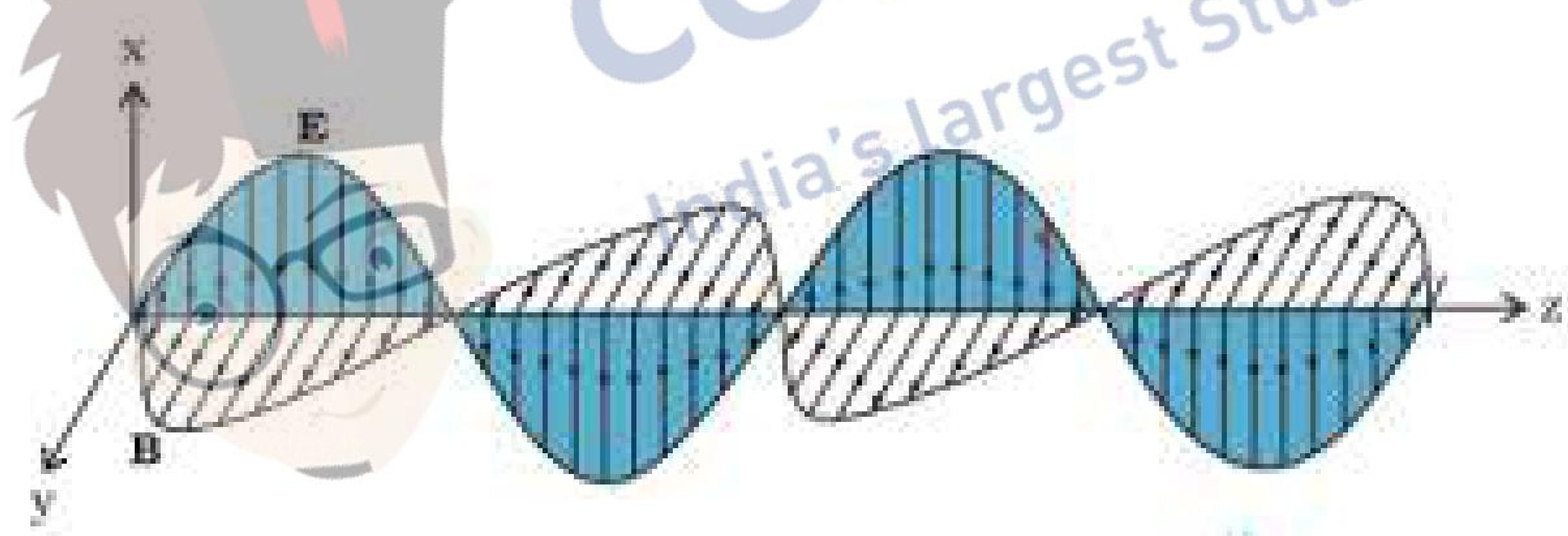
MARKING SCHEME

Senior Secondary School Term II Compartment Examination, 2022
PHYSICS (Subject Code–042)
[Paper Code : 55/6/1]

Q. No.	EXPECTED ANSWERS / VALUE POINTS	Marks	Total Marks
	Section A		
1.	a) i) Reason of using shortwave band 1 ii) Reason of experimental demonstration in low frequency region 1		
	i) Ionosphere reflects waves in these bands.	1	
	ii) The frequency that we get even with modern electronic circuits is hardly about 10^{11} Hz, this is why experimental demonstration of electromagnetic waves had to come in low frequency region.	1	
	OR		
	b) i) Diagram 1 ii) Identification of wave ½ Use ½		
	i) 	1	
	[Note : Award full marks even if a student takes E and B on Y and X axis.]		
	ii) X rays Use : As a diagnostic tool in medicine / treatment of cancer / or any other.	½ ½	2
2	a) Reason 1 b) Finding value of Kinetic energy ½ Finding value of potential energy ½		
	a) Alpha particle reverses its direction of motion , due to strong repulsive force, exerted by positively charged nucleus without even actually touching the gold nucleus.	1	
	b) E_n = -3.4eV (given) E_k = $-E_n$ = 3.4eV U = $2E_n$ = - 6.8 eV	½ ½	2

