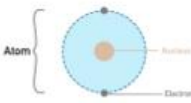


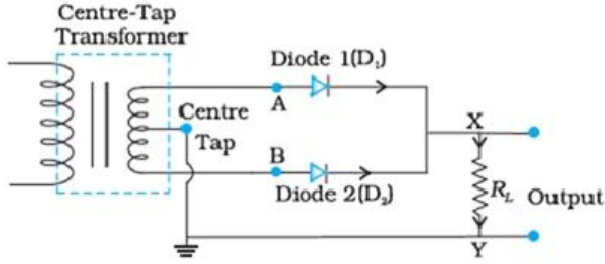
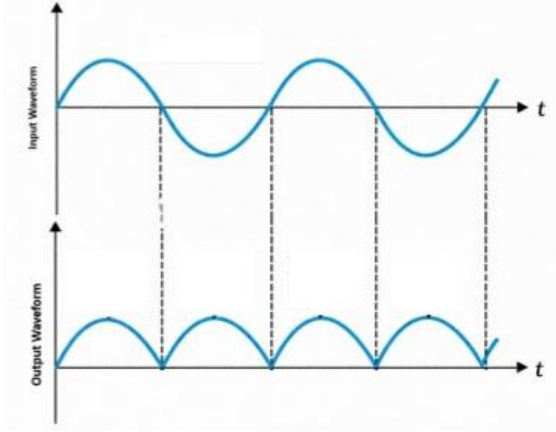
MARKING SCHEME: PHYSICS (042) Session: 2025–26			
Code: 55/ 4 / 2			
	SECTION A		
Q. No.	VALUE POINTS/EXPECTED ANSWERS	Marks	Total Marks
1.	(C) 300 %	1	1
2.	(A) $\frac{L}{2}$	1	1
3.	(A) Drift velocity only	1	1
4.	(C) $\frac{m_1}{m_2} < \frac{q_1}{q_2}$	1	1
5.	(A) infrared region	1	1
6.	(D) Decrease by 50% of its initial value	1	1
7.	(C) depletion region	1	1
8.	(C) $1.5 \times 10^{-4} \text{ Am}^2$	1	1
9.	(C) 0 and 10	1	1
10.	(B) $2 \times 10^8 \text{ ms}^{-1}$	1	1
11.	(B) Only Mo will not show photoelectric emission	1	1
12.	(B) maximum kinetic energy of photoelectrons will remain the same	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.	(A) Both Assertion (A) and Reason (R) are true, and Reason (R) is the correct explanation of Assertion (A).	1	1
15.	(C) Assertion (A) is true, but Reason (R) is false.	1	1

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18.	Finding the new value of hole concentration 1½ Identifying the semiconductor ½ $n_e n_h = n_i^2$ $\text{Hole concentration } (n_h) = \frac{n_i^2}{n_e}$ $= \frac{5 \times 10^8 \times 5 \times 10^8}{4 \times 10^{12}}$ $n_h = 6.25 \times 10^4 \text{ m}^{-3}$ The new semiconductor formed is n-type semiconductor.	½ ½ ½ ½	2
19.	Finding the position of object in the given question. 2 Given: $R = -16 \text{ cm}$ (concave mirror) $m = -\frac{v}{u} = -2$ $v = 2u$ Now for concave mirror, $f = -8 \text{ cm}, v = 2u, u = ?$ $\frac{1}{v} + \frac{1}{u} = \frac{1}{f}$ $\frac{1}{2u} + \frac{1}{u} = \frac{1}{-8}$ $\frac{1+2}{2u} = \frac{1}{-8}$ $\frac{2u}{3} = -8$ $u = -\frac{24}{2} = -12 \text{ cm}$ $\therefore u = -12 \text{ cm}$	½ ½ ½ ½	2
20.	Proving the density of nuclear matter to be same for all nuclei. 2  $\text{Volume of a nucleus} = \frac{4}{3} \pi R^3$		

