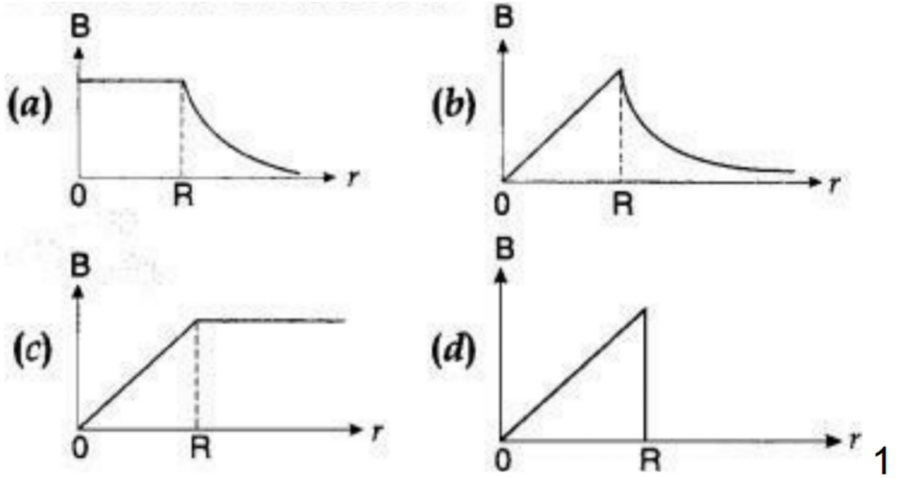
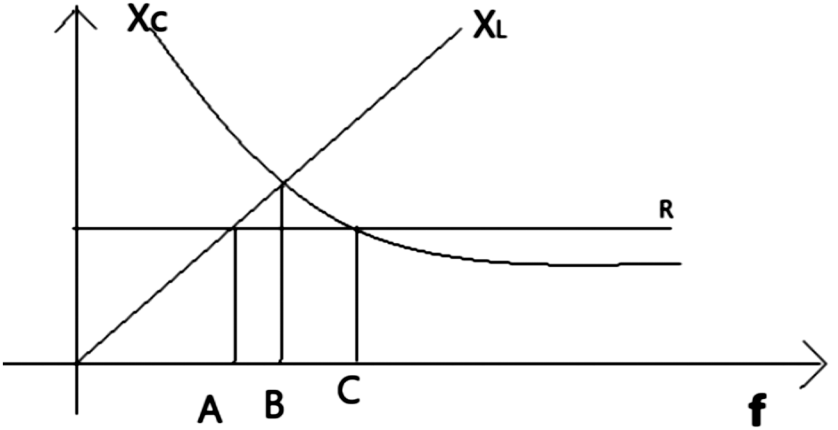
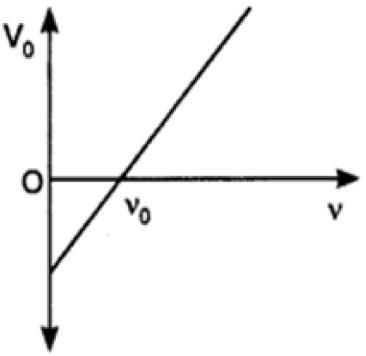
Pre-Board Examination : 2025-26

Sub : Physics

(The figures in the margin indicate full marks for the questions)

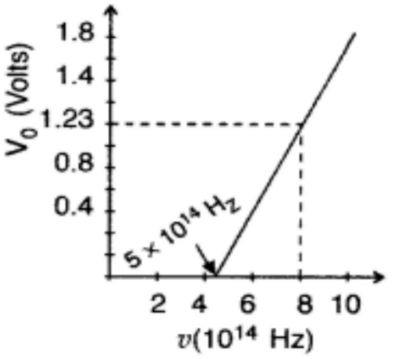
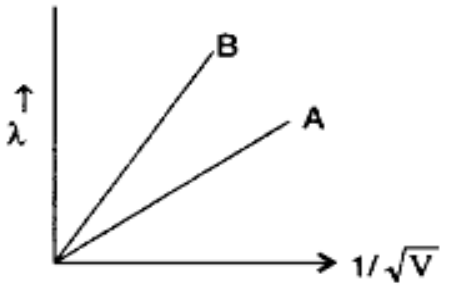
Time – 3 hours **Full marks-70**

