No. of printed pages: 07

INDIAN SCHOOL SOHAR SET- 2

PRE-BOARD I EXAMINATION (2023-24)

SUBJECT: PHYSICS THEORY (042)

CLASS: XII **Maximum Marks: 70**

DATE: 20/11/2023 **Time Allowed: 3 hours**

GENERAL INSTRUSTIONS:

1. There are 33 questions in all. All questions are compulsory.
2. This question paper has five sections: Section A, Section B, Section C, Section D and Section E. All the sections are compulsory.
3. **Section A** contains sixteen MCQ of **one** mark each, **Section B** contains five questions of **two** marks each, **Section C** contains seven questions of **three** marks each, **Section D** contains two case study-based questions of **four** marks each and **Section E** contains three long answer questions of **five** marks each.
4. There is no overall choice. However, an internal choice has been provided in section B, C, D and E. You have to attempt only one of the choices in such questions.
5. Use of calculators is not allowed.
6. You may use the following values of physical constants wherever necessary.

$c = 3 \times 10^8$ m/s $h = 6.6 \times 10^{-34}$ J s $e = 1.6 \times 10^{-19}$ C

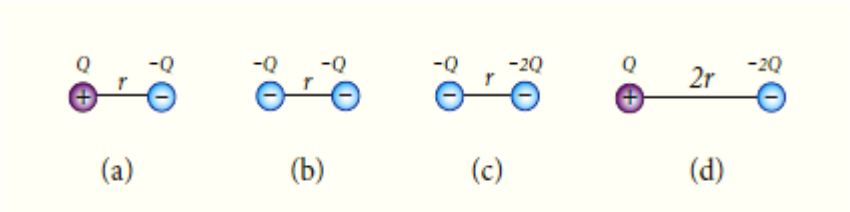
$\mu_0 = 4\pi \times 10^{-7}$ Tm A^{-1} $\varepsilon_0 = 8.854 \times 10^{-12}$ C^2 N^{-1} m^{-2}

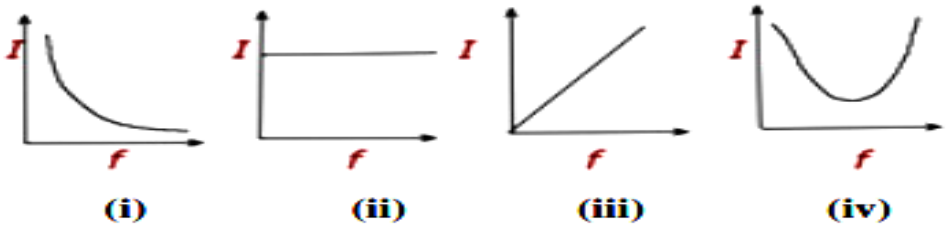
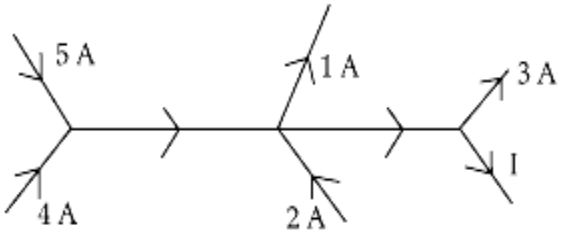
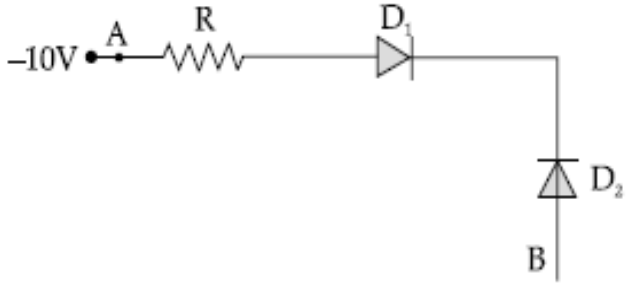
$\frac{1}{4\pi\varepsilon_0} = 9 \times 10^9\ Nm^2C^{-2}$

