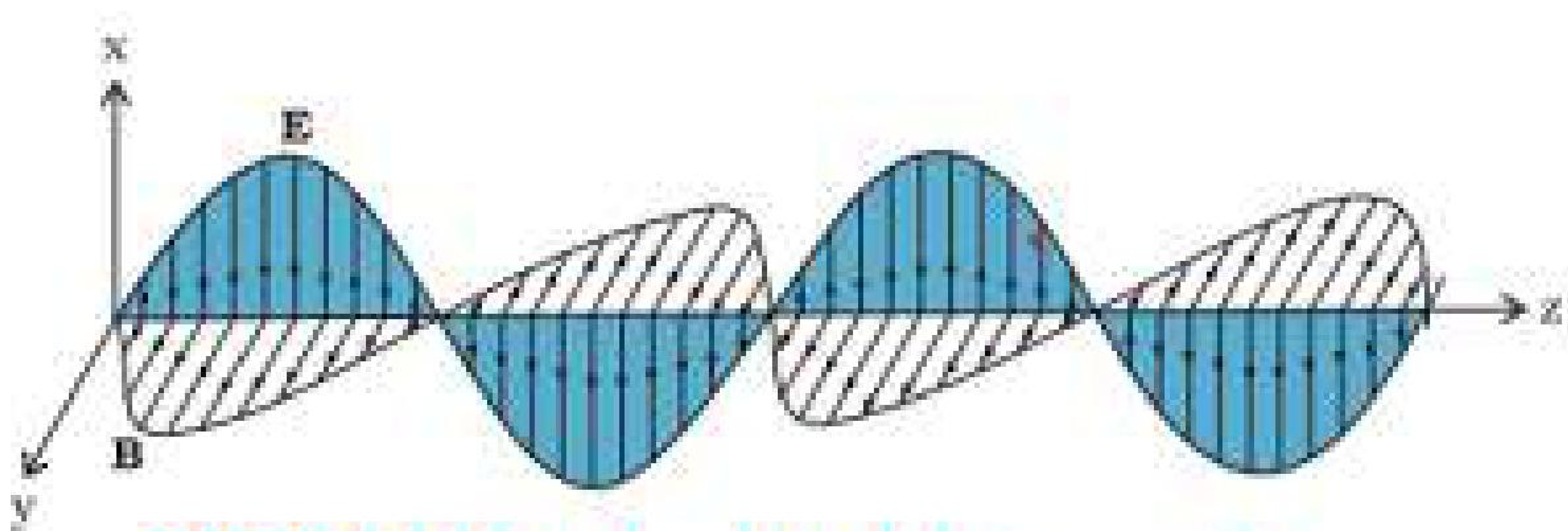
MARKING SCHEME

Senior Secondary School Term II Compartment Examination,2022
PHYSICS THEORY (042)
[55/6/2]

Q. No.	**EXPECTED ANSWERS / VALUE POINTS**	Marks	Total Marks
	Section A		
1.	a) Explanation 1 b) Conditions for two light sources to be coherent ½ + ½ a) Crystal is electrically neutral as the charge of additional electrons provided by donor impurity is just equal and opposite to that of the ionised cores in the lattice. b) (i) The waves from two light sources should have zero or constant phase difference. (ii) The waves should be of same frequency/wavelength.	 1 ½ ½	 2
2	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. 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. OR b) i) Diagram 1 ii) Identification of wave ½ Use ½ i)  **[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.	 1 1 1 ½ ½	 2
3	a) Reason 1 b) Finding value of Kinetic energy ½ Finding value of potential energy ½		