3

a) Reason	1
b) Definition of intensity of light in photon picture	1

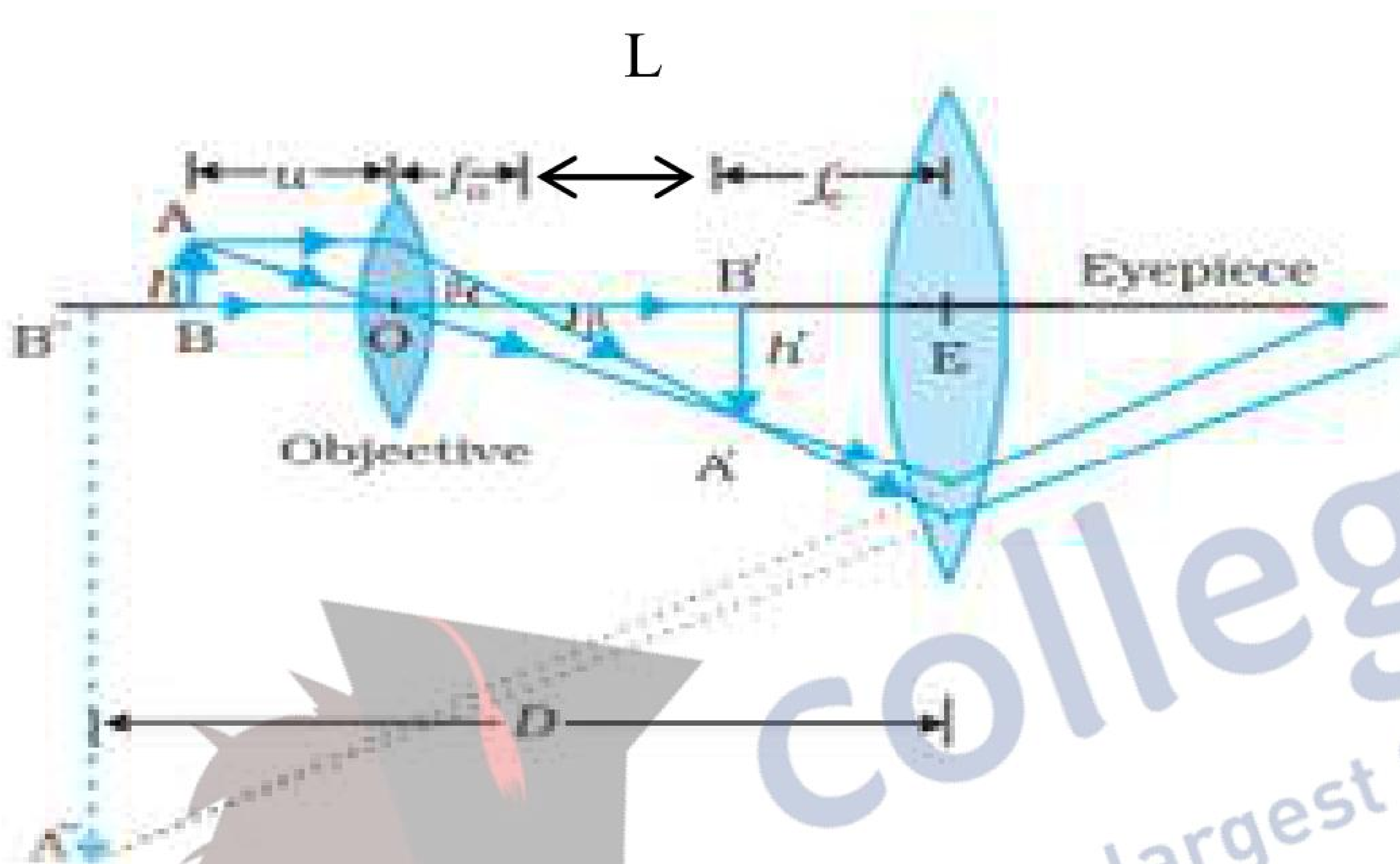
a) The crystal maintains an overall charge neutrality as the charge of additional charge carriers is just equal and opposite to that of the ionised cores in the lattice. — 1

b) It is defined as the energy transmitting per unit area, per unit time.
Alternatively: It is proportional to number of photons per unit area per unit time. — 1 — 2

