CBSE
Sample Question Paper 1

Physics
Class XII

Time : 3 hrs **Maximum Marks : 70**

General Instructions

(i) All questions are compulsory. There are 26 questions in all.

(ii) This question paper has five sections : Section A, Section B, Section C, Section D and Section E.

(iii) Section A contains five questions of one mark each, Section B contains five questions of two marks each, Section C contains twelve questions of three marks each, Section D contains one value based question of four marks and Section E contains three questions of five marks each.

(iv) There is no overall choice. However, an internal choice has been provided in one question of two marks, one question of three marks and all the three questions of five marks weightage. You have to attempt only one of the choices in such questions.

(v) You may use the following values of physical constants wherever necessary :

$$c = 3 \times 10^8 \text{ m/s}$$

$$h = 6.63 \times 10^{-34} \text{ Js}$$

$$e = 1.6 \times 10^{-19} \text{ C}$$

$$\mu_0 = 4\pi \times 10^{-7} \text{ T m A}^{-1}$$

$$\varepsilon_0 = 8.854 \times 10^{-12} \text{ C}^2 \text{ N}^{-1} \text{ m}^{-2}$$

$$1/(4\pi\varepsilon_0) = 9 \times 10^9 \text{ N m}^2 \text{ C}^{-2}$$

$$\text{Mass of electron } (m_e) = 9.1 \times 10^{-31} \text{ kg}$$

$$\text{Mass of neutron} = 1.675 \times 10^{-27} \text{ kg}$$

$$\text{Mass of proton} = 1.673 \times 10^{-27} \text{ kg}$$

$$\text{Avogadro's number} = 6.023 \times 10^{23} \text{ per gram mole}$$

$$\text{Boltzmann constant} = 1.38 \times 10^{-23} \text{ JK}^{-1}.$$

SECTION A

(1 × 5 = 5)

1. Define one ampere of current using the concept of force between two parallel current carrying conductors of infinite length.

2. Name the electromagnetic radiations used for,

(a) water purification

(b) eye surgery.

3. A signal of 5 kHz frequency is amplitude modulated on a carrier wave of frequency 2 MHz, what are the frequencies of the side bands produced?

4. The permeability of a magnetic material is 0.9983. Name the type of magnetic material it represents.

5. Write the expression for Bohr's radius in hydrogen atom.

SECTION B

(2 × 5 = 10)

6. Two electric bulbs P and Q have their resistance in the ratio 1 : 3. They are connected in series across a battery. Find the ratio of the power dissipation in these bulbs.

OR

In a potentiometer arrangement for determining the emf of a cell, the balance point of a cell in open circuit is 350 cm. When a resistance of 9Ω is used in the external circuit of the cell, the balance point shifts to 300 cm. Determine the internal resistance of the cell.

7. An electric dipole of length 4 cm, when placed with its axis making an angle of 60° with a uniform electric field, experiences a torque of $4\sqrt{3}$ Nm. Calculate the potential energy of the dipole, if it has charge ± 8 nC.

8. (i) Define mutual inductance.

(ii) A pair of adjacent coils has a mutual inductance of 1.3 H. If the current in one coil changes from 0 to 20 A in 0.5 s, what is the change of flux linkage with the other coil?

9. Draw a plot showing the variation of (i) electric field (E) and (ii) electric potential (V) with distance r due to a point charge Q.

10. A convex lens of focal length 20 cm is placed co axially in contact with a concave lens of focal length 25 cm. Determine the power of the combination. Will the system be converging or diverging in nature?

SECTION C

(3 × 12 = 36)

11. Draw V-I characteristics of a p-n junction diode. Answer the following questions, giving reasons:

(i) Why is the current under reverse bias almost independent of the applied potential up to a critical voltage ?

(ii) Why does the reverse current show a sudden increase at the critical voltage Name any semiconductor device which operates under the reverse bias in the breakdown region

12. Distinguish between 'sky waves' and 'space waves' modes of propagation in communication system.

(a) Why is sky wave mode propagation restricted to frequencies up to 40 MHz?

(b) Give two examples where space wave mode of propagation is used.

13. An electron and a photon each have a wavelength 1.00 nm. Find

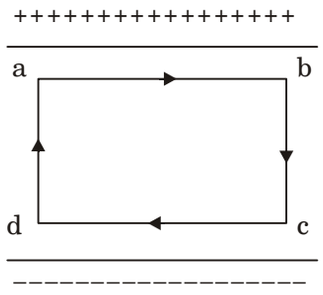
(a) their momenta,

(b) the energy of the photon and

(c) the kinetic energy

14. (a) Obtain the expression for the energy stored per unit volume in a charged parallel plate capacitor.

(b) The electric field inside a parallel plate capacitor is E. Find the amount of work done in moving a charge q over a closed rectangular loop abcda.

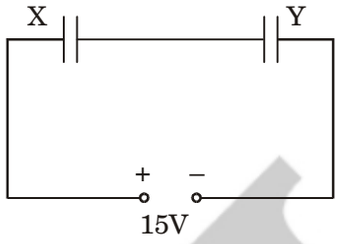


OR

(a) Derive the expression for the capacitance of a parallel plate capacitor having plate area A and plate separation d.

(b) Two charged spherical conductors of radii R_1 and R_2 when connected by a conducting wire acquire charge q_1 and q_2 respectively. Find the ratio of their surface charge densities in terms of their radii.

15. Two parallel plate capacitors X and Y have the same area of plates and same separation between them. X has air between the plates while Y contains a dielectric medium of $\varepsilon r = 4$.



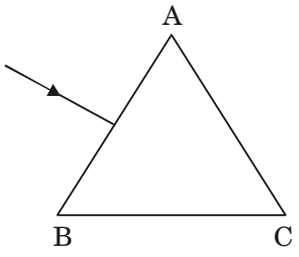
(i) Calculate capacitance of each capacitor if equivalent capacitance of the combination is 4 μF.

