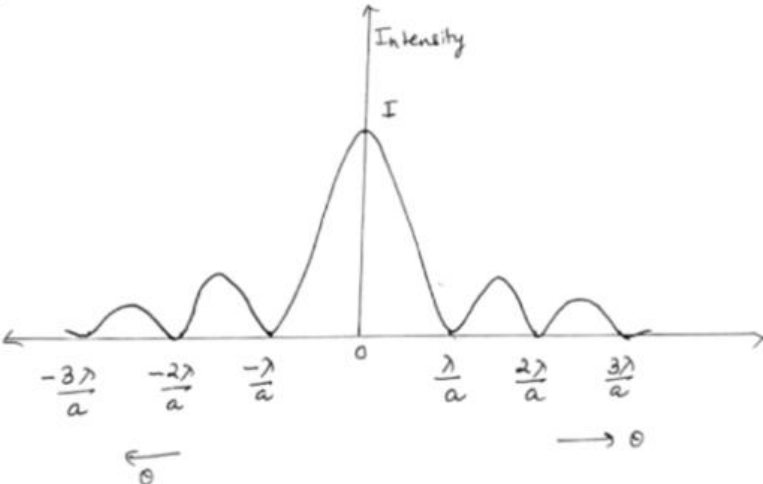
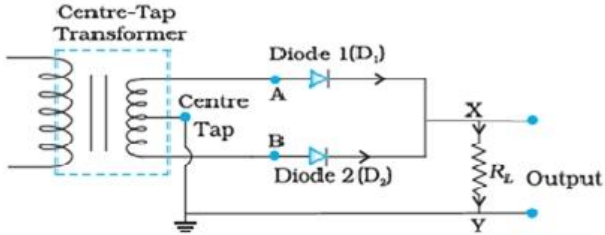


MARKING SCHEME: PHYSICS (042) Session: 2025–26			
Code: 55/ 4 / 3			
	SECTION A		
Q. No.	VALUE POINTS/EXPECTED ANSWERS	Marks	Total Marks
1.	(B) Only Mo will not show photoelectric emission.	1	1
2.	(B) $2 \times 10^8 \text{ m s}^{-1}$	1	1
3.	(C) 0 and 10	1	1
4.	(C) depletion region	1	1
5.	(C) $\frac{m_1}{m_2} < \frac{q_1}{q_2}$	1	1
6.	(A) infrared region	1	1
7.	(D) decrease by 50% of its initial value.	1	1
8.	(C) τ decreases with temperature but 'n' does not change appreciably.	1	1
9.	(B) relative position and orientation of the coils	1	1
10.	(B) Mobility decreases with increase in temperature.	1	1
11.	(D) 75Ω	1	1
12.	(B) $\frac{3}{4}$	1	1
13.	(D) Both assertion(A) and Reason (R) are false.	1	1
14.	(A) Both Assertion (A) and Reason (R) are true, and Reason (R) is the correct explanation of Assertion (A).	1	1
15.	(A) Both Assertion (A) and Reason (R) are true, and Reason (R) is the correct explanation of Assertion (A).	1	1

16.	(C) Assertion (A) is true, but Reason (R) is false.	1	1
SECTION B			
17.	Finding the new value of hole concentration 1½ Identifying the semiconductor ½ $n_e n_h = n_i^2$ 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.	½ ½ ½ ½	2
18.	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 = $2pE = 2(2qa)E$ $= 2 \times 1 \times 10^{-6} \times 10 \times 10^{-2} \times 100$ Net work done = $2 \times 10^{-5} \text{ J}$	½ ½ ½ ½	2
19.	(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.	1 1	

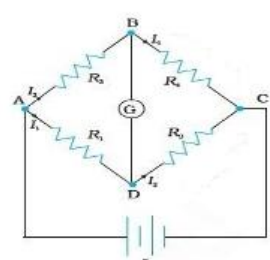
Alternatively: Amplitude (A) $\propto (1 + \cos \theta)$; for back wave $\theta = 180^\circ \Rightarrow \text{Amplitude} = 0$ OR (b) <table border="1" style="width: 100%;"><tr><td>(i) Depicting the variation of intensity</td><td style="text-align: right;">1</td></tr><tr><td>(ii) Effect on linear width</td><td style="text-align: right;">1</td></tr></table> (i)  (ii) The linear width of the central maximum will decrease. Note: Award ½ mark if the student gives only the formula.	(i) Depicting the variation of intensity	1	(ii) Effect on linear width	1	1 1	2
(i) Depicting the variation of intensity	1					
(ii) Effect on linear width	1					
20. <table border="1" style="width: 100%;"><tr><td>Finding nature and focal length</td><td style="text-align: right;">2</td></tr></table> $\frac{1}{f} = ({}^a\mu_g - 1) \left(\frac{1}{R_1} - \frac{1}{R_2} \right)$	Finding nature and focal length	2	½			
Finding nature and focal length	2					