	$= \frac{4}{3} \pi (R_0 A^{\frac{1}{3}})^3$ $= \frac{4}{3} \pi R_0^3 A$ $\rho = \frac{\text{mass of nucleus}}{\text{volume of nucleus}}$ $= \frac{mA}{\frac{4}{3} \pi R_0^3 A} = \frac{3m}{4\pi R_0^3}$	$\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$	2
21.	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 = $2 \times 10^{-5} \text{ J}$	$\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$	2
	SECTION C		
22.	(a) Finding the magnitude and direction of: (i) Net magnetic field at a point on conductor (1). $1\frac{1}{2}$ (ii) Net force per unit length on conductor (1). $1\frac{1}{2}$ (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. 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. 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. Direction will be along negative z axis/ into the plane of the paper.	$\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$	

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	 Let the input voltage A with respect to the centre tap at any instant is positive. At that instant, voltage at B being out of phase will be negative. So, diode D_1 gets forward biased and conducts (while D_2 being reverse biased is not conducting). Hence, during this positive half cycle we get an output current. When voltage at A becomes negative w.r.t. centre tap, the voltage at B would be positive. In this part of the cycle diode D_1 would not conduct but diode D_2 would be giving output current. 	1 1 $\frac{1}{2}$ $\frac{1}{2}$	 3
24.	(a) Calculating the radius of the innermost electron orbit in hydrogen atom. $\frac{1}{2}$ (b) Calculating speed of electron in the same orbit. $\frac{1}{2}$ (a) The radius of innermost electron orbit is given by, $r = -\frac{e^2}{8\pi\epsilon_0 E} \text{ -----(1)}$ where E = Energy of electron in hydrogen atom in innermost orbit ($n = 1$). Using formula, $E_n = -\frac{13.6}{n^2} \text{ eV}$	$\frac{1}{2}$	

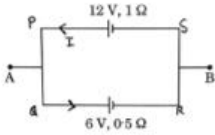
	For $n=1$, $E_1 = -\frac{13.6}{1^2} \text{ eV} = -13.6 \times 1.6 \times 10^{-19} \text{ J} = -2.2 \times 10^{-18} \text{ J}$ -----(2) Substituting the value of E for $n=1$ from equation (2) into (1), we get $r = -\frac{9 \times 10^9 \times (1.6 \times 10^{-19})^2}{2(-2.2 \times 10^{-18})}$ $= 5.3 \times 10^{-11} \text{ m}$ (b) The speed of electron in this orbit is $v = \frac{e}{\sqrt{4\pi\epsilon_0 m r}}$ $= \frac{1.6 \times 10^{-19}}{\sqrt{\frac{1}{9 \times 10^9} \times 9.1 \times 10^{-31} \times 5.3 \times 10^{-11}}}$ $= 2.2 \times 10^6 \text{ m/s}$ Alternatively The radius of innermost electron orbit in H – atom is given by $r_n = \frac{n^2}{Z} r_0$ where $r_0 = 0.529 \text{ \AA}$ Using $n=1$, $Z=1$, $r_1 = 0.529 \times 10^{-10} \text{ m}$ Speed of electron in this orbit, $v_n = \frac{1}{137} \frac{c}{n}$ where $c = 3 \times 10^8 \text{ m/sec}$ $= \frac{1}{137} \frac{3 \times 10^8}{1} = 2.19 \times 10^6 \text{ m/s}$	$\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$	
25.	(a) Explaining the dual aspect of matter 1 (b) Finding de Broglie wavelength of emitted electrons 2 (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.	$\frac{1}{2}$ $\frac{1}{2}$	3

