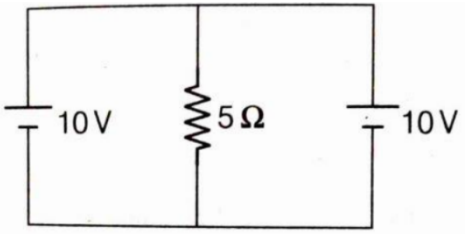
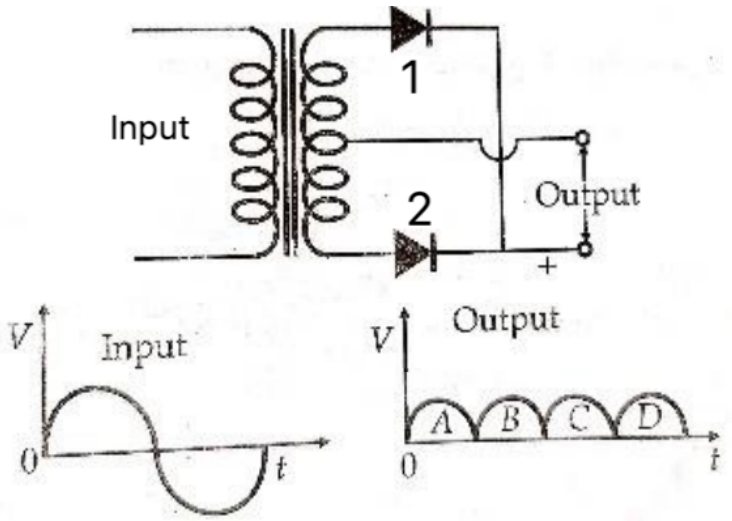
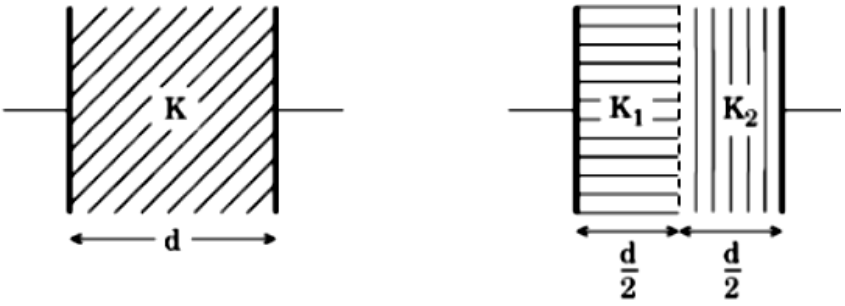
Pre-Board Examination : 2025-26
Sub : Physics

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

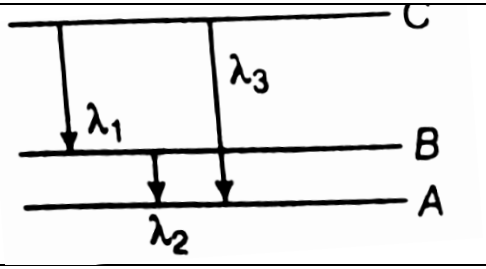
Time – 3 hours Full marks-70

1.	**Answer following questions : 1x8=8**
a	What is the angle between the directions of electric dipole moment and electric field at any, (i) axial point and (ii) equatorial point due to an electric dipole?
b	The current through the 5Ωresistor is  (a) 2A (b) 4A (c) Zero (d) 1A
c	A neutron, a proton, an α particle and an electron enter a region of constant magnetic field with equal velocities . The magnetic field is along the inward normal to the plane of the paper. The tracks of the particles are labelled in figure. The electron follows track…. and the alpha particle follows track…. (a) A , C (b) C , A (c) B , D (d) D , B
d	A coil having 500 sq. loops of side 10 cm is placed normal to magnetic flux which increases at a rate of 1 T/s. The induced emf is (a) 0.1V (b) 0.5V (c)1V (d) 5 V