Mass of electron = 9.1×10^{-31} kg Mass of neutron = 1.675×10^{-27} kg

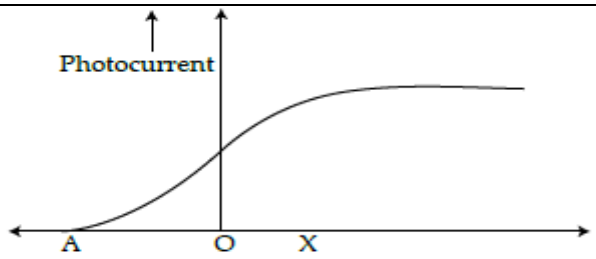
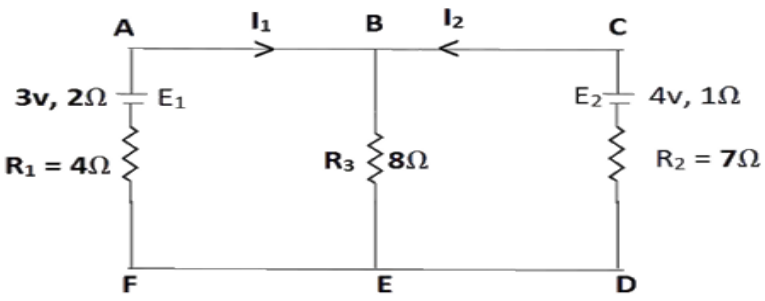
Mass of proton = 1.673×10^{-27} kg Avogadro's number = 6.023×10^{23} per gram mole

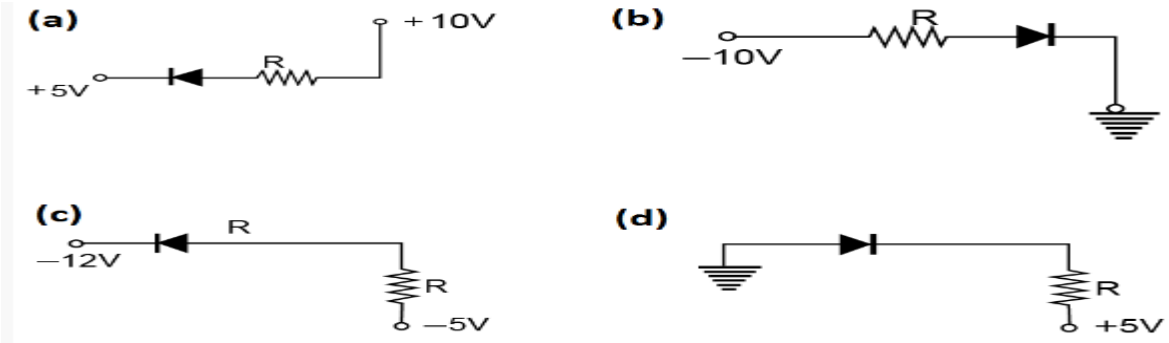
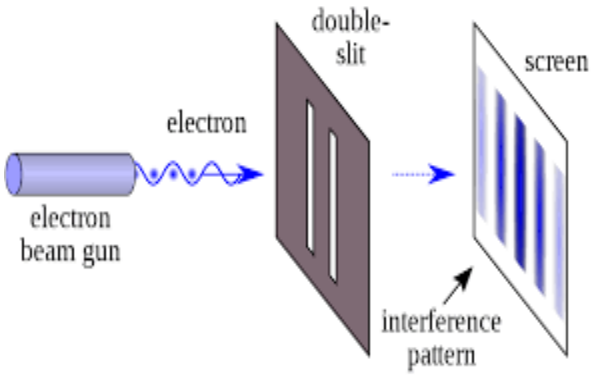
Boltzmann constant = 1.38×10^{-23} JK^{-1}

