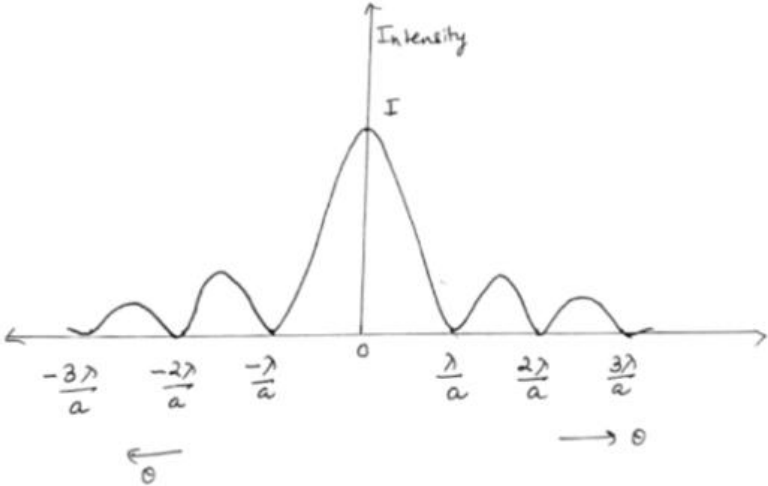
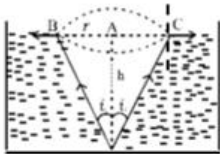


MARKING SCHEME: PHYSICS (042) Session: 2025–26			
Code: 55/ 4 / 1			
	SECTION A		
Q. No.	VALUE POINTS/EXPECTED ANSWERS	Marks	Total Marks
1.	(A) $(\rho_1 + \rho_2) / 2$	1	1
2.	(C) $\frac{m_1}{m_2} < \frac{q_1}{q_2}$	1	1
3.	(B) ne	1	1
4.	(B) $[ML^2T^{-3}A^{-1}]$	1	1
5.	(A) $-\hat{i}$	1	1
6.	(C) 0 and 10	1	1
7.	(B) $2 \times 10^8 \text{ ms}^{-1}$	1	1
8.	(B) cut-off potential will increase	1	1
9.	(B) Only Mo will not show photoelectric emission	1	1
10.	(D) Decrease by 50% of its initial value	1	1
11.	(A) Infrared region	1	1
12.	(C) Depletion region	1	1
13.	(A) Both Assertion (A) and Reason (R) are true, and Reason (R) is the correct explanation of Assertion (A).	1	1
14.	(C) Assertion (A) is true, but Reason (R) is false.	1	1
15.	(D) Both assertion(A) and Reason (R) are false.	1	1

16.	(A) Both Assertion (A) and Reason (R) are true, and Reason (R) is the correct explanation of Assertion (A).	1	1
SECTION B			
17.	Calculating the amount of work done 2 Work done in turning the dipole in an external field = $-pE(\cos \theta_2 - \cos \theta_1)$ Given: $\theta_1 = 0^\circ$ (stable equilibrium) and $\theta_2 = 180^\circ$ (unstable equilibrium) Net work done in turning the dipole from its position of stable equilibrium to the position of unstable equilibrium = $2pE = 2(qa)E$ $= 2 \times 1 \times 10^{-6} \times 10 \times 10^{-2} \times 100$ $\text{Net work done} = 2 \times 10^{-5} \text{ J}$	$\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$	2
18.	(a) Stating Huygens' Principle 1 Justifying the absence of the back wave 1 According to Huygens' principle, each point of the wavefront is the source of a secondary disturbance and the wavelets emanating from these points spread out in all directions with the speed of the wave. These wavelets emanating from the wavefront are usually referred to as secondary wavelets and if we draw a common tangent to all these spheres, we obtain the new position of the wavefront at a later time. The amplitude of the secondary wavelets is maximum in the forward direction and zero in the backward direction. Alternatively: Amplitude (A) $\propto (1 + \cos \theta)$; for back wave $\theta = 180^\circ \Rightarrow \text{Amplitude} = 0$ OR (b) (i) Depicting the variation of intensity 1 (ii) Effect on linear width 1	1 1	

