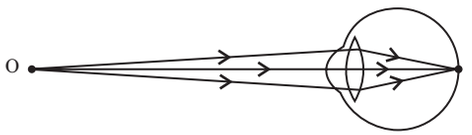
(ii) It can also be due to some tension in the ciliary muscles holding the eye lens. In this case, focal length of the eye lens decreases and the eye is not fully relaxed. [½]

The image of the object at infinity is not formed on the retina of the eye so the myopic eye cannot see it clearly. The image formed in front of the retina of the eye is as follows:



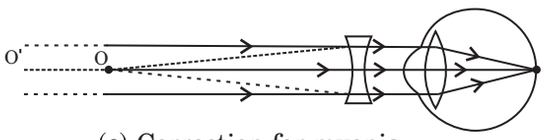
(b) Myopic Eye [½]

The far point of the myopic eye is near to the eye as shown below:



(a) Far point of a myopic eye [½]

It can be corrected by using concave lens of suitable focal length. Concave lens bring the image back on to the retina.

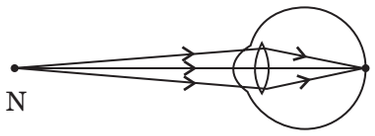


(c) Correction for myopia [½]

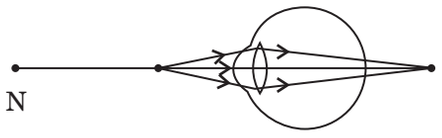
(b) The atmosphere of the earth consists of different layers of different densities. Light emitted by the stars pass through these layers before reaching our eyes. Due to the change in the density and refractive index, the light bends towards the normal as it passes through each layer. As a result the apparent position of the stars is different from the actual position. The apparent position of the stars changes as the density of the layers changes continuously. This change in the apparent position of the stars appears to us as twinkling of stars. [½]

3. Presbyopia is the defect of vision which he is suffering from. It's a common defect of vision, which generally occurs at old age and in which presbyopia eye has its near point greater than 25 cm and it gradually increases as the eye becomes older. It can be corrected by using a convex lens of appropriate power. [1½]

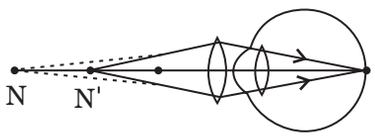
Given below is the ray diagram to show presbyopia and its correction:



(a) Near point of a Presbyopia eye

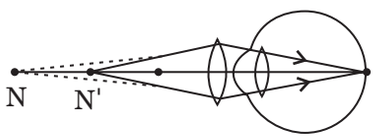


(b) Presbyopia eye



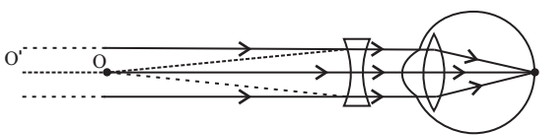
(c) Correction for Presbyopia eye [1½]

4. (i) The complete diagram to show image formation in first case is as follows:



The eye defect which has been corrected in this case is hypermetropia. [1½]

(ii) The complete diagram to show image formation is second case is as follows:



The eye defect which has been corrected in this case is myopia. [1½]

5. (a) The functions of various parts of human eye is as follows: [½]

(i) **Cornea:** It allows light to enter the eye ball acting as a window to the world. [½]

(ii) Iris: It controls the amount of light entering the eye. [½]

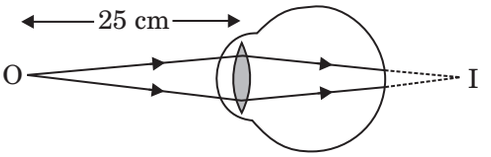
(iii) **Crystalline lens:** It is used to focus the images of the objects on the retina which are at different places.

(iv) **Ciliary muscles:** These muscles alter the focal length of the crystalline lens to clearly focus the image of the objects. [½]

(b) The Sun is far away from us during sunrise and sunset. Sunlight travels longer distance through the atmosphere before reaching our

eyes. Scattering of blue light is more than the red light. Therefore, more of the red light reaches our eyes and hence sun appears red. No this phenomenon will not be observed as the moon as moon has no atmosphere. So no scattering of light takes place. [½ + ½]

6. (a) If a person cannot read newspaper placed nearby, the person is suffering from hypermetropia i.e. far-sightedness. The person is unable to see the nearby objects distinctly and can only see far-by objects with a clear vision. The diagram below illustrates this defect:



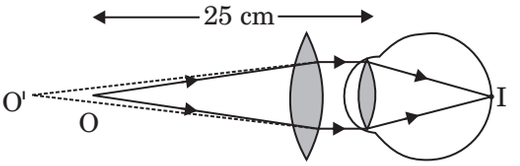
[½]

Two possible causes of hypermetropia are:-

(i) The focal length of the eye lens is too long.

(ii) The size of eyeball is too small. [1]

Hypermetropia is corrected with a convex lens so that the image is formed on the retina. [1]



(b) These advertisements help in making awareness of eye donation. We could donate our eyes after our death because eyes can be used even after a person's death. We can give vision to blind people so that they can see this beautiful world. [2½]

7. (a) The parts that control the amount of light entering into the human eyes are iris and pupil. Between the cornea and the lens we have a muscular coloured diaphragm called iris, which has a small hole in it, called the pupil. Iris is the coloured part that we see in the eye. The size of the pupil varies with the help of iris. In dim light, the size of the pupil increases with the help of iris to allow more light to enter the eye. In bright light,- the pupil contracts to allow less light to enter into the eye. [1½ + 1]

(b) Retina acts as the screen for the images formed by the eye lens. It is the delicate membrane and Inverted and real images are formed on the retina. The retina contains several light sensitive cells which give electrical signals to the brain through optical nerve. [1]

(c) Yes, the corneal-impairment can be cured by replacing the defective cornea with the cornea of the donated eye. Eyes live, even after death. One pair of eyes can give vision to two corneal blind people. We should organize groups to donate eyes because:

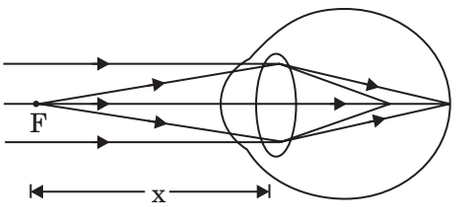
(i) 4.5 million people are suffering from corneal blindness.

(ii) It is our responsibility to pass on eyes so that we can light the life of others.

(iii) Eye donation does not disfigure face. [1½]

8. (a) The two reasons because of which Myopia might have arisen are excessive curvature of the eye lens or elongation of the eyeball. [1]

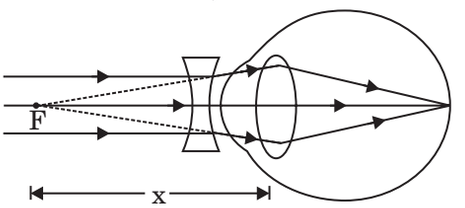
(i) A person with this defect can see nearby objects clearly but cannot see distant objects clearly. [1]



Defective eye

[1]

(ii) Myopic eye can be corrected by using a concave lens of suitable power as that will form the image on the retina and person can see clearly.



Corrected eye

[1]

Given,

Focal length = –5 (as it is a concave lens)

$$\text{Power} = \frac{1}{f}$$

$$= \frac{-1}{5} = -0.2D$$

Thus the negative sign depicts that this is a diverging or concave lens. [1]

Topic 2: Dispersion & Refraction

DISPERSION OF WHITE LIGHT BY A GLASS PRISM

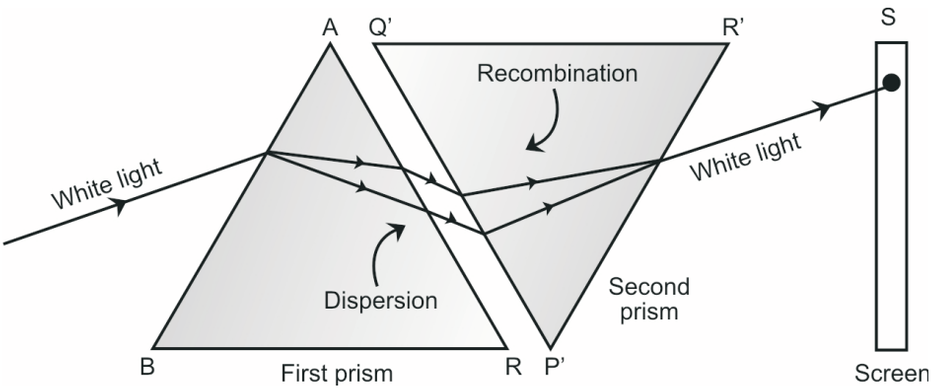
The phenomenon of splitting up of white light into its constituent seven colours on passing through a prism is called dispersion of light.

In the year 1665, Newton discovered that if a beam of white light is passed through a triangular glass prism, the white light splits to form a band of seven colours on a white screen held on the other side of the prism.

The colour sequence obtained on the screen is given by the famous acronym VIBGYOR where :

V stands for Violet
I stands for Indigo
B stands for Blue
G stands for Green
Y stands for Yellow
O stands for Orange
R stands for Red

- Violet colour bends through maximum angle whereas the red colour bends the least on passing through the prism.
- If the second identical prism is placed in an inverted position with respect to the first prism,all the seven colours recombine to form white light.



Atomspheric Refraction

The refraction of light caused by the earth's atmosphere is called atmospheric refraction.

- **TWINKLING OF STARS**

  The twinkling of stars is due to the atmospheric refraction of star's light.

  When the light coming from a star enters the earth's atmosphere, it undergoes refraction due to the varying optical densities of layers of air. This causes the star's image to change slightly in brightness and position, hence "twinkle."

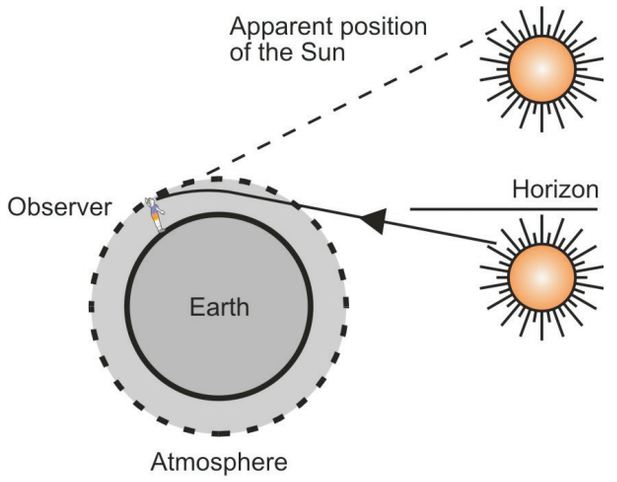
- **PLANETS DO NOT TWINKLE**

  The planets are much closer to the earth and are thus considered as the collection of infinite point sources of energy.

  The total variation in the amount of light entering our eye from all the point sources of light will average out to be zero. Thereby nullifying the twinkling effect. Hence planets do not twinkle.

- **ADVANCED SUNRISE AND DELAYED SUNSET**

  The sun is visible to us about 2 minutes before the actual sunrise and 2 minutes after the actual sunset because of atmospheric refraction. The actual sunrise takes place when the sun is just above the horizon.



Atmospheric refraction effects at sunrise and sunset

Scattering of light

The phenomenon in which a part of the light incident on a particle is redirected in different direction is called scattering of light.

TYNDALL EFFECT

The scattering of light by the colloidal particles of the medium due to which the path of the light becomes visible is known as Tyndall effect.

Tyndall effect can also be observed when sunlight passes through a dense forest.

BLUE COLOUR OF THE CLEAR SKY

The sunlight consists of seven coloured lights mixed together. When sunlight passes through the atmosphere, the shorter wavelength of blue light is scattered all around the sky by the tiny particles (atoms and molecules) present in the atmosphere. Some of the scattered blue light enters in our eyes as a result the sky appears blue.

If the earth had no atmosphere, there would not have been any scattering and the sky would have looked dark. The sky appears dark to the astronaut flying at very high attitudes because scattering is not prominent at such heights due to the lack of atmosphere.

COLOUR OF THE SUN AT SUNRISE AND SUNSET

At the time of sunrise and sunset, the sun is near the horizon. The sun rays have to travel much larger part of the atmosphere to reach on earth. As a result most of the light of smaller wavelength i.e. blue coloured light gets scattered away. Where as the light of larger wavelength i.e. red coloured light is scattered least and hence reaches the earth. Hence, the sun appears reddish at sunrise and sunset.

When the sun is overhead, the sunlight has to travel much smaller portion of earth's atmosphere. As a result, a little of the blue and violet colours are scattered out, due to which the sun appears shiny silver (white).

DANGER SIGNALS ARE RED

Out of all the colours of visible light, red colour has the longest wavelength. Therefore red colour is least scattered. That is why danger signals are red.

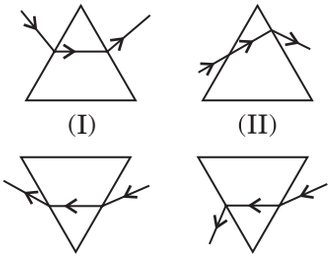
PREVIOUS YEARS' EXAMINATION QUESTIONS

TOPIC 2

1 Mark Questions

1. Give an example of a phenomenon where Tyndall effect can be observed. **[TERM 2, 2011]**

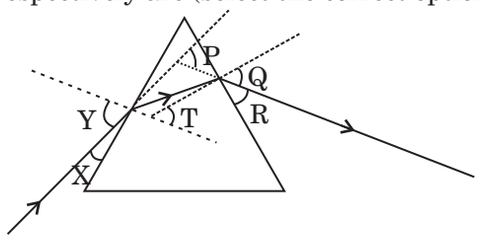
2. While performing the experiment to trace the path of a ray of light passing through a glass prism, four students marked the incident ray and the emergent ray in their diagrams in the manner shown below.



The correct path of the rays has been showed by:
(a) I
(b) II
(c) III
(d) IV **[TERM 2, 2012, 2013, 2014]**

3. In an experiment to trace the path of a ray of light through a glass prism for different values of angle of incidence a student would find that the emergent ray:
(A) is parallel to the incident ray
(B) perpendicular to the incident ray
(C) is parallel to the refracted ray
(D) bends at an angle to the direction of incident ray **[TERM 2, 2012, 2013]**

4. In the following diagram, the path of a ray of light passing through a glass prism is shown:
In this diagram the angle of incidence, the angle of emergence and the angle of deviation respectively are (select the correct option):

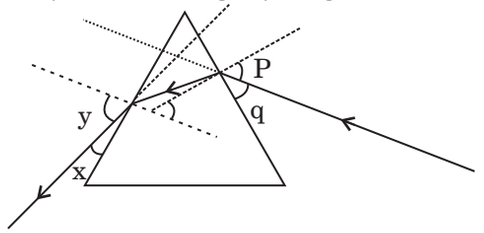


(A) X, R and T
(B) Y, Q and T
(C) X, Q and P
(D) Y, Q and P

[TERM 2, 2014, 2016]

5. The number of triangular surfaces of a prism with which you do experiment of tracing the path of light ray through a glass prism is:
(a) only one.
(b) only two.
(c) only three.
(d) only four. **[TERM 2, 2015]**

6. Study the following ray diagram:



In this diagram, the angle of incidence, the angle of emergence and the angle of deviation respectively have been represented by
(a) y, p, z
(b) x, q, z
(c) p, y, z
(d) p, z, y **[TERM 2, 2017]**

2 Marks Questions

7. Draw a ray diagram to show the refraction of light through a glass prism. Mark on it (a) the incident ray, (b) the emergent ray and (c) the angle of deviation.

[TERM 2, 2011]

8. Explain with the help of a diagram, how we are able to observe the sunrise about two minutes before the sun gets above the horizon.

[TERM 2, 2011]

9. Draw a labelled ray diagram to illustrate the dispersion of a narrow beam of white light when it passes through a glass prism.

[TERM 2, 2012]

10. A star appears slightly higher (above) than its actual position in the sky. Illustrate it with the help of a labeled diagram.

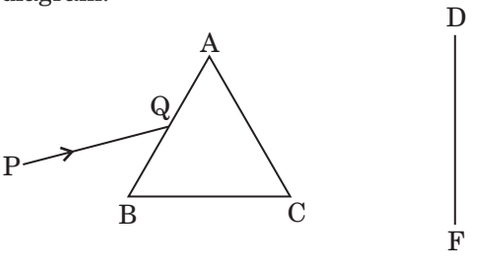
[TERM 2, 2012]

3 Marks Questions

11. State the difference in colors of the sun observed during sunrise/sunset and noon. Give explanation for each.

[TERM 2, 2013]

12. A narrow beam *PQ* of white light is passing through a glass prism *ABC* as shown in the diagram.



Trace it on your answer sheet and show the path of the emergent beam as observed on the screen *DE*.
(i) Write the name and cause of the phenomenon observed.
(ii) Where else in nature is this phenomenon observed?
(iii) Based on this observation, state the conclusion which can be drawn about the constituents of white light.

[TERM 2, 2014]

13. State the cause of dispersion of white light by a glass prism. How did Newton, using two identical glass prisms, show that white light is made up of seven colours? Draw a ray diagram to show the path of a narrow beam of a white light, through a combination of two identical prisms arranged together in inverted position with respect to each other, when it is allowed to fall obliquely on one of the faces of the first prism of the combination.

[TERM 2, 2016, 2017]

5 Marks Questions

14. Draw a ray diagram showing refraction of light through a glass prism and mark the following:
(a) Incident ray
(b) Emergent ray
(c) Refracted ray

(d) Angle of incidence
(e) Angle of deviation
(f) Angle of emergence

[TERM 2, 2015]

15. What is atmospheric refraction? Use this phenomenon to explain the following natural events.

[TERM 2, 2016]

Solutions

1. Tyndall effect can be easily seen in forest canopy due to presence of moisture droplets in atmosphere. These moisture droplets tend to trap dust particles. Further, when sunlight passes through this **colloidal solution**, the rays get scattered, making the path of light visible to us. [1]

2. In prism diagram when the light goes from rarer medium to denser medium, it bends towards the normal and when travels from denser medium to rarer medium it moves away from the normal.

Hence the correct option is c. [1]

3. (B) perpendicular to the incident ray

[1]

4. In this diagram the angle of incidence, the angle of emergence and the angle of deviation are Y, Q and P, respectively. So, option (D) is correct.

[1]

5. The correct option is (b).

A glass prism has two triangular bases. [1]

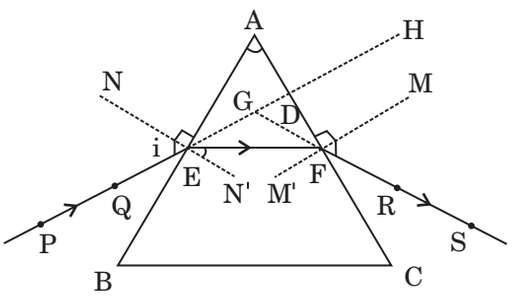
6. The correct option is (c) p, y, and z.

Angle of incidence is represented by 'p' which is the angle formed between the incident ray and the normal ray

Angle of emergence is represented by 'y' which is the angle between the emergent ray and normal ray. [½]

Angle of deviation is represented by 'z' is formed when the emergent ray is bent at some certain angle towards the incident ray. [½]

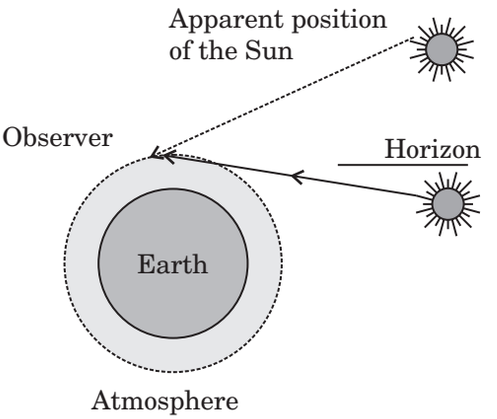
7.



[1]

(i) PQ – Incident ray
(ii) RS – Emergent ray
(iii) ∠HGS – Angle of deviation [1]

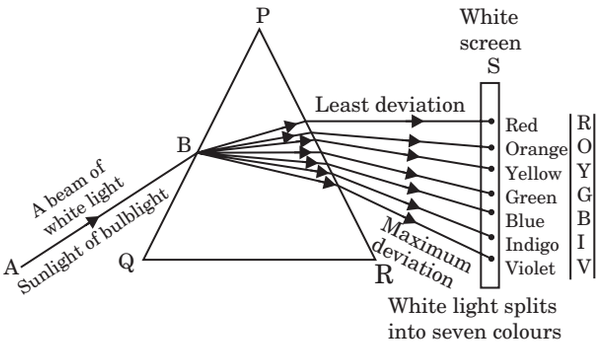
8.



[1]

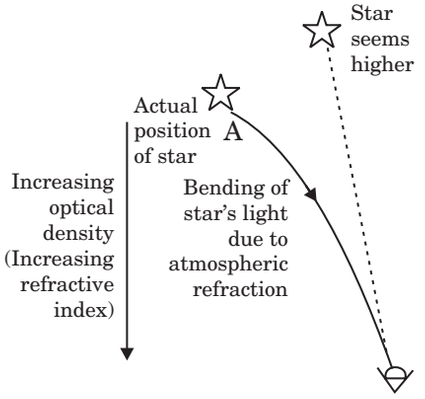
The Sun is visible to us about 2 minutes before the actual sunrise, because of atmospheric refraction. In atmospheric refraction, the bending of light rays takes place. This bending happens due to variation in density at different levels in atmosphere through which light is passing. By actual sunrise, we mean the actual crossing of the horizon by the Sun. The actual and apparent positions of the Sun are with respect to the horizon. The time difference between actual sunset and the apparent sunset is about 2 minutes. Due to this principle we are able to see it 2 minutes before the actual sunrise happening. [1]

9. The phenomenon in which white light splits into its elemental colors is called dispersion of white light. All the colors travel in the same speed when they travel in vacuum, but when they hit a medium such as a prism, the colors bend or refract at different angles, and therefore the speed changes. And, therefore they emerge in different, distinct directions which may seem like a spectrum to us. The **color red bends the least** whereas, violet deviates the most, and in short you can say it is the **wavelength**, angle of refraction and speed of the color. Below is the diagram where we have placed two identical prisms (one inverted) so that light passes through the second prism and comes out again as white light. [1]



[1]

10. The twinkling of stars is due to atmospheric refraction of star light as the starlight undergoes continuous refraction on entering the earth's atmosphere before it reaches the earth. Since the atmosphere bends starlight towards the normal at each layer, so the starlight appears to come from a point which is slightly higher than the star. So, the star appears slightly higher than its actual position. [½]



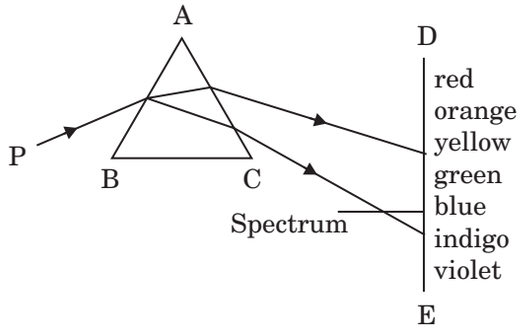
[½]

For example, in figure, though the actual position of a star is at A, but due to atmospheric refraction, it seems higher in the sky, as our eye will see the star at that position from where light enters it in the straight line direction. Due to atmospheric refraction, the sun also seems higher than it actually is. [1]

11. During sunset or sunrise, the sun appears reddish in color to the observer on the surface of the earth. During daytime, sunlight travels longer distances so, the short wavelengths get scattered by the atmospheric particles. Hence, sunlight is left with only longer wavelengths which are either reddish or orange in color. This is the reason we see the sun as red or orange at this hour of time. [1½]

The sun appears to be white during noon time. Sunrays travel shorter distance at noon and contain all the wavelengths of light which combine to form white color. Hence, the Sun appears white to the observer on the surface of the earth. [1½]

12.