Section - B

4 a)

a) Ray diagram	1
b) Derivation of angular magnification	2



— 1

Linear magnification due to objective (m_o)

$$m_o = \frac{h'}{h} = \frac{L}{f_o} \quad \text{-----------------------------} \quad (1)$$ — ½

Linear magnification due to eye piece (m_e) when final image is formed at near point (D)

$$m_e = 1 + \frac{D}{f_e} \quad \text{-----------------------------} (2)$$ — ½

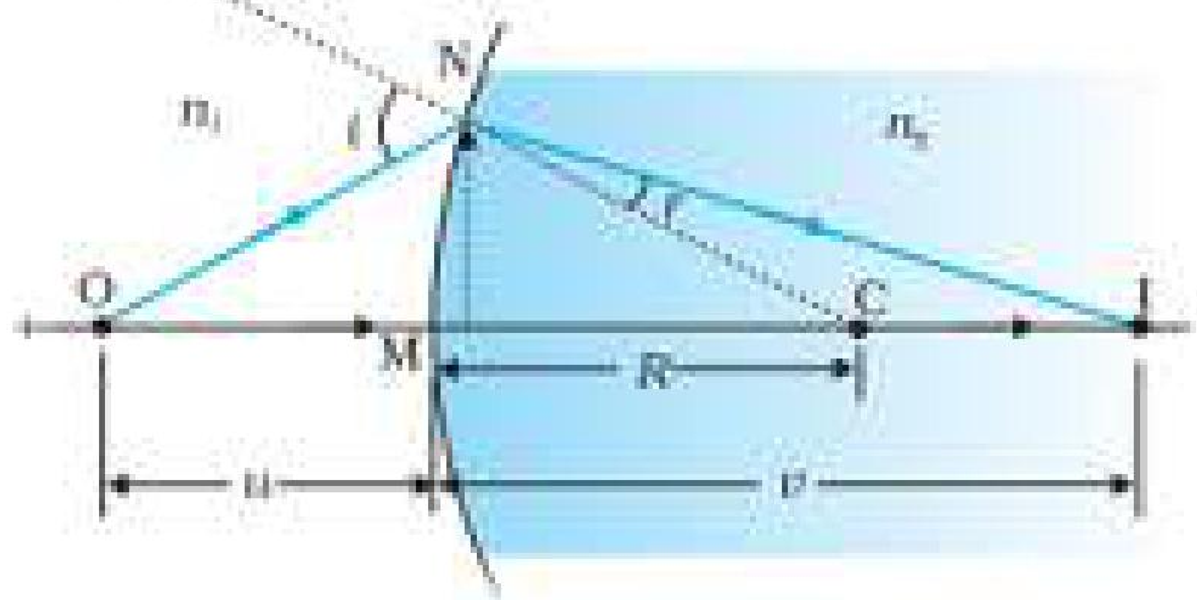
Total magnification $m = m_o \times m_e$ — ½

$$m = \frac{L}{f_o}\left(1 + \frac{D}{f_e}\right)$$ — ½

OR

b)