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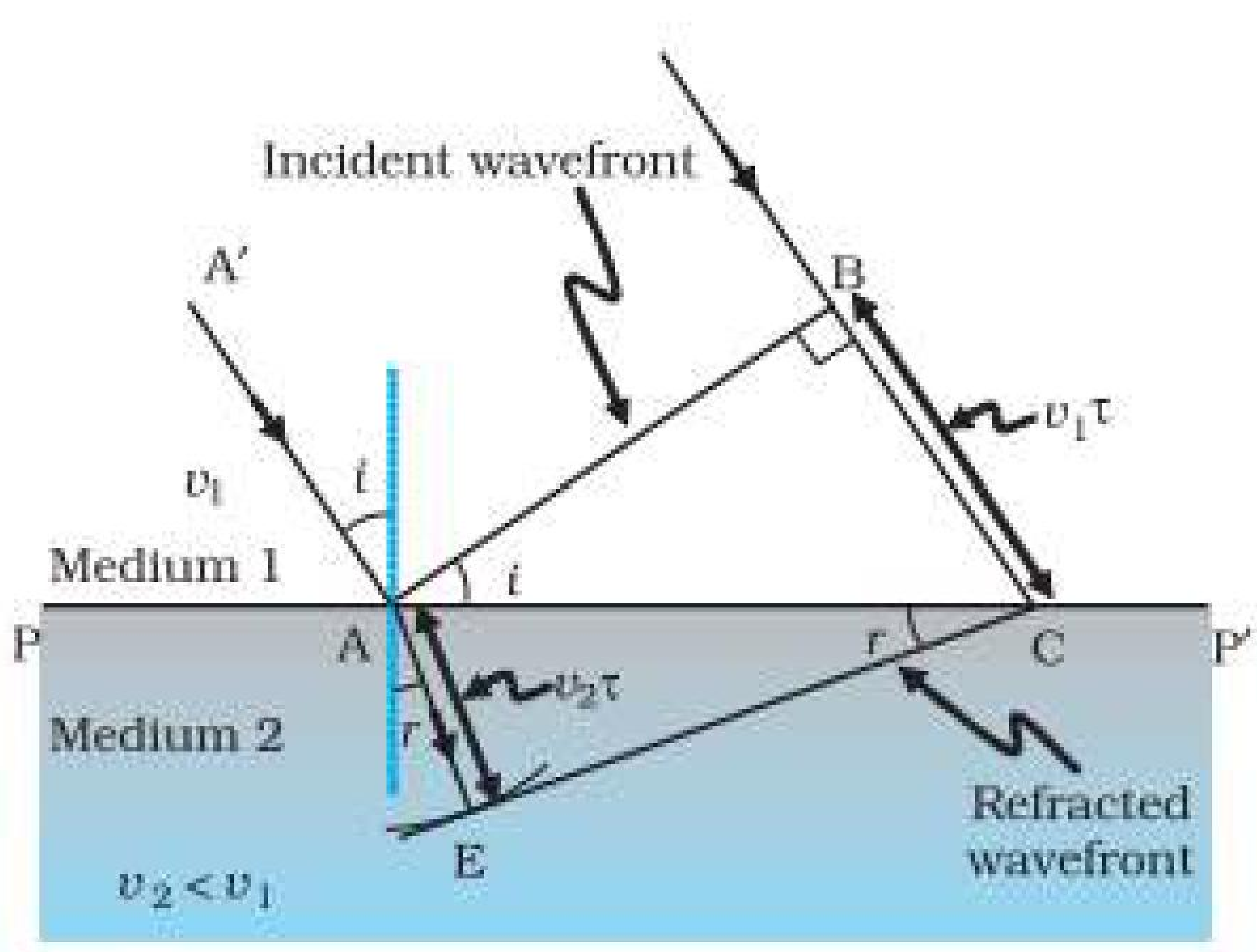
	a) Alpha particle reverses its direction of motion, due to strong repulsive force, exerted by positively charged nucleus without even actually touching the gold nucleus. b) $E_n = -3.4eV$ (given) $E_k = -E_n = 3.4eV$ $U = 2E_n = -6.8\ eV$	1 ½ ½	2
	Section - B		
4	a) a) Explanation — 1 Two differences — 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. **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. 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  Consider the triangles ABC and AEC, we readily obtain $Sin\ i = \frac{BC}{AC} = \frac{v_1\tau}{AC}$ And	1 1+1 1	