1.	**Answer following questions : 1x8=8**
a	An electric dipole is placed at an angle of 30^0 with an electric field of intensity $2x10^5$ N/C. It experiences a torque equal to 4 N m. Calculate the magnitude of charge on the dipole, if the dipole length is 2 cm. (a) 6 mC (b) 4 mC (c) 2 mC (d) 8 mC
b	.Kirchhoff's first law, i.e. $\Sigma I = 0$ at a junction, deals with the conservation of (a) Charge (b) Energy (c) Momentum (d) Angular momentum
c	The correct plot of the magnitude of magnetic field B vs distance r from centre of the wire is, if the radius of wire is R  1

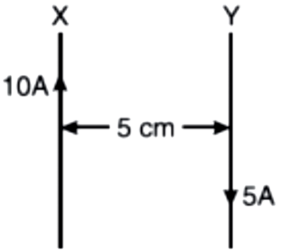
d	Magnetic flux ϕ (in weber) linked with a closed circuit of resistance 10 ohm varies with time t (in seconds) as $\phi = 5t^2 - 4t + 1$ The induced electromotive force in the circuit at t = 0.2 sec. is (a) 0.4 volts (b) – 0.4 volts (c) – 2.0 volts (d) 2.0 volts
e	Q7. The figure shows variation of R, X_L and X_C with frequency f in a series L, C, R circuit. Then for what frequency point, the circuit is inductive (a) A (b) B (c) C (d) All points 
f	The stopping potential V_0 for photoelectric emission from a metal surface is plotted along with the y-axis and frequency v of incident light along the x-axis. A straight line is obtained as shown. Planck's constant is given by  a) product of the slope of the line and charge on the

	electron b) intercept along y-axis divided by the charge on the electron c) product of the intercept along x-axis and mass of the electron (d) the slope of the line
g	In Rutherford's α -particle scattering experiment, what will be correct angle for α scattering for an impact parameter b = 0 ? (a) 90º (b) 270º (c) 0º (d) 180º
h	What is use of the filter in the output circuit of a full wave rectifier ? What type of filter it is ?
2	A parallel plate capacitor is charged by a battery. The battery is disconnected and a dielectric slab is inserted between the plates. What will be the effect on its (i) Capacitance (ii) Charge (iii) Potential difference (iv) Electric field 2
3	Define temperature coefficient of resistance. The resistance of a tungsten filament at 150^0C is 133 Ω. What will be its resistance at 5000C? Given the temperature coefficient of tungsten is 0.0045 $^0C^{-1}$. 2
4	Find the expression for the displacement current . 2 Or Name the following parts of the electromagnetic

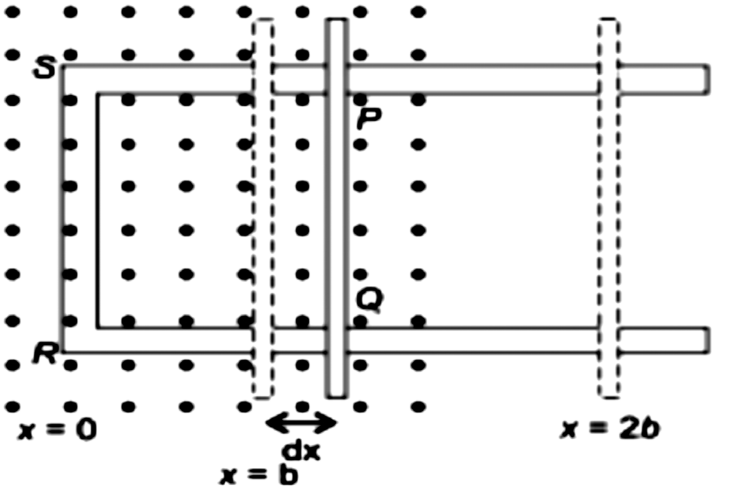
	spectrums. a) used in radar systems for aircraft navigation b) used to treat muscular strain c) used in hospitals for diagnosing diseases Also, briefly describe how these waves can be produced. 2
5	In a plane electromagnetic wave, the electric field oscillates sinusoidally at a frequency of 2.0×10^{10} Hz and amplitude 48 V m^{-1}. (a) What is the wavelength of the wave? (b) What is the amplitude of the oscillating magnetic field? Or Show that the average energy density of the E field equals theaverage energy density of the B field. [$c = 3 \times 10^8$ m s^{-1}.] 2
6	An equiconvex lens of refractive index 'μ_1' , focal length 'f' and radius of curvature 'R' is immersed in a liquid of refractive index 'μ_2' (i) $\mu_2 > \mu_1$ (ii) $\mu_2 < \mu_1$ Draw the ray diagram in the two cases when a beam of light coming parallel to principal axis is incident on the lens. Also find the focal length of the lens in terms of the original focal length of the refractive index of the glass of the lens and that of the medium. 2
7	Using the graph shown in the figure for stopping potential v/s the incident frequency of photons, calculate Planck's constant.