(i) The name of the observed phenomenon is dispersion of light. The reason behind this is that different wavelengths of light travel with different speed in the glass prism. [1]

(ii) In a rainbow [1]

(iii) White light consists of seven different wavelength which are violet, indigo, blue, green, yellow, orange and red. [1]

13. When white light (which is a mixture of light rays of different colors) travel through a prism, they travel with different speed and bend through different angles, which leads to dispersion of light.

Different colours of light bend through different angles with respect to the incident ray, as they pass through a prism. The red light bends the least while the violet the most. Thus, the rays of each colour emerge along different paths and thus - become distinct. It is the band of distinct colours that we see in a spectrum. [1]

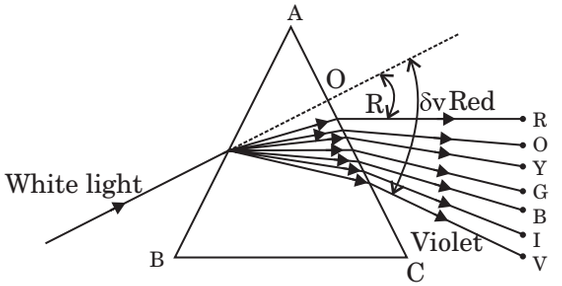
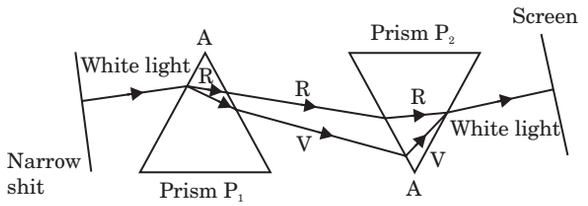


Fig.: Dispersion of white light by a glass prism

Newton's Experiment:



[1]

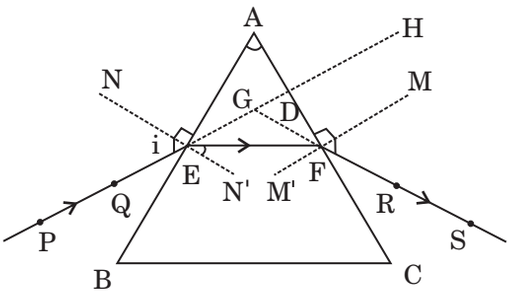
Take two identical prisms P_1 and P_2 as shown in the figure above. Keep the second prism P_2 in an

inverted position with respect to the first prism. Let us pass a narrow beam of white light so that it falls on the first prism P_1.

The first prism P_1 disperses the white light into seven colours because of refraction, as there is change in the medium from air to glass. These seven colors are received by the second prism P_2 on its surface, and recombine them in to a white light while emerging from the other side of prism P_2. This happens because the second prism P_2 which has been kept in an inverted position undoes the effect of the first prism P_1 on the narrow beam of white light. Hence the seven colors that are dispersed by the first prism can be again re-combined into a white light.

This observation gave Newton the idea that the sunlight is made of seven colors. [1]

14.



[5]

(iv) PE- Incident ray Angle of incidence

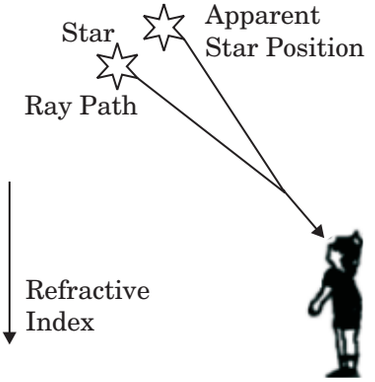
(v) EF- Refracted ray Angle of refraction

(vi) FS- Emergent ray Angle of emergence

15. Refraction takes place due to the change in the density. The density of the atmosphere decrease as we go upwards. It is due to the increase in the distance above the sea level. When light pass through the Earth's atmosphere the density of the atmosphere changes and therefore refraction takes place. This is known as atmospheric refraction. [½]

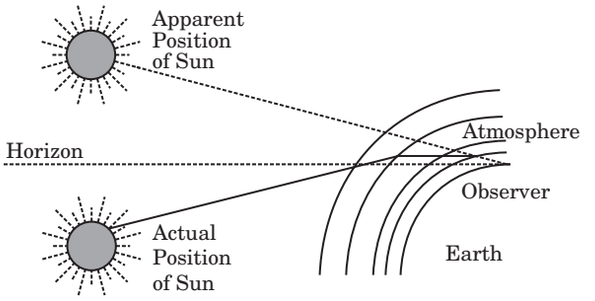
(a) Twinkling of stars: It is due to atmospheric refraction. As light travels from the star towards the Earth, it refracts several times due to the change in the density of the atmosphere. The density decreases as the distance from the sea level increases. The object is always seen in the direction of light reaching the observer's eye so it appears higher than its actual position. [½]

Due to the change in the density of layers, refractive indices of the layers also changes. Due to the variation in refractive indices, the light from a star passes through atmospheric air changing its path and therefore, intensity of light reaching the eye is different. It leads to the twinkling of stars. [½]



[1]

(b) Advanced sun-rise and delayed sun-set: As light travels from the Sun towards the Earth, it refracts several times due to the change in the density of the atmosphere. The density decreases as the distance from the sea level increases. The object is always seen in the direction of light reaching the observer's eye so it appears higher than its actual position. This is the reason there is a shift in the position of the Sun by about 0.5°. Therefore, the sun appears to rise early and set late. [1½]



[1]

Smart Notes .....

CHAPTER 12

Electricity

Chapter Analysis with respect to Last 3 Years' Board Exams

List of Topics	**2016**	**2017**	**2018**
Electric current, potential difference and electric current		1Q (5 marks), 1Q (1 mark)	
Ohm's law; Resistance, Resistivity, Factors on which the resistance of a conductor depends	2Q (5 marks)	3Q (1 mark)	1Q (1 mark), 1Q (2 marks), 1Q (3 marks)
Series combination of resistors, parallel combination of resistors and its applications in daily life	2Q (1 mark)	2Q (3 marks)	1Q (3 marks)
Heating effect of electric current and its applications in daily life		1Q (2 marks)	1Q (3 marks)
Electric power, Inter relation between P, V, I and R			
	1Q (3 marks)	1Q (3 marks)	

On the basis of above analysis, it can be said that from exam point of view Series combination of resistors, parallel combination of resistors its applications in daily life Ohm's law, Resistance, Resistivity, Factors on which the resistance of a conductor depends are the most important topics of the chapter. This chapter is important from exam point of view.

Summary

Knowing your Chapter at Glance:

- A switch makes a conducting link between the cell and the bulb.
- A continuous and closed path of an electric current is called an electric circuit.

  Electric charge is the property of matter due to which it produces and experience electrical effects.

Charges are of two types:

(a) Positive charge

(b) Negative charge

- The unit of electric charge is **coulomb** and 1 coulomb is the charge contained in 6x1018 electrons.

Properties of electric charge

(a) Electric charges can neither be destroyed nor be created.

(b) Charges are additive i.e. total charge is the algebraic sum of the individual charges.

- Unlike (opposite) charges attract each and like (similar) charges repel each other.

COULOMB'S LAW

The force of attraction or repulsion between two charges is directly proportional to the product of two charges and inversely proportional to the square of distance (r) between them,

$F = \frac{K\, q_1 q_2}{r^2}$ where K is constant of proportionality.

- Electrostatics is the branch of electricity, which deals with the study of charges at rest.

ELECTRIC CURRENT

Electric Current can be defined as the rate of flow of electric charge through any section of a conductor.

or

The quantity of charge flowing per unit time.

$$I = \frac{Q}{t} \text{ or } Q = It$$

- SI unit of current is Ampere (A)

$$1 \text{ Ampere} = \frac{1 \text{ coulomb}}{1 \text{ second}}$$

Therefore, 1 ampere of current is said to be flowing through the conductor if one coulomb of charge flows through it in one second.

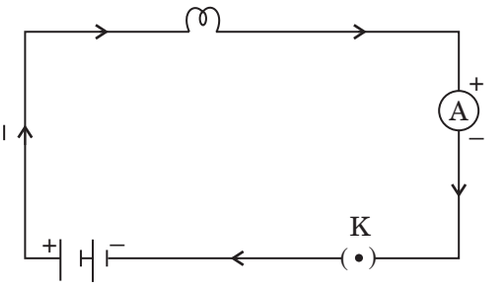
- 1 mA (milliampere) =10 – 3 A

  1 μ A (microampere) = 10 – 6 A
- Ammeter is the instrument used for measuring the current and has low resistance.

  It is connected in series always. The symbol is

DIRECTION OF CURRENT

Conventional current is said to flow from positive to negative, that is, opposite to the flow of electrons.



ELECTRIC POTENTIAL DIFFERENCE (or POTENTIAL DIFFERENCE)

Electric potential difference between two points P and Q on a conductor through which a current is flowing is defined as the amount of work done to move a unit charge from P to Q.

$$V = \frac{W}{Q} \text{ or } W = QV$$

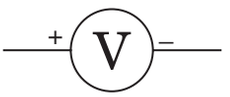
V = Electric potential difference, Q = charge, W = work done.

The S.I. unit of electric potential difference is volt (V)

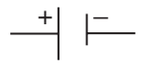
$$1 \text{ Volt (V)} = \frac{1 \text{ Joule (J)}}{1 \text{ Coulomb (C)}}$$

Electric potential difference or potential difference is said to be one volt if one joule of work is done to move one coulomb of charge from one point to other.

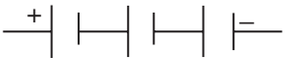
- Voltmeter is the instrument used for measuring potential difference between 2 points and has high resistance. It is always connected in parallel. Symbol is



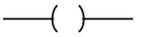
Symbols of commonly used components in circuit diagram



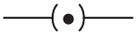
An electric cell



Battery

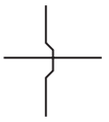


Open electric circuit



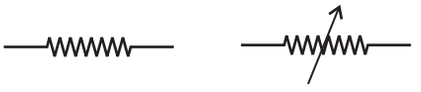
Closed electric circuit

Connecting wires

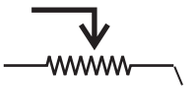


Wires crossing without joining

Electric bulb

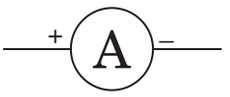


Resistor

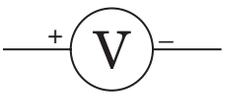


Rheostats

Galvanometer



Ammeter



Voltmeter

Ohm's Law

Potential difference across the two points of a metallic conductor is directly proportional to current through the circuit provided that temperature remains constant.

$I \propto V$

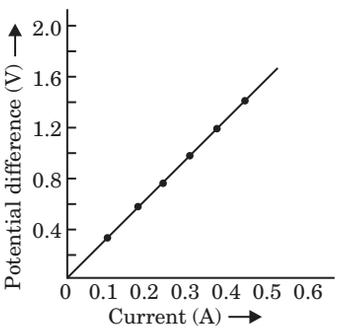
$V \propto I$ V = Potential difference

$V = RI$ R = Resistance

I = Current

Here, R is called the electrical resistance or resistance of the conductor.

- Thus, V/I is a constant ratio which is called resistance (R).



- Resistance is the property of a conductor to resist the flow of charges through it.

$$R = \frac{V}{I}$$

- The S.I. unit of resistance is Ohm (Ω) $\quad 1 \text{ Ohm } (\Omega) = \dfrac{1 \text{ volt (1 V)}}{1 \text{ Ampere (1 A)}}$

- The resistance of a conductor is said to be one ohm if a current of one ampere flows through it when a potential difference of one volt is applied across its ends.

FACTORS AFFECTING RESISTANCE OF A CONDUCTOR

- Resistance of a conductor is directly proportional to its length

$$R \propto l$$

R = Resistance, l = length of wire.

- Resistance of a conductor is inversely proportional to cross-section area (thickness) of the conductor.

$$R \propto \frac{1}{A}$$

- Different metals offer different resistances to the flow of current. This is also called as the specific resistance or resistivity of a metal.
- The resistance of a conductor changes with temperature.

$$R \propto \ell$$
$$R \propto \frac{1}{A}$$
$$R \propto \frac{\ell}{A}$$
$$R \propto \frac{\rho\ell}{A}$$

where,

R	-	Resistance
ρ	-	Resistivity
l	-	Length of a conductor
A	-	Cross-sectional area

RESISTIVITY

If the length of the wire is 1 m and cross-section area is 1 m^2,

$$R = \frac{\rho l}{A}$$
$$R = \frac{\rho \times 1}{1^2}$$
$$\Rightarrow R = \rho$$

- Therefore, resistivity of a material is defined as the resistance offered by a cube of side 1 m of that material.
- The S.I. unit of resistivity is Ωm.
- Resistivity does not change with change in length or area of cross sectional but it changes with change in temperature.
- Resistivity range of metals and alloys is 10-8 to 10-6 Ωm.
- Range of resistivity of insulators in 1012 to 1017 Ωm.
- Resistivity of alloy is generally higher than that of its constituent metals.
- Alloys do not oxidise readily at high temperature,so they are commonly used in electrical heating devices.
- Copper and aluminum are used for electrical transmission lines as they have low resistivity.
- Semiconductors are materials having resistivity between that of insulator and a conductor. They are used in making integrated circuits.
- Superconductors are materials that lose their resistivity at low temperature. The phenomenon of complete loss of resistivity by substances below a certain temperature is called superconductivity.

RESISTANCES IN SERIES

Resistances are said to be connected in series if they are joined end to end and the same current flows through each one of them, when a potential difference is applied across the combination.

Then, equivalent resistance of the combination

$$R = R1 + R2 + R3$$

RESISTANCES IN PARALLEL

Resistors are said to be in a parallel connection if one end of each resistance is connected to one point and the other is connected to another point. The potential difference across each resistor is the same and is equal to the applied potential difference between the two points.

Then, equivalent resistance of the combination

$$\frac{1}{R_e} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$$

Heating effect of current

When an electric current is passed through a conductor, heat is produced in it. This is known as Joule's Heating Effect. Mathematically, it can be expressed as

$$H = I^2Rt$$

Electrical energy

The total work done by a current in an electric circuit is known as Electric Energy.

$$W = H = VIt = I^2Rt = \frac{V^2}{R}t$$

S.I. unit of energy is Joule(J).

1 KJ = 1000 J

Electric Power

The rate at which work is done by an electric current is called Electric Power.

$$P = VI$$

$$P = I^2R$$

$$P = \frac{V^2}{R}$$

S.I. unit of power is Watt(W).

$$1 \text{ watt} = \frac{1 \text{Joule}}{1 \text{second}} = 1 \text{ volt} \times 1 \text{ ampere}$$

$1 W = 1 Js^{-1} = 1 VA$

1 kilowatt = 1000W

1 Horse Power = 746 W

- The commercial unit of electric energy is called kilowatt hour (kWh) or unit.

  1 KWh = 3.6 × 106 J

  1 KWh = 1 unit of electrical energy.

  1 KW = 1000 W

Applications of heating effect of current

- The following electrical appliances are based on heating effect: Electric iron, geyser, toaster, oven, kettle etc.
- **Electric fuse**: If the electric current flowing through the circuit increases above a specified value, more heat is produced, the fuse melts, breaks the circuit and therefore saves the valuable electrical appliances and gadgets.

Power rating

It is the electrical energy consumed per second by the appliance when connected across the marked voltage of the mains.

Efficiency of an electrical device

It is ratio of the output power to the input power.

$$\text{Efficiency } \eta = \frac{\text{Output power}}{\text{Input power}}$$

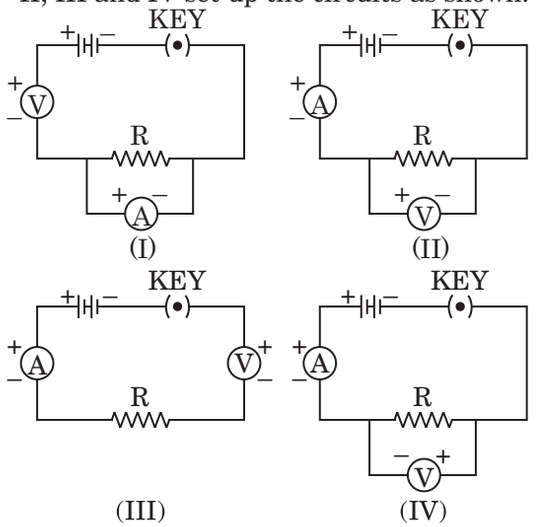
PREVIOUS YEARS' EXAMINATION QUESTIONS

1 Mark Questions

1. Mention any two factors on which the resistance of a cylindrical conductor depend

[TERM 1, 2011, 2013]

2. While performing the experiment on studying the dependence of current (I) on the potential difference (V) across a resistor, four students I, II, III and IV set up the circuits as shown:

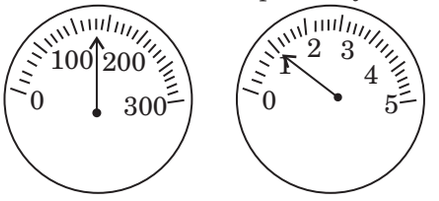


The correct result will be obtained by student:

(a) I
(b) II
(c) III
(d) IV

[TERM 1, 2011]

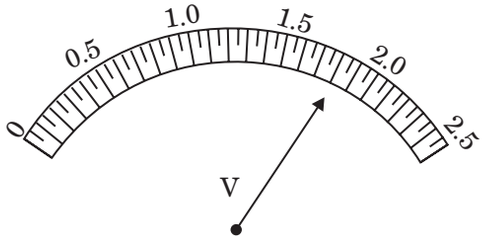
3. The figures given below show the readings of a milliammeter and a voltmeter connected in an electric circuit. Assuming that the instruments do not have any zero error, the current flowing through the circuit and the potential difference across the conductor respectively are



(a) 160 mA and 1.1 V
(b) 130 mA and 1.2 V
(c) 130 mA and 1.1 V
(d) 130 mA and 1.5 V

[TERM 1, 2011]

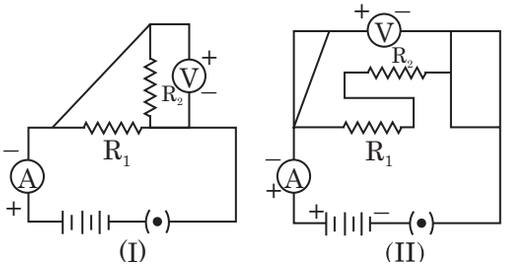
4. What is the least count of the following voltmeter?



(a) 0.5 V
(b) 0.1 V
(c) 0.05 V
(d) 0.005 V

[TERM 1, 2011, 2013, 2015, 2017]

5. The resistors R1 and R2 are connected in:
(a) Parallel in both circuits
(b) Series in both circuits
(c) Parallel in circuit I and in series in circuit II.
(d) Series in circuit I and in parallel in circuit II

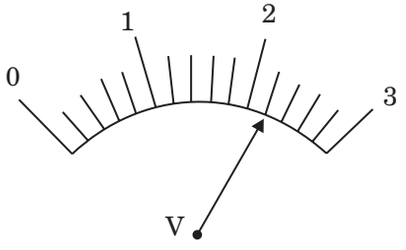


[TERM 1, 2011]

6. Which is having more resistance: A 100 W bulb or a 60 W bulb?

[TERM 1, 2013]

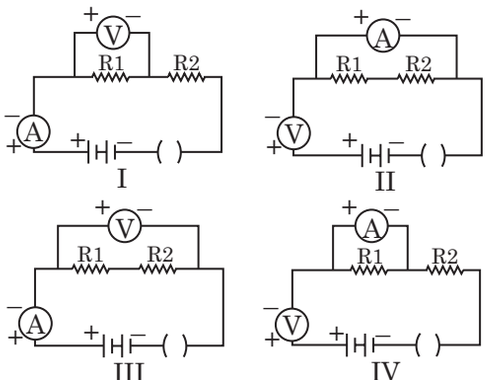
7. Four students measured the following readings by observing, the position of pointer of voltmeter



(a) 2.5 V
(b) 2.0 V
(c) 2.2 V
(d) 2.4 V

[TERM 1, 2013]

8. In the experiment on finding equivalent resistance of two resistors, connected in series, four students I, II, III and IV set up the circuit as shown below:



The correct connections have been made by student
(a) I
(b) II
(c) III
(d) IV

[TERM 1, 2013]

9. If two resistances of 2 ohm each are connected in parallel, the equivalent resistance is
(a) 1 ohm
(b) 2 ohm
(c) 4 ohm
(d) 8 ohm

[TERM 1, 2013]

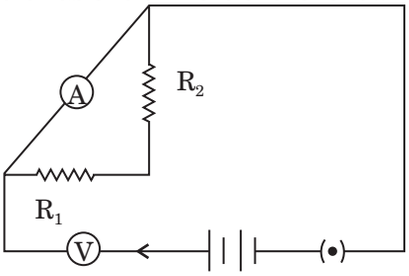
10. While performing the experiment to study the dependence of current on potential difference if the circuit that is used to measure current and voltage is kept on for a long time then
(a) The voltmeter will start giving wrong readings
(b) The ammeters zero error will change
(c) The resistor will get heated up changing the value of R
(d) The potential difference of the cell will change

[TERM 1, 2013]

11. What is meant by the statement that the potential difference between two points is 1 volt?

[TERM 1, 2014]

12. For carrying out the experiment, on finding the equivalent resistance of two resistors connected in series, a student sets up the circuit as shown. On further verification he finds out that the circuit has one or more of the following faults.



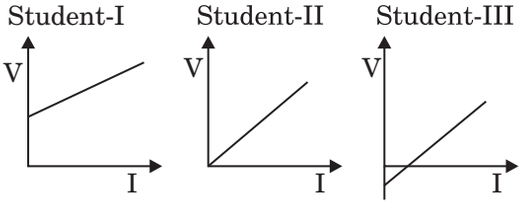
(i) The resistors R_1 and R_2 have not been correctly connected in series.
(ii) The voltmeter has not been correctly connected in the circuit.
(iii) The ammeter has not been correctly connected in the circuit.