	$\frac{1}{f'} = (\mu_g - 1) \left(\frac{1}{R_1} - \frac{1}{R_2} \right)$ $\frac{f'}{f} = \frac{(\mu_g - 1)}{(\mu_g - 1)} = \frac{1.5 - 1}{\left(\frac{1.5}{1.25} - 1 \right)} = \frac{0.5}{0.25} \times 1.25$ $\frac{f'}{f} = 2.5$ or $f' = 2.5 \times 20 = 50\text{cm}$ Nature $\rightarrow$ converging.	$\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$	2
21.	Differentiating between nuclear fission and nuclear fusion 1 One example each $\frac{1}{2} + \frac{1}{2}$ Nuclear fission: When heavy nucleus splits into smaller nuclei. Nuclear fusion: If two light nuclei combine to form a single larger nucleus. Example (Nuclear fission): ${}_0^1\text{n} + {}_{92}^{235}\text{U} \rightarrow {}_{92}^{236}\text{U} \rightarrow {}_{56}^{144}\text{Ba} + {}_{36}^{89}\text{Kr} + 3{}_0^1\text{n}$ Example (Nuclear fusion): ${}_1^1\text{H} + {}_1^1\text{H} \rightarrow {}_1^2\text{H} + \text{e}^+ + \nu + 0.42\text{Mev}$	$\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$	2
SECTION C			
22.	Explaining the working with the help of circuit diagram 2 Depicting the input and output waveforms $\frac{1}{2} + \frac{1}{2}$ 	1	

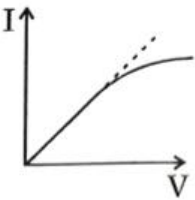
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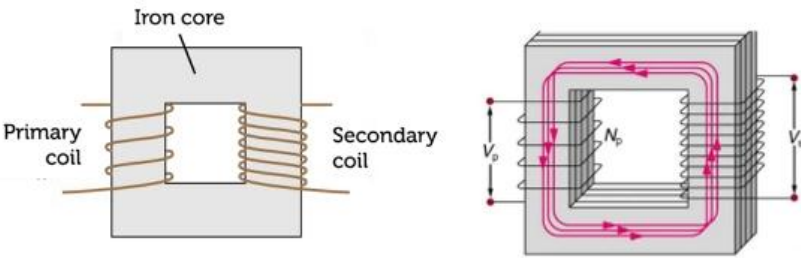
	OR (b) <table border="1"> <tr> <td>(i) Deriving expression for induced emf</td> <td>1 ½</td> </tr> <tr> <td>(ii) Finding the effective value of current</td> <td>1 ½</td> </tr> </table> (i) Induced emf $= \varepsilon = \frac{d\phi}{dt}$ $= \frac{d}{dt}(\vec{B} \cdot \vec{A})$ $\varepsilon = \frac{d}{dt}(B_0 \sin \omega t \times \ell b)$ $= B_0 \omega \ell b \cos \omega t$ (ii) Instantaneous value of current $= \frac{ \varepsilon }{R} = \frac{B_0 \omega \ell b \cos \omega t}{R}$ $I_{eff} = \frac{I_0}{\sqrt{2}}$ $= \frac{B_0 \omega \ell b}{R\sqrt{2}}$	(i) Deriving expression for induced emf	1 ½	(ii) Finding the effective value of current	1 ½	½ ½ ½ ½ ½ ½	3		
(i) Deriving expression for induced emf	1 ½								
(ii) Finding the effective value of current	1 ½								
25.	<table border="1"> <tr> <td>Defining X-rays</td> <td>1</td> </tr> <tr> <td>Production of X-rays</td> <td>1</td> </tr> <tr> <td>Two uses of X-rays</td> <td>½ + ½</td> </tr> </table> The waves of the electromagnetic spectrum whose wavelength lies between 1 nm to 10^{-3} nm. The X-rays are produced by X-ray tubes or when inner shell electrons move from one energy level to a lower energy level. Alternatively: Waves produced when a metal target is bombarded by high energy electrons. Uses of X-rays: - Used as a diagnostic tool in medicine. - For treatment of certain forms of cancer. - Scanning luggage at airports. - Inspecting materials for structural flaws. (Any two)	Defining X-rays	1	Production of X-rays	1	Two uses of X-rays	½ + ½	1 1 ½ + ½	3
Defining X-rays	1								
Production of X-rays	1								
Two uses of X-rays	½ + ½								