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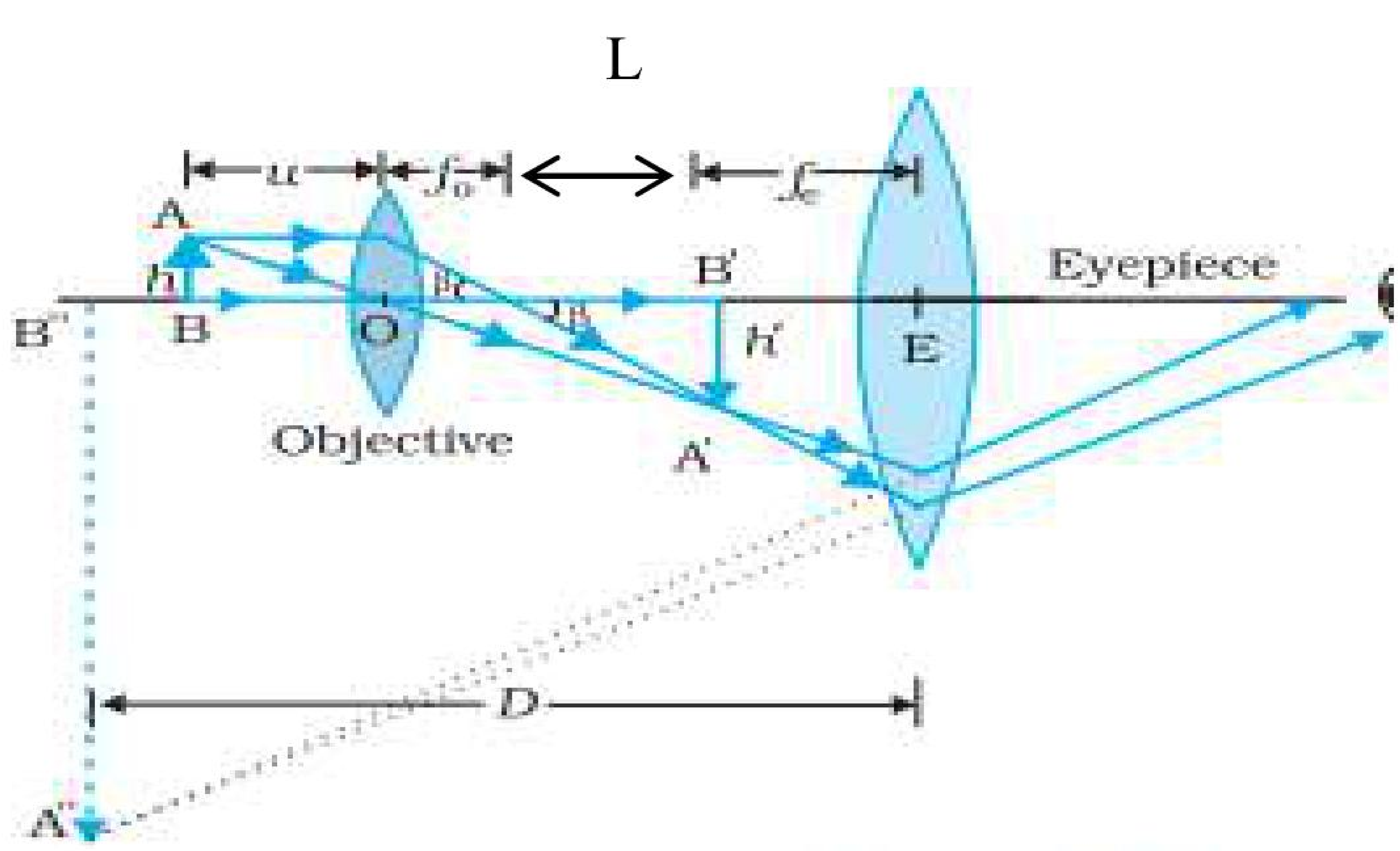
	$Sin\ r = \frac{AE}{AC} = \frac{v_2\tau}{AC}$ where i and r are the angles of incidence and refraction, respectively. Thus we obtain $\frac{Sin\ i}{Sin\ r} = \frac{v_1}{v_2}$------------.(1) If c represents the speed of light in vacuum, then, $n_1 = \frac{c}{v_1}$ and $n_2 = \frac{c}{v_2}$ are known 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 ½	3
5.	Calculating a) Distance of third minima 1 ½ b) Distance of second maxima from the central maxima 1 ½ a) $x = (2n+1)\frac{\lambda D}{2d}$ $= \frac{(2\times2+1)\times500\times1\times10^{-9}}{2\times10^{-3}}$ $= \frac{5\times5\times10^{-4}}{2} = 12.5 \times 10^{-4} m = 1.25\ mm$ b) $x = \frac{n\lambda D}{d}$ $x = \frac{2\times500\times1\times10^{-9}}{10^{-3}}$ $x = 10^{-3}$ m = 1mm	½ ½ ½ ½ ½ ½	3
6.	a) a) Ray diagram 1 b) Derivation of angular magnification 2  Linear magnification due to objective (m_o)	1	