(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 (λ') = $\frac{h}{mv}$ $\lambda' = \frac{h}{m\sqrt{\frac{2hc}{m\lambda}}}$ $\lambda' = \sqrt{\frac{h\lambda}{2mc}}$	$\frac{1}{2}$ $\frac{1}{2}$ 1	3						
26. <table border="1"> <tr> <td>Defining Microwaves</td> <td>1</td> </tr> <tr> <td>Production of Microwaves</td> <td>1</td> </tr> <tr> <td>Two uses of Microwaves</td> <td>$\frac{1}{2} + \frac{1}{2}$</td> </tr> </table> Microwaves are short wavelength radio waves with frequencies in gigahertz (GHz). These are produced by special vacuum tubes called klystrons, magnetrons and Gunn diodes. Uses: - These are used in radar system in aircraft navigation. - These can also be used in radar for the speed guns to time fast balls, tennis serves and automobiles. - These can also be used in microwave ovens. [Any two]	Defining Microwaves	1	Production of Microwaves	1	Two uses of Microwaves	$\frac{1}{2} + \frac{1}{2}$	1 1 $\frac{1}{2} + \frac{1}{2}$	3
Defining Microwaves	1							
Production of Microwaves	1							
Two uses of Microwaves	$\frac{1}{2} + \frac{1}{2}$							

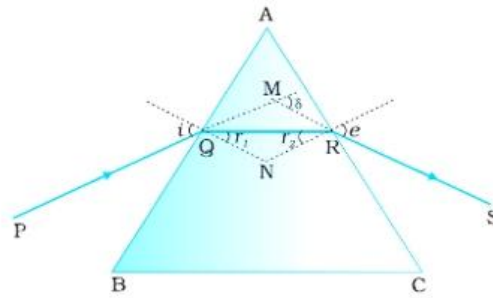
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Alternatively $\varepsilon = \varepsilon_0 - \varepsilon_p$ (III) Potential difference (V) = $\frac{Q}{C}$ $V = \frac{Qd}{A\varepsilon_0}$ $V \propto d$ (ii) Work done = $k \left[\frac{q_1 q_2}{a} + \frac{q_1 q_3}{a} + \frac{q_2 q_3}{a} \right]$ $= \frac{k}{a} [(q)(-4q) + (q)(2q) + (-4q)(2q)]$ $= -\frac{k(10q^2)}{a}$ Work done to dissociate is $+\frac{k(10q^2)}{a}$ OR (b) <table border="1"> <tr> <td>(i) Reason for:</td> <td></td> </tr> <tr> <td>(I) Instantaneous establishment of current.</td> <td>1</td> </tr> <tr> <td>(II) Low internal resistance.</td> <td>1</td> </tr> <tr> <td>(III) assertion not true.</td> <td>1</td> </tr> <tr> <td>(ii) Calculating:</td> <td></td> </tr> <tr> <td>Emf</td> <td>1</td> </tr> <tr> <td>Internal resistance</td> <td>1</td> </tr> </table> (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.	(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	1 1/2 1 1/2	HO
(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															

	(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)  In loop PQRSP, $-6 - 0.5I + 12 - 1 \times I = 0$ $-1.5I + 6 = 0$ $I = \frac{6}{1.5} = 4A$ $V_{AB} = \mathcal{E} - Ir = 12 - 4 \times 1$ $= 8V$ Internal resistance = $\frac{r_1 r_2}{r_1 + r_2}$ $= \frac{0.5 \times 1}{1.5}$ $= \frac{1}{3} \Omega$	$\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$	5
32.	(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 the ratio of the speed of light in vacuum to the speed of light in the medium. Alternatively $n_{21} = \frac{c}{v}$	1	

(ii)

 $\frac{1}{2}$

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

$$r_1 + r_2 = A \quad \dots\dots\dots(i)$$

 $\frac{1}{2}$

The total deviation δ is the sum of the deviations at the two faces.

$$\delta = i + e - A \quad \dots\dots\dots(ii)$$

 $\frac{1}{2}$

For $\delta = \delta_m$; $i = e$ which implies $r_1 = r_2$

From equation (i) and (ii)

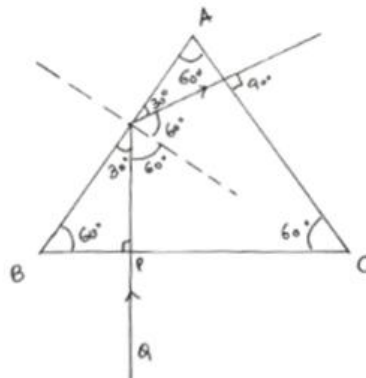
$$r = \frac{A}{2}; i = \frac{A + \delta_m}{2}$$