26.	(a) Distinguishing between isotopes and isobars with one example. 1+1 (b) Deriving relation between atomic mass unit (u) and electron volt (eV). 1 (a) Isotopes are atoms of the same element with the same atomic number but different mass number. Isobars are all nuclides with the same mass number. Alternatively: Isotopes of an element contain the same number of protons but different numbers of neutrons. Isobars are atoms of different elements with the same mass number but different atomic numbers. Examples: ${}^2_1\text{H}$ and ${}^3_1\text{H}$ (Isotopes) $\frac{1}{2}$ ${}^3_1\text{H}$ and ${}^3_2\text{He}$ (Isobars) $\frac{1}{2}$ (Any other example should be given full credit) (b) Einstein mass-energy equivalence is $E = mc^2$ Energy equivalent of 1 u is, $E = 1.6605 \times 10^{-27} \times (2.9979 \times 10^8)^2$ $= 1.4924 \times 10^{-10} \text{ J}$ $= \frac{1.4924 \times 10^{-10}}{1.602 \times 10^{-19}} \text{ eV}$ $= 0.9315 \times 10^9 \text{ eV}$	1 1 3
27.	(a) Explanation 1 (b) Deriving the Balance Condition of a Wheatstone Bridge 2 (a) Current is a scalar quantity because it does not follow law of vector addition. The current with an arrow is only to signify the direction of conventional current. (b) 	1 $\frac{1}{2}$

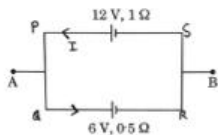
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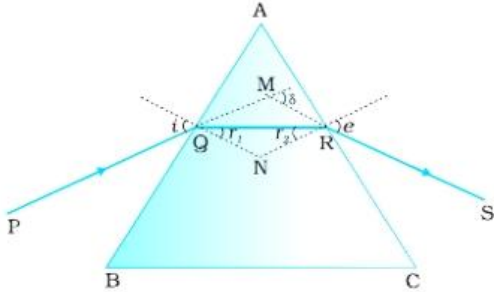
	SECTION D		
29.	(i) (B) real, virtual (ii) (D) apertures of objective lens and eyepieces (iii) (C) The distance between two lenses is more than $(f_o + f_e)$ (iv) (A) 84 cm OR (D) 20	1 1 1 1	4
30.	(i) (C)  (ii) (C) equal to sum of error in voltmeter reading and the error in ammeter reading. (iii) (B) 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 1	4
	SECTION E		
31.	(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.	1	

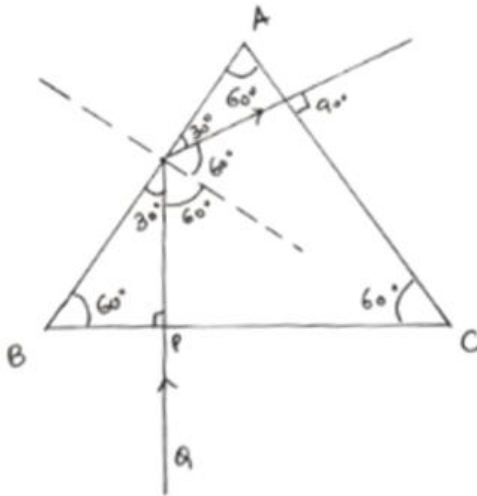
Alternatively The frequency at which the impedance is minimum ($Z=R$). Alternatively Frequency at which $X_L = X_C$ (II) Power factor: It is the ratio of resistance to impedance of the series LCR circuit. Alternatively $\cos \phi = \frac{R}{Z}$, where ϕ is the angle between the voltage and the current. Alternatively $\cos \phi = \frac{V_R}{V}$ $P = V_{\text{eff}} I_{\text{eff}} \cos \phi$, P is maximum when $\cos \phi$ is unity. (ii) (I) $Z = \sqrt{R^2 + \left(\omega L - \frac{1}{\omega C}\right)^2}$ $= \sqrt{(400)^2 + \left(100\pi \times \frac{5}{\pi} - \frac{1 \times \pi}{100\pi \times 50 \times 10^{-6}}\right)^2}$ $= \sqrt{160000 + 90000}$ $= \sqrt{250000}$ $= 500\Omega$ (II) $I_{\text{rms}} = \frac{V_0}{Z\sqrt{2}}$ $= \frac{140}{500 \times 1.4} = 0.2\text{A}$ OR (b) <table border="1"> <tr> <td>(i) Drawing Labelled diagram</td> <td>1</td> </tr> <tr> <td>Obtaining the ratio $\frac{V_s}{V_p}$</td> <td>2</td> </tr> <tr> <td>(ii) Finding</td> <td></td> </tr> <tr> <td>(I) Current in the primary coil</td> <td>1</td> </tr> <tr> <td>(II) Output voltage</td> <td>1</td> </tr> </table>	(i) Drawing Labelled diagram	1	Obtaining the ratio $\frac{V_s}{V_p}$	2	(ii) Finding		(I) Current in the primary coil	1	(II) Output voltage	1	1 1 $\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$	HOME
(i) Drawing Labelled diagram	1											
Obtaining the ratio $\frac{V_s}{V_p}$	2											
(ii) Finding												
(I) Current in the primary coil	1											
(II) Output voltage	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 flux ϕ 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 $\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$	HOME 5
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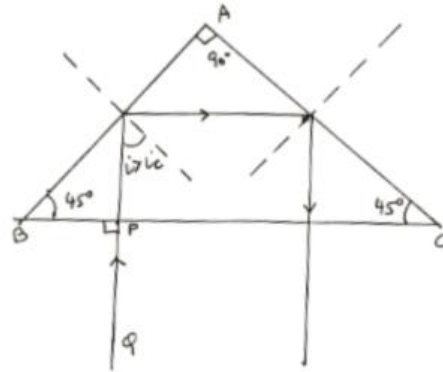
32.	(a) (i) Reason for: (I) Electric field perpendicular to the equipotential surface at a point. 1 (II) Reduction of electric field inside the dielectric. 1 (III) Potential difference decreases when the plates of a capacitor are brought closer. 1 (ii) Obtaining expression for the work done. 2 (i) (I) 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 $(V) = \frac{Q}{C}$ $V = \frac{Qd}{A\epsilon_0}$ $V \propto d$ (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 $+\frac{k(10q^2)}{a}$	1	
		1	
		1	
		1/2	
		1	
		1/2	