Out of these three, the actual fault in the circuit is/are:

(a) Both (i) and (ii)
(b) Both (ii) and (iii)
(c) Only (i)
(d) Only (ii)

[TERM 1, 2014]

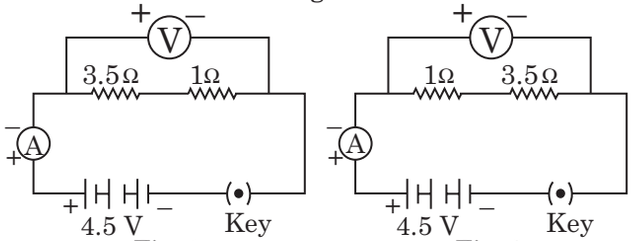
13. In the experiment on studying the dependence of current I on the potential difference V, three students plotted the following graphs between V and I. The graph that is likely to be correct is that of:



(a) Student I only
(b) Student II only
(c) Student III only
(d) All the three students

[TERM 1, 2014, 2018]

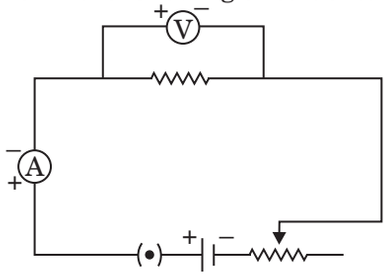
14. For the circuits shown in figure-1 and figure-2 the ammeter reading would be:



(a) 1.0 A in figure 1 and 0.0 A in figure 2
(b) 0.0A in both
(c) 1.0A in both
(d) 1.0A in figure 1 and 1.0A in figure 2

[TERM 1, 2014]

15. The two circuit components shown connected in parallel in the following circuit are:

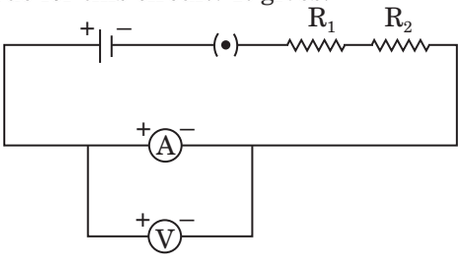


(a) Rheostat and voltmeter
(b) Voltmeter and resistor
(c) Voltmeter and ammeter
(d) Ammeter and resistor

[TERM 1, 2014]

16. To determine the equivalent resistance of a series combination of two resistors R_1 and R_2, a student arranges the following set up.

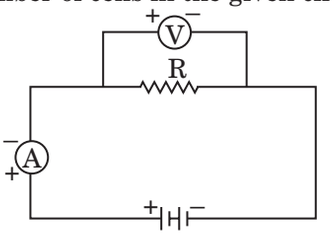
Which one of the following statements will be true for this circuit? It gives:



(a) Incorrect reading for both current I and potential difference V.
(b) Correct reading for current I, but incorrect reading for potential difference V.
(c) Correct reading for potential difference V but incorrect reading for current I.
(d) Correct readings for both V and I.

[TERM 1, 2014]

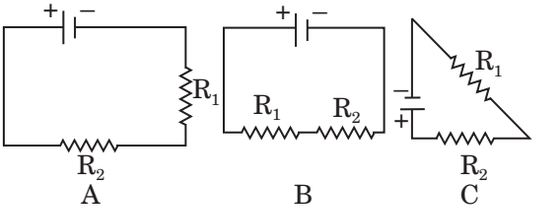
17. Which one of the following is correct about the current I through the circuit and potential difference V across the resistor R, if one increases the number of cells in the given circuit?



(a) V will increase, I will decrease
(b) I will increase, V will decrease
(c) Both I and V will increase
(d) Only V will increase and I will remain unchanged

[TERM 1, 2014]

18. Two resisters R_1 and R_2 are to be connected in series combination. Out of the following the correct combination is shown in:



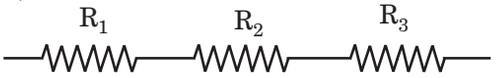
(a) Only A
(b) Only B
(c) Only C
(d) All of them A, B and C

[TERM 1, 2014]

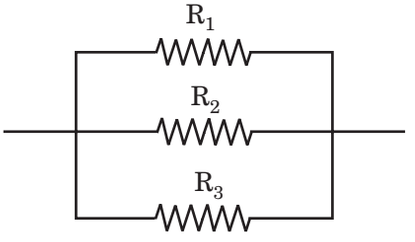
19. What happens to the resistance of a conductor when its area of cross-section is increased?

[TERM 1, 2015]

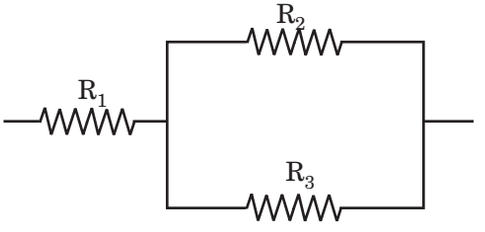
20. To determine the equivalent resistance of three resistors arranged in parallel four students connected the resistors as shown in figures A, B, C and D.



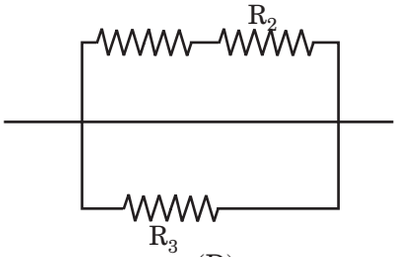
(A)



(B)



(C)

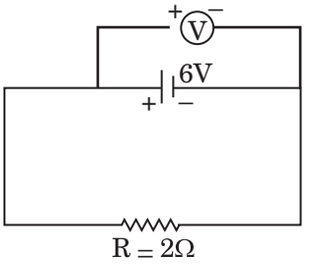


(D)

Which one is correct?
(a) A
(b) B
(c) C
(d) D

[TERM 1, 2015]

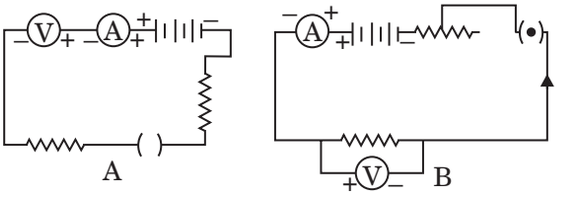
21. When a student connects a voltmeter across the terminals of a battery, it measures 6V. If he connects a resistance of 2Ω across the terminals of the battery as shown in the figure, then the current flowing through this resistance (R) must be:



(a) 2A
(b) 3A
(c) 4A
(d) 6A **[TERM 1, 2015]**

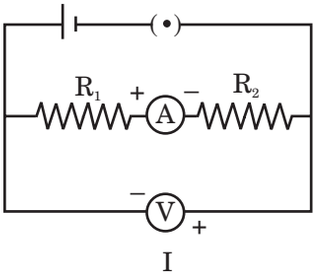
22. Which one of the following precautions is NOT to be taken while conducting the experiment to determine the equivalent resistance of two resistors connected in series?
(a) Get the circuit diagram checked by your teacher before passing current
(b) Connect +ve terminal of the ammeter to the +ve terminal of the battery
(c) Wait at least for 30 seconds after closing the key
(d) Take care that the battery is not short circuited **[TERM 1, 2015]**

23. Which of the following experimental set up is correct for verification of Ohm's law?

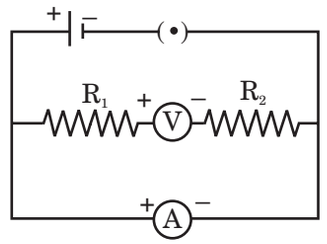


(a) A
(b) B
(c) Both A and B
(d) Neither A nor B **[TERM 1, 2015]**

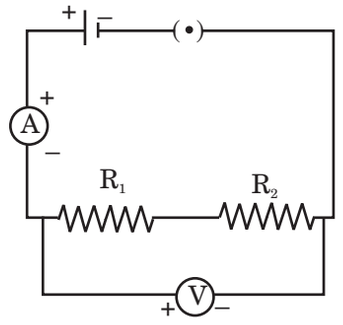
24. In the experiment to determine equivalent resistance of two resistorsR1 and R2 in series, which of the circuit diagrams show the correct way of connecting the voltmeter?
(a) I and II



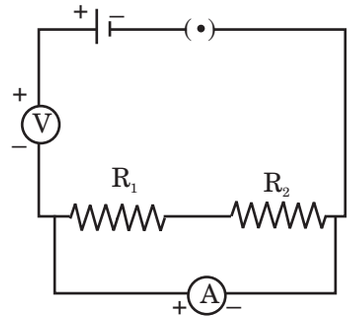
I



II



III

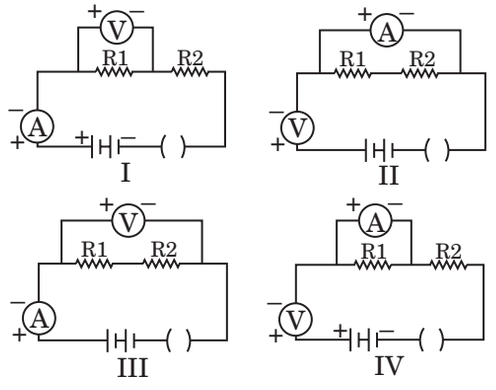


IV

(b) II and III
(c) I and III
(d) II and IV

[TERM 1, 2015]

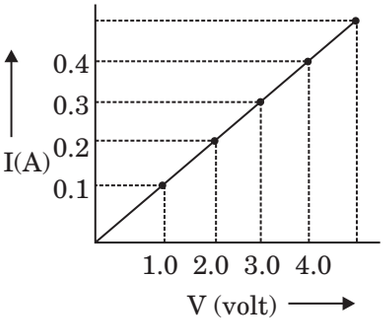
25. In the experiment on finding equivalent resistance of two resistors, connected in series, four students I, II, III and IV set up the circuit as shown below:



The correct connection have been made by student:
(a) I
(b) II
(c) III
(d) IV

[TERM 1, 2015, 2016, 2017]

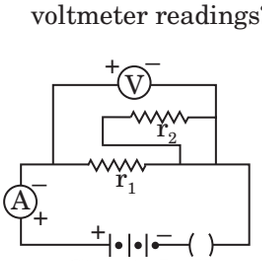
26. In the experiment to study the dependence of current on potential difference across a resistor, a student obtained a graph as shown in the diagram. The value of resistance of the resistor is:



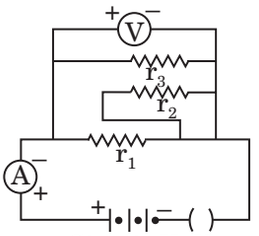
(a) 01 Ω
(b) 1 Ω
(c) 10 Ω
(d) 100 Ω

[TERM 1, 2017]

27. Study the two circuits I and circuit II shown below. In circuit I, ammeter reads current I_1 and voltmeter reads voltage V_1. In the circuit II, ammeter reads current I_2 and voltmeter reads voltage V_2. Which one of the following is the current statement about the ammeter and voltmeter readings?



Circuit I



Circuit II

(a) $I_1 > I_2; V_1 = V_1$
(b) $I_1 < I_2; V_1 = V_1$
(c) $I_1 > I_2; V_1 > V_2$
(d) $I_1 < I_2; V_1 < V_2$

[TERM 1, 2017]

2 Mark Questions

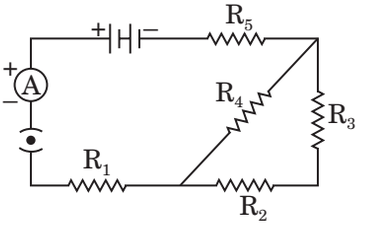
28. Calculate the electrical energy consumed by a 1200W toaster in 20 minutes.

[TERM 1, 2011]

29. Why do the wires connecting an electric heater to the mains not glow while its heating element does?

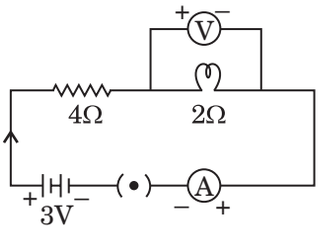
[TERM 1, 2011]

30. Consider the following circuit diagram. If $R_1 = R_2 = R_3 = R_4 = R_5 = 3\Omega$ find the equivalent resistance of the circuit.



[TERM 1, 2014]

31. Study the following electric circuit.



[TERM 1, 2015]

32. Three resistors of 10Ω, 15Ω, 5Ω are connected in parallel. Find their equivalent resistant.

[TERM 1, 2016]

33. Why do we use copper and aluminum wire for transmission of electric current? Why not iron?

[TERM 1, 2017]

34. The values of current (I) flowing through a given resistor of resistance (R), for the corresponding values of potential difference (V) across the resistor are as given below:

V (volts)	0.5	1.0	1.5	2.0	2.5	3.0	4.0	5.0
I (amperes)	0.1	0.2	0.3	0.4	0.5	0.6	0.8	1.0

[TERM 1, 2018]

3 Mark Questions

35. (a) Why do copper or aluminum wires generally used for electrical transmission and distribution purposes?

(b) Two wires, one of copper and other of manganin, have equal lengths and equal resistances .Which wire is thicker? Given that resistivity of copper is lower than that of manganin. **[TERM 1, 2011]**

36. Resistance of a metal wire of length 1m is at . If the diameter of the wire is 0.3mm, what will be the resistivity of the metal at that temperature?

[TERM 1, 2011]

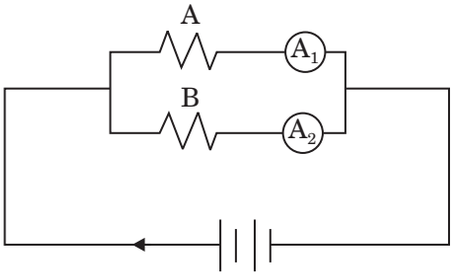
37. (i) What precautions should be taken to avoid the overloading of domestic electric circuits?

(ii) An electric oven of 2 kW power rating is operated in a domestic electric circuit that has a current rating of 5A. If the supply voltage is 220V, what result do you expect? Explain. **[TERM 1, 2011]**

38. State the law that relates current through a conductor and the potential difference between its ends. Represent the law mathematically. Represent graphically, the variation of current I as a function of potential difference V.

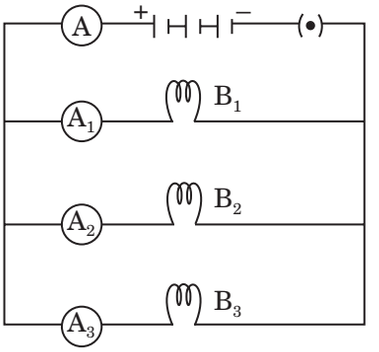
[TERM 1, 2013]

39. In a circuit, the two resistance wires A and B are of same length and same material, but A is thicker than B. Which ammeter A1or A2 will indicate higher reading for current? Give reason.



[TERM 1, 2013, 2015]

40. Study the circuit shown in which three identical bulbs B_1, B_2 and B_3 are connected in parallel with a battery of 4.5 V



(i) What will happen to the glow of other two bulbs if the bulb B_3 gets fused?

(ii) If the wattage of each bulb is 1.5 W how much reading will the ammeter A show when all the three bulb glow simultaneously.

(iii) Find the total resistance of the circuit.

[TERM 1, 2014]

41. Name the physical quantity which is (i) same (ii) different, in all the bulbs when three bulbs of:

(a) Same wattage are connected in series

(b) Same wattage are connected in parallel

(c) Different wattage are connected in series

(d) Different wattage are connected in parallel

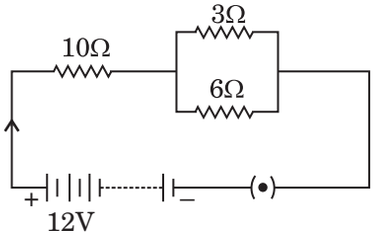
[TERM 1, 2014]

42. (a) The components of an electric circuit are 0.5 m long nichrome wire XY, an ammeter, a voltmeter; four cells of 1.5 V each, rheostat and a plug key. Draw a diagram of the circuit to study the relation between potential difference across the terminals X and Y of the wire and current flowing through it.

(b) State the law that relates potential difference across a conductor with the current flowing through it.

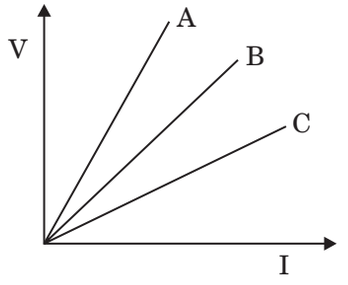
[TERM 1, 2014]

43. Consider the circuit shown in the diagram. Find the current in 3Ωresistor.



[TERM 1, 2015]

44. (a) A student performs an experiment with 4 cells and a resistance wire and an ammeter in series and observes that when the number of cells in the circuit is decreased, the value of current through the wire also decreases. Name the law that is involved in the experiment and write its mathematical form. V-I graph for two resistors , and their series combinations are shown in the figure below. Which graph represents the series combination of the other two? Give reason.



(b) Write difference between ammeter and voltmeter.

[TERM 1, 2015, 2017]

45. (a) Write Joule's law of heating.

(b) Two lamps, one rated 100 W; 220 V, and the other 60 W; 220 V, are connected in parallel to electric main supply. Find the current drawn by two bulbs from the line, if the supply voltage is 220 V.

[TERM 1, 2016, 2018]

46. (a) Fuse acts like a watchman in an electric circuit. Justify this statement.

(b) Mention the usual current rating of the fuse wire in the line to

(i) lights and fans

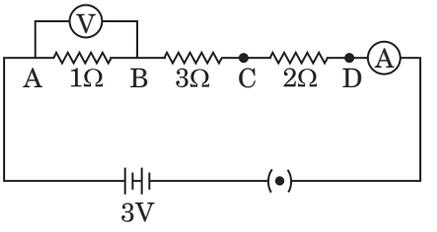
(ii) appliance of 2kw or more power

[TERM 1, 2013]

47. Resistance of three resistors are given as R_1 = 10Ω, R_2 = 20Ω, R_3 = 30Ω. Calculate the effective resistance when they are connected in series. Also calculate the current flowing when the combination is connected to a 6V battery.

[TERM 1, 2017]

48. How would the reading of voltmeter (V) change if it is connected between C and D? Justify your answer.



[TERM 1, 2017]

49. Show how would you join three resistors, each of resistance 9Ω so that the equivalent resistance of the combination is

(i) 13.5Ω (ii) 6Ω

[TERM 1, 2018]

50. (a) List the factors on which the resistance of a conductor in the shape of a wire depends.

(b) Why are metals good conductors of electricity whereas glass is bad conductor of electricity? Give reasons.

(c) Why are alloys commonly used in electrical heating devices? Give reasons.

[TERM 1, 2018]

5 Mark Questions

51. Two resistors of resistance 3 ohm and 6 ohm respectively are connected to a battery of 6V so as to have: Maximum resistance and maximum current. Suggest the probable method of resistor combination and the corresponding current that will flow through the circuit. Which sort of connection is preferable in house hold circuits? Give one reason.

[TERM 1, 2013]

52. Two identical resistors, each of resistance 50 Ohm are connected (i) in series (ii) in parallel, in turn; to a battery of 10 V. Calculate the power consumed in the combination of resistor in the two cases and ratio of the power consumed in the combination of resistor in the two cases.

[TERM 1, 2013]

53. (a) A fuse wire melts at 5A .If it is desired that the fuse wire of same material melt at 10 A, then whether the new fuse wire should be of smaller or larger radius than the earlier one? Give reasons for your answer.

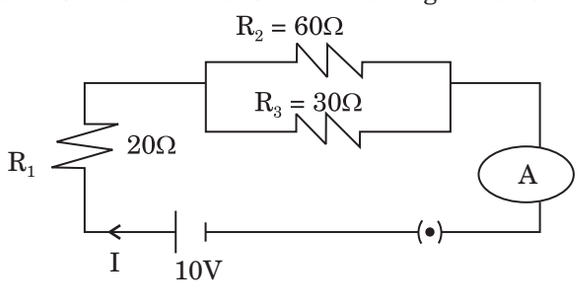
(b) If the radius of a current carrying conductor is halved, how does current through it change?

[TERM 1, 2016]

54. Define resistance of a conductor. State the factors on which resistance of a conductor depends. Name the device which is often used to change the resistance without changing the voltage source in an electric circuit. Calculate the resistance of 50 m length of wire of cross sectional area 0.01 square mm and of resistivity $5 \times 10^{-8}\Omega$m.

[TERM 1, 2016]

55. For the circuit shown in the diagram calculate.



(a) the total effective resistance of the circuit

(b) the total current in the circuit

(c) the value of current through 20Ω resistor

[TERM 1, 2017]

Solutions

1. The resistance of an electric cylindrical conductor depends on its

(i) Length

(ii) Area of Cross section

It is directly proportional to the length (l) and inversely proportional to the area of cross section (A). [1]

2. To study the dependence of current (I) on the potential difference (V) across a resistor in acircuit, ammeter is always connected in series and voltmeter is connected in parallel across the points between which potential difference is to be measured. Also, for the circuit to work, the positive terminal of the ammeter and the voltmeter is connected to the positive terminal of the battery. [1]

Hence, option (b) is correct.

3. Consider the figure of milliammeter. There are 10 intervals between 100mA and 200 mA readings. Therefore, the value of each interval will be:

$$\frac{200-100}{10} = \frac{100}{10} = 10\text{mA}$$

Because the needle is at the third interval, so the reading will be:

100 + 30 = 130 mA [½]

Now, consider the voltmeter. There are 10 intervals between 0V and 2 V readings. Therefore, the value of each interval will be:

$$\frac{2-0}{10} = \frac{2}{10} = 0.2\text{V}$$

Because the needle is at the sixth interval, so the reading will be:

$0.2 \times 6 = 1.2$ V [½]

Hence, option (b) is correct.

4. The correct option is (c).

$$\text{least count} = \frac{\text{value measured in n divisions}}{\text{no.of divisions}}$$

$$= \frac{0.5}{10} = 0.05V$$

[1]

5. In figure I, the current will divide at junction of R_1 and R_2. Also, the voltage will remain the same at all the junctions, and we know that voltage remains the same in parallel connection. Hence, R_1 and R_2 are connected in parallel. [½]

In figure II, both R_1 and R_2 are connected end to end and we know that an end to end connection is a series connection. So, both R_1 and R_2 are connected in series. [½]

Hence, option (c) is correct.

6. As $P = \frac{V^2}{R}$

$\therefore\ P \propto \frac{1}{R}$

It is clear that for same voltage if the power is high, the resistance will be smaller.