e	In an AC circuit V and I are given by $V = 50 \sin 50t$ volt and $I = 100 \sin (50t + \pi/3)$ mA. The power dissipated in the circuit (a)2.5 kW (b) 1.25 kW (c) 5.0 kW (d) 500 W
f	Which of the following metals is not sensitive to visible light? (a) Cesium (b)Sodium (c) Rubidium (d) Cadmium
g	The ionisation energy of hydrogen atom is 13.6 eV. Following Bohr's theory the energy corresponding to a transition between 3rd and 4th orbits is (a) 3.40 eV (b) 1.51 eV (c) 0.85 eV (d) 0.66 eV
h	A full wave rectifier circuit along with the output is shown. The contribution from the diode 2 are  (a) C (b) A , C (c) B,D (d) A,B,C,D
2	The space between the plates of a parallel plate capacitor is completely filled in two ways. In the first

	case, it is filled with a slab of dielectric constant K. In the second case, it is filled with two slabs of equal thickness and dielectric constants K_1 and K_2 respectively as shown in the figure. The capacitance of the capacitor is same in the two cases. Obtain the relationship between, K, K_1 and K_2  (Case 1) (Case 2) 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	The oscillating magnetic field of an EM wave is given by $B_y = 8 \times 10^{-6} \sin [2 \times 10^{11} t + 300 \pi x]$ Tesla (a) Calculate the wave length of EM wave (b) Write down the expression for oscillating electric field. 2
5	Electromagnetic radiations with wavelength: (i) λ_1 are used to kill germs in water purifier. (ii) λ_2 are used in TV communications.

	(iii) λ_3 play an important role in maintaining earth's warmth. Name the part of EM spectrum to which these radiations belongs. Arrange these wavelengths in decreasing order of their magnitude. 2
6	Yellow light ($\lambda = 6000$Å) illuminates a single slit of width 1 x 10^{-4} m. Calculate (i)the distance between the two dark lines on either side of the central maximum, when the diffraction pattern is viewed on a screen kept 1.5 m away from the slit (ii)the angular spread of the first diffraction minimum 2
7	An alpha particle, a proton and an electron are moving with equal kinetic energy. Which one of these particles has the longest de-Broglie wavelength? Give reason. 2
8	Explain briefly the Hallwach's experimental observation on photoelectric effect. 2
9	The work function of caesium metal is 2.14 eV. when light of frequency 6×10^{14} Hz is incident on the metal surface, photoemission of electrons occurs. Find a) Energy of incident photon b)Maximum kinetic energy of photoelectrons. 2
10	Find the relation between the three wavelengths λ_1 , λ_2 and λ_3 from the energy level diagram shown below.



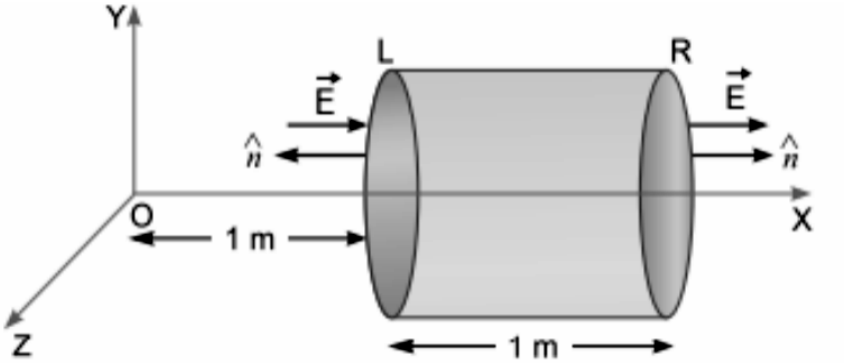
2

11 Draw a plot of potential energy of a pair of nucleons as a function of their separation. Write two important conclusions which you can draw regarding the nature of nuclear forces. 2

Or

Explain how energy is produced in sun ? 2

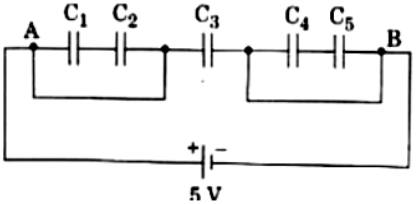
12 A hollow cylindrical box of length 1m and area of cross-section 25 cm^2 is placed in a threedimensional coordinate system as shown in the figure. The electric field in the region is given by $\vec{E} = 50xi$, t where E is in N/C and x is in metres.