	(i)  (ii) The linear width of the central maximum will decrease. Note: Award ½ mark if the student gives only the formula.	1	
19.	Calculating the area 2  $r = h \times \tan i$ [as $i = i_c$] $\sin i_c = \frac{1}{\mu} = \frac{1}{\sqrt{2}} \Rightarrow i_c = 45^\circ$ $r = h$ $\text{Area} = \pi r^2$ $\quad = 3.14 \times (1)^2$ $\text{Area} = 3.14 \text{ m}^2$	1/2 1/2 1/2 1/2	2

20.	Drawing graph Two conclusions 1 $\frac{1}{2} + \frac{1}{2}$ Conclusions from the graph 1. Many of the α-particles pass through the foil, without suffering any collisions. 2. Only a few incident α-particles scatter by more than 1°. 3. About 1 in 8000 α-particles deflect by more than 90°. (Any Two)	1	
21.	Finding the new value of hole concentration Identifying the semiconductor 1 $\frac{1}{2}$ $\frac{1}{2}$ $n_e n_h = n_i^2$ $\text{Hole concentration } (n_h) = \frac{n_i^2}{n_e}$ $= \frac{5 \times 10^8 \times 5 \times 10^8}{4 \times 10^{12}}$ $n_h = 6.25 \times 10^4 \text{ m}^{-3}$ The new semiconductor formed is n-type semiconductor.	$\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$	2

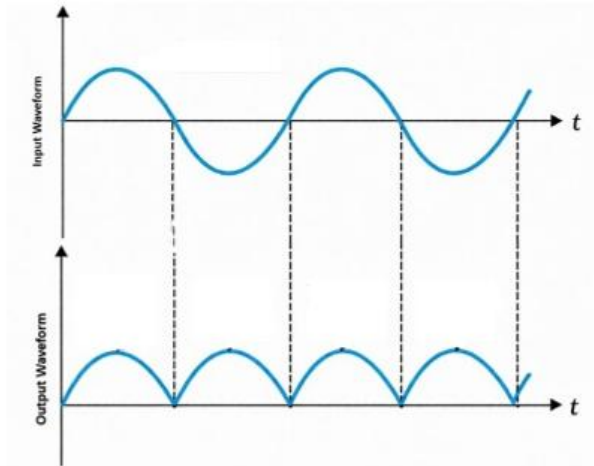
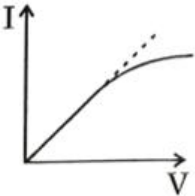
SECTION C		
22.	Stating Kirchoff's Rules $\frac{1}{2} + \frac{1}{2}$ Finding Current flowing through branch FC 2 Junction Rule: At any junction, the sum of the currents entering the junction is equal to the sum of the currents leaving the junction. $\frac{1}{2}$ Loop Rule: The algebraic sum of changes in potential around any closed loop involving resistors and cells in the loop is zero. $\frac{1}{2}$ Note:- Full credit to be given if stated mathematically. For loop AFCBA $3i_1 + i_1 - i_2 = -3 + 5 - 2$ $4i_1 - i_2 = 0$ $4i_1 = i_2 \quad \text{-----(i)}$ For loop FEDCF $i_2 + 4(i_1 + i_2) = 2$ $4i_1 + 5i_2 = 2 \quad \text{-----(ii)}$ Solving equations (i) and (ii), $i_1 = \frac{1}{12} \text{ A}$ $i_2 = \frac{1}{3} \text{ A}$ Note: Award full marks if a student solves using another appropriate current distribution in the above circuit.	3