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

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

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

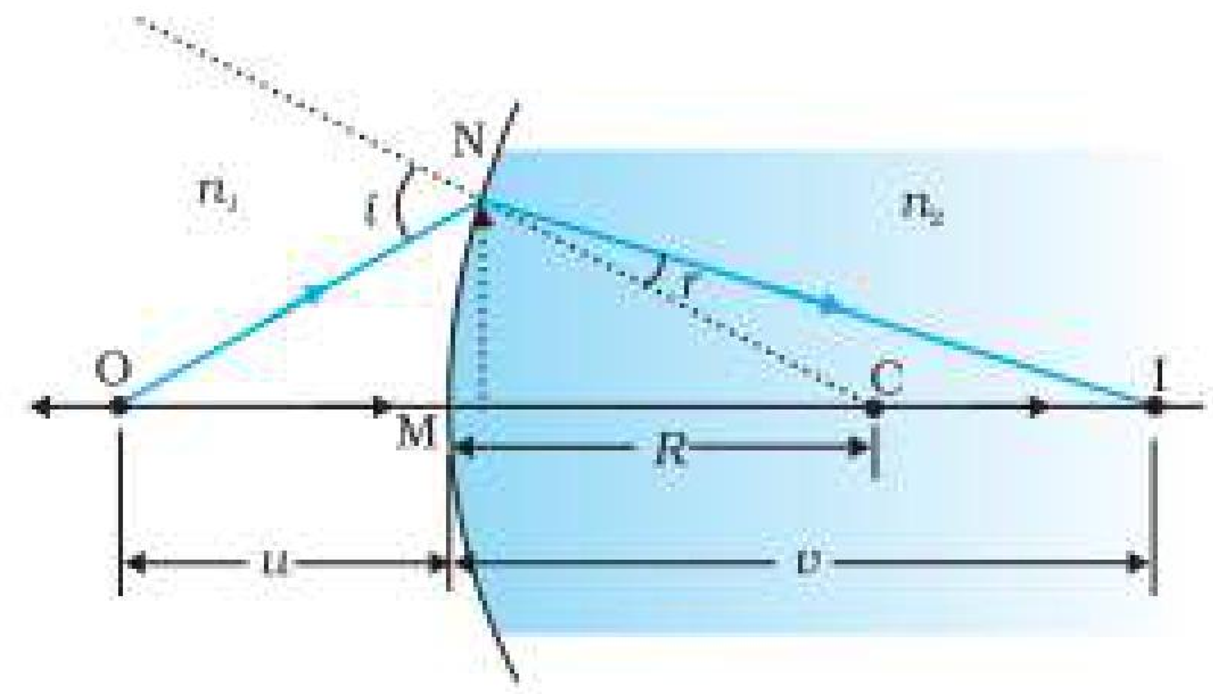
Total magnification $m = m_o \times m_e$ ½