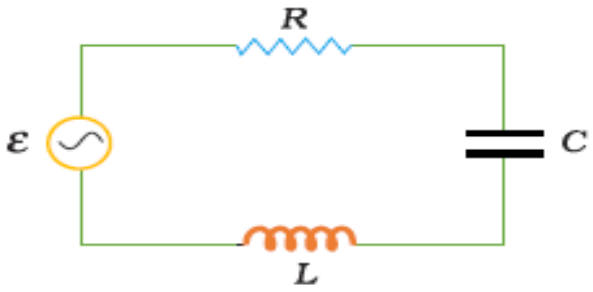
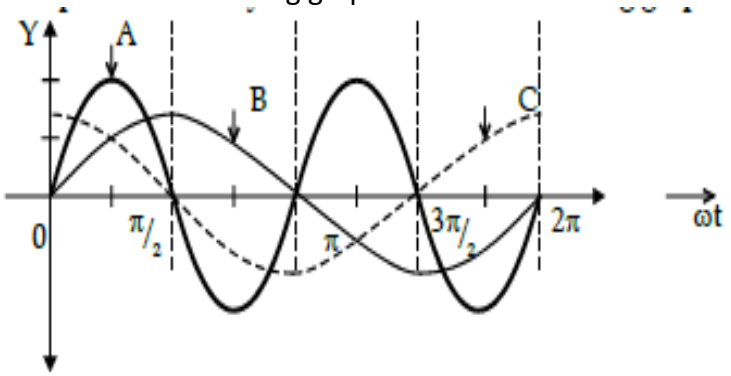
Qn's. No		Marks
	Section - A **All questions are compulsory. In case of internal choices, attempt any one of them.**	
1	A cylinder of radius R and length L is placed in a uniform electric field E parallel to the cylinder axis. The total flux for the surface of the cylinder is given by: (a) Zero (b) πr^2 (c) $E\pi r^2$ (d) $2E\pi r^2$	1
2	When a charge of 1C moving with velocity 1 m/s normal to a magnetic field experiences a force of 1 N, then the magnitude of the magnetic field is (a) 1 Gauss (b) 1 Tesla (c) 1 Orested (d) 1 tesla/sec	1
3	With increase in frequency of an A.C. supply, the impedance of a series L-C-R circuit (a) remains constant. (b) increases. (c) decreases. (d) decreases at first, becomes minimum and then increases.	1
4	Rank the electrostatic potential energies for the given system of charges in increasing order.  (a) 1 = 4 < 2 < 3 (b) 2 = 4 < 3 < 1 (c) 2 = 3 < 1 < 4 (d) 3 < 1 < 2 < 4	1
5	The relative permeability of a substance X is slightly less than unity and that of substance Y is slightly more than unity then – (a) x is paramagnetic and y is ferromagnetic (b) x is diamagnetic and y is ferromagnetic (c) x and y both are paramagnetic (d) x is diamagnetic and y is paramagnetic.	1

6	To convert a galvanometer to ammeter a shunt S is to be connected with the galvanometer. The effective resistance of the ammeter then is (a) GS/(G+S) (b) (G+S)/GS (c) G+S (d) G+ S/ S	1
7	An inductor 20 mH, a capacitor 50 μF and a resistor 40 Ω are connected in series across a source of emf V = 10 sin 340 t. The power loss in AC circuit is (a) 0.76 W (b) 0.89 W (c) 0.51 W (d) 0.67 W	1
8	Which of the following graphs represent the variation of current(I) with frequency (f) in an AC circuit containing a pure capacitor?  (a) ii (b) iii (c) iv (d) i	1
9	Apply Kirchhoff's law to find the current I in the part of the following circuit.  (a) 5 A (b) 3 A (c) 7 A (d) 1	1
10	The radius of curvature of the curved surface of a plano-convex lens is 20 cm. If the refractive index of the material of the lens be 1.5, it will (a) act as a convex lens only for the objects that lie on its curved side. (b) act as a concave lens for the objects that lie on its curved side. (c) act as a convex lens irrespective of the side on which the object lies. (d) act as a concave lens irrespective of side on which the object lies.	1
11	The self-inductance L of a solenoid of length *l* and area of cross-section A, with a fixed number of turns N increases as (a) *l* and A increase. (b) *l* decreases and A increases. (c) *l* increases and A decreases. (d) both *l* and A decrease	1
12	In Figure, assuming the diodes to be ideal,  (a) D1 is forward biased and D2 is reverse biased and hence current flows from A to B (b) D2 is forward biased and D1 is reverse biased and hence no current flows from B to A and vice versa. (c) D1 and D2 are both forward biased and hence current flows from A to B. (d) D1 and D2 are both reverse biased and hence no current flows from A to B and vice versa.	1