It means that the resistance of 60W bulb will be more than that of a bulb of a 100W. [1]

7. The correct option is (c).

After reading the scale, it can be seen that there are 5 number of divisions. So the least count of this voltmeter is 0.2 V and the reading of the voltmeter on the position of pointer is 2.2V. [1]

8. The correct option is (c) Student III.

The ammeter must be connected in series, with the battery and the series combination of the two resistors, and the voltmeter should be in parallel across the series combination of the two resistors. [1]

9. $R_1 = R_2 = 2\Omega$

$$\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2}$$

$$\frac{1}{R_p} = \frac{1}{2} + \frac{1}{2}$$

$$R_p = 1\Omega$$

Hence, the correct option is (a) 1 ohm. [1]

10. The correct option is (c) the resistor will get heated up changing the value of R. The resistors start heating up if the circuit is kept on for a long time and the value of R changes as the result of it. [1]

11. It means that one volt is the 1 joule of work done to move a charge of 1 coulomb from one point to the other.

Therefore, $1 \text{ volt} = \frac{1 \text{ Joule}}{1 \text{ Coulomb}}$ [1]

12. The correct answer is option B because voltmeter cannot be connected in series and Ammeter cannot be connected in parallel. [1]

13. The correct answer is option B. Only the graph made by student II is likely to be correct because it demonstrates a direct proportionality between the voltage and current, which is true according to the Ohm's law. [1]

14. The correct answer is option C. In both the circuits the key is closed. Resistance are connected in series therefore equivalent resistance in both the circuits is,

$R = 3.5 + 1 = 4.5\ \Omega$ [½]

Current flowing through the circuit can be calculated by the formula $I = \frac{V}{R}$,

$\therefore I = \frac{4.5}{4.5} = 1A \left[\because V = 4.5 \text{and } R = 4.5\right]$ [½]

15. The correct answer is option B. The two components connected in parallel in the following circuit are Voltmeter and resistor. [1]

16. The correct answer is option B. This is because the voltmeter has been connected incorrectly in the circuit hence it will show incorrect reading for potential difference V. [1]

17. The correct answer is option C. Both I and V will increase. This is because if the numbers of cells are increased in the circuit the total potential difference would be the sum of potential difference of all the cells. Hence, V will increase. As, the potential difference increases current flowing through the circuit will increase as well. [1]

18. The correct answer is option D. This is because in all the circuits one end of both the resistance R_1 and R_2 is connected together at a single point and the remaining ends are connected to the positive and negative terminal of the battery. Hence, they are connected in series. [1]

19. Resistance of a conductor is inversely proportional to its area of cross-section. Therefore, when the area of cross-section increases, its resistance decreases. [1]

20. To determine the equivalent resistance of three resistors arranged in parallel, option B is correct. This is because the starting point of all the three resistors are at higher potential end whereas the ending point of all the three resistors are at lower potential end. [1]

21. Current flowing through the resistor R is given by,

$I = \frac{V}{R}$ [½]

The voltage measured is 6V whereas the resistance is 2Ω, therefore

$$I = \frac{6}{2}$$ [½]

I = 3A

Hence, the current flowing through the resistor R is 3A. Hence option (b) is correct.

22. Immediately after closing the key, current starts flowing and we can conduct the experiment. Wait time of 30 seconds is not required. Therefore, option (c) is not to be taken as precaution. [1]

23. Experimental setup shown in circuit diagram B is correct for the verification of the Ohm's law. To verify Ohm's law, we need to plot a graph with V along x-axis and I along y-axis and for this, we need a rheostat present in the circuit as shown in setup B and a voltmeter across the resistors and an ammeter in series. [1]

24. Circuit diagram I and III (option C) show correct way of connecting the voltmeter to determine equivalent resistance of two resistors R_1 and R_2 in series because voltmeter must be connected in parallel across the resistors. [1]

25. In the experiment on finding equivalent resistance of two resistors, connected in series, the correct connections have been made by student III as voltmeter should be in parallel and ammeter should be in series. [1]

Therefore, option c is correct.

26. As graph is uniform so we can take any value of V and I from the graph.

$$R = \frac{V}{I} = \frac{1}{0.1}$$

R = 10 Ω [1]

Hence the correct option is (c) 10Ω.

27. Ammeter reading will be less in circuit I(resistances are connected in series) than in circuit II(resistances are connected in parallel) as total resistance of circuit I is more than total resistance of circuit II. There will be no change in the reading of voltmeter because applied voltage remains the same in both the circuits. [1]

28. Power = 1200W = $\frac{1200}{1000}$ = 1.2 kW

Time = 20 minutes = $\frac{20}{60} = \frac{1}{3}$ hours [1]

Energy = Power × Time

Energy = $1.2 \times \frac{1}{3}$ = 0.4 kWH

Hence, the energy consumed by the toaster is 0.4kWH. [1]

29. The heating element of the heater is made up of alloy which has very high resistance so when current flows through the heating element, because of high resistance, it becomes hot and glows red. On the contrary the resistance of the cord is usually low, as it is made up of copper or aluminum and hence it does not glow. [2]

30. It is given that $R_1 = R_2 = R_3 = R_4 = R_5 = 3\Omega$

In the circuit, R_2 and R_3 are in series.

$\therefore$ $R_{23} = R_2 + R_3 = 3 + 3 = 6\Omega$

Now, R_{23} is connected parallel to R_4.

$$\therefore \frac{1}{R_{234}} = \frac{1}{R_{23}} + \frac{1}{R_4}$$ [1]

$$= \frac{1}{6} + \frac{1}{3} = \frac{1+2}{6} = \frac{3}{6} = \frac{1}{2}$$

$\Rightarrow$ $R_{234} = 2\Omega$

Now, R_1, R_5 and R_{23} are in connected series.

$\therefore R_{12345} = R_1 + R_5 + R_{234}$

= 3 + 3 + 2 = 8Ω

Hence, the equivalent resistance of the circuit is 8C. [1]

31. 4Ω and 2Ω are in series, so the resultant resistance is

$R_s = 4 + 2 \Rightarrow R_s = 6\Omega$ [1]

The current through the circuit is

$$I = \frac{V}{R}$$

$$I = \frac{3}{6}$$

$\Rightarrow$ I = 0.5 A [1]

32. Given, $R_1 = 10$, $R_2 = 15$, $R_3 = 5\Omega$

In parallel combination, the reciprocal of total resistance is;

$$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$$

$$\Rightarrow \frac{1}{R} = \frac{1}{10\Omega} + \frac{1}{15\Omega} + \frac{1}{5\Omega}$$

$$= \frac{3+2+6}{30}\Omega$$

$= \frac{11}{30}\Omega$ [1]

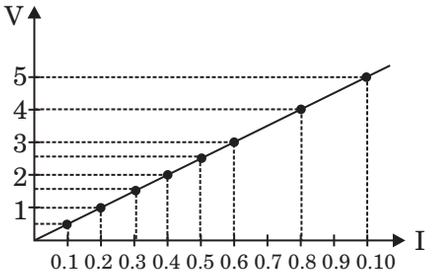
$\frac{1}{R} = \frac{11}{30}$ |

So, $R = \frac{30}{11}$ |

So, the equivalent resistance for the given resistors is $\frac{30}{11}$ | [1]

33. We use copper and aluminum wire for transmission of electric current as both copper and aluminum are good conductors of electricity and they offer least resistance to the flow of electricity. As compared to copper and aluminum, iron has more power loss due to its higher resistance. [2]

34. The graph between current (I) and potential difference (V) is as follows:



[1]

Resistance of the resistor (R) = Slope of the line

$= \frac{y_2 - y_1}{x_2 - x_1} = \frac{1 - 0.5}{0.2 - 0.1} = \frac{0.5}{0.1}$

Resistance of the resistor (R) = 5 Ω [1]

35. (a) Copper or aluminum wires are generally used for electrical transmission and distribution purposes as they have low resistivity. Low resistivity decreases the resistance and hence increases the amount of current in the circuit. Hence, they are good conductors of electricity. [1½]

(b) Manganin is an alloy of copper with nickel and manganese. Manganese and nickel are the two metals that have more resistivity than pure copper. Thus the manganin has to be thicker to have the same resistance. [1½]

36. Length of the metal wire, L = 1m

Diameter of the wire

$= 0.3\text{mm} = \frac{3}{10}\text{mm} = \frac{3}{100}\text{cm} = \frac{3}{100 \times 100}\text{m} = 3 \times 10^{-4}\text{m}$

$\therefore$ Radius of the wire $= \frac{3 \times 10^{-4}}{2} = 1.5 \times 10^{-4}\text{m}$

Resistance = 26 Ω [1]

Resistivity, $\rho = \frac{RA}{L} = \frac{R \times \pi r^2}{L}$

$= \frac{26 \times 3.14\left(1.5 \times 10^{-4}\right)^2}{1}$ [1]

$= 18.369 \times 10^{-8}$

$= 18.4 \times 10^{-8}\ \Omega\text{m}$

Hence, the resistivity of the metal at 20°C is 18.4×10^{-8} Ωm. [1]

37. (i) Precautions that needs to be taken are: -

(a) Avoid usage of too many electrical appliances at the same time. [½]

(b) More than one electrical appliances should never be connected to a single socket. [½]

(c) An electric fuse of appropriate current rating should be used along with the electric circuit. [½]

(ii) Power (P) = 2kW or 2000W

Voltage or potential difference (V) = 220V

Now, P = V × I

Or, $I = \frac{P}{V}$

$= \frac{2000}{220} = 9.09\text{A}$

The fuse wire can withstand current up to 5A only. Hence, it will, melt which results in short circuit. [1½]

38. The Ohm's law gives the relation between the current through a conductor and the potential difference between its ends. It states that, "If the temperature remains same then the electric current through a conductor is directly proportional to the potential difference between its ends. [1]

Mathematically,

$V \propto I$

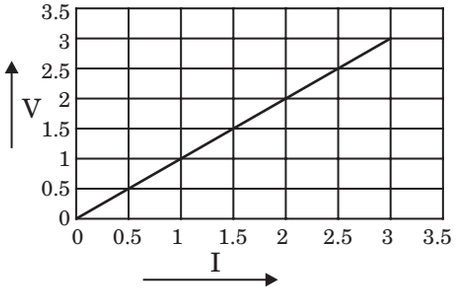
$\frac{V}{I} = R$

$V = IR$

Where R is a constant known as resistance. [1]

The following graph represents the variation of current with potential difference. If the current is taken on x-axis and potential difference on y-axis. It can be seen from the graph that the

potential difference varies linearly with the current. So we can say that potential difference across the end of the conductor is directly proportional to the current.



[1]

39. It is known that $R \propto \frac{l}{A}$

According to the question, the length and material of both the wires are same but the area is different because A is thicker than B. So, the area of A would be greater than that of B. Now as, resistance is inversely proportional to the area of the wire, it means if the area of the wire is increasing, the resistance will be decreasing accordingly. So, the resistance of wire A is less than that of wire B. [1]

Also, $I = \frac{V}{R}$ [1]

It means the current flow in a wire with low resistance is more than the wire with high resistance. So, there will be more current in wire A. Therefore, ammeter A1 will indicate the higher reading for current. [1]

40. (i) The other two bulbs will still glow even if bulb B_3 gets fused because all the bulbs are connected in a parallel connection. [1]

(ii) Wattage of each bulb is 1.5 W and the voltage of battery is 4.5 W.

Power is given by the formula, P = V × I

$\Rightarrow I = \frac{P}{V}$

Substitute the values of P and V in the formula

$\Rightarrow \mathrm{I} = \frac{1.5}{4.5} A$

$\Rightarrow \mathrm{I} = \frac{1}{3} A$

Total current

$= \mathrm{I} + \mathrm{I} + \mathrm{I} = 3\mathrm{I} = 3 \times \frac{1}{3} = 1\mathrm{A} \left[\because \mathrm{I} = \frac{1}{3}\mathrm{A}\right]$

The ammeter A will show the reading as 1A [1]

(iii) Resistance is given by the formula, $R = \frac{V}{I}$

$\therefore \mathrm{R} = \frac{4.5}{1} = 4.5\Omega$

Therefore, the total resistance of the circuit is 4.5Ω. [1]

41. (a) (i) When three bulbs of same wattage are connected in series then the electric current, potential difference across the bulb and the resistance will remain the same. [½]

(ii) No physical quantity would be different. [½]

(b) (i) When three bulbs of same wattage are connected in parallel then the electric current, potential difference across the bulb and the resistance will remain the same. [½]

(ii) No physical quantity would be different.

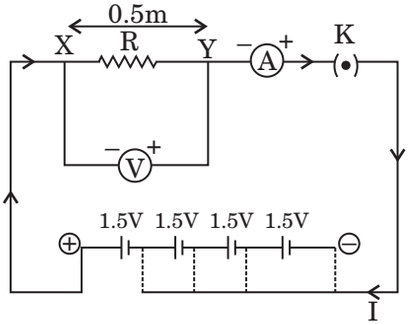
(c) (i) When three bulbs of different wattage are connected in series then the electric current would be equal. [½]

(ii) Potential difference across the bulb and the resistance will be different since they have different wattage. [½]

(d) (i) When three bulbs of different wattage are connected in parallel then Potential difference across the bulb would be the same. [½]

(ii) The electric current and the resistance will be different since they have different wattage. [½]

42. (a)The circuit diagram has been shown below:



[1]

(b) The law that relates potential difference across a conductor with the current flowing through is the Ohm's law. It states that "At constant temperature, the current flowing through a conductor is directly proportional to the potential difference across its ends." [1]

$V \propto I \Rightarrow V = IR$ [1]

43. The current in the circuit is

$$I = \frac{V}{R}$$

$$I = \frac{12V}{10\Omega + \frac{60\Omega \times 3\Omega}{6\Omega + 3\Omega}}$$

$$\Rightarrow I = \frac{12V}{10\Omega + 2\Omega} = 1A$$ [1]

Since the resistors in the parallel combination (6Ω and 3Ω)the potential difference will be same across both the resistance.

$$R_p = \frac{6\Omega \times 3\Omega}{6\Omega + 3\Omega} = 2\Omega$$

$V_p = IR_p = 1 \times 2 = 2$ V

Now, $I_{3\Omega} = \frac{V_p}{R_{3\Omega}} = \frac{2}{3}A$ [1]

Hence, current through 3Ω resistor $= \frac{2}{3}$A = 0.67A [1]

44. (a) This experiment is based on Ohm's law

$$\frac{V}{I} = \text{constant}$$

$$\frac{V}{I} = R$$

V = IR [½]

Where, V is the potential difference between two points

I is the current flowing

R is resistance

A represents the series combination of *B* and *C* because in series combination, the equivalent resistance becomes greater than the individual resistance. [½]

Also, slope of *A* is greater than *B* and *C*. Therefore, resistance of *A* is greater than *B* and *C*. [½]

(b)

Ammeter	Voltmeter
• It is to be connected in series. • It has comparatively low resistance. • It is used to find the amount of current flowing in the circuit.	• It is to be connected in parallel. • It has high resistance. • It is used to find the potential difference in the circuit.

[1½]

45. (a) Joule's law of heating states that "when electric current flows through resistance element, the flowing charges suffer resistance and the work done to overcome that resistance is converted into heat energy". [1]

(b) Let for first lamp,

P_1 = 100 W and V_1 = 220 V

$$I_1 = \frac{P_1}{V_1}$$

$$I_1 = \frac{100}{220} = 0.45A$$ [1]

For the second lamp, P_2 = 60 *W* and V_2 = 220 *V*

$$I_2 = \frac{P_2}{V_2}$$

$$I_2 = \frac{60}{220} = 0.27A$$

Therefore the current drawn by the first bulb is 0.45 A and by the second bulb is 0.27 A. [1]

46. (a) Fuse acts like a watchman in the electric circuit because the fuse is that part of the circuit which have a very low melting point, so, when a high amount of current is passed, high amount of heat is also generated in the fuse, so it melts and break the circuit and prevent us from fire. [1]

(b) (i) The usual current rating of fuse wire in the line to lights and fans is normally 15-20 A or less. [1]

(ii) The usual current rating of fuse wire in the line to the appliance of 2kW or more power is 30A. [1]

47. Let be the effective resistance of R_1, R_2 and R_3.

Here, R_1 = 10 Ω, R_2 = 20 Ω, R_3 = 30 Ω and they are connected in series with each other.

So, $R = R_1 + R_2 + R_3 = 10 + 20 + 30 = 60$ [1]

Therefore the equivalent resistance is 60Ω

Current flowing in the circuit when connected to a 6V battery is,

$$I = \frac{V}{R}$$ [1]

$$I = \frac{6}{60} = \frac{1}{10}$$

I = 0.1 A

Hence the current flowing in the circuit is 0.1 A. [1]

48. Let R be the total resistance of the circuit.

As all the resistance are connected in series with each other.

So,

$R = R_1 + R_2 + R_3 = 1 + 3 + 2$

$R = 6\ \Omega$ [1]

Current flowing through the circuit,

$$I = \frac{V}{R} = \frac{3}{6}$$

I = 0.5 A

Reading of voltmeter when connected between A and B.

$V_{AB} = IR_1 = 0.5 \times 1$

$V_{AB} = 0.5$ V [1]

Reading of voltmeter when connected between C and D.

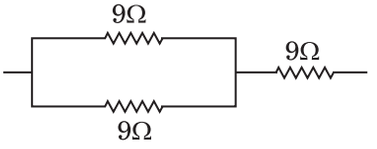
$V_{CD} = IR_3 = 0.5 \times 2$

$V_{CD} = 1.0$ V

Since the current flowing in the circuit will be same for all the resistors, so the potential difference will depend on the value of resistance of different resistors. [1]

Hence higher the resistance, higher the potential difference across each resistors.

49. (i) Let the two resistors are joined in parallel with one in series.

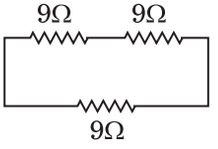


[½]

Equivalent resistance of the two resistors in parallel $= \frac{9 \times 9}{9 + 9} = \frac{81}{18} = \frac{9}{2} = 4.5\Omega$

Equivalent resistance of the combination of resistors now in series = 4.5 + 9 = 13.5 Ω [1]

(ii) Let the two resistors are joined in series with one in parallel.



[½]

Equivalent resistance of two resistors in series = 9 + 9 = 18 Ω

Equivalent resistance of the 18Ω resistor and 9Ω resistor arranged in parallel

$$= \frac{18 \times 9}{18 + 9} = \frac{162}{27} = 6\Omega$$

[1]

50. (a) Resistance of conductor depends on four factors which are as follows:

(i) Resistance depends on the temperature of the conductor. [½]

(ii) Resistance is inversely related to the area of cross section of the conductor.

$$R \propto \frac{1}{A}$$

[½]

(iii) Resistance depends on the material of the conductor which is represented by ρ.

$R \propto r$ [½]

(iv) Resistance of the conductor is directly related to the length of the conductor.

$R \propto 1$ [½]

(b) Number of free electrons in metals are more than the number of free electrons in glass. Therefore metal is a good conductor of electricity while glass is a bad conductor. [½]

(c) Alloys have low electrical conductivity (higher resistance) and low melting point. Hence alloys are used in electrical heating devices rather than pure metals. [½]

51. (i) To get maximum resistance, both the resistors should be connected in series. So, to get the effective resistance in series combination,

$R_s = R_1 + R_2$

$R_s = 3 + 6$

$R_s = 9\Omega$ [1]

To find out the corresponding current that will flow through this circuit,

Using Ohm's law, V = *IR*

As V = 6*V*

$$I = \frac{V}{R_s}$$

$$I = \frac{6}{9}$$

I=0.67A [1]

(ii) To get the maximum current through the circuit, the effective resistance of the circuit should be minimum. To get the minimum resistance, both the resistors should be connected in parallel. So to find out the effective resistance,

$$\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2}$$

$$\frac{1}{R_p}=\frac{1}{3}+\frac{1}{6}$$

$$R_p=2W$$

[1]

Using Ohm's law to find out the corresponding current through the circuit,

V = IR

$$V=IR$$

$$I=\frac{V}{R_p}$$

$$I=\frac{6}{2}$$

$$I=3A$$

[1]

In house hold circuits, there are many appliances which are needed to work out independently. So parallel connection is always preferred in the house hold circuits so that all the devices may work out independently and also the potential difference may remain same across each device. [1]

52. It is given that,

$R_1 = R_2 = 50\Omega$ and V = 10V

(i) The total resistance in series combination,

$$R_s = R_1 + R_2$$

$$R_s=50+50$$

$$R_s=100|$$

[1]

The power consumed in series combination,

$$P_s=\frac{V^2}{R_s}$$

$$=\frac{10^2}{100}P_s=1W$$

[1]

(ii) The total resistance in parallel combination,

$$\frac{1}{R_p}=\frac{1}{R_1}+\frac{1}{R_2}$$

$$=\frac{1}{50}+\frac{1}{50}$$

$$R_p=25W$$

[1]

The power consumed in parallel combination,

$$P_p=\frac{V^2}{R_p}$$

$$=\frac{10^2}{25}$$

$$P_p=4W$$

[1]

The ratio of power consumed in both the cases,

$$\frac{P_1}{P_2}=\frac{1}{4}$$

$P_1 : P_2 = 1 : 4$ [1]

53. (a) The new fuse wire should have large radius because current is inversely proportional to the resistance of the conductor and resistance of a conductor decreases on increasing the radius of conductor. [2½]

(b) Resistance of a conductor wire = $\frac{\rho L}{A}$. Where ρ = resistivity, L = length, A = cross section Area. So, if radius is halved, Area becomes $\frac{1}{4}$th and so resistance becomes 4 times.

So current becomes $\frac{1}{4}$th, if the potential difference across the conductor remains same. [2½]

54. Resistance is defined as the opposition to the flow of electrical current through a conductor. If 'V' be the potential difference between the two terminals of a conductor and 'I' be the current through it, then, [1]

$$\frac{V}{I}=\text{constant}=R$$

[1]

'R' is called the resistance of the material.

Factors on which resistance of the conductor depends are thickness or cross sectional area of the wire, length, temperature and the conductivity of the material that is used. [1]

Potentiometer is the device which is often used to change the resistance without changing the voltage source in an electric circuit.

As we know that $R = \frac{\rho L}{A}$ [1]

It is given that $\rho = 5 \times 10^{-8}$ Ωm, L = 50m and A = 0.01 square mm = $0.01 \times 10^{-6}m^2$

Hence using these values in $R = \frac{\rho L}{A}$

$$R=\frac{5\times10^{-8}\times50}{0.01\times10^{-6}}$$

$$R=\frac{5\times10^{-8}\times50}{10^{-8}}$$

$R = 250\ \Omega$

Hence the resistance of the required wire is 250 Ω. [1]

55. (a) Given, $R_1 = 20\ \Omega$

$R_2 = 60\Omega$

$R_3 = 30\Omega$

Total effective resistance around R_2 and R_3 which are connected in parallel is,

$$\frac{1}{R_{23}} = \frac{1}{R_2} + \frac{1}{R_3}$$

$$\frac{1}{R_{23}} = \frac{1}{R_2} + \frac{1}{R_3}$$

$$\frac{1}{R_{23}} = \frac{1}{60} + \frac{1}{30}$$

$$\frac{1}{R_{23}} = \frac{1+2}{60}$$

$$\frac{1}{R_{23}} = \frac{3}{60}$$

[1]

$$\frac{1}{R_{23}} = \frac{1}{20}$$

$R_{23} = 20\Omega$

As, R_1 and R_{23} are connected in series

So, the total effective resistance of the circuit is

$R = R_1 + R_{23}$

$R = 20 + 20$

$R = 40$ W [1]

(b) The total current in the circuit is

$$I = \frac{V}{R}$$

Where, V = 10 V

$$I = \frac{V}{R}$$

$$I = \frac{1}{4}$$

I = 0.25 A [2]

(c) The value of current through 20Ω resistor is same i.e. 0.25A because R_1 is connected in series. [1]

Smart Notes .....