a) Ray diagram	1
b) Derivation	2



1

for small angles,

$\tan \angle NOM = \frac{MN}{OM}$

$\tan \angle NCM = \frac{MN}{MC}$ ½

$\tan \angle NIM = \frac{MN}{MI}$

Now, for ΔNOC, ∠ i is the exterior angle. Therefore, ∠ i = ∠NOM + ∠NCM

$i = \frac{MN}{OM} + \frac{MN}{MC}$

Similarly,

r = ∠NCM - ∠NIM ½

i.e. $r = \frac{MN}{MC} - \frac{MN}{MI}$

By Snell's law

$n_1 \sin i = n_2 \sin r$

or for small angles , $\sin i \approx i$ and $\sin r \approx r$

$n_1 i = n_2 r$

Substituting i and r , we get ½

$$\frac{n_1}{OM} + \frac{n_2}{MI} = \frac{n_2 - n_1}{MC}$$

Where OM , MI and MC represent magnitude of distances.

Applying the Cartesian sign convention

OM = -u , MI = +v , MC = +R

Substituting these in equation , we get ½ 3

$$\frac{n_2}{v} - \frac{n_1}{u} = \frac{n_2 - n_1}{R}$$

5.

a) Finding the ratio of intensity of bright and dark fringes	2
b) Calculating the wavelength	1

a)

$$r = \frac{A_1}{A_2} = \sqrt{\frac{I_1}{I_2}} = \sqrt{\frac{9}{1}} = \frac{3}{1}$$ 1

$$\frac{I_{max}}{I_{min}} = \frac{(r+1)^2}{(r-1)^2} = \left(\frac{4}{2}\right)^2 = \frac{4}{1}$$ 1

b) Wavelength of refracted light

$$\lambda = \frac{\lambda_{air}}{n} = \frac{3 X 600}{4} = \frac{1800}{4}$$ ½

= 450 nm ½ 3

6. (a)

a) Explanation	1
Two differences	1 + 1

Maximum intensity is obtained at a point on the screen when the path difference is (2n+1) $\frac{\lambda}{2}$. With increasing 'n' only one- third, one-fifth, one-seventh etc. of the slit contribute, hence intensity of maxima decreases sharply. — 1

Alternatively

With the increase of order (n) the number of secondary wavelets responsible for the formation of secondary maxima decreases, resulting in sharp decrease of intensity.