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

OR

b)

a) Ray diagram	1
b) Derivation	2



1

for small angles,

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

$\tan \angle NCM = \frac{MN}{MC}$

$\tan \angle NIM = \frac{MN}{MI}$ ½

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

now, 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

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

Here , 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

$\frac{n_2}{v} - \frac{n_1}{u} = \frac{n_2 - n_1}{R}$ ½ 3

7.

a) Obtaining Bohr's second postulate from de-Broglie hypothesis	2
b) Identification of transition of electron	½ + ½

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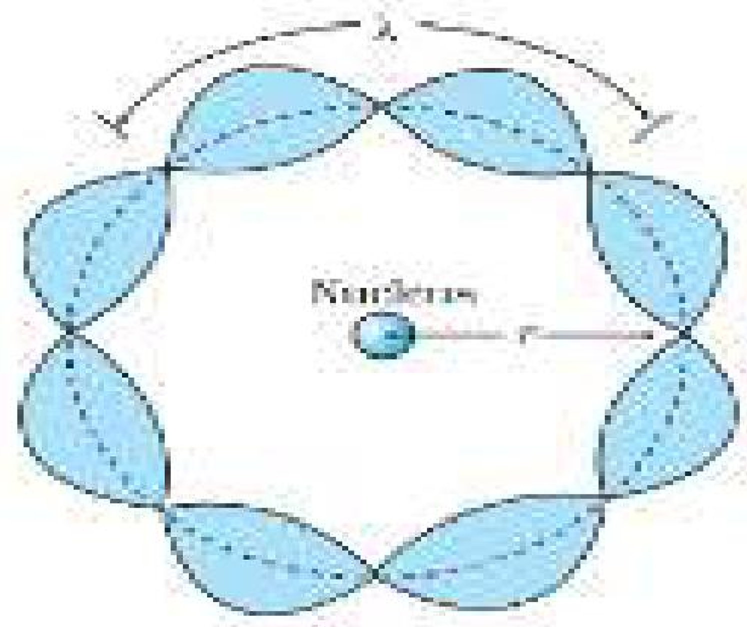
a)



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 -------- ½

λ is de-broglie wavelength associated with the electron in the n^{th} orbit.

Now $\lambda = \frac{h}{p} = \frac{h}{mv_n}$ (2) ½

From equation (1) and (2)

$2\pi r_n = \frac{nh}{mv_n}$ ½

$mv_n r_n = \frac{nh}{2\pi}$ ½

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 ½

(ii) For minimum wavelength: transition of electron is from n = ∞ to n= 2 ½

Total: 3

8.

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 , $\lambda = \frac{h}{mv}$

$$\frac{\lambda_\alpha}{\lambda_p} = \frac{m_p}{m_\alpha}$$ ½

As, $m_\alpha > m_p$ $\Rightarrow \lambda_p > \lambda_\alpha$ ½

b) For photoelectric emission wavelength of radiation must be lesser than the threshold wavelength. ½

Thus lights of wavelength 430 nm and 450 nm can cause photoelectric emission ½

Threshold frequency (ν_o)

$\nu_o = \frac{c}{\lambda_o} = \frac{3\times10^8}{600\times10^{-9}} = 5 \times 10^{14}$ Hz ½ + ½

Total: 3

9.