(ii) Calculate the potential difference between the plates of X and Y.

(iii) Estimate the ratio of electrostatic energy stored in X and Y

16. (a) Show using a proper diagram how unpolarised light can be linearly polarized by reflection from a transparent glass surface.

(b) The figure shows a ray of light falling normally on the face AB of an equilateral glass prism having refractive index $\frac{3}{2}$, placed in water of refractive index $\frac{4}{3}$. Will this ray suffer total internal reflection on striking the face AC? Justify your answer



17. Name the parts of the electromagnetic spectrum which is

(a) Suitable for radar systems used in aircraft navigation

(b) Used to treat muscular strain

(c) Used as a diagnostic tool in medicine

Write in brief, how these waves can be produced.

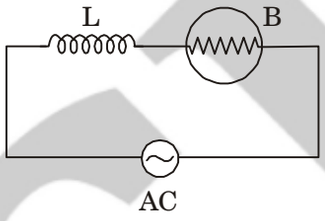
18. An inductor L of inductance X_L is connected in series with a bulb B and an ac source. How would brightness of the bulb change when,

(i) number of turn in the inductor is reduced

(ii) an iron rod is inserted in the inductor

(iii) a capacitor of reactance $X_C = X_L$ is inserted in series in the circuit.

Justify your answer in each case.



19. A charge Q of mass M moving in a straight line is accelerated by potential difference V. It enters a uniform magnetic field B perpendicular to its path. Deduce an expression in terms of V for the radius of the circular path in which it travels?

20. Define mutual inductance between a pair of coils. Derive an expression for the mutual inductance of two long coaxial solenoids of same length wound one over the other.

21. A voltage $V = V_o \sin \omega t$ is applied to a series LCR circuit. Derive the expression for the average power dissipated over a cycle.

Under what condition is

(i) no power dissipated even though the current flows through the circuit

(ii) maximum power dissipated in the circuit?

22. A bar magnet of magnetic moment 6J/T is aligned at 60° with a uniform external magnetic field of 0.44T. Calculate,

(a) the work done in turning the magnet to align its magnetic moment,

(i) normal to the magnetic field

(ii) opposite to the magnetic field

(b) the torque on the magnet in the final orientation in case (ii).

SECTION D

(4 × 1 = 4)

23. Asha's mother read an article in the newspaper about a disaster that took place at Chernobyl. She could not understand much from the article and asked a few questions from Asha regarding the article. Asha tried to answer her mother's questions based on what she learnt in Class XII Physics

(a) What was the installation at Chernobyl where the disaster took place?

(b) What, according to you, was the cause of this disaster?

(c) What are the values shown by Asha?

SECTION E

(5 × 3 = 15)

24. Draw a simple circuit of a CE transistor amplifier. Explain its working. Show that the voltage gain, A_v of the amplifier is given by $A_v = -\frac{\beta_{ac} R_L}{r_i}$, where β_{ac} is the current gain, R_L is the load resistance and ri is the input resistance of the transistor. What is the significance of the negative sign in the expression for the voltage gain?

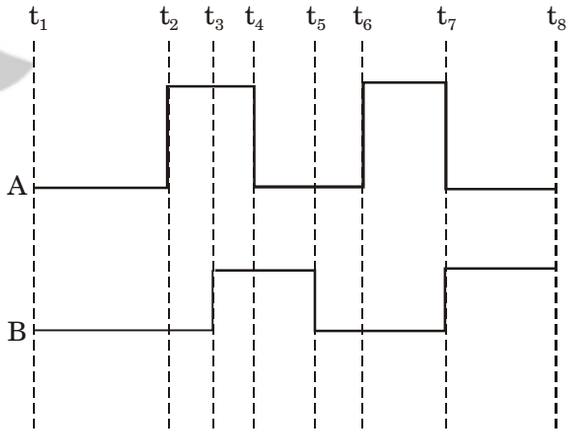
OR

(a) Draw the circuit diagram of a full wave rectifier using p-n junction diode. Explain its working and show the output, input waveforms.

(b) Show the output waveforms (Y) for the following inputs A and B of

(i) OR gate

(ii) NAND gate



25. Using Bohr's postulates, derive the expression for the frequency of radiation emitted when electron in hydrogen atom undergoes transition from higher energy state (quantum number n_i) to the lower state, (n_f). When electron in hydrogen atom jumps from energy state $n_i = 4$ to $n_f = 3, 2, 1$, identify the spectral series to which the emission lines belong.

OR

(a) Draw the plot of binding energy per nucleon (BE/A) as a function of mass number A. Write two important conclusions that can be drawn regarding the nature of nuclear force.

(b) Use this graph to explain the release of energy in both the processes of nuclear fusion and fission.

(c) Write the basic nuclear process of neutron undergoing β-decay. Why is the detection of neutrinos found very difficult?

26. (a) In Young's double slit experiment, describe briefly how bright and dark fringes are obtained on the screen kept in front of a double slit. Hence obtain the expression for the fringe width.

(b) The ratio of the intensities at minima to the maxima in the Young's double slit experiment is 9 : 25. Find the ratio of the widths of the two slits.

OR

(a) Describe briefly how a diffraction pattern is obtained on a screen due to a single narrow slit illuminated by a monochromatic source of light. Hence obtain the conditions for the angular width of secondary maxima and secondary minima.

(b) Two wavelengths of sodium light of 590 nm and 596 nm are used in turn to study the diffraction taking place at a single slit of aperture 2×10^{-6} m. The distance between the slit and the screen is 1.5 m. Calculate the separation between the positions of first maxima of the diffraction pattern obtained in the two cases.