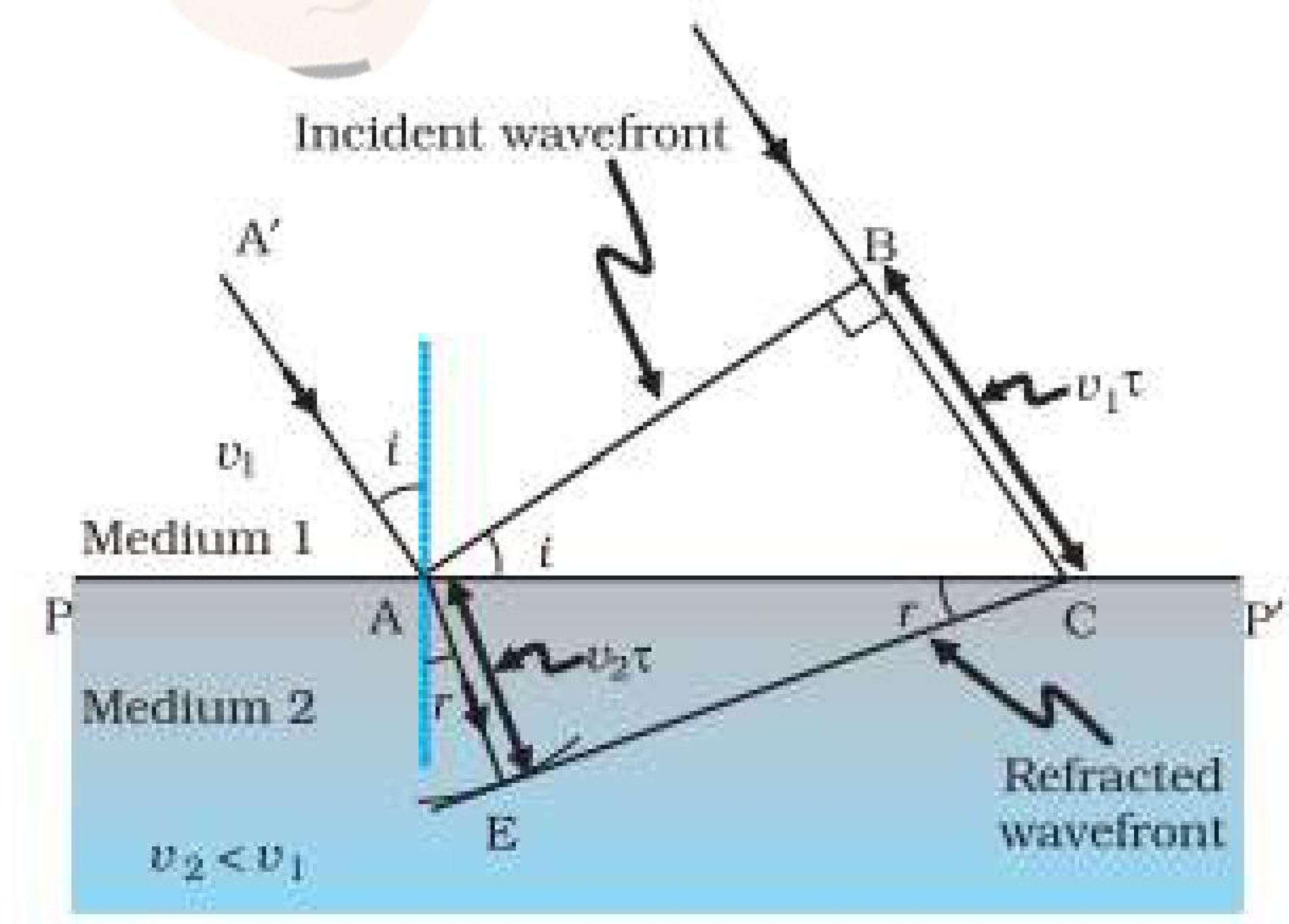
Differences (any two)

1. Diffraction is a pattern formed as a result of superposition of waves from different portions of the same wave front. Interference is a pattern on a screen a result of superposition of single slit diffraction from two slits.
2. In diffraction pattern width of central maximum is twice the width of secondary maxima. In interference pattern width of each maxima is same. — 1+1