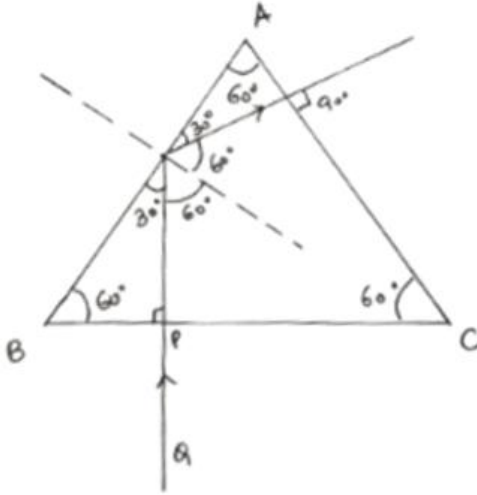
23.	(a) Finding the magnitude and direction of: (i) Net magnetic field at a point on conductor (1). 1½ (ii) Net force per unit length on conductor (1). 1½ (i) Magnetic field due to conductor (2) at a point on conductor (1) is $B_1 = \frac{\mu_0 I}{2\pi d}$ along positive z - axis. ½ Magnetic field due to conductor (3) at a point on conductor (1) is $B_2 = \frac{3\mu_0 I}{4\pi d}$ along negative z - axis. ½ Magnitude of net magnetic field is $B_2 - B_1 = \frac{3\mu_0 I}{4\pi d} - \frac{\mu_0 I}{2\pi d} = \frac{\mu_0 I}{4\pi d}$ along negative z - axis. ½ Direction will be along negative z axis/ into the plane of the paper. ½ (ii) Force per unit length on conductor (1) due to conductor (2) $= \frac{\mu_0 I_1 I_2}{2\pi d}$ $= \frac{\mu_0 I^2}{\pi d}$ (attractive) ½ Force per unit length on conductor (1) due to conductor (3) $= \frac{3\mu_0 I^2}{2\pi d}$ (repulsive) Magnitude of net force per unit length on conductor (1) due to (2) & (3) $= \frac{\mu_0 I^2}{2\pi d}$ ½ Direction of the net force per unit length will be repulsive or along positive y-axis. ½ OR (b) (i) Deriving expression for induced emf 1 ½ (ii) Finding the effective value of current 1 ½ (i) Induced emf $= \varepsilon = \frac{d\phi}{dt}$ $= \frac{d}{dt}(\vec{B} \cdot \vec{A})$ ½		
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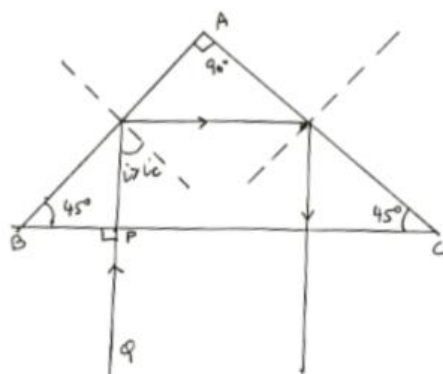
	$ \varepsilon = \frac{d}{dt}(B_0 \sin \omega t \times \ell b)$ $= B_0 \omega \ell b \cos \omega t$ (ii) Instantaneous value of current $= \frac{ \varepsilon }{R} = \frac{B_0 \omega \ell b \cos \omega t}{R}$ $I_{eff} = \frac{I_0}{\sqrt{2}}$ $= \frac{B_0 \omega \ell b}{R\sqrt{2}}$	$\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$	3
24.	(a) Finding: Direction of induced current 1 Time for which current persists in the loop. 1 (b) Plotting graphs showing variation of magnetic flux, magnitude of induced emf as a function of time. 1 (a) As the magnetic flux linked with the loop is decreasing, hence in accordance with Lenz's Law, the induced current will be in the clockwise direction. $t = \frac{25 \text{ cm}}{25 \text{ cm/s}} = 1 \text{ s}$ (b)	1 1 $\frac{1}{2} + \frac{1}{2}$	3
25.	Defining infrared waves 1 Reason for being referred to as heat waves 1 Two uses $\frac{1}{2} + \frac{1}{2}$ Infrared waves are the waves produced by hot bodies and molecules. Alternatively: They are electromagnetic (em) waves whose wavelength lies between 1mm to 700nm. They are referred to as heat waves because water molecules present in most materials readily absorb infrared waves. After absorption, their thermal motion increases, that is, they heat up and heat their surroundings.	1 1	