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

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	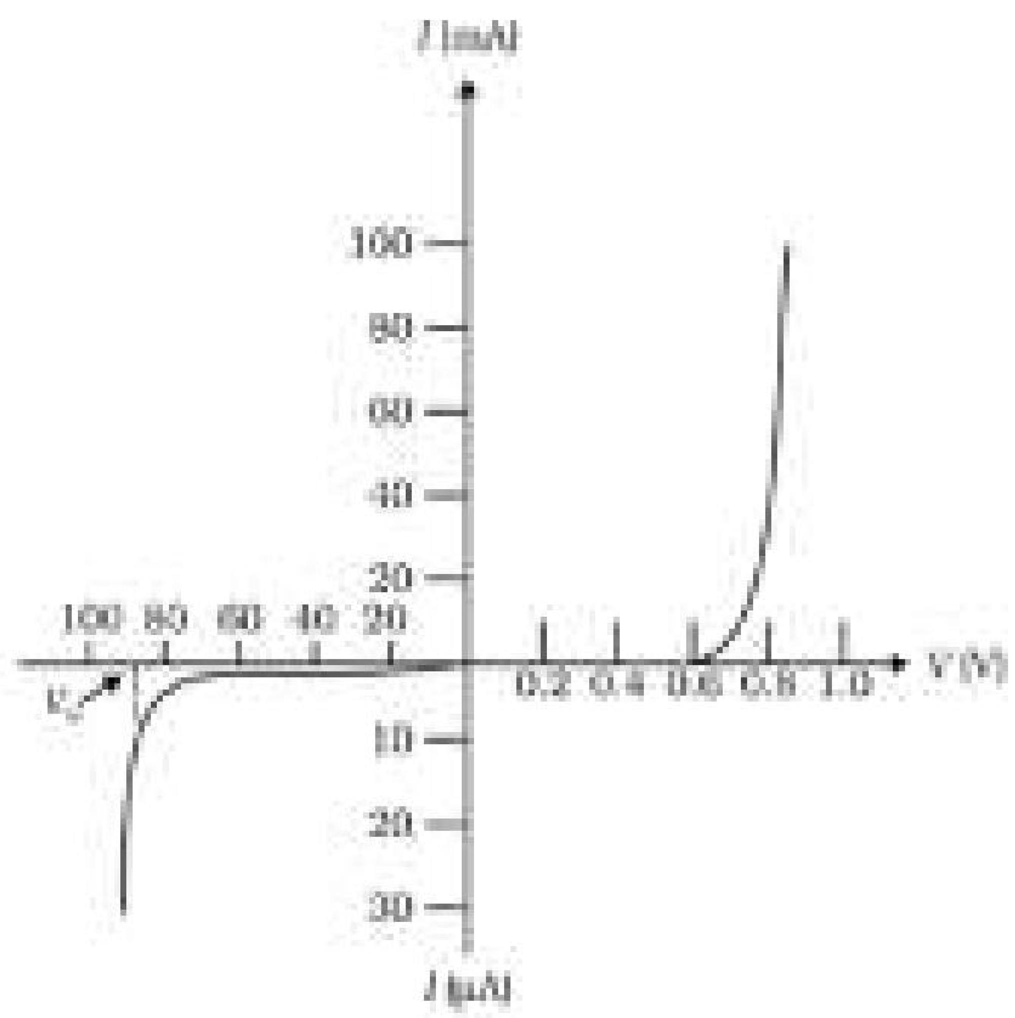 a) As the applied voltage increases minority charge carrier concentration will not increase. So, it is independent of applied voltage. a) At the breakdown voltage, a large number of covalent bonds break, resulting in the increase of large number of charge carriers. Hence current increases suddenly.	1 1 1	3
10.	(a) Determination of the type of reaction 2 (b) Ratio of nuclear density of ${}^{30}_{15}P \& {}^{14}_{7}N$ 1 (a) Mass of the products = 19.992439 + 4.002603 = 23.995042 u Mass of the reactant = (2 × 12.000000) u = 24.00000 u As the mass of the reactants is more than the mass of the products, the reaction is exothermic. (b) 1:1	½ ½ ½ +½ 1	3
11.	Formation of barrier potential 1 Effect on barrier potential under (a) Forward bias 1 (b) Reverse bias 1 In a p-n-junction diode, the loss of electrons from the n- region and the gain of electrons by the p-region causes a difference of potential across the junction of the two regions. This potential tends to prevent the movement of electrons from the n region to the p region. Hence a potential barrier is created across the junction. (a) In forward bias, the barrier potential is reduced. (b) In reverse bias, the barrier potential increases.	1 1 1	3
	Section - C		
12.	a) (ii) b) (iv) c) (ii) d) (ii) e) (iv)	1 1 1 1 1	5

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