3. In diffraction pattern intensity of maxima goes on decreasing as we move away from central maximum. In interference pattern intensity of all maxima is same.
4. In diffraction pattern there is no absolute minima. In interference pattern absolute minima depends on amplitude of waves superposing.

OR

(b)

Diagram	1
Verification of Snell's law	2



1

Consider the triangles ABC and AEC, we readily obtain

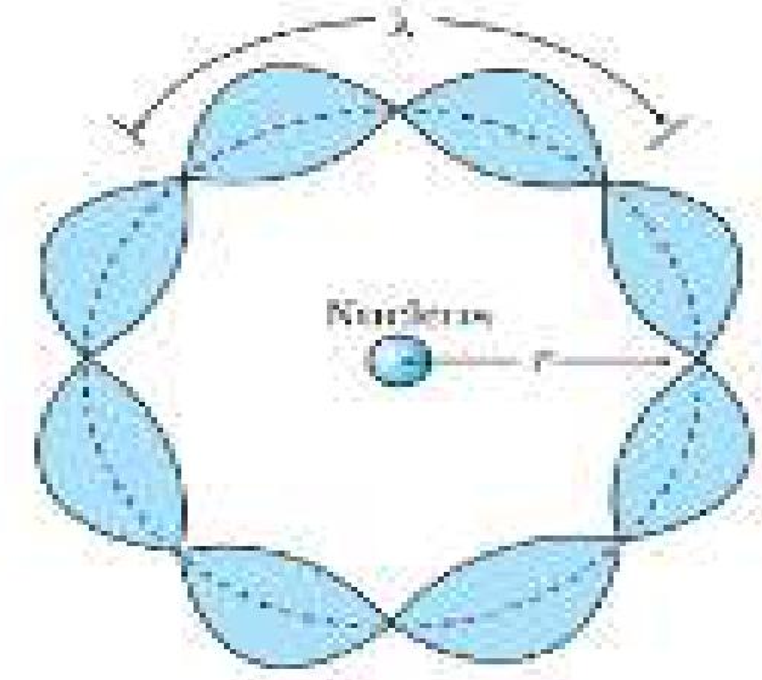
$$Sin\ i = \frac{BC}{AC} = \frac{v_1\tau}{AC}$$