	Alternatively: When infrared waves pass through a medium, they heat up the medium. Uses: 1. Infrared lamps are used in physical therapy. 2. They help in maintaining Earth's average temperature. 3. They are used in satellites for military purpose. 4. They are used in satellites to observe growth of crops. 5. They are used in remote switches. (Any Two)	1/2 + 1/2	3				
26.	<table border="1"> <tr> <td>(a) Explaining the dual aspect of matter</td> <td>1</td> </tr> <tr> <td>(b) Finding de Broglie wavelength of emitted electrons</td> <td>2</td> </tr> </table> (a) According to the de Broglie relation, wavelength λ associated with a particle of momentum p is given as: $\lambda = \frac{h}{p} = \frac{h}{mv}$ λ is the characteristic of a wave whereas momentum p is a typical characteristic of a particle. The de Broglie relation connects the two characteristics. (b) Kinetic energy of the electron $= \frac{1}{2}mv^2$ $\frac{1}{2}mv^2 = \frac{hc}{\lambda}$ $v = \sqrt{\frac{2hc}{m\lambda}}$ De Broglie wavelength of the electron $(\lambda') = \frac{h}{mv}$ $\lambda' = \frac{h}{m\sqrt{\frac{2hc}{m\lambda}}}$ $\lambda' = \sqrt{\frac{h\lambda}{2mc}}$	(a) Explaining the dual aspect of matter	1	(b) Finding de Broglie wavelength of emitted electrons	2	1/2 1/2 1/2 1	3
(a) Explaining the dual aspect of matter	1						
(b) Finding de Broglie wavelength of emitted electrons	2						

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		$\frac{1}{2}$	
		$\frac{1}{2}$	3
	SECTION D		
29.	(i) (C)  (ii) (C) equal to the sum of error in voltmeter reading and the error in ammeter reading. (iii) (B) readings in both voltmeter and ammeter increase. (iv) (B) $v_2 > v_3 > v_1$ OR (C) $E_2 > E_3 > E_1$	1 1 1	HOME 4

	In the quadrilateral AQNR, two of the angles (at the vertices Q and R) are right angles. Therefore, the sum of the other angles of the quadrilateral is 180°. $\angle A + \angle QNR = 180^\circ$ From the triangle QNR, $r_1 + r_2 + \angle QNR = 180^\circ$ Comparing these two equations, we get $r_1 + r_2 = A \dots\dots\dots(i)$ The total deviation δ is the sum of the deviations at the two faces. $\delta = i + e - A \dots\dots\dots(ii)$ For $\delta = \delta_m$; $i = e$ which implies $r_1 = r_2$ From equation (i) and (ii) $r = \frac{A}{2}; i = \frac{A + \delta_m}{2}$ Refractive index of the prism $n_{21} = \frac{n_2}{n_1} = \frac{\sin \frac{(A + \delta_m)}{2}}{\sin \frac{A}{2}}$ (iii)  The ray QP strikes the face BC normally and hence goes undeviated. As $i > i_c$, it undergoes TIR. It strikes the face AC normally and comes out undeviated.	$\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$	HOME 1 1
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Alternatively

The ray QP strikes the surface BC normally and hence goes undeviated. As $i > i_c$, it undergoes TIR. As at face AC, $i > i_c$, it undergoes TIR. The ray comes out of the face BC undeviated.

(Award full credit of this part if the student takes the value of A other than 60° or 90° and traces the path correctly and according to the angle taken)

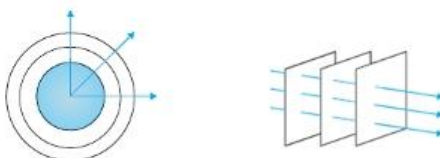
OR

(b)

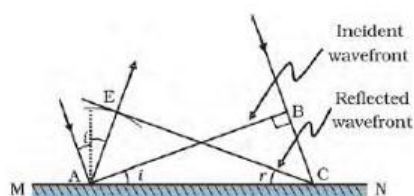
(i) Differentiating between a ray and a wavefront	1
(ii) Showing reflected wavefront	1
Verifying the law of reflection	2
(iii) Depiction of refraction	1

(i) Ray – It is a straight line depicting the rectilinear propagation of light.

