

## CBSE Sample Paper Class 12 Physics Set 4

**SUBJECT: PHYSICS**  
**CLASS : XII**

**MAX. MARKS : 70**  
**DURATION : 3 HRS**

### General Instruction:

- All questions are compulsory. There are 27 questions in all.
- This question paper has **four** sections : Section A, Section B, Section C and Section D.
- Section A contains **five** questions of **one** mark each, Section B contains **seven** questions of **two** marks each, Section C contains **twelve** questions of **three** marks each and Section D contains **three** questions of **five** marks each.
- 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.
- You may use the following values of physical constants wherever necessary :

$$c = 3 \times 10^8 \text{ m/s}, \quad h = 6.63 \times 10^{-34} \text{ Js}, \quad e = 1.6 \times 10^{-19} \text{ C}, \quad \mu_0 = 4\pi \times 10^{-7} \text{ TmA}^{-1},$$

$$\epsilon_0 = 8.854 \times 10^{-12} \text{ C}^2 \text{N}^{-1} \text{m}^{-2}, \quad m_e = 9.1 \times 10^{-31} \text{ kg}, \quad \frac{1}{4\pi\epsilon_0} = 9 \times 10^9 \text{ Nm}^2 \text{C}^{-2},$$

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

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

$$\text{Avogadro's number} = 6.023 \times 10^{23} \text{ per gram mole}, \quad \text{Boltzmann constant} = 1.38 \times 10^{-23} \text{ JK}^{-1}$$

### SECTION – A

Questions 1 to 5 carry 1 mark each.

- A concave lens of refractive index 1.5 is immersed in a medium of refractive index 1.65. What is the nature of the lens ?
- What is the meaning of the term ‘attenuation’ used in communication system?
- Define the term conductivity of a conductor. On what factors does it depend.
- What is the electric flux through a cube of side 1 cm which encloses an electric dipole ?
- What can be the cause of helical motion of charged particle?

### SECTION – B

Questions 6 to 12 carry 2 marks each.

- Show that the radius of the orbit in hydrogen atom varies as  $n^2$ , where  $n$  is the principal quantum number of the atom.
- Distinguish between ‘intrinsic’ and ‘extrinsic’ semiconductors.
- Use the mirror equation to show that an object placed between  $f$  and  $2f$  of a concave mirror produces a real image beyond  $2f$ .

**OR**

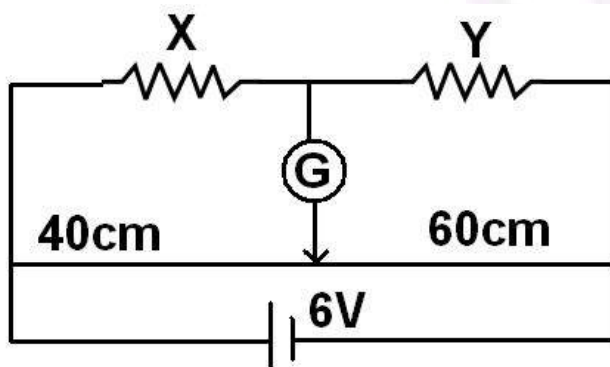
Find an expression for intensity of transmitted light when a polaroid sheet is rotated between two crossed polaroids. In which position of the polaroid sheet will the transmitted intensity be maximum ?

9. Two wires A and B of the same material and having same length, have their cross sectional areas in the ratio 1:6. What would be the ratio of heat produced in these wires when same voltage is applied across each?
10. State the underlying principle of a transformer. How is the large scale transmission of electric energy over long distance done with the use of transformers ?
11. (i) How are eddy currents reduced in a metallic core?  
(ii) Give two uses of eddy currents.
12. The wavelength  $\lambda$  of photon and the de-Broglie wavelength of an electron have the same value. Show that energy of photon is  $(2\lambda mc/h)$  times the kinetic energy of electron; where  $m$ ,  $c$  and  $h$  have their usual meaning.

### SECTION – C

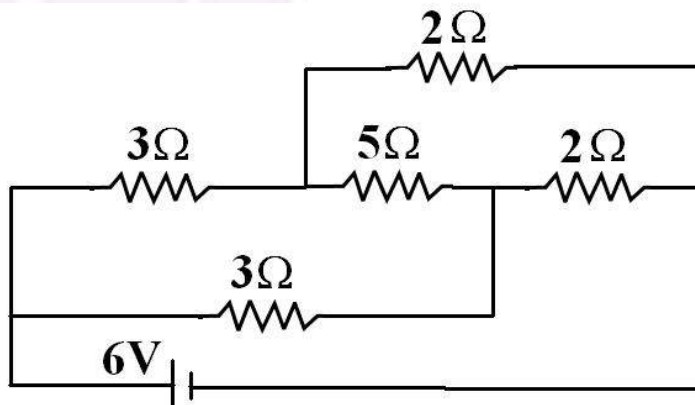
Questions 13 to 24 carry 3 marks each.

13. In the given circuit, a metre bridge is shown in the balanced state. The metre bridge wire has a resistance of  $1 \Omega \text{cm}^{-1}$ . Calculate the unknown resistance  $X$  and the current drawn from the battery of a negligible internal resistance if the magnitude of  $Y$  is  $6 \Omega$ . If at the balancing point, we interchange the position of galvanometer and the cell, how it will affect the position of the galvanometer?



OR

Calculate the current drawn from the battery in the given network shown here. State Kirchhoff's loop law and name the law on which it is based on.