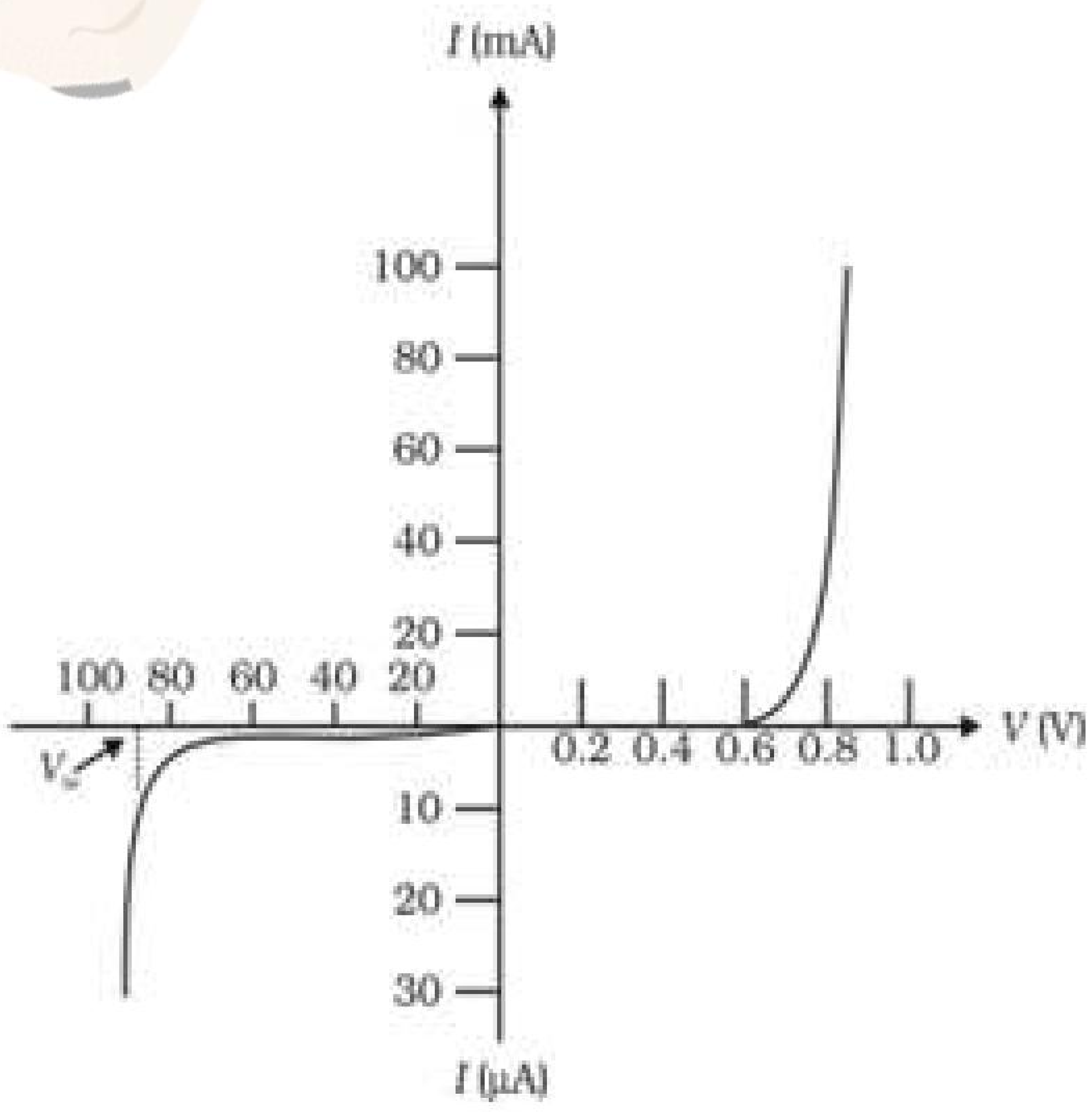
And

$$Sin\ r = \frac{AE}{AC} = \frac{v_2\tau}{AC}$$ ½

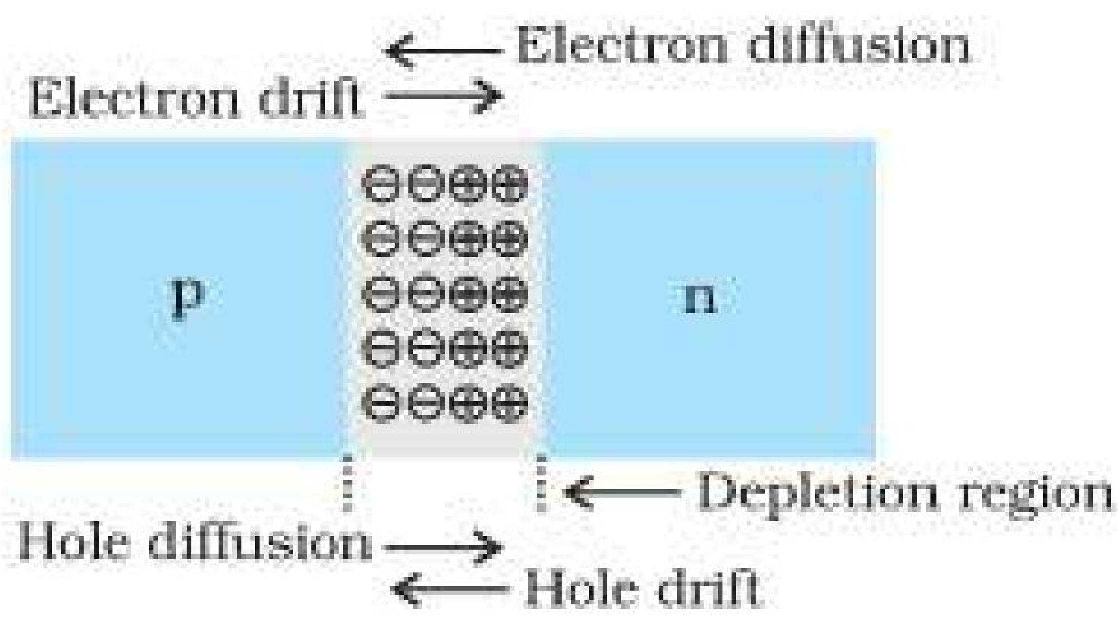
where i and r are the angles of incidence and refraction, respectively.