Smart Notes .....

CHAPTER 13

Magnetic Effects of Electric Current

Chapter Analysis with respect to Last 3 Years' Board Exams

List of Topics	**2016**	**2017**	**2018**
Magnetic field, field lines, field due to a current carrying conductor, field due to current carrying coil or solenoid	1Q (1 mark)	1Q (5 marks)	
Force on current carrying conductor, Fleming's left hand rule	1Q (2 marks)		1Q (5 marks)
Electromagnetic induction. Induced potential difference, Induced current. Fleming's Right Hand Rule, Direct current	1Q (3 marks)	1Q (5 marks)	
Alternating current : frequency of AC. Advantage of AC over DC,. Domestic electric circuits	1Q (3 marks)		

On the basis of above analysis, it can be said that from exam point of view, Fleming's left hand rule, force on current carrying conductor and magnetic file lines are the most important topics of the chapter.

Summary

Knowing your Chapter at Glance:

- A magnet is a substance, which has both attractive and directive properties. Magnet is also known as Lodestone and it is chemically the oxide of iron (Fe_3O_4).
- H.C. Oersted first noticed the magnetic effect of electric current. According to him, a needle kept near the wire carrying current will deflect due to the magnetic field produced. Any change in the direction of current will show variation in the deflection.

PROPERTIES OF MAGNET

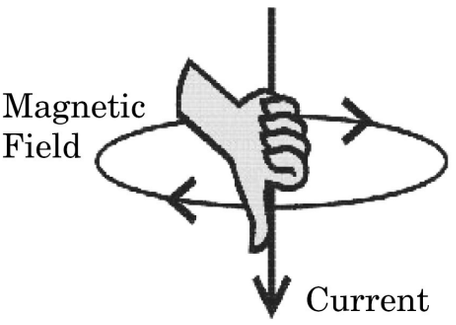
- Every magnet has two poles i.e. North and South pole.
- Like poles attract and Unlike poles repel each other.
- If a bar magnet is suspended by a thread and if it is free to rotate, its South Pole will move towards the North Pole of the earth and vice versa.
- Magnets attract objects of iron, cobalt and nickel.
- The space around them in which the force of attraction and repulsion can be detected. This space is known as magnetic field.
- SI unit of magnetic field is Tesla(T).
- Magnetic field has both magnitude as well as direction.
- We can describe the magnetic field around a magnet by magnetic field lines. These are the curved paths along which magnetic force is acting on them in the magnetic field of the bar magnet. These lines are called magnetic lines of forces.

CHARACTERISTICS OF FIELD LINES

1. Magnetic lines of force start from the North Pole and end at the South Pole(outside).
2. Field lines are closed curves.
3. Field lines are closer means greater is the strength of magnetic field.
4. Two magnetic lines of force can not intersect each other because if they do so, there would be two directions of magnetic field at that point, which is not possible.
5. Direction of field lines inside a magnet is from South to North.

Right Hand Thumb Rule

Imagine the straight conductor in your right hand such that the thumb points in the direction of current. The direction of curling of fingers of the right hand gives the direction of magnetic field lines.



Magnetic Field Due to Current Through a Straight Conductors

It can be represented by concentric circles at every point on conductor.

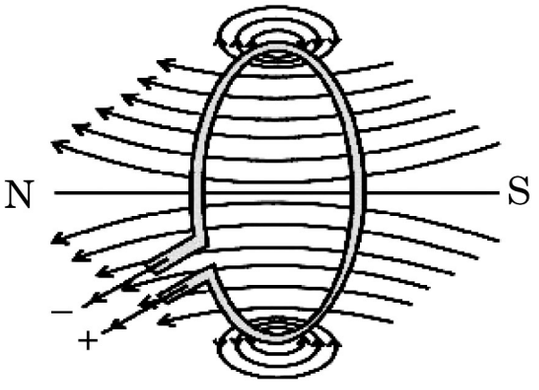
If the current (I) in the conductor is increased, then the strength of magnetic field is also increased.

$$\mathbf{B} \propto \mathbf{I}$$

If the distance (r) of the compass from the conductor is increased, the deflection of the needle decreases,

$$B \propto \frac{1}{r}$$

Magnetic Field Due to Current Through a Circular Loop



- It can be represented by concentric circles at every point.
- The direction of the magnetic field at the centre is perpendicular to the plane of the coil.

Factors affecting magnetic field of a circular current carrying conductor

Magnitude (B) of magnetic field

The magnitude of the magnetic field (B) at the centre of the coil is

1. Directly proportional to the current (I) flowing through it,

$$\mathbf{B \propto I}$$

Current is in clockwise direction

2. Inversely proportional to the radius (r) of the coil,

$$\mathbf{B \propto \frac{1}{r}}$$

3. Directly proportional to the total number of turns (N) in the coil,

$$\mathbf{B \propto N}$$

Looking at the face of the coil, if the current around that face is in clockwise direction, the face is the South Pole; while if the current around that face is in the anticlockwise direction, the face is the North Pole.

Current is in anticlockwise direction

An insulated copper wire wound on a cylindrical cardboard (or plastic) tube such that its length is greater than its diameter is called a solenoid.

1. The magnetic field lines inside the solenoid are nearly straight and parallel to its axis. Thus, the magnetic field inside a solenoid is uniform.
2. The magnetic field lines are exactly identical to those due to a cylindrical bar magnet with one end of the solenoid acting as a South Pole and its other end as a North-Pole. Thus, a current-carrying solenoid behaves like a bar magnet with fixed polarities at its ends.

The magnitude of the magnetic field inside the solenoid is

(i) Directly proportional to the current (I) flowing through the solenoid,

$$B \propto I$$

(ii) Directly proportional to the number of turns per unit length of the solenoid (n) and not on the total number of turns on the solenoid,

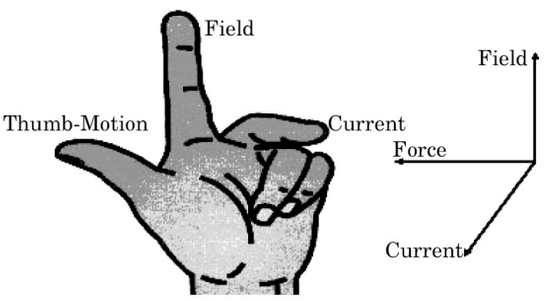
$$B \propto n$$

($n = \frac{N}{\ell}$, where N is the total number of turns in the solenoid and l is its length)

$$B \propto nI$$

- A permanent magnet is made from steel. As steel has more retentivity than iron, it does not lose its magnetism easily.
- Apart from different varieties of steel (carbon steel, chromium steel, cobalt and tungsten steel), some alloys like Alnico (aluminium, nickel and cobalt) and Nipermag (an alloy of iron, nickel, aluminum and titanium) are used to make very strong permanent magnets.
- An electromagnet is a temporary strong magnet and is just a solenoid with its winding on a soft iron core.
- Electro magnetic induction is the conversion of mechanical energy into electrical energy.
- Ampere suggested that when a current I passes through a conductor of length l placed in a perpendicular magnetic field B, then the force experienced is given by $F=IBl\sin\theta$, where θ is the angle between the length of the conductor and magnetic field.

Fleming Left-Hand Rule



- Stretch the thumb, the first finger and the central finger of the left hand so that they are mutually perpendicular to each other. If the first (fore) finger points in the direction of the magnetic field, the central finger points in the direction of current, then the thumb points in the direction of motion of the conductor (i.e., direction of force on the conductor).

ELECTRIC MOTOR

It is a device used to convert electrical energy to mechanical energy. It works on the principle of force experienced by a current carrying conductor in a magnetic field. The two forces in the opposite sides are equal and opposite.

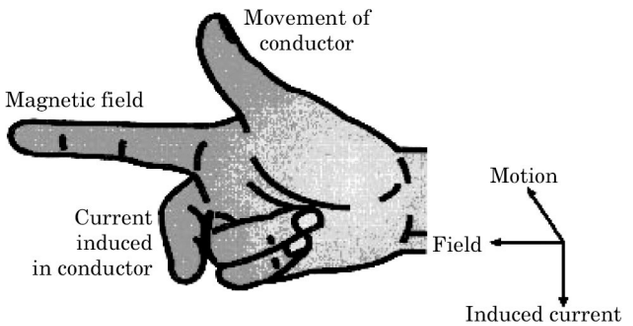
FARADAY'S LAW

The rate at which the magnetic flux linked with a coil changes, produces the induced emf or current. more the rate ,more the current and vice versa.

$$I = \frac{e}{R \times t} = \frac{\text{Change in flux}}{\text{Resistance} \times \text{Time}}$$

FLEMING'S RIGHT-HAND RULE (DYNAMO RULE)

Stretch the thumb, the fore finger and the central finger of the right hand so that they are mutually perpendicular to each other. If the first (fore) finger points in the direction of magnetic field, the thumb points in the direction of motion of the conductor, then the central finger points in the direction of induced current.



- Working principle of electric generator
- Used to find direction of induced current.
- Generator works on the principle of Electromagnetic Induction. It converts the mechanical energy available into electrical energy. A.C. Generator produces potential which reverses after every 180° rotation of the coil. D.C. Generator means the generator which produces unidirectional current.

DOMESTIC ELECTRIC CIRCUITS

The electric power to a house is supplied either through overhead wires or through underground cables. The cable has three separate insulated wires:

(a) Live wire (positive) with red insulation cover

(b) Neutral wire (negative) with black insulation cover

(c) Earth wire with green insulation cover

- The potential difference between live and neutral wire in India is 220V.

Alternating Current

An electric current which changes its direction (i.e., polarity) after a certain fixed interval of time is called alternating current.

Direct Current

An electric current which always flows in the same direction is called direct current. The polarities (+ve and -ve) of DC are fixed. The current supplied by a cell or a battery is DC.

Short-circuiting

'In household connections, short-circuiting occurs when the live (positive) wire and the neutral (negative) wire come in direct contact with each other.

Reasons of short-circuiting

(a) Damage to the insulation of the power-lines

(b) A fault in an electric appliance due to which current does not pass through it.

An electric fuse is a device, which is used in series to limit the current in an electric circuit so that it easily melts due to overheating when excessive current passes through it. A fuse is a wire of a material with very low melting point.

EARTHING

Connecting the outer frame of an appliance to earth to avoid shock caused by the fault or current leakage.

PREVIOUS YEARS' EXAMINATION QUESTIONS

1 Mark Questions

1. In domestic circuits the colour of neutral wire is:
(a) Black
(b) Red
(c) Green
(d) Orange **[TERM 1, 2013]**

2. State the effect of a magnetic field on the path of a moving charged particle.
[TERM 1, 2016]

2 Marks Questions

3. Why does a current carrying conductor experiences a force when it is placed in a magnetic field? State Fleming's left-hand rule.
[TERM 1, 2011]

4. Identify the poles of the magnet in the given figure (1) and (2).

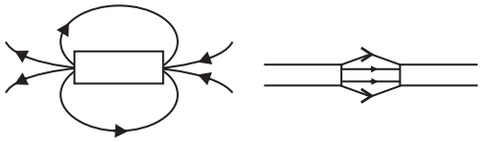


Figure I Figure II
[TERM 1, 2014]

5. Explain briefly two methods of producing induced current. **[TERM 1, 2015]**

6. State how the magnetic field produced by a straight current carrying conductor at a point depends on
(a) current through the conductor
(b) distance of point from conductor
[TERM 1, 2016]

3 Marks Questions

7. A student while studying the force experienced by a current carrying conductor in a magnetic field records the following observations.
(a) The force experienced by the conductor increases as the current is increased.
(b) The force experienced by the conductor decreases as the strength of the magnetic field is increased.
Which of the two observations is correct and why? What is the resistance of a conductor due to?
[TERM 1, 2013]

8. How will the magnetic field produced at a point due to a current carrying circular coil change if we:
(a) increase the current flowing through the coil?
(b) reverse the direction of current through the coil?
(c) increase the number of turns in the coil?
[TERM 1, 2014]

9. (a) Mention the factors on which the direction of force experienced by a current carrying conductor placed in a magnetic field depend.
(b) Under what condition is the force experienced by a current carrying conductor placed in a magnetic field maximum?
(c) A proton beam is moving along the direction of a magnetic field. What force is acting on proton beam?
[TERM 1, 2015]

10. Define alternating current and direct current. Explain why alternating current is preferred over direct current for transmission over long distances. **[TERM 1, 2016]**

11. A student performs an experiment to study the magnetic effect of current around a current carrying straight conductor with the help of a magnetic compass. He reports that
(i) The degree of deflection of the magnetic compass increases when the compass is moved away from the conductor.
(ii) The degree of deflection of the magnetic compass increases when the current through the conductor is increased.
Which of the above observations of the student appears to be wrong and why?
[TERM 1, 2016]

5 Marks Questions

12. Briefly explain an activity to plot the magnetic field lines around a bar magnet. Sketch the field pattern for the same specifying field directions. A region 'A' has magnetic field lines relatively closer than another region 'B'. Which region has a stronger magnetic field? Give a reason to support your answer.
[TERM 1, 2011]

13. Briefly explain an activity to plot the magnetic field lines around a straight current carrying conductor. Sketch the field pattern for the same, specifying current and field directions.
What happens to this field
(i) if the strength of the current is decreased?
(ii) if the direction of the current is reversed?
[TERM 1, 2011]

14. (a) State the rule to determine the direction of
(i) Magnetic field produced around a straight conductor carrying current
(ii) Force experienced by current-carrying straight conductor placed in a magnetic field which is perpendicular to it.
(iii) Current induced in a coil due to its rotation in a magnetic field.
(b) Name two safety measures commonly used in domestic electric circuits and appliances.
[TERM 1, 2014]

15. What is a solenoid? Draw the patterns of magnetic field lines of a solenoid through which a steady current flows. What does the pattern of field lines inside the solenoid indicate? Write a use of it.
[TERM 1, 2014]

16. (a) A coil of insulated copper wire is connected to a galvanometer. What will happen if a bar magnet is:
(i) Pushed into the coil with its north pole entering first?
(ii) Withdrawn from inside the coil?
(iii) Held stationary inside the coil?
(b) Name the above phenomenon and mention the name of the scientist who discovered it. State the law that relates the direction of current in the coil with the direction of motion of the magnet.
[TERM 1, 2017]

17. Consider a circular loop of wire lying in the plane of the paper. Let the current pass through the loop clockwise. With the help of a diagram explain how the direction of the magnetic field can be determined inside and outside the loop.
(a) Name the law used to find the direction of magnetic field.
(b) Draw a diagram to represent a uniform magnetic field in a given region.
(c) List two properties of magnetic field lines.
[TERM 1, 2017]

18. (a) State Fleming's left-hand rule
(b) Write the principle of working of an electric motor.
(c) Explain the function of the following parts of an electric motor:
(i) Armature
(ii) Brushes
(iii) Splitring
[TERM 1, 2018]

Solutions

1. The correct option is (a) Black.

In domestic circuits, the live wire is red in colour, neutral wire is black and earth wire is green. [1]

2. There is no work done by magnetic field, so the speed of a charged particle and kinetic energy in a magnetic field remain constant. The magnetic force acts perpendicular to the velocity of the particle which causes circular motion. [1]

3. A current carrying conductor has a magnetic field associated with it. The current in the conductor and the magnet gives rise to the magnetic field. These two fields interact with each other and produce a force on the conductor. [1]

The direction of the magnetic force on a current carrying conductor is determined by Fleming's left-hand rule. It states that if the forefinger, thumb and middle finger of the left hand are stretched such that they all are mutually perpendicular to each other. Now, if forefinger points in the direction of the magnetic field and middle finger in the direction of the current, then thumb will point in the direction of the force acting on the conductor. [1]

4. The direction in which a north pole of the compass needle moves inside it will be considered as the direction of the magnetic field. Therefore this derives that the field lines emerge from North Pole and merge at the South Pole. [1]

Hence, the poles in the given figures are

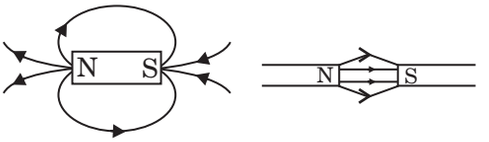


Figure I Figure II [1]

5. Induced current can be produced in the following ways:
(i) By varying current in one coil, current can be induced in the neighboring coil. [1]
(ii) By moving a magnet towards or away from a coil, current can be induced in it. [1]

6. (a) The magnetic field produced by a current carrying conductor increases with increase in the current through the conductor i.e. $B \propto I$. [1]
(b) The magnitude of the magnetic field produced by a current carrying conductor decreases with increase in distance from the conductor i.e. $B \propto \frac{1}{r}$ [1]

7. The magnetic force on a current carrying conductor depends directly upon the current in the conductor and the strength of the magnetic field i.e. $F = Bil$ [1]

So, if the current or the magnetic field is increased in the conductor, the force experienced by the conductor will also increase. Therefore the first observation is correct. [1]

The resistance in a conductor depends upon the length, cross-sectional area, and material of the conductor. [1]

8. (a) The magnetic field produced at a point due to a current carrying circular coil will increase if we increase the current flowing through the coil this is because the magnetic field is directly proportional to the current flowing through the conductor i.e. $B \propto I$ [1]

(b) If the direction of the current through the coil is reversed then the polarity of the magnetic field gets reversed as well. This means that the south pole of the magnetic field becomes the north pole and vice versa. [1]

(c) If the number of turns in the coil is increased then the magnetic field will increase because the magnetic field is directly proportional to the number of turns in the coil i.e. $B \propto n$ where n is number of turns. [1]

9. (a) If a current carrying conductor is placed in a magnetic field, there will a force experienced by it. The direction of this force depends on the following factors:

(i) The direction of the magnetic field.

(ii) The direction of the current in the conductor. [1]

(b) According to Fleming's left-hand rule, when the directions of the current and magnetic field are perpendicular to each other, it experiences the maximum force. [1]

(c) No force will be experienced by the proton beam because it is moving along the direction of a magnetic field. [1]

10. **Alternating Current (AC):** When the direction of the flow of electrons switches back and forth at a regular interval, then this type of electrical current is called alternating current. [½]

Direct current (DC): When the flow of electric charges is unidirectional, then this type of electrical current is called direct current. [½]

Alternating current is preferred over direct current for transmission over long distances due to following reasons:

(a) It is easy to maintain and change the voltage of AC current for transmission and distribution. [½]

(b) The cost of plants for AC transmission (circuit breakers, transformers etc) is much lower than the equivalent DC transmission. [½]

(c) AC is produced at the power stations, so it is better to use AC then DC instead of converting it. [½]

(d) When a large fault occurs in a network, it is easier to interrupt in an AC system, when a large fault occurs in a network, as the sine wave current will naturally tend to zero at some point making the current easier to interrupt. [½]

11. The distance between the conductor and compass and the strength of the magnetic field are inversely proportional to each other. So, there will be a decrease in the strength of magnetic field when the distance between the conductor and the compass increases. Due to which the degree of deflection of the compass should decrease, instead of increasing. So, observation (i) is wrong. [3]

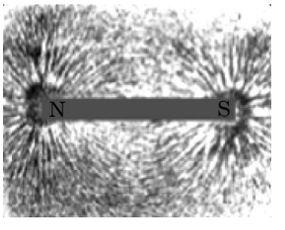
12. The following activity can be used to plot the magnetic field lines around a bar magnet. [½]

(i) Take a drawing board and with the help of some adhesive material, fix a white paper sheet on it. [½]

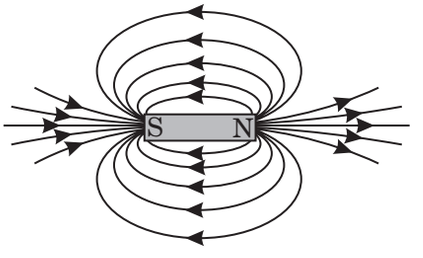
(ii) Now in the center of this sheet, put a bar magnet and sprinkle some of the iron filings around it. [½]

(iii) After that, tap the board gently. [½]

It is observed that the iron filings get arranged in a pattern shown in the following figure. [½]



Following diagram shows the field pattern for the same specifying field directions:



[½]

The reason behind this pattern is that the iron fillings experience a force exerted by the influence of the magnet. These lines represent the magnetic field lines of the bar magnet.

The closeness of the magnetic field lines shows the strength of the magnetic field in that particular region. It indicates that the strength of the magnetic field and closeness of the magnetic field lines are directly proportional to each other. As the magnetic field lines in the region 'A' are relatively closer than the region 'B', so the region 'A' has a stronger magnetic field. [2]

13. Activity:

(1) Take a battery (9V), a variable resistance (or rheostat), an ammeter (0-10A), a straight long thick wire, and a plug key. [½]

(2) Fix a rectangular cardboard and then insert the thick wire through the center. It should be normal to the plane of the cardboard. [½]

(3) Connect the wire vertically with the battery, key and a plug. [½]

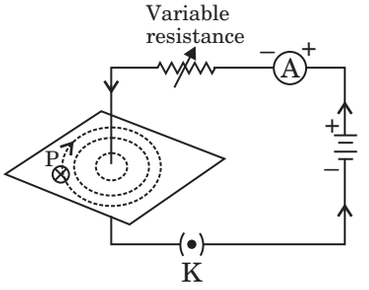
(4) Sprinkle some iron filings on the cardboard and make sure that filings are uniformly sprinkled. [½]

(5) Note the current through the ammeter while keeping the variable of the rheostat at a fixed position. [½]

(6) Key should be closed, that allows current to flow through the wire. It is important to keep the wire vertically straight between the points X and Y. [½]

(7) Tap the cardboard gently then observe the pattern of the filings. There will be a pattern of concentric circles formed by the filings. These concentric circles represent the magnetic lines. [½]

Now, a compass should be placed at a point, say P. The direction of the field which is produced by the electric current through the straight wire will be given by the direction of the north pole of the compass needle at the same point.



[½]

(i) There will be a decrease in the strength of the magnetic field if the strength of the current decreases. [½]

(ii) The direction of the magnetic field line also reverses. [½]

14. (a) (i) When a magnetic field is produced by a straight current carrying conductor, its direction is determined by Maxwell's right-hand thumb rule. According to it if you holding the current-carrying conductor in your right hand such that the thumb points in direction of the current, then circled fingers of that hand gives the direction of the magnetic field due to the current. This rule is also called Maxwell's Corkscrew Rule. [1]

(ii) Force experienced by current-carrying straight conductor placed in a magnetic field which is perpendicular to it can be determined by Fleming's Left Hand Rule.

It states that if the forefinger, thumb and middle finger of the left hand are stretched such that they all are mutually perpendicular to each other. Now, if forefinger points in the direction of the magnetic field and middle finger in the direction of the current, then thumb will point in the direction of the force acting on the conductor. [1]

(iii) When a coil rotates in a magnetic field, it induces current. The direction of this induced current can be determined by Fleming's Right Hand Rule. It states that if we stretch the thumb, forefinger and the middle finger of the right hand at right angles to one another in such a way that the forefinger points in the direction of magnetic field. Then, the direction of motion of conductor (force) is given by thumb, the direction of magnetic field is indicated by the forefinger and the middle finger points the direction of induced current.