Wavefront – It is the locus of points which oscillate in same phase.

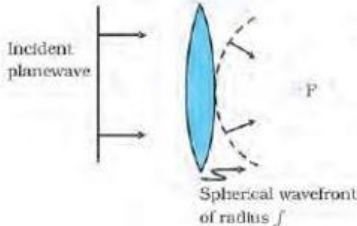
Alternatively

(ii)

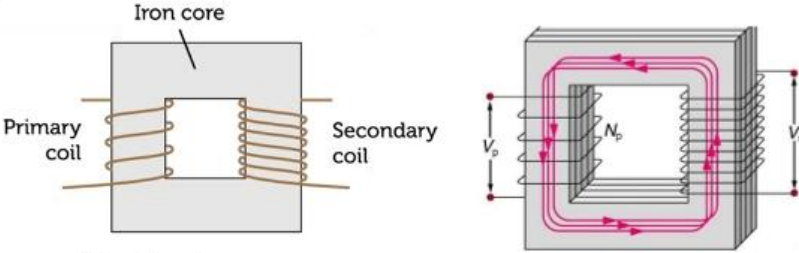


$\frac{1}{2}$
 $\frac{1}{2}$

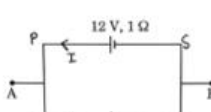
1

	If v represents the speed of the wave in the medium and τ represents the time taken by the wavefront to advance from the point B to C then the distance $BC = v\tau$ Let CE represent the tangent plane drawn from the point C to this sphere. Then, $AE = BC = v\tau$ If we now consider the triangles EAC and BAC we will find that they are congruent. Therefore, the angles i and r would be equal. (iii) 	$\frac{1}{2}$ 1 $\frac{1}{2}$ 1	5	
32.	(a) (i) Defining: (I) Resonant frequency 1 (II) Power factor of series LCR circuit 1 Value of power factor when power dissipated is maximum. 1 (ii) Calculating: (I) Impedance of the circuit 1 (II) rms value of the current 1 (i) (I) For series LCR circuit, the frequency at which the current amplitude is maximum. Alternatively The frequency at which the impedance is minimum ($Z=R$). Alternatively Frequency at which $X_L = X_C$	1		

	(II) Power factor: It is the ratio of resistance to impedance of the series LCR circuit. Alternatively $\cos \phi = \frac{R}{Z}, \text{ where } \phi \text{ is the angle between the voltage and the current.}$ Alternatively $\cos \phi = \frac{V_R}{V}$ $P = V_{\text{eff}} I_{\text{eff}} \cos \phi$, P is maximum when $\cos \phi$ is unity.	1	
		1	
(ii)	(I) $Z = \sqrt{R^2 + \left(\omega L - \frac{1}{\omega C}\right)^2}$ $= \sqrt{(400)^2 + \left(100\pi \times \frac{5}{\pi} - \frac{1 \times \pi}{100\pi \times 50 \times 10^{-6}}\right)^2}$ $= \sqrt{160000 + 90000}$ $= \sqrt{250000}$ $= 500\Omega$	$\frac{1}{2}$	
	(II) $I_{\text{rms}} = \frac{V_0}{Z\sqrt{2}}$ $= \frac{140}{500 \times 1.4} = 0.2A$	$\frac{1}{2}$	
		$\frac{1}{2}$	
	OR		
(b)	(i) Drawing Labelled diagram Obtaining the ratio $\frac{V_S}{V_P}$ (ii) Finding (I) Current in the primary coil (II) Output voltage	1 2 1 1	