	 2
8	Derive the expression for the de Broglie wavelength of an electron moving under a potential difference of V volts . 2
9	Two lines, A and B, in the plot given below show the variation of de-Broglie wavelength, λ versus $1/\sqrt{V}$, Where V is the accelerating potential difference, for two particles carrying the same charge. Which one of two represents a particle of smaller mass ?  . 2
10	(a) The radius of the innermost electron orbit of a hydrogen atom is 5.3×10^{-11} m. Calculate its radius in n = 3 orbit. (b) The total energy of an electron in the first excited state of the hydrogen atom is -3.4 eV. Find out its (i) kinetic energy and potential energy in this state. 2

11	Calculate the energy released in MeV in the following nuclear reaction: $^{238}_{92}U \longrightarrow {}^{234}_{90}Th + {}^{4}_{2}He + Q$ [Mass of $^{238}_{92}U$ = 238.05079 u, Mass of $^{234}_{90}Th$ = 234.043630 u, Mass of $^{4}_{2}He$ = 4.002600 u, 1u = 931.5 MeV/c²] 2
12	Find the electric potential due to an electric dipole at an arbitrary point . 3 Or Prove that there is always loss of energy on sharing charges between two capacitors . 3
13	(i) The amount of charge passing through cross-section of wire is $q = t^2 + 4t + 1$,find the value of current at t = 1s (ii) The resistance of a thin wire of silver is = 1.0 Ω at 20°C. The wire is placed in a liquid bath and its resistance rises to 1.2Ω. find the temperature of the bath in°C .($\alpha = 3.8 \times 10^{-3}$ /°C) 1½+1½=3 Or (i) Prove that $v_d = \frac{I}{neA}$, where symbols are having usual meanings . (ii) A copper wire has a cross-sectional area of

	7.85×10^{-7} m^2. The number density of copper is 8.5×10^{28} m^{-3}. Calculate the mean drift velocity of the electrons through the wire when the current is 1.4 A. 1½+1½=3
14	(i) Find the expression for force acting on a current carrying conductor placed in a uniform magnetic field. (ii) Two parallel straight wires X and Y separated by a distance 5 cm in air carry current of 10 A and 5 A respectively in opposite direction as shown in diagram. Calculate the magnitude and direction of the force on a 20 cm length of the wire Y.  1+½+1½=3 Or Find the expression for the magnetic field due to a bar magnet at a point on its axial line . 3
15	Describing the principle of a moving coil galvanometer . Find the expression for its current sensitivity and voltage sensitivity . On what factors these depend. 3 Or (a)Distinguish the magnetic properties of dia, para and ferromagnetic substances in terms of (i) susceptibility and (ii) permeability. Give one example of each of these materials.

	(b) Why does the magnetisation of a paramagnetic material decrease on cooling? 3
16	Figure shows a rectangular conductor PQRS in which the conductor PQ is free to move in a uniform magnetic field B perpendicular to the plane of the paper. The field extends from x = 0 to x = b and is zero for x > b. Assume that only the arm PQ possesses resistance r. When the arm PQ is pulled outward from x = 0 to x = 2b and is then moved backward to x =0 with constant speed v, obtain the expressions for the flux and the induced emf. Sketch the variations of these quantities with distance $0 \leq x \leq 2b$.