Refractive index of the prism

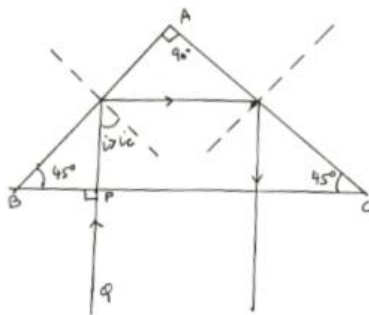
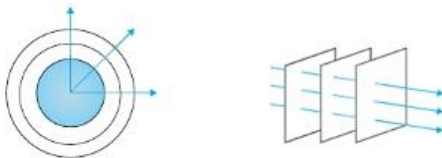
$$n_{21} = \frac{n_2}{n_1} = \frac{\sin \frac{(A + \delta_m)}{2}}{\sin \frac{A}{2}}$$

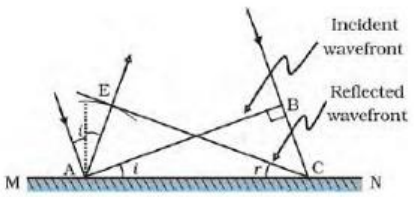
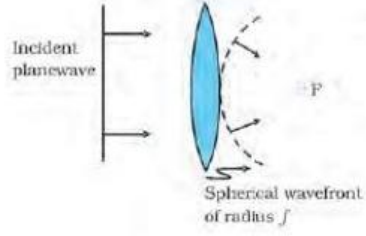
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(iii)

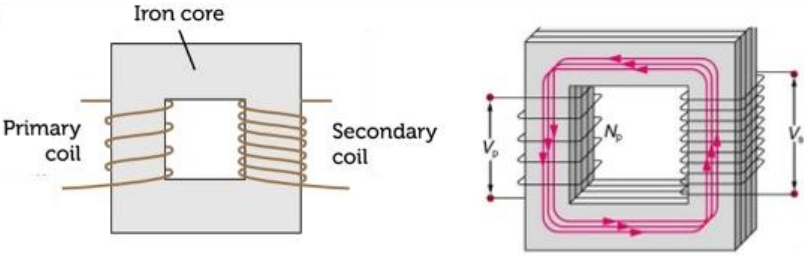


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The ray QP strikes the face BC normally and hence goes undeviated. As $i > i_c$, it undergoes TIR. It strikes the face AC normally and comes out undeviated. Alternatively  The ray QP strikes the surface BC normally and hence goes undeviated. As $i > i_c$, 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) <table border="1" data-bbox="373 920 1181 1059"><tr><td>(i) Differentiating between a ray and a wavefront</td><td>1</td></tr><tr><td>(ii) Showing reflected wavefront</td><td>1</td></tr><tr><td>Verifying the law of reflection</td><td>2</td></tr><tr><td>(iii) Depiction of refraction.</td><td>1</td></tr></table>	(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	1
(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 	$\frac{1}{2}$ $\frac{1}{2}$								

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

(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 $\cos \phi = \frac{V_R}{V}$	1
$P = V_{\text{eff}} I_{\text{eff}} \cos \phi$, P is maximum when $\cos \phi$ is unity.	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) $I_{\text{rms}} = \frac{V_0}{Z\sqrt{2}}$ $= \frac{140}{500 \times 1.4} = 0.2\text{A}$	$\frac{1}{2}$
OR	
(b)	
(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: $\varepsilon_p = -N_p \frac{d\phi}{dt}$ $\varepsilon_p = v_p \quad [\because \text{primary coil has zero resistance}]$ $\varepsilon_s = v_s \quad [\because \text{secondary coil is an open circuit}]$ $v_s = -N_s \frac{d\phi}{dt} \quad \text{-----(i)}$ $v_p = -N_p \frac{d\phi}{dt} \quad \text{-----(ii)}$ 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 $\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$	5
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