	(i)  (Anyone of the above) The induced emf or voltage across secondary with N_s turns is: $\varepsilon_s = -N_s \frac{d\phi}{dt}$ The alternating ϕ flux also induces an emf, called back emf. This is: $\varepsilon_p = -N_p \frac{d\phi}{dt}$ $\varepsilon_p = v_p$ [$\because$ primary coil has zero resistance] $\varepsilon_s = v_s$ [$\because$ secondary coil is an open circuit] $v_s = -N_s \frac{d\phi}{dt} \quad \text{-----(i)}$ $v_p = -N_p \frac{d\phi}{dt} \quad \text{-----(ii)}$ Dividing (i) by (ii) $\frac{v_s}{v_p} = \frac{N_s}{N_p}$ (ii) (I) $P = V_p I_p$ $3.3 \times 10^3 = 220 \times I_p$ $I_p = \frac{3.3 \times 10^3}{220} = 15 \text{ A}$ (II) $\frac{v_s}{v_p} = \frac{N_s}{N_p}$ $\frac{220}{v_s} = \frac{100}{5000}$ $v_s = 11000 \text{ V}$	1 $\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$	5
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33. (a) (i) Reason for: (I) Electric field perpendicular to the equipotential surface at a point. 1 (II) Reduction of electric field inside the dielectric. 1 (III) Potential difference decreases when the plates of a capacitor are brought closer. 1 (ii) Obtaining expression for the work done. 2 (i) (I) If the field were not normal to the equipotential surface, it would have non-zero component along the surface. To move a unit test charge against the direction of the component of the field, work would be done. This is in contradiction to the definition of equipotential surface. Alternatively $\oint \vec{E} \cdot d\vec{l} = V_A - V_B; V_A = V_B$ for equipotential surface $\oint \vec{E} \cdot d\vec{l} = 0 \Rightarrow \cos \theta = 0$ as $E \neq 0$ & $dl \neq 0$ and $\theta = 90^\circ$ (II) When a dielectric is placed in an external electric field, due to polarization of its molecules, an electric field is induced in a direction opposite to the external field, hence net electric field inside is reduced. Note: Full credit to be given if explained diagrammatically. Alternatively $\epsilon = \epsilon_0 - \epsilon_p$ (III) Potential difference $(V) = \frac{Q}{C}$ $V = \frac{Qd}{A\epsilon_0}$ $V \propto d$	1 1 1	
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(ii) Work done = $k \left[\frac{q_1 q_2}{a} + \frac{q_1 q_3}{a} + \frac{q_2 q_3}{a} \right]$ $= \frac{k}{a} [(q)(-4q) + (q)(2q) + (-4q)(2q)]$ $= -\frac{k(10q^2)}{a}$ Work done to dissociate is $+\frac{k(10q^2)}{a}$.		$\frac{1}{2}$
(b)	OR	
(i) Reason for: (I) Instantaneous establishment of current. (II) Low internal resistance. (III) assertion not true. (ii) Calculating: Emf Internal resistance	1 1 1 1 1	
(i) (I) Electric field is established throughout the circuit, almost instantly (with the speed of light) causing at every point a local electron drift. Establishment of a current does not have to wait for electrons from one end of the conductor travelling to the other end. However, it does take a little while for the current to reach its steady value. (II) $I = \frac{\varepsilon}{R + r}$ The maximum current that can be drawn from a cell is for $R=0$ and it is $I_{\max} = \frac{\varepsilon}{r}$ (III) The Ohm's law asserts that the plot of I vs V is linear i.e. R is independent of V. But this condition is not applicable for diodes.		1 1 1
(ii) $\varepsilon_{AB} = \frac{\varepsilon_1 r_2 + \varepsilon_2 r_1}{r_1 + r_2}$ $= \frac{12 \times 0.5 + 6 \times 1}{1.5}$ $= 8V$ Alternatively (for emf only)		$\frac{1}{2}$ $\frac{1}{2}$

	In loop PQRSP, $-6 - 0.5I + 12 - 1 \times 1 = 0$ $-1.5I + 6 = 0$ $I = \frac{6}{1.5} = 4\text{A}$ $V_{AB} = \mathcal{E} - Ir = 12 - 4 \times 1$ $= 8\text{ V}$ Internal resistance = $\frac{r_1 r_2}{r_1 + r_2}$ $= \frac{0.5 \times 1}{1.5}$ $= \frac{1}{3} \Omega$	$\frac{1}{2}$ $\frac{1}{2}$	5
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