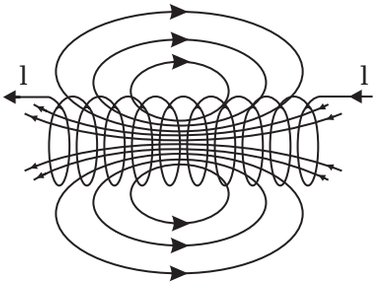
(b) Following safety measures are commonly used in domestic circuits and appliances:

(i) Electric fuse are being used in the circuit. This saves the appliances and other electrical items from a short circuit in case of overflow of the current supply. [1]

(ii) To prevent shocks from leakage of the current, earthing is done in the circuit. This transfers the leaked current to the ground. [1]

15. A solenoid is an electrical component constructed by winding a long insulated wire in the form of a tightly packed helix.

Following diagram shows the pattern of the magnetic field lines of a solenoid



[2½]

Both solenoid and bar magnet have the same pattern of field line. The field lines are in the form of parallel straight lines which are inside the solenoid. This indicates that inside the solenoid, the magnetic field is the same at all points i.e. the field is uniform inside the solenoid.

Solenoids are widely used as electromagnets.[2½]

16. (a) (i) When a bar magnet is pushed into the coil with its north pole entering first, an induced current is produced in the coil due to the change of magnetic field which causes a deflection in the galvanometer. The direction of current in the coil is anti-clockwise. [1]

(ii) When a bar magnet is withdrawn from inside the coil, again an induced current is produced but with a deflection in opposite direction. The direction of current in the coil is clockwise. [1]

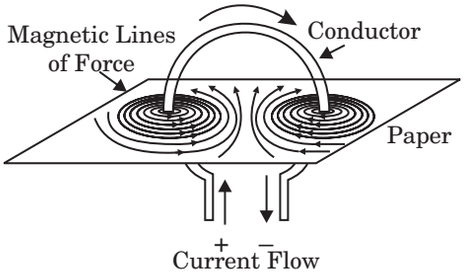
(iii) When a bar magnet held stationary inside the coil, no induced current will produce in the coil, because there is no change of magnetic field. Therefore, galvanometer shows no deflection. [½]

(b) The phenomenon used above is electromagnetic induction and it was discovered by Michael Faraday.

Fleming's right-hand rule: It states that if we stretch the thumb, the forefinger and the middle finger of our right hand so that they are perpendicular to each other. The forefinger indicates the direction of magnetic field, the thumb indicates the direction of motion of conductor and the middle finger indicates the direction of induced current. [2½]

17. (a) Maxwell's Right hand thumb rule is used to find the direction of magnetic field. [1]

(b) The following is a diagram which represent a uniform magnetic field in a given region:- [1]



[1]

Direction of field inside the loop is perpendicular to the plane of paper pointing inwards and outside the loop in opposite direction. [1]

(c) The two properties of magnetic field lines are:-

(i) The magnetic field lines never intersect each other. [½]

(ii) Always a closed loop is formed by the magnetic field lines. [½]

18. (a) Fleming's left-hand rule: When forefinger, thumb and middle finger of the left hand are stretched such that they are perpendicular to each other and if forefinger points towards the direction of the magnetic field and middle finger gives the direction of the current, then thumb will gives the direction of the force acting on the conductor. [1]

(b) Electric motor works on basis of the magnetic effect of current. When a current carrying loop is placed in a magnetic field, a force is experienced by it and it rotates. The direction of its rotation is determined by Fleming's left hand rule. [1]

(c) The function of the parts of the electric motor is as follows:

(i) Armature: The armature contains a single loop of copper wire in the form of a rectangle. It generates electromotive force. [1]

(ii) Brushes: It works as commutator and reverse the direction of current through the coil periodically. [1]

(iii) Split rings: These are used to connect the two ends of the armature coil. The role of the split ring in a dc motor is to allow current to flow in the magnetic circuit.[1]

Smart Notes .....

CHAPTER 14

Sources of Energy

Chapter Analysis with respect to Last 3 Years' Board Exams

List of Topics	**2016**	**2017**	**2018**
Different forms of energy, conventional and non-conventional sources of energy			
Fossil fuels, solar energy, biogas, wind, water tidal energy nuclear energy	1Q (1 mark), 1Q (2 marks)	1Q (1 mark), 1Q (3 marks)	1Q (3 marks)
Renewable versus non-renewable sources.		1Q (3 marks)	

On the basis of above analysis, it can be said that from exam point of view, renewable and non renewable sources of energy are the most important topics of the chapter.

Topic 1: Source of Energy

Summary

Knowing your Chapter at Glance:

- **Source of Energy.** The actual resource from which energy can be harnessed directly or indirectly is called source of energy. They can be classified into two groups.
- Characteristics of a Source of Energy.

  A good source of energy should fulfill the following characteristics :

(i) Provide adequate amount of energy per unit mass or volume at constant rate over a long period of time.

(ii) Burn without giving out any smoke or harmful gases.

(iii) Easily available and convenient to use.

(iv) Easy to store, handle and safe to transport.

Conventional Source of energy	Non- Conventional Source of energy
Sources which are being used since long time.	Sources whose use has started only recently.
Examples: coal,wood,wind etc.	Examples: Sun,wave

All the forms of energy are stated under the **law of conservation of energy**. According to this law, "The total energy in the universe always remain constant, i.e., energy can neither be created nor destroyed, but can only be transformed from one form into another e.g., friction turns kinetic energy into thermal energy.

Fuel : The material which are burnt to produce heat energy are known as fuels. E.g wood,coal,LPG etc.

Characteristics of a good fuel

(i) free from any kind of pollution.

(ii) easy to store and transport.

(iii) easily accessible.

(iv) economical.

(v) having a high calorific value

(vi) having a low content of non-combustible substances i.e., it should leave less residue on burning.

Conventional sources of energy

- **Fossil fuels** are those fuels which are formed from the organic remains of prehistoric plants and animals, e.g., coal, oil and natural gas (petroleum).

  It is non-renewable source of energy

Disadvantages of fossil fuel:

It causes air pollution. When we burn fossil fuel,poisonous gases like oxides of carbon,nitrogen, sulphur are released.

Fossil fuels release a lot of smoke.

They cause acid rain.

- **Thermal Power Plant.** A power-generating plant which uses heat energy to generate electricity

  Working of thermal power plant

  Such plants use coal, petroleum and natural gas to produce electricity. The steam produced by burning of fossil fuels runs the turbine to generate electricity. The transmission of electricity is more efficient. These plants are setup near coal or oil fields to minimise the cost of transportation and production.
- **Hydroelectric power plants.** A power generating plant that uses the energy of flowing water to produce electricity is called hydroelectric power plant. The electricity generated is called hydroelectricity.

Working of hydropower plant

Stored water behind the dam is allowed to fall freely from a suitable height on the blades of a turbine. This rotates the armature coil of generator rapidly and electricity is generated.

Disadvantages of hydropower plant

- Hydropower can be established in certain locations. Also, a large area is required to build a dam and results in rehabitation people.
- Vegetation gets submerged under water.
- **Biomass.** The residue of living organisms such as remains of plants, animal and their products from which fuel can be obtained is called biomass.
- Biomass is a renewable source of energy.
- Biomass can be used

(a) as a bio fuel
(b) for the production of fibre, paper, chemicals or heat
(c) as a source of energy in industries
(d) to generate electricity
(e) to produce biogas by its anaerobic digestion.

Benefits of charcoal over wood:

- No flame
- Charcoal produces more energy
- Release less smoke
- **Biogas.** The mixture of gases produced during decomposition of bio mass such as cow-dung, various plant materials like residue of harvested crops, vegetable waste and sewage in the absence of oxygen is called bio gas. It is also known as 'go-bar gas'.

  Biogas is mixture of methane (75%), carbon dioxide (25%) with the traces of hydrogen, nitrogen and hydrogen sulphide.

Uses of biogas. Biogas can be used for :

- cooking and heating
- running tubewells and water pump engines
- as an illuminant in gas lanterns
- in bio-diesel production
- as a vehicle fuel
- **Wind Energy.** The kinetic energy possessed by the blowing wind is called wind energy.

Working

When wind passes through the blades of a windmill, the blades experience an upward force, due to its peculiar I shape known as aerodynamic air foil shape. This produces a lift and generates the torque which rotates the blades.

Advantages

No pollution

Renewable

No recurring cost

Disadvantages

Wind farms can only be established at those places where the wind speed is greater than 15 km/hr.

Wind turbine cannot work if there is no wind and wind speed is not so high. So we need to store a power backup.

High set up cost.

Towers and specially blades are exposed to rough weather. So blades get damaged and increases the cost of maintenance.

- **Wind Energy Farm.** The place where a large number of windmills are erected over a large area is called wind energy farm. In India, largest wind energy farm is established near Kanyakumari in Tamil Nadu. It generates 380 MW of electricity.

PREVIOUS YEARS' EXAMINATION QUESTIONS

TOPIC 1

1 Mark Questions

1. List two practical uses of biogas in rural areas.
[TERM 1, 2014]

2. Write the characteristic features of the micro organisms which help in the production of biogas in a biogas plant.
[TERM 1, 2016]

3. Thermal power plants are setup near coal or oil fields. Give reason.
[TERM 1, 2017]

2 Marks Question

4. Give two examples each of the following:
(i) Renewable sources of energy
(ii) Non-renewable sources of energy
[TERM 1, 2011]

3 Marks Questions

5. Differentiate between renewable and non-renewable sources of energy with one example for each
[TERM 1, 2017]

6. Draw a neat diagram of a biogas plant and label:
(i) inlet of slurry
(ii) digester
(iii) gas outlet
[TERM 1, 2017]

Solutions

1. Two practical uses of biogas in rural areas are:

(a) Bio-gas is an excellent fuel so it is used for cooking. [½]

(b) It is also used as a transportation fuel. [½]

2. These are the anaerobic bacteria. They help in the anaerobic (without oxygen) breakdown of the biomass that helps in conversion of biomass to biogas. [1]

3. Thermal power plants are setup near coal or oil fields because it is easier to transmit electricity over distance than transporting coal or oil over the same distance. [1]

4. (i) Renewable sources of energy are those sources that can be replenished. Examples of renewable sources of energy are wind and water. [1]

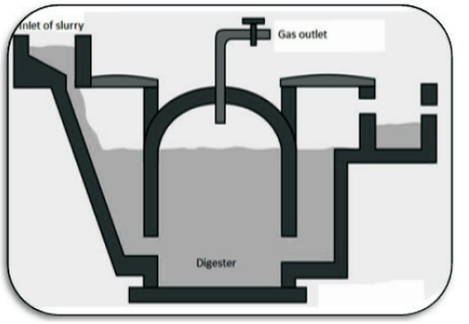
(ii) Non- renewable sources of energy are those sources that cannot be replenished because their formation takes billions of years. Examples non-renewable sources of energy are natural gas and petroleum. [1]

5.

Renewable Sources	Non-renewable Sources
• The resources that can be renewed are called renewable resources. • Renewable resources are inexhaustible. • Renewable resources are not affected by the human activities. • For example:-Wind	• The resources that are present in fixed quantities are called non-renewable resources. • Non-renewable resources are exhaustible. • Non-renewable resources are affected by human activities. • For example:-Fossil fuels

[3]

6. The following is the diagram of a biogas plant:-



[3]

Topic 2: Non Conventional Sources of Energy

Summary

Non conventional sources of energy

- **Solar Energy.** The enormous amount of energy radiated by the sun in all direction in the form of heat and light is called solar energy. It is the ultimate source of energy.
- **Solar Cooker.** The device which cooks the food without using any conventional cooking fuel and converts solar energy directly into heat energy is known as solar cooker.
- It works on the principle that black surface absorbs more heat as compared to white or a reflecting surface under identical conditions.

Construction and working

- It consists of a well metallic or wooden box which is painted dull black.
- The collection of solar energy is done either by using a plane mirror or a large concave mirror which acts as a reflector attached to one of the top edges of the box.
- The top of the box exposed to the sun and covered by one or more transparent cover such as glass plate to trap the heat inside the box.

- The glass lid allows the heat radiation (infrared rays) from sun to enter inside but does not allow the reflected heat radiation to escape or go outside the box. This heat is absorbed by the blackened surface. Thus the heat loss is reduced due to reflection.
- This heat is utilised to cook the food. Thus solar cooker saves substantial amount of cooking fuel and contributes towards the economy of a family.
- **Solar Cell.** The device that converts solar energy directly into electrical energy is called solar cell. They are made from special grade semi-conducting materials like silicon, germanium, gallium etc.
- **Solar Panel.** It consists of a large number of solar cells joined together in a particular pattern to obtain large electrical power for practical uses.

Uses of solar panel/solar cells.

They are used

(i) as a source of electric power in satellites and space probes.

(ii) to provide electric power to off-shore drilling rig platforms and light houses.

(iii) for recharging the batteries during day.

(iv) for operating traffic lights, water pumps, and other household electrical appliances in remote areas.

(v) in calculators and electronic watches.

(vi) by TV relay stations or wirless transmission systems located in remote areas use solar panels.

- Energy from Sea

The oceans cover about 70% of the earth's surface area. They contain a lot of energy because water has a high specific heat capacity. Ocean acts as a renewable source of energy. The energy from oceans is available in different forms,

(i) Tidal energy. The energy produced by the surge of ocean water during high and low tides due to difference in sea-levels is called tidal energy. The high and low tides occur due to the gravitational pull of the moon.

Tidal energy is harnessed by constructing a dam near the shores. During high tides water flows into the dam and during low tides, water flows out. This flowing water rotates the turbine, present at the opening of dam and produces electricity.

(ii) Sea-wave Energy.

The strong wind blowing across the sea generates waves in the sea. Kinetic energy possessed by these sea waves can be used to generate electricity.

(iii) Ocean Thermal Energy Conversion (OTEC)

- Water at the surface of an ocean or sea warms up by the solar energy while the deeper water remains cold.
- The temperature difference between the surface water and water at a depth of 2 km is approximately 20°C (293 K) or more.
- The energy available due to this temperature difference is called ocean thermal energy.
- **Geothermal Energy:** The energy obtained from hot molten rocks and trapped hot fluid inside the earth is called geothermal energy.
- At some depth below the surface of earth, the rocks get heated due to fission of radioactive materials present in it which liberates large amount of energy.
- Due to geological changes these molten rocks in the interior of earth are pushed upwards and trapped in certain regions are called 'hot spots'.
- The underground water which comes in contact with these hot spots gets heated and is converted into steam.
- The steam trapped inside the rocks at high pressure is taken out through a pipe to a turbine to generate electricity.
- In some places hot water comes to the surface through some outlets. These outlets are called 'hot-springs or geysers'.
- **Nuclear Energy:** The energy produced during nuclear reaction such as nuclear fission or fusion is called nuclear energy. According to Einstein theory, every substance has energy due to its mass also. If a substance loses an amount 'Δm' of its mass, an equivalent amount ΔE of energy is produced, where

$$\Delta E = (\Delta m)c^2$$

Where c is the speed of light which is equal to 3×10^8 m/s. This relation is known as 'Einstein's mass energy relation.

- **Nuclear Fission:** The process in which a heavy nucleus is broken into two nearly equal fragments producing a tremendous amount of energy. This process is called nuclear fission.
- This phenomenon is the basis of nuclear reactors to produce electricity, useful products and nuclear bomb also.
- **Nuclear Fusion:** The process in which lighter nuclei moving at very high speed fuse together to form a single heavier nucleus, releases a tremendous amount of energy called nuclear fusion.

- In practice, nuclear fusion is very difficult process.
- It needs millions of degrees of temperature and millions of pascals of pressure to carry it.
- Hydrogen bomb is based on this phenomenon.

  Major disadvantage is that the energy obtained from fusion process could not be controlled so far.
- Major Hazards and Limitations of Nuclear Power Generation.

(i) Environmental contamination due to improper nuclear waste storage and its disposal.

(ii) High cost of installation.

(iii) Limited availability of nuclear fuel.-

(iv) Risk of accidental leakage of harmful radiation during processing of nuclear fuel or damage.

(v) Land becomes barren.

- Environmental Consequences of Increasing Demand for Energy.

(i) Burning of fossil fuels pollutes the air and water.

(ii) Production of greenhouse gases, like CO^2 methane, increase the global warming.

(iii) Depletion of ozone layer increases the ultraviolet radiation in the environment causing harmful effects on the living things.

Steps to reduce the energy consumption.

- Avoid misuse of conventional sources of energy which are limited in nature.
- Alternate sources of energy such as solar energy, wind energy, hydro energy, etc., should be used instead of non-renewable sources of energy.
- Efficiency of energy sources should be repeatedly maintained for getting the maximum efficiency.

PREVIOUS YEARS' EXAMINATION QUESTIONS

TOPIC 2

1 Mark Questions

1. State any two reasons which make the large scale usage of nuclear energy prohibitive.

[TERM 1, 2011]

2. What is tidal energy?

[TERM 1, 2015]

2 Marks Questions

3. A student constructed a model of box type solar cooker. Instead of using glass sheet he used a transparent plastic sheet to cover the open face of the box. He found that this cooker does not function well. What could be the possible drawbacks in his model? Explain the advantage of painting black the inner and outer surfaces of the cooker and that of cooking vessels.

[TERM 1, 2011]

4. You are given two solar cookers, one with a plane mirror as reflector and the other with concave mirror as reflector. Which one is more efficient? Give reason for your answer. State one more use of concave mirror.

[TERM 1, 2013]

3 Marks Questions

5. (a) What is geothermal energy?

(b) What are the advantages of wind energy?

[TERM 1, 2011]

6. Dams are constructed to generate electricity from water stored at a height. People living in neighboring areas protested against it to save the flora and fauna.

(i) What type of energy is possessed by the stored water?

(ii) What is the energy transformation that takes place in hydroelectric power plant?

(iii) What values of the people are shown by this act? (Any two)

[TERM 1, 2014, 2018]

7. Why is it not possible to make use of solar cells to meet all our energy needs? State at least three reasons to support your answer.

[TERM 1, 2014]

8. List any three hazards of nuclear waste.

[TERM 1, 2015]

9. Explain the principle and process of converting ocean thermal energy into electricity.

[TERM 1, 2016]

Solutions

1. The reasons which make the large scale usage of nuclear energy prohibitive are:

(1) Installation of a nuclear power plant is very expensive. [½]

(2) It involves a high risk of environmental contamination. [½]

2. The gravitational forces exerted by the rotation of the Earth, the Sun and the Moon cause the sea level to rise and fall, this results in tides. Tides are a regular phenomenon and occur frequently. The massive movement of water is harnessed and converted into usable form of energy. This energy obtained from the rise and fall of tides is called the tidal energy. [½ + ½]

3. Glass sheet is able to create a green house effective it does not allow the heat to escape out and it makes the temperature inside the cooker to rise, but the transparent plastic sheets cannot stop the infra radiations to escape, so it is not capable in creating the green house effect. Black color is capable of absorbing more heat and hence the inner and outer surfaces of the cooker and that of cooking vessels are painted black. [2]

4. The concave mirror is also called as a converging mirror. It converges the light to a single point i.e. focus. So, a solar cooker with concave mirror as reflector can converge all the heat on a single point and produce greater heat than a solar cooker which has a plane mirror as reflector. In this way, a solar cooker having a concave mirror is more efficient. [1]

The one more use of concave mirror is in the microscope so that they can reflect the light on the objects that are to be viewed. [1]

5. (a) Due to geological changes, molten rocks are formed in the deeper hot regions of the earth's crust which are pushed upwards and trapped in certain regions, called hotspots. When the underground water comes in contact with the hot spot, steam is generated. As more steam is formed, it comes out in the form of hot springs when it gets compressed at high pressure and that produces geothermal power. [½]

(b) Advantages of wind energy are:

(1) Wind energy is environment friendly

(2) It is an efficient source of renewable energy.

(3) It requires no recurring expenses for the production of electricity. [1½]

6. (i) The energy possessed by the stored water is potential energy. [1]

(ii) The water held in the dams possesses potential energy. This potential energy is converted into kinetic energy as the water falls on the turbine. The kinetic energy of falling water is converted into the kinetic energy of the armature of the generator that is connected to the turbine. This kinetic energy of the armature is then converted to the electrical energy. [1]

(iii) It shows that people care about the nature and they are aware of their rights. [1]

7. (i) The process of manufacturing the solar cells is very expensive, silver used for interconnection of the cells in the panel further adds to the cost. [1]

(ii) Solar energy can be collected only when the sun is shining. It cannot generate electricity on cloudy days or at night. [1]

(iii) Solar panel installations require a large open area to work efficiently. It is less efficient in congested areas. [1]

8. Nuclear waste is generated when radioactive elements are used to generate nuclear energy. This nuclear waste possess following threats:

(a) Radioactivity from these wastes can cause severe health problems such as cancer. [1]

(b) Exposure to radioactive particles can cause genetic disorder and this change in genetic structure could pass on to the next generation. [1]

(c) There is always a risk of huge explosion due to the large amount of energy that is produced in these reactions. [1]

9. Ocean Thermal Energy also called as Ocean Thermal Energy Conversion (OTEC) refers to a method of using the temperature difference between the deep parts of the sea which are cold and the shallow parts of the sea which are warm to run a heat engine and produce useful work. Basically, Ocean thermal energy conversion is an electricity generation system. The deeper parts of the ocean are cooler because the heat of sunlight cannot penetrate very deep into the water. Here the efficiency of the system depends on the temperature difference. Greater the temperature difference, greater the efficiency. The difference in temperature in the oceans between the deep and shallow parts is maximum in the tropics, 20 to 25o C. Tropics receive a lot of sunlight which warms the surface of the oceans, increasing the temperature gradient. [3]

Smart Notes .....

CHAPTER 15

Our Environment

Chapter Analysis with respect to Last 3 Years' Board Exams

List of Topics	**2016**	**2017**	**2018**
Eco-system			
Environmental problems, Ozone depletion	1Q (1 mark), 1Q (3 marks)		
Waste production and their solutions	1Q (3 marks)		1Q (3 marks)
Biodegradable and non-biodegradable substances			

On the basis of above analysis, it can be said that from exam point of view , waste production and their solution and Environmental problems are the most important topics of the chapter.

Topic 1: Ecosystem & Food Chain

Summary

Knowing your Chapter at Glance:

ECOSYSTEM

All interacting organisms in an area together with the non-living constituents of the environment forms the ecosystem.

COMPONENTS OF ECOSYSTEM

Biotic component	Abiotic component
↓	↓
Living component	Non-living component
↓	↓
Includes producers, consumers, decomposers	Includes physical environment

TYPES OF ECOSYSTEM

Natural ecosystem

The ecosystem that exist in nature on its own. E.g. forest,lake,ocean.

Artificial ecosystem

Man-made ecosystem are called artificial ecosystem. E.g. crop field,aquarium,ponds.

- The biotic community of an ecosystem includes three types of organisms:

(a) Producer organisms (or Autotrophs) which synthesize their own food. All the green plants are producers.