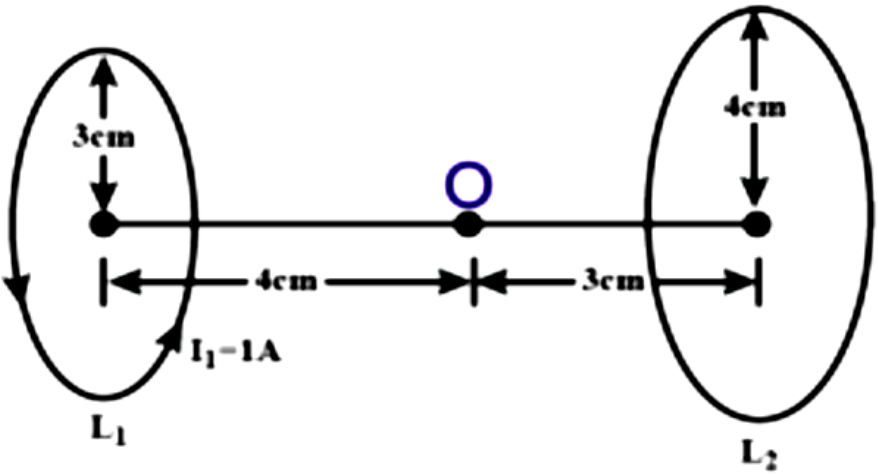


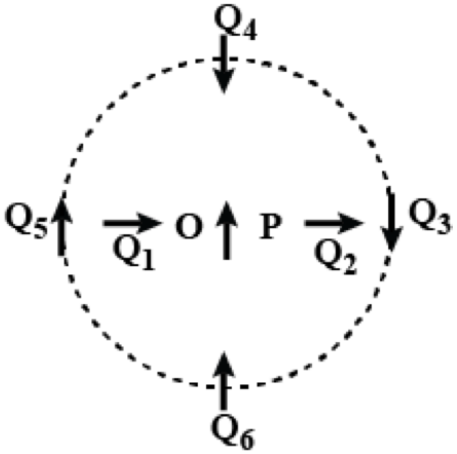
Find (i) net flux through the cylinder.

(ii) charge enclosed by the cylinder . 3

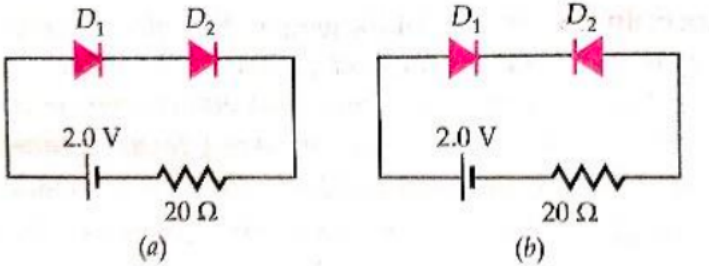
Or

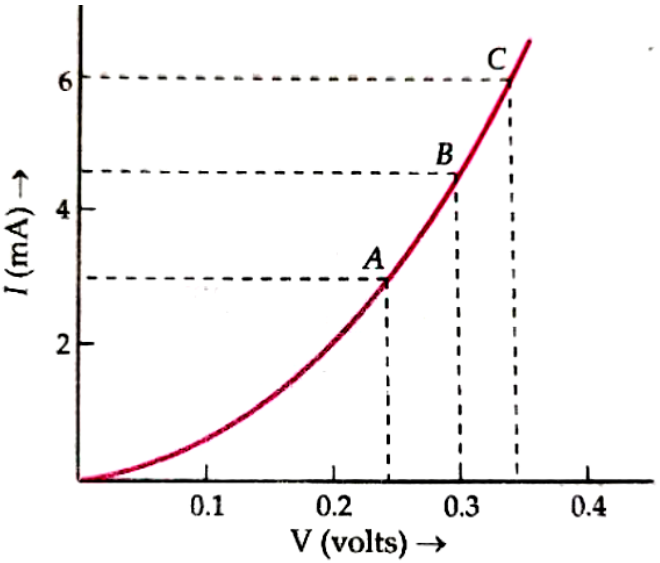
	In the figure given below, find the equivalent capacitance of the network between A and B 3  $C_1 = C_5 = 8\mu F$, $C_2 = C_3 = C_4 = 4\ \mu F$ (i) Calculate effective capacitance between A and B (ii) Maximum charge supplied by the source (iii) The energy stored in the network
13	Electric charge is uniformly distributed on the surface of a spherical balloon. Show how electric intensity and electric potential vary (a) on the surface (b) inside and (c) outside. 3 Or (a) State Gauss theorem in electrostatics. Using it, prove that the electric field at a point due to a uniformly charged infinite plane sheet is independent of the distance. (b) How is the field directed if (i) the sheet is positively charged, (ii) negatively charged? 2+1= 3
14	(i) What is the nature of trajectory of a charged particle in a uniform magnetic field with initial velocity at an angle , in between 0° and 90°, with the direction of the magnetic field ? Explain . (ii) A circular coil, having 100 turns of wire, of radius 20cm each, lies in the XY plane with its centre at the