14. Two capacitors of unknown capacitances  $C_1$  and  $C_2$  are connected first in series and then in parallel across a battery of 100 V. If the energy stored in the two combinations is 0.045 J and 0.25 J respectively, determine the value of  $C_1$  and  $C_2$ . Also calculate the charge on each capacitor in parallel combination.

15. Draw a block diagram of a detector for AM signal and show, using necessary processes and the waveforms, how the original message signal is detected from the input AM wave.
16. State the principle of working of a galvanometer.  
A galvanometer of resistance  $G$  is converted into a voltmeter to measure upto  $V$  volts by connecting a resistance  $R_1$  in series with the coil. If a resistance  $R_2$  is connected in series with it, then it can measure upto  $V/2$  volts. Find the resistance, in terms of  $R_1$  and  $R_2$ , required to be connected to convert it into a voltmeter that can read upto  $2V$ . Also find the resistance  $G$  of the galvanometer in terms of  $R_1$  and  $R_2$ .
17. (a) Explain briefly the process of emission of light by a Light Emitting Diode (LED).  
(b) Which semiconductors are preferred to make LEDs and why?  
(c) Give two advantages of using LEDs over conventional incandescent lamps.
18. Draw a circuit diagram of a transistor amplifier in CE configuration.  
Define the terms : (i) Input resistance and (ii) Current amplification factor. How are these determined using typical input and output characteristics ?
19. Answer the following questions :  
(a) In a double slit experiment using light of wavelength  $600\text{ nm}$ , the angular width of the fringe formed on a distant screen is  $0.1^\circ$ . Find the spacing between the two slits.  
(b) Light of wavelength  $5000\text{ \AA}$  propagating in air gets partly reflected from the surface of water. How will the wavelengths and frequencies of the reflected and refracted light be affected?
20. 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 and (iii) a capacitor of reactance  $X_C = X_L$  is inserted in series in the circuit. Justify your answer in each case.
21. 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.
22. Draw a labelled ray diagram of an astronomical telescope in the normal adjustment position and find the magnitudes of a) The length of the telescope b) The magnification of the telescope if the focal length of the objective lens is  $= 15\text{ m}$  and the focal length of an eye lens is  $5\text{ cm}$ .
23. Write Einstein's photoelectric equation and mention which important features in photoelectric effect can be explained with the help of this equation. The maximum kinetic energy of the photoelectrons gets doubled when the wavelength of light incident on the surface changes from  $\lambda_1$  to  $\lambda_2$ . Derive the expressions for the threshold wavelength  $\lambda_0$  and work function for the metal surface.
24. In the study of Geiger-Marsden experiment on scattering of  $\alpha$  particles by a thin foil of gold, draw the trajectory of  $\alpha$ -particles in the coulomb field of target nucleus. Explain briefly how one gets the information on the size of the nucleus from this study. From the relation  $R = R_0 A^{1/3}$ , where  $R_0$  is constant and  $A$  is the mass number of the nucleus, show that nuclear matter density is independent of  $A$ .

## SECTION – D

Questions 25 to 27 carry 5 marks each.

25. a) For same value of angle of incidence, the angles of refraction in three media are  $15^\circ$ ,  $20^\circ$  and  $25^\circ$  respectively. In which medium, the velocity of light will be minimum?  
b) Derive the relationship between angle of incidence, angle of prism and angle of minimum deviation for an equilateral prism.

**OR**

- a) State the conditions for total internal reflection to occur.  
b) A right angled prism of refractive index  $n$  has a plate of refractive index  $n_1$  so that  $n_1 < n$ , cemented to its diagonal face. The assembly is in air. A ray is incident on AB.  
i). Calculate the angle of incidence at AB for which the ray strikes the diagonal face at the critical angle.  
ii). Assuming  $n = 1.352$ , calculate the angle of incidence at AB for which the refracted ray passes through the diagonal face undeviated.
26. Find the expression for the energy stored in the capacitor. Also find the energy lost when the charged capacitor is disconnected from the source and connected in parallel with the uncharged capacitor. Where does this loss of energy appear?

**OR**

- (a) An electric dipole is held in uniform electric field.  
(i) Using suitable diagram, show that it does not undergo any translatory motion.  
(ii) Define torque, giving its SI unit; derive an expression for the torque acting on this dipole.  
(b) A capacitor is made of a flat plate of area  $A$  and second plate having a stair like structure as shown in figure below. If width of each stair is  $A/3$  and height is  $d$ . Find the capacitance of the arrangement.
27. (a) State Ampere's circuital law. Use this law to obtain the expression for the magnetic field inside an air cored toroid of average radius ' $r$ ', having ' $n$ ' turns per unit length and carrying a steady current  $I$ .  
(b) An observer to the left of a solenoid of  $N$  turns each of cross section area ' $A$ ' observes that a steady current  $I$  in it flows in the clockwise direction. Depict the magnetic field lines due to the solenoid specifying its polarity and show that it acts as a bar magnet of magnetic moment  $m = NIA$ .

**OR**

- (a) Define mutual inductance and write its S.I. units.  
(b) Derive an expression for the mutual inductance of two long co-axial solenoids of same length wound one over the other.  
(c) In an experiment, two coils  $c_1$  and  $c_2$  are placed close to each other. Find out the expression for the emf induced in the coil  $c_1$  due to a change in the current through the coil  $c_2$ .