	For Questions 13 to 16, two statements are given –one labelled Assertion (A) and other labelled Reason (R). Select the correct answer to these questions from the options as given below. A. Assertion and Reason are true and Reason is the correct explanation of Assertion. B. Assertion and Reason are true but Reason is NOT the correct explanation of Assertion. C. Assertion is true but Reason is false. D. Both Assertion and Reason are false.	
13	**Assertion (A):** The focal length of a concave mirror is *f* and an object is placed at a distance *x* from the focus. The magnification produced by the mirror is *f/x*. **Reason (R):** magnification = size of object / size of image.	1
14	**Assertion (A):** The direction of the electric field is always perpendicular to the equipotential surface. **Reason (R):** Work is done by the electric force in moving a charge between any two points on an equipotential surface is zero.	1
15	**Assertion (A):** A diamond of refractive index √6 is immersed in a liquid of refractive index √3. If light travels from diamond to liquid, total internal reflection will take place when angle of incidence is 30°. **Reason (R):** μ = 1/sin C, where μ is the refractive index of diamond with respect to the liquid.	1
16	**Assertion (A):** Silicon is preferred over Germanium for making semiconductor devices. **Reason (R):** The energy gap of Germanium is more than the energy gap of Silicon.	1
	Section – B **All questions are compulsory. In case of internal choices, attempt any one.**	
17	Explain the formation of potential barrier and depletion region in a p-n junction diode. What is effect of applying forward bias on the width of depletion region?	2
18	Find the frequency of light which ejects electrons from a metal surface, fully stopped by a retarding potential of 3.3 V. If photo electric emission begins in this metal at a frequency of 8×10^{14} Hz, calculate the work function (in eV) for this metal.	2
19	Explain the processes of nuclear fission and nuclear fusion by using the plot of binding energy per nucleon (BE/A) versus the mass number A.	2
20	A wire of length Lo has a resistance Ro. It is gradually stretched till its length becomes 2Lo. (a) Plot a graph showing variation of its resistance R with its length L during stretching. (b) What will be its resistance when its length becomes 2Lo?	2
21	Calculate the radius of curvature of a equi-concave lens of refractive index 1.5, when it is kept in a medium of refractive index 1.4, to have a power of –5 D? **OR** A ray of light passes through an equilateral prism such that the angle of incidence is equal to the angle of emergence and each of these equal to 3/4 of the angle of the prism. What is the value of angle of deviation?	2
	Section - C **All questions are compulsory. In case of internal choices, attempt any one.**	
22	(a) State two distinguishing features of nuclear force. (b) Draw a plot showing the variation of potential energy of a pair of nucleons as a function of their separation. Mark the regions on the graph where the force is (i) attractive, and (ii) repulsive.	3
23	A spherical conducting shell of inner radius r1 and outer radius r2 has a charge Q. A charge q is placed at the centre of the shell. a) Find out the surface charge density on the inner and outer surfaces of the shell. b) Is the electric field inside a cavity (with no charge) zero, even if the shell is not spherical, but has any irregular shape? Explain.	3
24	The following graph shows the variation of photocurrent for a photosensitive metal:	

	 (i) Identify the variable X on the horizontal axis. (ii) What does the point A on the horizontal axis represent? (iii) Draw this graph for three different values of frequencies of incident radiation v1, v2 and v3(v1 >v2 > v3) for same intensity. (iv) Draw this graph for three different values of intensities of incident radiation	3
25	E1 and E2 are two batteries having emfs of 3V and 4V and internal resistances of 2Ω and 1Ω respectively. They are connected as shown in Figure below. Using Kirchhoff 's Laws of electrical circuits, calculate the currents I_1 and I_2 	3
26	i) Calculate the de-Broglie wavelength of the electron orbiting in the n = 2 state of hydrogen atom. ii) Threshold wavelength for a metal having work function W_0 is λ_0. What is the threshold wavelength for the metal having work function $W_0/2$?	3
27	a) Identify the part of electromagnetic spectrum used in (i) radar and (ii) eye surgery b) Identify the electromagnetic waves whose wavelengths vary as: (i) 10^{-12} m < λ < 10^{-8} m (ii) 10^{-3} m < λ < 10^{-1} m. Write one use for each.	3
28	(a) Define mutual inductance. (b) If a change in current of 0.01 A in one coil produces a change in magnetic flux of 2×10^{-2} Wb in the other coil, what is the mutual inductance (in henry) of the two coils? (c) A pair of adjacent coils has a mutual inductance of 1.5 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? **OR** (a) Draw a labelled diagram of a step-up transformer. Obtain the ratio of secondary to primary voltage in terms of number of turns and currents in the two coils. (b) A power transmission line feeds input power at 2200 V to a step-down transformer with its primary windings having 3000 turns. Find the number of turns in the secondary to get the power output at 220 V.	3
	Section – E CASE STUDY	
29	**Read the passage given below and answer the questions that follow.** **p-n junction diode:** p-n junction is a semiconductor diode. It is obtained by bringing p-type semiconductor in close contact with n- type semiconductor. A thin layer is developed at the p- n junction which is devoid of any charge carrier but has immobile ions. It is called depletion layer. At the junction a potential barrier appears, which does not allow the movement of majority charge carriers across	