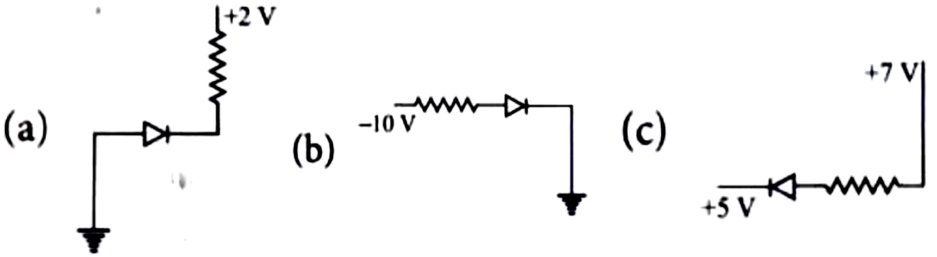
3

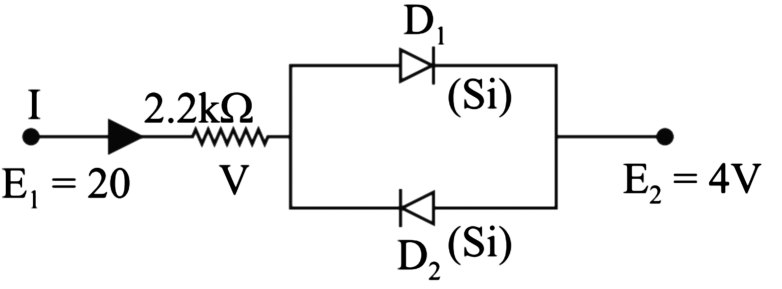
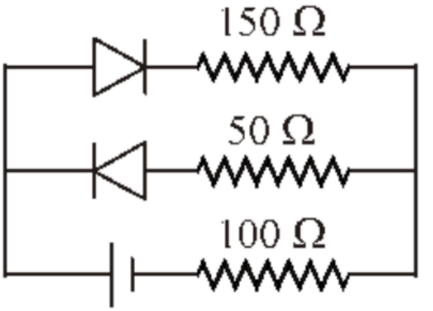
Or

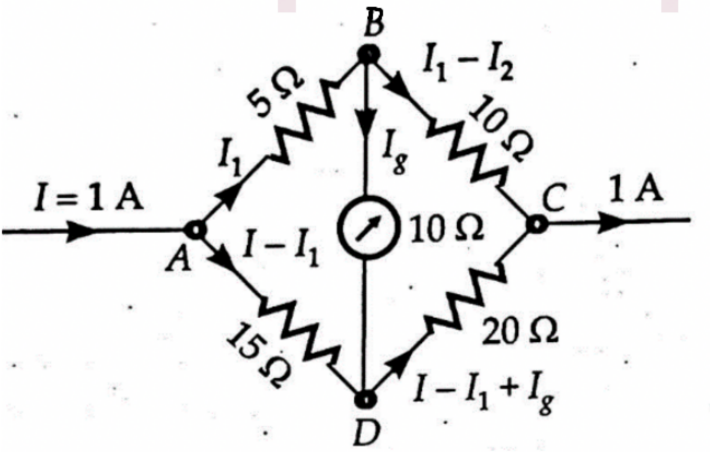
A horizontal wire of 10 m long extending from east to west is falling with a speed of 5 m/s at right angles to the horizontal component of earth's magnetic field equal to 0.30×10^{-4} Wb/m^2.

(a) What is the instantaneous value of the emf induced

	in the wire? (b) What is the direction induced current? (c) Which end of the wire is at the higher electric potential?. 3
17	A series LCR circuit with R = 20 Ω , L = 2H and C = 50 μF is connected to a 200 V A.C source of variable frequency- (i) What is the amplitude of the current and its rms value. (ii) what is the average power transferred to the circuit in one complete cycle at resonance (iii) Calculate the potential drop across the capacitor? 1+1+1=3 Or In an ideal transformer, the number of turns of primary and secondary is 1000 and 2000 respectively. (i) If maximum voltage in primary is 120V, what is the maximum voltage in secondary? (ii) if the current in primary coil is 5 Amp calculate current in secondary coil? 3
18	(i) Describe the formation secondary minimas in the difraction of light at a single slit . 2 (ii) Prove that size of the central maxima in the difraction pattern of light at single slit is twice that of the secondary maximas . 1 Or