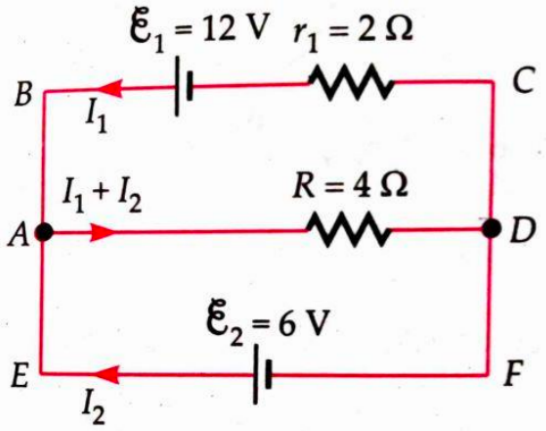
	origin of co-ordinates. Find the magnetic field, at the point (0, 0, 20√3cm), when the coil carries a current of $(2/\pi)$ A. 3 Or Two coaxial circular loops L_1 and L_2 of radii 3cm and 4cm are placed as shown. What should be the magnitude and direction of the current in the loop L_2 so that the net magnetic field at the point O be zero?  3
15	The following figure shows a small magnetized needle P placed at a point O. The arrow shows the direction of its magnetic moment. The other arrows show different positions (and orientations of the magnetic moment) of another identical magnetized needle Q.	

	 (a)Which configurations will be in stable equilibrium ? (b)Which configurations will be in unstable equilibrium? (c) Which configuration is having the lowest potential energy ? Explain each case . 3 Or (i)Explain using a labelled diagram the principle and working of a moving coil galvanometer. (ii)Obtain the relation between the current sensitivity and voltage sensitivity. 2+1= 3
16	State the Faraday's laws of electromagnetic induction . Plot a graph showing the variation of (i) Magnetic flux versus the current (ii) Induced emf versus $\frac{di}{dt}$

	(iii) Magnetic potential energy stored versus the current. 1½+½+½+½=3 Or Obtain the expression for the mutual inductance of two long co-axial solenoids S_1 and S_2 wound one over the other, each of length L and radii r_1 and r_2 and n_1 and n_2 be number of turns per unit length, when a current I is set up in the outer solenoid S_2. 3
17	(i)An ac voltage of emf $e = E_0 \sin \omega t$ is applied across a capacitor of capacitance C, find an expression for the AC flowing in the circuit. Draw the phasor diagram to show the phase relationship between current and voltage. (ii) What is capacitive reactance ? (iii) Draw its variation with ω . 1½+1+½=3 Or (i) 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. (ii) A step-up transformer converts a low voltage into high voltage. Does it not violate the principle of conservation of energy? Explain. 2+1=3
18	An equilateral glass prism has a refractive index 1.6 in air. Calculate the angle of minimum deviation of the prism, when kept in a medium of refractive index $\frac{4\sqrt{2}}{5}$

	Or Two monochromatic waves emanating from two coherent sources have the displacements represented by $y_1 = a \cos \omega t$ and $y_2 = a \cos (\omega t + \phi)$, where ϕ is the phase difference between the two displacements (i) Show that the resultant intensity at a point due to their superposition is given by $I = 4I_o \cos^2 \frac{\phi}{2}$, where $I_o = a^2$. (ii) Hence obtain the conditions for constructive and destructive interference.	3
19	(i) For a extrinsic semiconductor, indicate on the energy band diagram the donor and acceptor levels?	1½
	(ii) Determine the currents through the resistances of the circuits shown in Fig  	1½
	Or (i) Give the ratio of number of holes and the no. of conduction electrons in an intrinsic semiconductor.	1