	the junction in the absence of any biasing of the junction. p-n junction offers low resistance when forward biased and high resistance when reverse biased. (i) In the middle of depletion layer of reverse biased p- n junction, the (a) Electric field is zero (b) Potential is zero (c) Potential is maximum (d) Electric field is maximum. (ii)The energy gap is maximum in (a) Metals (b) Superconductors (c)Insulators (d) Semiconductors. (iii)The number of minority carriers crossing the junction of diode depends primarily on the (a) Concentration of doping impurities (b) Magnitude of potential barriers (c) Magnitude of the forward bias voltage (d) Rate of thermal generation of electron –hole pairs (iv) In the following figure, the diodes which are forward biased, are  (a) c only (b) a and c only (c) b and c only (d) a,b and c only **OR** (iv) When a forward bias is applied to a *p-n* junction, it (a) raises the potential barrier (b) reduces the majority carrier current to zero (c) lowers the potential barrier (d) None of the above.	4
30	**Interference (Young's Double slit experiment)**  (i) What is the path difference between the two light waves coming from coherent sources, which produces 3rd maxima. (a) λ (b) 2 λ (c) 3 λ (d) 0 (ii) What is the correct expression for fringe width(β). (a) λ d/D (b) λdD (c) d/ λ D (d) Dλ/d (iii) what is the phase diff. between two interfering waves producing 1st dark fringe. (a) π (b) 2π (c) 3π (d) 4π	4

	(iv) The ratio of the widths of two slits in Young's double slit experiment is 4:1. Evaluate the ratio of intensities at maxima and minima in the interference pattern. (a) 1:1 (b) 1:4 (c) 3:1 (d) 9:1 **OR** (iv) In a Young's double slit experiment, the separation between the slits is 0.1 mm, the wavelength of light used is 600 nm and the interference pattern is observed on a screen 1m away. Find the separation between bright fringes. (a) 6.6 mm (b) 6.0 mm (c) 6 m (d) 60cm	
	Section – E **All questions are compulsory. In case of internal choices, attempt any one of them.**	
31	A 2 µF capacitor, 100 Ω resistor and 8 H inductor is connected in series with an ac source. i) Find the frequency of the ac source for which the current drawn in the circuit is maximum. What is this frequency called? ii) If the peak value of emf of the source is 200 V, calculate the maximum current. iii)Draw a graph showing variation of amplitude of circuit current with changing frequency of applied voltage in a series LCR circuit for two different values of resistance R1 and R2 (R1 > R2) iv) In a series LCR circuit, $V_L = V_C \neq V_R$. What is the value of power factor for this circuit? **OR** The figure shows a series LCR circuit connected to a variable frequency 230 V source. L = 5.0 H, C = 80 µF, R = 40 Ω.  i) Determine the source frequency which drives the circuit in resonance. ii) Obtain the impedance of the circuit and the amplitude of current at the resonating frequency. iii) Determine the rms potential drops across the three elements of the circuit. Show that the potential drop across the LC combination is zero at the resonating frequency. iv) A device 'X' is connected to an ac source $V = V_0 \sin \omega t$. The variation of voltage, current and power in one cycle is shown in the following graph:  a) Identify the device 'X'. b) Which of the curves A, B and C represent the voltage, current and the power consumed in the circuit? Justify your answer.	5

32	What is the difference in the construction of an astronomical telescope and a compound microscope? The focal lengths of the objective and eyepiece of a compound microscope are 1.25 cm and 5.0 cm, respectively. Find the position of the object relative to the objective in order to obtain an angular magnification of 30 when the final image is formed at the near point. **OR** (i) Drive the mirror formula. What is the corresponding formula for a thin lens? (ii) Draw a ray diagram to show the image formation by a concave mirror when the object is kept between its focus and the pole. Use this diagram, drive the magnification formula for the image formed.	5
33	i) An electric field is uniform and acts along + x direction in the region of positive x. It is also uniform with the same magnitude but acts in – x direction in the region of negative x. The value of the field is E = 200 N/C for x > 0 and E = – 200 N/C for x < 0. A right circular cylinder of length 20 cm and radius 5 cm has its centre at the origin and its axis along the x-axis so that one flat face is at x = + 10 cm and the other is at x = – 10 cm. Find: (a) What is the net outward flux through the side of the cylinder? (b) What is the net outward flux through the cylinder? (c) what is net charge inside the cylinder? (d) What is the net charge inside the cylinder? ii) An electric dipole of length 2 cm, when placed with its axis making an angle of 60^0 with a uniform electric field of 10^5 N/C. If it experiences a torque of $8\sqrt{3}$ Nm. Calculate the magnitude of charge on the dipole, and its potential energy. **OR** i) Find the expression for the potential energy of a system of two point charges q1 and q2 located at r1 and r2 vectors, respectively in an external electric field E vector. ii) Draw equipotential surfaces due to an isolated point charge (– q) and depict the electric field lines. iii) Three point charges + 1 μC, – 1 μC and + 2 μC are initially infinite distance apart. Calculate the work done in assembling these charges at the vertices of an equilateral triangle of side 10 cm.	5