Thus we obtain

	$$\frac{Sin\ i}{Sin\ r} = \frac{v_1}{v_2} \qquad \text{------(1)}$$ If c represents the speed of light in vacuum, then, $$n_1 = \frac{c}{v_1}$$ and $$n_2 = \frac{c}{v_2}$$ are known as the refractive indices of medium 1 and medium 2, respectively. In terms of the refractive indices, eq. (1) can be written as $n_1 \sin i = n_2 \sin r$ This is the Snell's law of refraction.	½ ½ ½	3
7.	a) Ratio of de- Broglie wavelengths and justification ½ + ½ b) Identification of wavelengths and its justification ½ + ½ Calculation of threshold frequency 1 a) de- Broglie wavelength , $\lambda = \frac{h}{mv}$ $$\frac{\lambda_\alpha}{\lambda_p} = \frac{m_p}{m_\alpha}$$ As, $m_\alpha > m_p \Rightarrow \lambda_p > \lambda_\alpha$ b) For photoelectric emission wavelength of radiation must be lesser than the threshold wavelength. Thus lights of wavelength 430 nm and 450 nm can cause photoelectric emission Threshold frequency (ν_o) $\nu_o = \frac{c}{\lambda_o} = \frac{3\times10^8}{600\times10^{-9}} = 5 \times 10^{14}$ Hz	½ ½ ½ ½ ½ + ½	3
8.	a) Obtaining Bohr's second postulate from de-Broglie hypothesis 2 b) Identification of transition of electron ½ + ½  a) For an electron moving in n^{th} circular orbit of radius r_n, the total distance is circumference of the orbit. Thus $2\pi r_n = n\lambda$ ……..(1) where n = 1, 2, 3 -------- λ is de-Broglie wavelength associated with the electron in the n^{th} orbit. Now $\lambda = \frac{h}{p} = \frac{h}{mv_n}$ ………..(2) From equation (1) and (2)	½ ½	

	$2\pi\, r_n = \frac{nh}{mv_n}$ $mv_n\, r_n = \frac{nh}{2\pi}$ Which is quantum condition proposed by Bohr for the angular momentum of the electron. b) For Balmer series of hydrogen spectrum $$\frac{1}{\lambda} = R\left(\frac{1}{2^2} - \frac{1}{n^2}\right)$$ (i) For maximum wavelength : transition of electron is from n = 3 to n=2 (ii) For minimum wavelength: transition of electron is from n = ∞ to n= 2	½ ½ ½ ½	 3
9.	a) Verifying nature of reaction 2 b) Ratio of nuclear density 1 a) Mass of reactants = (1.007825+3.016049) u = 4.023874 u Mass of products = (2x 2.014102) u = 4.028204 u Mass of reactants < Mass of products Hence, reaction is Endothermic b) 1:1	 ½ ½ ½ ½ 1	 3
10.	V-I characteristics of p-n junction 1 a) Explanation of independency of reverse bias current on breakdown voltage 1 b) Explanation of sudden increase in current at breakdown voltage 1  **[Note : Do not deduct marks for not writing the values on the axis.]** a) The current is not limited by the magnitude of the applied voltage but is limited due to the concentration of the minority carriers on either side of the junction.	 1 1	

<table>
<tr><td></td><td>b) At the breakdown voltage, a large number of covalent bonds break, resulting in the increase of large number of charge carriers. Hence current increases suddenly.</td><td>1</td><td>3</td></tr>
<tr><td>11.</td><td>a) Diagram ½
Explanation of formation of p-n junction 1½
b) Explanation of the need to join p and n type semiconductor at atomic level 1

a)


During the formation of p-n junction due to concentration gradient across p and n sides, holes diffuse from p side to n side and electrons diffuse from n side to p side This motion of charge carriers gives rise to diffusion current across the junction.
Diffusion of electrons develops a layer of positive charge on n side of the junction and diffusion of holes develops a layer of negative charge on p side of the junction.
Due to this space charge region on either side of the junction an electric field is developed. This electric field drifts charge carriers across the junction and sets up drift current in a direction opposite to diffusion current.
This process continues until the diffusion current is equal to drift current. Thus p-n junction is formed.

c) No, Any slab, howsoever flat, will have roughness much larger than the inter-atomic spacing (~2 to 3 Å) and hence continuous contact at the atomic level will not be possible. The junction will behave as a discontinuity for the flowing charge carriers.</td><td>½
½
½
½
1</td><td>3</td></tr>
<tr><td></td><td>Section C</td><td></td><td></td></tr>
<tr><td>12.</td><td>a) (ii)
b) (iv)
c) (ii)
d) (ii)
e) (iv)</td><td>1
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1</td><td>5</td></tr>
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