(b) Consumer organisms (or Heterotrophs) which are dependent on others for food. All the animals are consumers.

(i) **Herbivores** : Some animals eat only plants. Those animals which eat only plants are called herbivores. Some of the examples are: cow, buffalo, goat, sheep, horse, deer, camel, ass, ox, elephant, monkey, squirrel, rabbit and hippopotamus. Since herbivores obtain their food directly from plants, therefore, herbivores (like cattle, deer, goat, etc.) are primary consumers.

(ii) **Carnivores** : Some animals eat only other animals. Those animals which eat only other animals as food are called carnivores. Some of the examples are : lion, tiger, frog, vulture, kingfisher, lizard, wolf, snake and hawk.

The carnivores are usually of two types

(a) small carnivores

(b) large carnivores.

The small carnivores which feed on herbivores (primary consumers) are called secondary consumers. For example, a grasshopper, rat, seed eating birds and frog, etc.

The large carnivores (or top carnivores) which feed upon the small carnivores (secondary consumers) are called tertiary consumers. For example, lion, tiger, birds of prey (such as hawk) and humans.

(iii) **Omnivores** : Some animals eat both, plants as well as other animals. Those animals which eat both, plants and animals, are called omnivores. Some of the examples are: man, dog, crow, sparrow, bear, mynah and ant.

(c) **Decomposer** organisms (or Saprotrophs) which consume the dead remains of other organisms. Certain bacteria and fungi are decomposers.

FOOD CHAIN

It is sequence of organisms through which energy is transferred in the form of food by the process of one organism consuming the other.

Algae (Producer) → Scorpion (Herbivore) →

Small Fish (Carnivore) → Swan (Large carnivore)

TROPHIC LEVEL

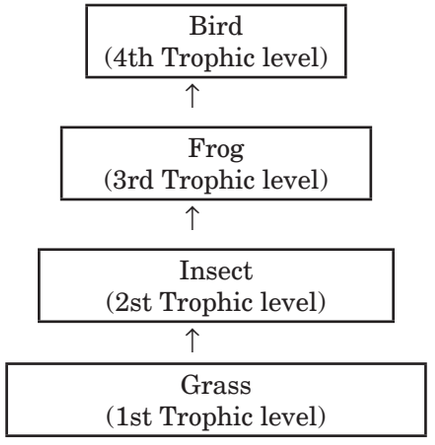
Each step or level of the food chain forms a trophic level.

(i) The autotrophs or the producers are at the first trophic level.

(ii) The herbivores or the primary consumers come at the second.

(iii) The small carnivores or the secondary consumers are at the third trophic level.

(iv) The larger carnivores or the tertiary consumer form the fourth trophic level.



CHARACTERISTICS OF A FOOD CHAIN

1. A food chain involves a nutritive interaction between the living organisms (biotic components) of an ecosystem.
2. In a food chain, there is unidirectional flow of energy from sun to producers and subsequently to series of different types of consumers.
3. Usually, there are 3 or 4 trophic levels in the food chain. In few chains, there may be maximum of 5 trophic levels.
4. At each transfer, generally 80-90% of energy is lost as heat in accordance with second law of thermodynamics.

10 percent law

Only 10% of energy is transferred to the next tropic level.

Biological magnification

The concentration of harmful chemicals increases with every next trophic level in a food chain is known as biological magnification.

PREVIOUS YEARS' EXAMINATION QUESTIONS

TOPIC 1

1 Mark Questions

1. What is meant by biological magnification?
[TERM 2, 2011]

2. Give an example to illustrate that indiscriminate use of pesticides may result in the degradation of the environment.
[TERM 2, 2014]

3. In a food chain, if 10,000 joules of energy is available to the producer, how much energy will be available to the secondary consumer to transfer it to the tertiary consumer?
[TERM 2, 2012]

4. Write one negative effect, on the environment, by affluent life style of few persons of a society.
[TERM 2, 2016]

3 Marks Questions

5. (a) What is an ecosystem? List its two main components.
(b) We do not clean ponds or lakes, but an aquarium needs to be cleaned regularly. Explain.
[TERM 2, 2013]

6. "Energy flow in a food chain is unidirectional." Justify this statement. Explain how the pesticides enter a food chain and subsequently get into our body.
[TERM 2, 2014]

7. Ramu has a piece of agricultural land in a village. He decides to set up a brick factory on it. His friend Shyam persuades him to change his decision in the interest of village because presence of a factory would severely affect the health of villagers as well as agricultural produce of others. Ramu understands and abandons his plans.
(a) Mention the values exhibited by Shyam.
(b) Explain how these values helped Shyam to save interests of his village
[TERM 2, 2016]

Solutions

1. Biological magnification is a process of progressive accumulation of chemicals which are toxic and non bio-degradable at each tropical level in nature. The maximum concentration of these chemicals gets accumulated in the organisms which occupy place in highest tropical level. [1]

2. Pesticides get washed away with the irrigation water and reach up to the water bodies where it gets dissolved into it and further entering into food chain. This may cause biomagnifications of pesticides by accumulating in the food chain.[1]

3. 90% of the energy is used by primary consumer and secondary consumer is left with only 10% of the energy which is transferred to the next trophic level. So, if 10,000 joules of energy is available to the producer then the secondary consumer will have 10% joules of energy which is 1000. Therefore, 1000 joules of energy will be available to the secondary consumer to transfer it to the tertiary consumer. [1]

4. Ozone depletion is one of the negative effects, on the environment caused by affluent life style of few persons of society. [1]

5. All the interacting organisms in an area together with the non-living constituents of the environment form an ecosystem. For example a garden is an ecosystem which consists of plants, insects, water, soil etc.

(a) The two components of the ecosystem are - Biotic and Abiotic.

Biotic components comprises of all the living organisms like humans, animals, plantsetc and Abiotic component comprises of the nonliving things like air, mineral soil, water and sunlight. [1]

(b) Ponds and lakes are an example of natural ecosystem whereas the aquarium is an example of artificial ecosystem. Ponds do not need to be cleaned because it has microorganisms, like bacteria and fungi that break-down the dead remains and waste products of organisms and clean the pond naturally. However, aquarium does not contain soil or decomposing bacteria or fungi which helps in degrading complex organic substance into simple inorganic substance, so it needs to be cleaned from time to time. [2]

6. The "Energy flow in a food chain is unidirectional" because, in the next trophic level, only 10% of the energy is available. So, higher trophic levels contain very less energy. Plants cannot reuse the energy in photosynthesis because most of the energy is lost as heat. That shows that energy flow in the ecosystem is unidirectional.

Pesticides enter a food chain and subsequently get in our body in following ways: [1]

(i) Some of the pesticides are either washed down into the soil or into water bodies. [½]

(ii) From the soil, plants absorb these pesticides along with water and minerals. And aquatic animal and plants take these chemicals from water. [½]

(iii) As these chemicals are not degradable, these get increased progressively at each trophic level. [½]

(iv) As the top level belongs to a human in any food chain, the maximum concentration of these chemicals accumulated in our bodies and this phenomenon is called as biological magnification. [½]

7. (a) Shyam is an environment friendly person. He is aware about the developments and their effects on nature. Also, he is cautious about the health and well being of people and society. [½]

(b) Shyam has saved the interest of villagers by many ways. Setting up of brick field may have following harmful effects on people and environment:

1. The brick kilns emit toxic fumes that contain high concentration of carbon monoxides and oxides of sulphur , which are harmful to eyes, lungs and throat.[½]
2. Irritation of the respiratory system is caused by Sulphur dioxide. Carbon monoxide inhalation also causes dizziness, vomiting and in higher concentrations it can be harmful to life. [½]
3. Particulate matters in the fumes such as smaller dust and smoke particles penetrate deeply into the lungs and get deposited there and cause several lung diseases. [½]
4. Plant health is also adversely affected by air pollution caused by the kilns. Pollutants like fluorine, lead and mercury cause a great damage to plants, affecting agriculture in the nearby area. [½]
5. Acid rains can occur because sulphur dioxide and oxides of nitrogen combines with water vapour in the atmosphere and forms mild acids like sulphuric acid and nitric acids. These acids then return to earth as rains. It causes extensive damage to plant life, aquatic life, to the buildings and causes pollution of lakes and rivers. [½]

Topic 2: Ozone Layer and Its Depletion

OZONE LAYER AND ITS DEPLETION

Ozone is a form of oxygen. The higher energy UV radiations split apart some molecular oxygen (O_2) into free oxygen (O) atoms. These atoms then combine with the molecular oxygen to form ozone.

$$O_2 \rightarrow O + O$$

$$O + O_2 \rightarrow O_3$$

(Ozone)

Function of ozone

Ozone is a poisonous gas but is not stable nearer to earth's surface. It absorbs the harmful radiations from the Sun. It shields the surface of the earth from the ultraviolet (UV) radiation of the sun.

Ozone depletion

The thinning of ozone layer is commonly called ozone depletion. Ozone is being depleted by air pollutants. Chlorofluorocarbons (CFC's) are the air pollutants that are mainly responsible for the depletion of ozone layer in the stratosphere. Besides, methane (CH4) and oxides of nitrogen also cause destruction of ozone.

Effects of ozone depletion

The thinning of ozone layer allows more ultraviolet (UV) radiations to pass through it which then strike the earth. These cause following harmful effects on man and animals :

(i) Skin cancer.

(ii) Damage to eyes and also increased incidence of cataract disease in eyes.

(iii) Damage to immune system.

WASTE DISPOSAL

The solid waste, that accumulate in the environment due to human activities can be categorized into two types :

(i) Bio-degradable waste

(ii) Non-biodegradable waste

Biodegradable waste

Those substances which are broken down by the activity of micro-organisms. These substances can easily be degraded by natural means i.e. by action of micro-organisms (like bacteria and fungi) into simpler harmless substances in some time.

Example : Domestic waste products, faecal matter, sewage, agricultural residue, paper, wood, cloth etc.

Non-biodegradable waste

These substances cannot be decomposed by microorganisms like bacteria. They are the major pollutants of the environment. They may enter into food-chain and harm the organisms.

Example : Insecticides, pesticides, DDT, mercury, lead, arsenic, aluminium, plastics, iron nails and radioactive waste. These non-biodegradable substances may occur in the environment in gaseous, liquid or solid form.

Methods of waste disposal

(a) **Sanitary land fills** : The waste is pulverised and spread over a low lying area. It is compacted and covered by a layer of earth. This reduces bulk of waste, prevents release of offensive odours and spread of pathogens.

(b) **Recycling of wastes** : Paper, glass, polythene, plastic, metals can be recycled. Waste coming from industries such as metals can be melted and recycled into solved metal.

(c) Composting : Organic waste is shredded, mixed with sewage sludge and spread in open to form compost. The domestic waste can easily be converted into manure.

(d) **Biogas and manure** can be prepared from the biodegradable waste. It costs much less than other fuel and fertilizers.

(e) **Pesticides and fertilizers** : Their use should be reduced by resorting to biological control (for pests) and organic farming.

(f) **Reuse**: It is a conventional technique to use an item again e.g. newspaper for making envelops.

PREVIOUS YEARS' EXAMINATION QUESTIONS TOPIC 2

1 Mark Questions

1. Why should biodegradable and non-biodegradable wastes be discarded in two separate dust bins? **[TERM 2, 2012, 2013]**
2. What happens when higher energy ultraviolet radiations act on the oxygen at the higher level of the atmosphere? **[TERM 2, 2012]**
3. Name two chemicals which are responsible for thinning of ozone layer **[TERM 2, 2015]**

2 Marks Questions

4. We often observe domestic waste decomposing in the bylanes of the residential colonies. Suggest ways to make people realise that the improper disposal of waste is harmful to the environment. **[TERM 2, 2012]**
5. What are decomposers? List two important roles they play in the environment. **[TERM 2, 2014]**
6. We should not use polybags as they are non biodegradable and cause pollution. How can we replace them to become environment friendly? **[TERM 2, 2015]**
7. Accumulation of harmful chemicals in our bodies can be avoided. Explain how this can be achieved. **[TERM 2, 2015]**

3 Marks Questions

8. The activities of the man had adverse effects on all forms of living organisms in the biosphere. Unlimited exploitation of nature by man disturbed the delicate ecological balance between the living and non-living components of the biosphere. The unfavorable conditions created by man himself threatened the survival not only of himself but also of entire living organisms on the mother earth. One of your classmates is an active member of 'Eco Club' of your school which is creating environmental awareness amongst the school students, spreading the same in the society and also working hard for preventing environmental degradation of the surroundings.
   (a) Why is necessary to conserve our environment?
   (b) State the importance of green and blue dustbins in the safe disposal of the household waste.
   (c) List two values exhibited by your classmate who is an active member of Eco-club of your school. **[TERM 2, 2016]**
6. Students in a school listened to the news read in the morning assembly that the mountain of garbage in Delhi, suddenly exploded and various vehicles got buried under it. Several people were also injured and there was traffic jam all around. In the brain storming session the teacher also discussed this issue and asked the students to find out a solution to the problem of garbage. Finally they arrived at two main points — one is soil management of the garbage we produce and the second is to generate less garbage at individual level.
   (a) Suggest two measures to manage the garbage we produce.
   (b) As an individual, what can we do to generate the least garbage? Give two points.
   (c) List two values the teacher instilled in his students in this episode. **[TERM 2, 2018]**

Solutions

1. Biodegradable and non-biodegradable wastes should be discarded in two separate dust bins because biodegradable waste can be recycled and mixing of the two waste makes it unfit for recycling, forming toxic compounds that cause pollution. [1]
2. When the higher energy UV radiations act on the oxygen at the higher level of atmosphere,ozone is formed. High energy UV radiations split apart some oxygen molecules into atomic oxygen which reacts with molecular oxygen to form ozone (O3) molecules. [1]
3. Methane (CH4), CFCs (chlorofluorocarbons) are two chemicals which are mainly responsible for thinning of ozone layer. CFCs releases from refrigerators, air coolers etc. [1]
4. 1. Improper disposal of waste will release harmful gases in the environment. It makes the environment unclean and unhygienic for normal living organisms. [½]
   2. It can release greenhouse gases which can further result in the global warming. [½]

3. The waste will flow to the water bodies along with the rain water and become a threat to the ground water and also to the aquatic life. [½]
4. Improper disposal of waste will serve as a breeding ground for mosquitoes and will create favourable conditions for the spread of various diseases. [½]

5. The micro organisms that consume dead organisms and break them down into simple chemical components like nitrogen, carbon and other nutrients which are important for living organism are called decomposers. [1]

(i) Decomposers eat dead animals and plants so in actual they clean the environment.[½]

(ii) Many nutrients like Nitrogen etc. are added by the decomposers to the soil, which help to enrich the fertility of the soil. [½]

6. Polybags do not decompose and that's why it is harmful to the environment. But we can choose an alternative for polybags to control the pollution. We can use paper bags, jute bags or handmade bags instead of polybags or we can also recycle the polybags. For heavier things, cloth bags can be used because we can use cloth bags multiple times. [2]

7. The accumulation of harmful chemicals in our bodies cannot be avoided completely but it can be reduced

- By avoiding toxic chemical pesticides, [½]
- Drinking plenty of water, [½]
- Washing the fruits and vegetables before eating, [½]
- Doing exercise and eating certified organic foods if possible etc. [½]

8. (a) It is necessary to conserve environment for protecting our atmosphere and living habitat from degradation. [½]

(b) Green dust-bin contains biodegradable waste or compostable material wastes from landfills and blue dust bins are used for non-biodegradable wastes. [1½]

(c) The two values exhibited are:

(i) Spread awareness in people to save environment. [½]

(ii) He is also working hard for preventing environmental degradation of the surrounding. [½]

9. (a) Two ways to manage the garbage are:

(i) Separate the wet and dry garbage to be recycled and used for different purposes. [½]

(ii) Dispose the garbage at proper place suggested by the municipality coorporations. [½]

(b) Two points to generate least garbage as an individual are:

(i) Cook required amount of food in kitchen so that no extra garbage is produced by us. [½]

(ii) Eatable kitchen waste can be provided to the pet animals instead of disposing off. [½]

(c) Two values which were instilled by the teacher in the students are:

(i) Students are made responsible so that they think about the environment. [½]

(ii) Teacher tries to make students learn about the importance of every individual for the environment. [½]

Smart Notes .....

CHAPTER 16

Management of Natural Resources

Chapter Analysis with respect to Last 3 Years' Board Exams

List of Topics	**2016**	**2017**	**2018**
Conservation and judicious use of natural resources			
Forest and wild life	1Q (2 marks)		
Coal and Petroleum conservation			
Basic concepts of evolution			
Examples of people's participation for conservation of natural resources. Big dams: advantages and limitations, alternatives, if any. Water harvesting. Sustainability of natural resources	1Q (2 marks)	1Q (3 marks)	1Q (3 marks)

On the basis of above analysis, it can be said that from exam point of view, water resources and their conservation are the most important topics of the chapter.

Topic 1: Natural Resources

Summary

Knowing your Chapter at Glance:

Natural resources are substances which are being exploited for supporting life.

TYPES OF NATURAL RESOURCES

Natural resources on the basis of their availability and abundance are classified as **inexhaustible** (air, water) and **exhaustible** (minerals, fossil fuels) resources.

Exhaustible resources are present in limited quantity and can be of two types:

Renewable resources

These resources can maintain themselves if managed wisely. These include forest, crops, ground water, wildlife, etc.

Non-renewable resource

These get exhausted with use because they are not recycled or replenished and are also called conventional sources of energy. These include minerals, fossil fuels, etc.

Inexhaustible

These are present in unlimited quantity

The three R's can help to save the environment.

- **Reduce**

This means you use less. When we save electricity by switching off unnecessary lights and fans, we reduce its use.

- **Recycle**

Certain articles like plastic, paper, glass, metals can be recycled instead of making them fresh. For this, we need to segregate our wastes so that the material to be recycled is not dumped along with other wastes.

- **Reuse**

This is better than recycling because the process of recycling uses some energy. For example, the plastic bottles in which we buy certain food-items can be used for storing things in the kitchen.

CONSERVATION

Thus, conservation is defined as the utilization of natural resources for the benefit of life so that it may yield sustainable benefit to the present generation as well as the future generations.

We need to use our resources carefully for the following reasons:

- The human population is increasing at a tremendous rate. Hence the demand for all the resources is increasing at an exponential rate but it is limited.
- The use of natural resources is a long-term perspective so that these will last for generations to come and should not be exploited.
- An equitable distribution of resources should be there for all, so that not just a handful of rich and powerful people benefit from the development of these resources.

WHAT SHOULD MAN DO TO CONSERVE NATURAL RESOURCES ?

In order to conserve natural resources, man should-

- use the natural resources wisely to check their depletion,
- recover the used resources for reuse,
- discover new resources as alternatives,
- not pollute the natural resources to keep them fit for use.
- Afforestation should be practised.
- Forest is a 'biodiversity hotspot' because it is an area where number of species or range of different life form exists.

USES OF FORESTS

- They are the store house of many valuable things like wood (as timber, firewood, wooden crates, paper board, etc); food and spices (like coconut, almond, cashew nuts, clove, cinnamon, etc); tannins; gums; resins; drugs; etc.

- They maintain biological diversity.
- They help to maintain a perfect water cycle in nature.
- They prevent floods.
- They prevent soil erosion.
- Agro-forestry is an absolute commercial forestry developed to fulfil the need of various forest based industries. It is done on the fallow land or free grazing land.
- Urban forestry involves growing of ornamental trees along roads, vacant lands and common parts of urban areas.

WILDLIFE

Wildlife means all those naturally occurring animals, plants and their species which are not cultivated,domesticated and tamed.

CONSERVATION OF WILD LIFE

Some of the measures to be taken for the conservation of wild-life are:

(i) Laws should be enforced to impose a ban on poaching or capturing of any animal.

(ii) The conservation of wild life should be done in Biosphere reserves (i.e., multipurpose protected areas meant for conservation of wild life, traditional life style of tribals and their domesticated animals), National parks (i.e., areas for protection of wild life maintained by the government where cultivation, grazing, hunting, etc are not allowed), Sanctuaries (i.e., protected natural habitats where hunting is not allowed but other activities are allowed).

(iii) Special attention should be paid to the conservation of endangered species of wild animals and birds to prevent their extinction altogether.

- Necessity of judicious use of coal and petroleum

  Coal and petroleum are fossil fuels found in earth's crust. They are non-renewable and exhaustible resources.

POLLUTION CAUSED BY BURNING COAL AND PETROLEUM BASED FUELS

In addition to carbon, these contain hydrogen, nitrogen and sulphur. When these are burnt, the products are carbon dioxide, water, oxides of nitrogen and sulphur. When combustion takes place in insufficient air (oxygen), then carbon monoxide is formed instead of carbon dioxide. These products are harmful and hence pollute the environment.

For example :

(i) Sulphur dioxide causes bronchitis and when it dissolves in rain water, it makes it acidic. The acid rain damages trees, buildings, metals, etc.

(ii) Nitrogen oxides also attack the breathing system and cause acid rain.

(iii) Carbon monoxide is a very poisonous gas. It stops RBC's from carrying oxygen from lungs and thus causing suffocation.

(iv) Carbon dioxide is a greenhouse gas which traps solar energy and leads to global warming.

STEPS TO REDUCE THE CONSUMPTION OF COAL AND PETROLEUM

Some simple choices can make a difference in our energy consumption patterns.

1. Switch off the lights, fans, etc when not needed.
2. Use of bio gas as domestic fuel should be encouraged.
3. Pressure cookers should be used for cooking food.
4. Solar cookers should be used wherever possible.

PREVIOUS YEARS' EXAMINATION QUESTIONS

TOPIC 1

1 Mark Questions

1. Give one example each from your daily life where the domestic waste can be effectively reused and recycled.

[TERM 2, 2014]

2 Marks Questions

2. List the products of combustion of fossil fuels. What are their adverse effects on the environment? **[TERM 2, 2012]**

3. We often observe domestic waste decomposing in the bylanes of residential colonies. Suggest ways to make people realise that the improper disposal of waste is harmful to the environment.

[TERM 2, 2013]

4. Why is sustainable management of natural resources necessary? Out of the two methods – reuse and recycle – which one would you suggest to practice and why?

[TERM 2, 2014]

5. Forests are "biodiversity hot spots". Justify this statement. **[TERM 2, 2016]**

3 Marks Questions

6. List any four disadvantages of using fossil fuels for the production of energy.

[TERM 2, 2011]

7. Farmers are using a large number of pesticides and fertilizers in their fields to increase crop production and to enhance their profits. But by doing so they are causing damage to the soil as well as to the environment. Do you agree with this statement? Why should we avoid eating fruits and vegetables without washing them properly? What values do you get from this?

[TERM 2, 2015]

8. (a) Charcoal is a better fuel than wood. Why?
(b) How does biogas plant help to reduce the problem of pollution?

[TERM 2, 2015]

9. Mineral riches of the earth crust are either extracted or used. For every ton of metal, a large amount of slag is discarded which damages the environment. Explain the kind of management that we need in this regard. Give any two values attained from this management system.