	(i) State Huygen's principle . (ii) Using Huygen's principle , establish the law of refraction . 1+2= 3
19	(i) Give the difference between valance band and conduction band ? (ii) What is the value of forbidden gap energy of germanium? (iii) Which of the following represents forward biasing and reverse biasing ?  1+½+1½=3 Or For a P-N junction diode forward bias is increased form 2.0V to 2.5 V so forward current is changed from 16.5 mA to 26.5 mA. For same diode reverse bias is increased form 5V to 10 V so the reverse current changes from 20 microampere to 30 microampere. Calculate the dynamic resistance for this diode in both the situations. Why there is a huge difference in the two values of the resistances ? 3

20	(i) In a p-n junction, width of depletion region is 300 nm and electric field of 7×10^5 V/m exists in it. Find the height of potential barrier. 1½ (ii) Determine the current I for the network. (Barrier voltage for Si diode is 0.7 volt).  1½ Or As shown in the circuit below the forward resistance of both diodes is 50 Ω and reverse resistance in infinite. If' emf of the battery is 6 V then calculate the current flowing through 100Ω.  3
21	(i) Give the difference between charging and discharging of a cell . 2 (ii) Determine the current flowing through the galvanometer G of Wheatstone Bridge shown in figure.



3

Or,

Define drift velocity and derive an expression for drift velocity of electrons in a conductor hence deduce Ohm's law. 1+2+2=5

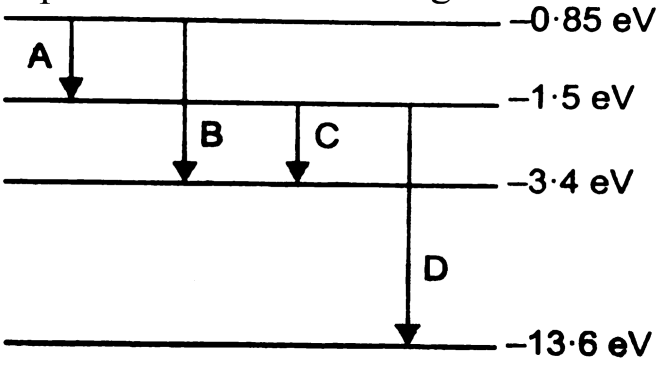
22 **(i)** Deduce Lens Maker's formula . 3

(ii)A double convex lens is made of a glass of refractive index 1.55, with both faces of the same radius of curvature. Find the radius of curvature required, if the focal length is 20 cm. 2

Or

(i) What is the focal length of a combination of a convex lens of focal length 30 cm and a concave lens of focal length 20 cm in contact? Is the system a converging or a diverging lens? Ignore thickness of lenses. 2

(ii) A tank is filled with water to a height of 12.5 m. The apparent depth of the needle lying at the bottom of the tank as measured by a microscope is 9.4 cm.

	What is the refractive index of water? If water is replaced by a liquid of refractive index 1.63 up-to the same height, by what distance would the microscope be moved to focus on the needle again? 2
23	(i) Show that the radius of the orbit in hydrogen atom varies as n^2 , where n is the principal quantum number of the atom. 2 (ii) The energy level diagram of an element is given here . Which transition corresponds to the emission of a spectral line of wavelength 102.7nm?  3 Or **(i)** Distinguish between nuclear fission and fusion. Show how both these processes energy is released. **(ii)** Calculate the energy release in MeV in the deuterium-tritium fusion reaction:- $^{2}_{1}H + {}^{3}_{1}H \rightarrow {}^{4}_{2}H + \text{n}$ using the data mass of $^{2}_{1}H$= 2.014102 u,

	mass of ${}_{1}^{3}H$ = 3.016949 u, mass of ${}_{2}^{4}He$ = 4.002603 u, mass of neutron = 1.008665 u, 1u = 931.5 MeV ,	2+3 =5