OR			
(b)			
(i) Reason for: (I) Instantaneous establishment of current. 1 (II) Low internal resistance. 1 (III) assertion not true. 1 (ii) Calculating: Emf 1 Internal resistance 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.		1	
(II) $I = \frac{\mathcal{E}}{R + r}$			
The maximum current that can be drawn from a cell is for $R=0$ and it is $I_{\max} = \frac{\mathcal{E}}{r}$		1	
(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	
(ii) $\mathcal{E}_{AB} = \frac{\mathcal{E}_1 r_2 + \mathcal{E}_2 r_1}{r_1 + r_2}$			$\frac{1}{2}$
$= \frac{12 \times 0.5 + 6 \times 1}{1.5}$ $= 8V$			$\frac{1}{2}$
Alternatively (for emf only)			
			
In loop PQRSP,			
$-6 - 0.5I + 12 - 1 \times I = 0$			
$-1.5I + 6 = 0$			

	$I = \frac{6}{1.5} = 4\text{A}$ $V_{AB} = \mathcal{E} - Ir = 12 - (4 \times 1)$ $= 8\text{ V}$ $\text{Internal resistance} = \frac{r_1 r_2}{r_1 + r_2}$ $= \frac{0.5 \times 1}{1.5}$ $= \frac{1}{3} \Omega$	$\frac{1}{2}$ $\frac{1}{2}$	5
33.	(a) (i) Defining refractive index 1 (ii) Deriving relation between refractive index in terms of δ_m and A. 2 (iii) Tracing path of light and relevant explanation. 1+1 (i) Refractive index of a medium is defined as the ratio of the speed of light in vacuum to the speed of light in the medium. <u>Alternatively</u> $n_{21} = \frac{c}{v}$ (ii)  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°.	1 $\frac{1}{2}$	

	$\angle A + \angle QNR = 180^\circ$ From the triangle QNR, $r_1 + r_2 + \angle QNR = 180^\circ$ Comparing these two equations, we get $r_1 + r_2 = A$(i) The total deviation δ is the sum of the deviations at the two faces. $\delta = i + e - A$(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 $n_{21} = \frac{n_2}{n_1} = \frac{\sin \frac{(A + \delta_m)}{2}}{\sin \frac{A}{2}}$	$\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$	
(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.	1 1	

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

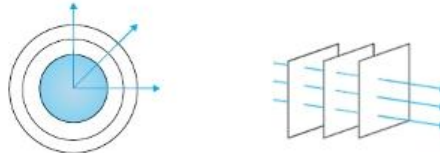
(i) Ray – It is a straight line depicting the rectilinear propagation of light.

$\frac{1}{2}$

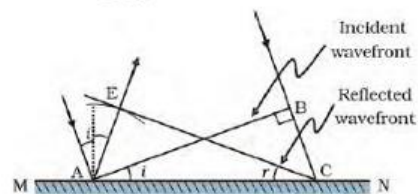
Wavefront – It is the locus of points which oscillate in the same phase.

$\frac{1}{2}$

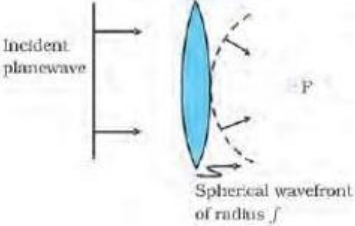
Alternatively



(ii)



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.	$\frac{1}{2}$	
(iii)		1 $\frac{1}{2}$	1
			5