	(ii) A semiconductor has equal electron and hole concentration of 6 x 10^{8} m^{-3} . On doping with a certain impurity electron concentration increases to 3 x10^{12} m^{-3}. Identify the type of semiconductor after doping ? 2
20	(i) What is dynamic resistance of PN junction diode ? (ii) Figure shows the characteristic curve of a junction diode. Determine the d.c. and a.c. resistance of the diode, when it operates at 0.3 V.  1+2=3 Or Explain with the help of suitable diagram, the two processes which occur during the formations of p-n junction diode. Hence define the terms depletion region and potential barrier? 3

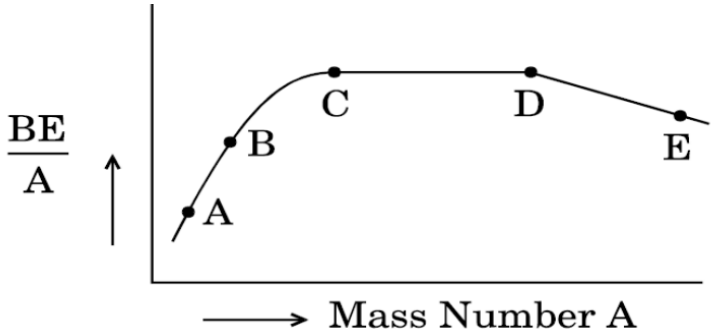
21	(i) State and explain Kirchhoff's laws. (ii) In the electric network shown in the figure, use Kirchhoff's rules to calculate the power consumed by the resistance R=4Ω  Or (i) Two wires A and B of the same material having length in the ratio 1:2 and radii in the ratio 2:1. What is the ratio of the resistance? 1½ **(ii)** A potential difference V is applied across a conductor of length L. How is the drift velocity affected when V is doubled and L is halved? 1½ (iii) A potential difference of 6V is applied across a conductor of length 0.12m . Calculate the drift velocity of the electrons , it the electron mobility is $5.6 \times 10^{-6}\ m^2\ v^{-1}\ s^{-1}$. **2**
22	**(i)** Define magnifying power of astronomical

	telescope at the normal setting . 1 **(ii)** An astronomical telescope has an angular magnification of magnitude 5 for distant objects. The separation between the objective and an eye piece is 36 cm and the final image is formed at infinity. Calculate the focal length of the objective and the focal length of the eye piece? 2 **(iii)** Give two reasons to explain why a reflecting telescope is preferred over a refracting telescope. 2 Or **(i)** The radii of curvature of both the surfaces of a lens are equal. If one of the surfaces is made plane by grinding, then will the focal length of lens change? Will the power change? 2 **(ii)** The refractive index of a material of a concave lens is n_1. It is immersed in a medium of refractive index n_2. A parallel beam of light is incident on the lens. Trace the path of emergent rays when (i) $n_2 = n_1$ (ii) $n_2 > n_1$ (iii) $n_2 < n_1$. 3
23	(i) Show that the expression of the wave number is $$\bar{v} = Z^2 R_H \left[\frac{1}{n_1^2} - \frac{1}{n_2^2}\right]$$ 2 (ii) Find the value of R_H. **1** (iii) Draw the hydrogen spectrum . 2 Or

(i) Imagine the fission of a $^{56}_{26}Fe$ into two equal fragments of $^{28}_{13}Al$ nucleus. Is the fission energetically possible? Justify your answer by working out Q value of the process.

Given: m $\{^{56}_{26}Fe\}$= 55.93494u, m $\{^{28}_{13}Al\}$ = 27.98191u.

(ii) The figure shows the plot of binding energy (BE) per nucleon as a function of mass number A. The letters A, B, C, D and E represent the positions of typical nuclei on the curve.



Point out, out of A, B, C, D and E , which one will undergo nuclear fission and which one will undergo nuclear fusion and which one is the most stable nucleus ? 2+3 =5