[TERM 2, 2015]

Solutions

1. Empty bottles of jam, picklesetccan be reused for storage purposes while old newspapers and, aluminum cans can be recycled. [1]

2. The buried remains of dead animals and plants are called fossils which are excellent fuels. These fossils are called fossil fuels like coal or gas. Combustion of fossil fuels produces harmful air pollutants, such as nitrogen oxides, sulphur dioxide, volatile organic compounds etc. [1]

Their adverse effects on the environments are as follows:

(A) The burning of coal and petroleum produces a lot of pollutants causing air pollution.

(B) Fossil fuels release oxides of carbon dioxide, nitrogen, sulphur, etc. that cause acid rain, which affects the soil fertility and portable water.

(C) The burning of fossil fuels produces gases such as carbon dioxide, has been linked to global warming. [1]

3. Some of the ways to make people realize that the improper disposal of waste is harmful to the environment are:

(a) Improper disposal of waste will serve as a breeding ground for mosquitoes and will create favorable conditions for the spread of various diseases. [1]

(b) Improper disposal of waste will release harmful gases into the environment. It will make the environment unclean and unhygienic for the normal living of the organisms.

(c) The waste will flow to water bodies along with the rainwater and become a threat to the ground water as well as for the aquatic organisms. [1]

4. To increase the overall life of natural resources, sustainable management of natural resources is necessary, specially non-renewable resources. It is possible to control the environmental pollution. This can be done by recycling or reusing resources. [1]

Reuse: If one thing can be reused then the cost of recycling can be saved.

Recycle: Sometimes to enhance the life of the resource, recycling is the best and only option because not every resource can be reused. [1]

5. Forests serve as a natural home to many biodiversities containing different species and plants such as animals, birds, plants, algae etc. Forests have divergent species of flora (plants) and fauna (animals) depending on geographic locations and availability of adequate resources for them to grow and flourish. The term biodiversity hotspot refers to the biologically rich areas around the world that have plants, animals and other microorganisms in their original habitat. Hence Forests are being referred to as biodiversity hot spots. [2]

6. The disadvantages of using fossil fuel for the production of energy are as follows:

(i) Fossil fuels are non-renewable resources for the production of energy in the environment. If they will be used extensively they will no longer be available for use. [1]

(ii) When they are used for energy production they emit a huge amount of toxic gases like sulphur and nitrogen in the atmosphere. Thus depleting our environment [1]

(iii) They also emit carbon dioxide thus increasing its concentration in environment and further causing global warming.

(iv) When fossil fuels are burn in low oxygen presence, they release carbon monoxide which is toxic and harmful gas for all the organisms in the environment. [1]

7. Every plant requires a specific pH range for proper growth and optimum yield. If a farmer is using a large number of pesticides and fertilizers in their fields to increase crop production, they change the pH of the soil which in turn makes it acidic or basic. In the long run, this can cause the soil to become infertile and can lead to soil erosion. Therefore, the use of pesticides and fertilizers should be done in a controlled manner. [1]

We should avoid eating fruits and vegetables without washing them properly because we don't know how they have been harvested, stored and packed. So washing them is the best way to get rid of any kind of impurities. [1]

Thus we can say that proper farming methods should be implemented to get healthy products and fruits and vegetables should be washed before consumption. [1]

8. (a) Charcoal is a better fuel than wood because it produces much less smoke than wood. Also, when an equal amount of wood and charcoal are burnt, charcoal produces almost twice the heat produced by the wood. One more reason to prefer charcoal over wood is its compact structure and ease of portability. [1½]

(b) Biogas plant makes use of bio-waste and sewage material to produce energy in a safe and efficient manner. This is a very good method to get rid of bio-waste on a large scale and produce energy without producing any noise or air pollution. [1½]

9. To save the environment from the damage which is caused by discarded slag, the 3R's method should be used. This method is Reduce, Reuse and Recycle of the mineral resources. The two values attained from this management system are:

(a) The needs should be reduced and one should stop being greedy. [1]

(b) The throwing of the substances and creating the wastes should be avoided by reusing the substances. [1]

Topic 2: Water Conservation

Summary

WATER FOR ALL

Water is a basic necessity for all terrestrial forms of life.

The pollution of river water is caused by dumping of untreated sewage and industrial wastes into it. This contamination can be found by two factors.

(i) The presence of coliform bacteria indicates its contamination by disease causing organisms.

(ii) If the measurement of pH of river water is below 7, then the river water is considered polluted.

- A multicrore, Ganga action plan, project was launched in 1985 to clean the river Ganga and make it pollution free.

DAMS

Dams are the large water storing bodies usually built by the government agencies. This stored water is then allowed to flow downstream at the desired rate.

Eg: Tehri dam - on river Ganga
Bhakra Nangal Dam - on river Satluj
Sardar Sarovar Dame - on river Narmada

Merits-

(a) Water stored in a dam is used for irrigation through a network of canals which ensures round the year water supply to the crop fields and help raise agricultural production. For example, the Indira Gandhi canal has brought greenery to considerable area of Rajasthan.

(b) Its continuous water supply to the people in towns and cities through pipelines after suitable treatment.

(c) The falling of water from the dam is used for generating electricity. The electricity thus produced is called hydro electricity.

Demerits:

Social problems :

Many tribals and peasants are displaced and rendered homeless.

These people are **NOT** given adequate compensation by the government for rehabilitation so as to start their life afresh.

Environmental problems :

Construction of dams contribute to deforestation and loss of biodiversity.

Variety of flora and fauna gets submerged under water.

Economic problems :

A huge amount of public money is spent without proportionate benefits.

MANAGEMENT AND CONSERVATION OF WATER RESOURCES

Rain Water Harvesting

This is done by saving and capturing rain water by special water harvesting structures. These structures include digging a series of deep pits on the beds of rivers, building small earthen dams, constructing dykes, sand and limestone reservoirs and setting roof-top water collecting units.

(a) Purpose of water harvesting system : To make rain water percolate under the ground so as to recharge ground water.

(b) Advantages of water harvesting system :

(i) The water stored in ground does not evaporate, spreads out to recharge wells and provides moisture for crops.

(ii) The water stored in ground does not promote breeding of mosquitoes.

(iii) The water stored in ground is protected from contamination by human and animal wastes.

(iv) The water stored in ground is utilized for the benefit of the local population.

PREVIOUS YEARS' EXAMINATION QUESTIONS

TOPIC 2

2 Marks Questions

1. List three problems which arise due to the construction of big dams. Suggest a solution for these problems. **[TERM 2, 2012]**
2. List and explain any two advantages associated with water harvesting at the community level. **[TERM 2, 2013]**
3. What is water harvesting? How can this technique help in the conservation of water? **[TERM 2, 2016]**

3 Marks Questions

4. (a) Water is an elixir of life, a very important natural resource. Your science teacher wants you to prepare a plan for a formative assessment activity, "How to save water, the vital natural resource". Write any two ways that you will suggest to bring awareness in your neighborhood, on 'how to save water'.
   (b) Name and explain any one way by which the underground water table does not go down further. **[TERM 2, 2017]**
5. What is a dam? Why do we seek to build large dams? While building large dams, which three main problems should particularly be addressed to maintain peace among local people? Mention them **[TERM 2, 2018]**

Solutions

1. There are certain disadvantages associated with the construction of dams across rivers.

   Environmental problems: The construction of dams across rivers leads to deforestation, which creates an imbalance in the natural ecosystem. [½]

   Solution: To compensate the deforestation, we should plant more trees. [½]

   Social problems: The construction of dams involves the building of large reservoirs and sometimes, it may result in the flooding of nearby towns and villages. [½]

   Solution: People should be relocated to safer places and affected people should be compensated well.

   Economic problems: The construction of dams requires huge amounts of monetary investments.

   Solution: We can try to make optimum use of the dams by generating electricity. [½]
2. Two advantages associated with water harvesting at the community level are as follows:
   (a) Overexploitation of water resources will be reduced. [1]
   (b) Helps to recharge the natural wells and provides moisture for vegetation over a wide area. [1]
3. The process of collection of rainwater for later use is called as water harvesting. This technique helps to conserve the water as:
   (a) It replenishes ground water [1]
   (b) It can be used for irrigation and also reduces soil erosion. [1]
4. (a) (i) Educate the residents of the community about efficient water practices, creating awareness among children, youth, housewives and elderly people about the importance of water in daily life. [1]
   (ii) Check for leaks in pipes, hoses, and taps in houses. Wastage of water due to continuous leakage and constant flow is a considerable water wastage which can be avoided using the best practices i.e always be careful about any water leakage. [1]
   (b) Rainwater harvesting: It is a technique in which rainwater is collected and stored in natural reservoirs or tanks to avoid the wastage due to run off. Rooftop harvesting is a method to conserve rainwater. In rooftop harvesting, the flow of rainwater can be intercepted by concrete surface and this concrete surface provide a household with high-quality drinking water and year-round storage. [1]
5. A dam is used to hold water and raise the level to form a reservoir. It is used to generate electricity or serves as a water supply.

   Large dams store more water to generate electricity; therefore, we seek to build large dams.

   The dams are generally constructed in hilly terrains. For the construction of dams: [1]
   (i) Large areas of agricultural land and human habitation are destroyed.
   (ii) Large ecosystems are sacrificed when submerged under the water in the dams.[1]
   (iii) People have to shift their houses to a different place which creates a lot of problem for them. [1]

Smart Notes .....

CBSE
Sample Question Paper 1

Science
Class X

Time : 3 hrs **MM : 80**

General Instructions

(i) The question paper comprises two sections, A and B. You are to attempt both the sections.
(ii) All questions are compulsory.
(iii) All questions of Section A and B are to be attempted separately.
(iv) There is an internal choice in two questions of three marks each and one question of five marks.
(v) Question numbers 1 and 2 in Section A are one mark questions. They are to be answered in one word or in one sentence.
(vi) Question numbers 3 to 5 in Section A are two marks questions. These are to be answered in 30 words each.
(vii) Question numbers 6 to 15 in Section A are three marks questions. These are to be answered in about 50 words each.
(viii) Question numbers 16 to 21 in Section A are 5 marks questions. These are to be answered in 70 words each.
(ix) Question numbers 22 to 27 in Section B are based on practical skills. Each question is a two marks question. These are to be answered in brief.

Section A

1. List two problems that may arise by planting trees of single variety over vast tracts of a forest. (1)

2. Write the chemical name and formula of the compound formed when iron is exposed to moist air. (1)

3. (i) Define Mendeleev periodic law.
(ii) Name the extreme left and extreme right group of the long form of periodic table. (2)

4. What would be the power of a concave lens which has a focal length of 20 cm. (2)

5. A solution of potassium chloride when mixed with silver nitrate solution forms an insoluble white substance. Write the chemical reaction involved and also mention the type of chemical reaction. (2)

6. "Energy flow in food chain is always unidirectional". Justify this statement. Explain how the pesticides enter a food chain and subsequently get into our body. (3)

7. A compound 'X' which is prepared from gypsum has a property of hardening when mixed with a proper quantity of water. (3)

(*a*) Identify the compound 'X'

(*b*) Write the chemical equation for its preparation.

(c) For what purpose is it used in hospitals?

8. (*a*) Only variations that confer an advantage to an individual organism will survive in a population. Do you agree with this statement? Why or why not?

(*b*) In evolutionary terms, can we say which among bacteria, spiders, fish and chimpanzees have a better body design ? Why or why not ? (3)

9. (*a*) A ray of light enters glass from water. Will it bend towards the normal or away from it?

(*b*) What would be the refractive index of water with respect to glass if $n_{glass} = 1.66$ and $n_{water} = 1.33$? (1+2)

10. (*a*) What is a magnetic field?

(*b*) Give any two properties of magnetic field lines. (3)

OR

(*a*) Define a magnetic field line.

(*b*) Draw a diagram showing field lines around a bar magnet. (3)

11. (*a*) At what potential is

(*i*) Live wire, (*ii*) Earth wire maintained?

(*b*) Why are devices connected parallel to each other in a domestic circuit? (1+2)

12. (*a*) How does binary fission differ from multiple fission?

(*b*) What would be the ratio of chromosomes number between an egg and its zygote? How is the sperm genetically different from the egg? (3)

13. (a) The chemical reactivity of the elements of group I increases downward while that of the elements of group 17 decreases downward. Explain.

(*b*) Write two limitations of Newland law of octave. (3)

14. (*a*) Name the causative agent of the disease "kala – azar" and its mode of asexual reproduction.

(*b*) What happens when

(*i*) Planaria gets cut into two pieces?

(*ii*) A mature spirogyra filament attains considerable length. (3)

15. Ramesh decided to buy a solar cooker to cook his meals on a daily basis. By doing so, he was happy that he would be using less L.P.G.

(*a*) Why are solar cookers black in colour?

(*b*) Why does a solar cooker have a cover of glass plate?

(*c*) What values are shown by Ramesh through his decision? (1+1+1)

16. (*a*) Give reasons for the following :

(*i*) Air holes of a gas burner have to be adjusted when the vessels being heated get blackened by the flame.

(*ii*) Use of synthetic detergent caused pollution of water.

(*b*) Write the IUPAC names of the following:

(*i*) HCOOH (*ii*) CH_3COCH_3

(*c*) Draw the electron dot structure of ethyne and also draw its structural formula. (5)

17. (*a*) Write chemical equations for the reactions taking place, when

(i) Cinnabar is roasted

(ii) Calamine is calcinated.

(iii) Manganese dioxide is heated with aluminium powder.

(*b*) Give reasons.

(i) Metals are regarded as electropositive elements.

(ii) Articles of aluminium do not corrode even though aluminium is an active metal.

(5)

18. (*a*) Explain the statement 'Bile does not contain any enzyme but it is essential for digestion'.

(*b*) Compare the structure and function of Alveoli in lungs with Nephrons in kidneys.

(*c*) Why is the rate of breathing in aquatic organisms much faster than that in terrestrial organisms? (5)

19. (*a*) Draw the structure of a neuron and label the following parts:

(i) Part of the neuron where information is acquired

(ii) Part of the neuron through which information travels as an electrical impulse.

(*b*) How does our body respond when adrenaline is secreted into the blood?

(*c*) How is the communication between the central nervous system and the other parts of the body facilitated? (5)

OR

(*a*) Diagrammatically depict 'Reflex arc'.

(*b*) How are brain and spinal cord protected in our body?

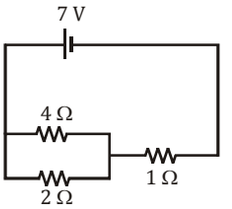
20. (*a*) During day, why is the colour of clear sky blue, on earth?

(*b*) What is scattering of light? When would the scattered light appear white?

(*c*) Explain the reddening of the sun at sunrise with the help of a diagram.

(1+2+2)

21. (*a*) Calculate the current through 4Ω resistor in the diagram shown below.



(*b*) A wire of resistance R is cut into 2 parts and both parts are connected in parallel to each other, giving the equivalent resistance as R′. Find the ratio of R to R'. (3+2)

SECTION B

22. Give two differences between ammeter and voltmeter. (2)

23. (*a*) What is focus of convex lens?

(*b*) Distance between which two things will give the focal length of a convex lens if an object at infinity, a convex lens and a screen are used? (2)

24. A student dipped a strip of pH paper in distilled water taken in a tube. As expected the pH paper turns green.

He then dissolved a pinch of common salt in the same test tube. What will be the expected change in colour of pH paper? Explain (2)

25. (i) Name the gas evolved when zinc reacts with hydrochloric acid.

(ii) Write the chemical equation and write the method to test the gas evolved. (2)

26. (*a*) While preparing a temporary stained mount of a leaf epidermal peel, how is the extra stain removed?

(*b*) To prepare a good temporary mount of the petunia leaf peel showing many stomata, from where does the student get the peel and why? (2)

27. (*a*) What is the function of cotyledons ?

(*b*) Define Germination of Seeds. (2)

CBSE
Sample Question Paper 2

Science
Class X

Time : 3 hrs **MM : 80**

General Instructions

(i) The question paper comprises two sections, A and B. You are to attempt both the sections.
(ii) All questions are compulsory.
(iii) All questions of Section A and B are to be attempted separately.
(iv) There is an internal choice in two questions of three marks each and one question of five marks.
(v) Question numbers 1 and 2 in Section A are one mark questions. They are to be answered in one word or in one sentence.
(vi) Question numbers 3 to 5 in Section A are two marks questions. These are to be answered in 30 words each.
(vii) Question numbers 6 to 15 in Section A are three marks questions. These are to be answered in about 50 words each.
(viii) Question numbers 16 to 21 in Section A are 5 marks questions. These are to be answered in 70 words each.
(ix) Question numbers 22 to 27 in Section B are based on practical skills. Each question is a two marks question. These are to be answered in brief.

Section A

1. Give two reasons why environmentalists are insisting upon sustainable natural resource management? (1)

2. Why does milk becomes sour when kept for a long time? (1)

3. (*a*) An element 'X' belong to the second group of the periodic table. What is the formula of its oxide. (2)

(*b*) Will it be a metal or non-metal?

4. (*a*) Relate refractive index of a medium to its optical density.

(*b*) Can absolute refractive index of a medium be less than 1? Give reason for your answer. (2)

5. Write balanced chemical equations for the following:

(*i*) Hydrogen + Nitrogen → Ammonia

(*ii*) Calcium + Water → Calcium hydroxide + hydrogen. (2)

6. (*a*) What are trophic levels in a food chain?

(*b*) Write a four trophic level food chain and represent in the form of an ecological pyramid. (3)

7. (*a*) What is chlor alkali process? Why is it called so. Write a chemical equation.

(*b*) Which by product of chlor alkali process is used for the manufacture of bleaching powder? Write equation. (3)

8. You have read in newspapers that sex ratio in many parts of the country has gone down to less than 900 : 1000. What does this mean? What is the reason behind it? How can you contribute in retrieving the situation? (3)

9. (*a*) How should a ray of light pass through a convex lens so that it goes without suffering any deviation?

(*b*) Which lens has more focal length, the one which has more power or the one with less power? (3)

10. (*a*) How does a magnetic compass help to find the direction of magnetic field?

(*b*) How will the density of field lines around a current carrying wire change, if more current is passed through it?

(*c*) What is the direction of magnetic field inside a current carrying solenoid? (3)

11. (*a*) Which of the following quantities change when an electron passes through a magnetic field : Speed of electron or direction of electron? Give reason for your answer.

(*b*) What will happen to an electron if it passes parallel to the magnetic field lines, in a magnetic field? (3)

12. (*a*) Differentiate between sperm and ova.

(*b*) Name the surgical methods of contraception in human beings. (3)

13. Write balanced chemical equations:

(*i*) Zinc sulphide is roasted. (3)

(*ii*) Cinnabar is roasted.

(*iii*) Manganese dioxide is heated with Aluminium.

OR

Two elements 'X' and 'Y' belong to the second group of the periodic table. '*X*' has 2 shells and *Y* has 3 shells in it.

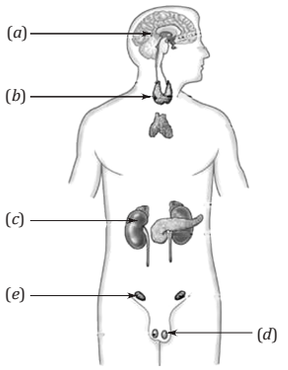
(*a*) Which is more metallic in nature and why?

(*b*) What is the formula of the chloride of 'X' and sulphide of 'Y' ?

(*c*) Is the valency of 'X' same as that of 'Y' or different? Why?

14. (1) Identify the endocrine glands (*a*), (*b*), (*c*) and (*e*) in the given diagram.

(2) List the functions of (*c*) and (*e*). (3)



OR

(*a*) Give a neat labelled diagram of Neuromuscular junction.

(*b*) What are the two components of Peripheral Nervous system?

15. (*a*) Give the principle of converting Ocean Thermal Energy to Electrical Energy.

(*b*) Give two advantages of using Ocean Thermal Energy.

(*c*) Why do we need to look for alternative sources of energy? (3)

16. (*a*) What is denatured alcohol? What is the need to denature alcohol?

(*b*) Explain why soaps are not effective cleaning agents in hard water.

(*c*) What happens when:

(*i*) ethanol reacts with sodium metal

(*ii*) ethanol reacts with conc. H_2SO_4 (5)

17. (*a*) With the help of an activity, how can you prove that oxygen and moisture are required for rusting.

(*b*) Define the term 'alloys'. Write two advantages of making alloys.

(*c*) Write the composition of :

(*i*) Bronze

(*ii*) 22- Carat Gold (5)

18. (*a*) State any two common features between all the respiratory organs?

(*b*) Explain the mechanism of gaseous exchange between tissues and blood.

(*c*) Name the Respiratory pigment present in Blood. State its significance. (5)

19. (*a*) Differentiate between Analogous and Homologous organs. Give an example in each case.

(*b*) "Birds have evolved from reptiles". State evidence to prove the statement.

(*c*) Planaria, insects, octopus and vertebrates all have eyes can we group eyes of these animals together to establish a common evolutionary origin? Justify your answer. (5)

20. (*a*) Explain why do stars twinkle?

(*b*) Why do the planets not twinkle?

(*c*) How does light reach the area, where direct sunlight does not reach?

(*d*) Explain how the path of light can become visible? (2 + 1 + 1 + 1)

OR

(*a*) Why does sun light passing through a prism give a spectrum?

(*b*) Draw a diagram showing dispersion of light by a glass prism.

(*c*) What light is referred to as white light? (2 + 2 + 1)

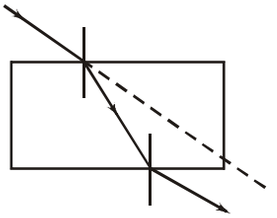
21. (*a*) By what factor would the resistance change if a wire is cut into 4 equal parts and all parts are put in parallel connection?

(*b*) In what kind of connection, series or parallel, would devices draw more energy per second, when put across the same potential difference?

(*c*) How many devices of power 22 W each can be put across 220 V, so that current in the circuit does not exceed 3A? (2 + 1 + 2)

SECTION B

22. Mark the lateral displacement in the diagram.



Give two factors on which lateral displacement depends. (1 + 1)

23. Draw the circuit used to verify Ohm's Law. (2)

24. A substance '*A*' is used as a preservative for pickles.
It turns blue litmus red.

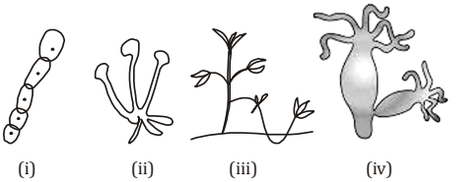
(*a*) Identify the substance. How does it smell like?

(*b*) Write the equation for its reaction with ethyl alcohol in the presence of conc. H_2SO_4. (2)

25. An aluminium wire was dipped in a solution of ferrous sulphate and kept for sometime. What change do you observe in the appearance of aluminium and ferrous sulphate. Explain your observations. (2)

26. A student puts germinating seeds into conical flask but forgets to put KOH solution in the hanging tube. Will he get the desired result? Explain your answer with appropriate reason. (2)

27. (*a*) Which two of the following four diagrams illustrate budding? (2)



(i) (ii) (iii) (iv)

(*b*) How is binary fission in Amoeba different from budding in yeast? (give two points)