MARKING SCHEME

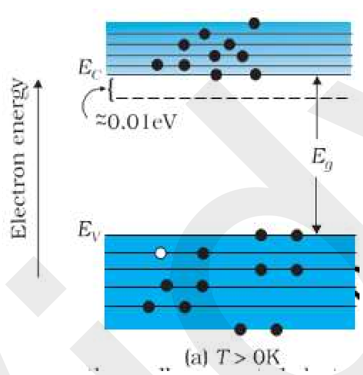
CLASS XII

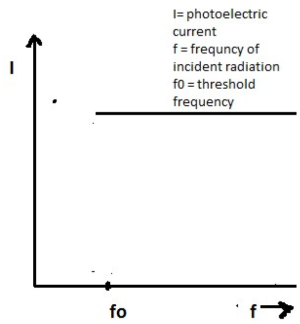
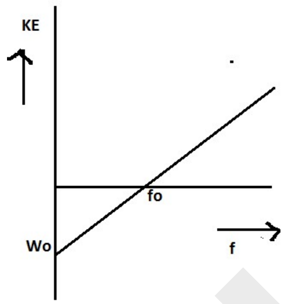
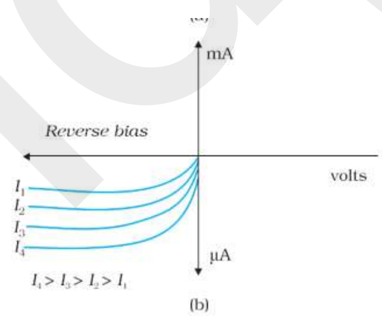
PHYSICS THEORY

TERM II

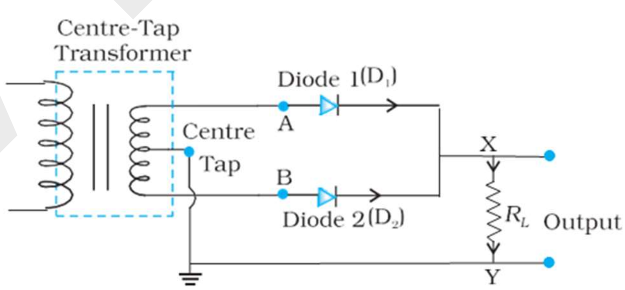
SESSION 2021 - 22

MM:35 **TIME: 2 Hours**

ANS 1	As given in the statement antimony is added to pure Si crystal, then a n -type extrinsic semiconductor would be so obtained, Since antimony(Sb) is a pentavalent impurity. Energy level diagram of n-type semiconductor  Donar Energy level	**1 Mark** **1 Mark**
ANS 2	No	**1/2 mark**
	Because according to Bohr's model, $En = -\frac{13.6}{n^2}$ and electrons having different energies belong to different levels having different values of n.	**1/2 mark**
	So, their angular momenta will be different, as $L = mvr = \frac{nh}{2\pi}$	**1 mark**
	OR	
(i)	The increase in the frequency of incident radiation has no effect on photoelectric current. This is because of incident photon of	**1/2**

<table>
<tr><td></td><td>increased energy cannot eject more than one electron from the metal surface.</td><td>mark</td></tr>
<tr><td></td><td>
</td><td>1/2 mark</td></tr>
<tr><td>(ii)</td><td>The kinetic energy of the photoelectron becomes more than the double of its original energy. As the work function of the metal is fixed, so incident photon of higher frequency and hence higher energy will impart more energy to the photoelectrons.</td><td>1/2 mark</td></tr>
<tr><td></td><td>
</td><td>1/2 mark</td></tr>
<tr><td>ANS 3</td><td>Photodiodes are used to detect optical signals of different intensities by changing current flowing through them.</td><td>1/2 mark</td></tr>
<tr><td></td><td>

I-V Characteristics of a photodiode</td><td>1/2 mark</td></tr>
</table>

	Applications of photodiodes: 1. In detection of optical signals. 2. In demodulation of optical signals. 3. In light operated switches. 4. In speed reading of computer punched cards. 5. In electronic counters (any two out of these or any other relevant application)	**(1/2) X 2= 1 mark**
	SECTION B	
ANS 4	From Bohr's theory, the frequency f of the radiation emitted when an electron de – excites from level n_2 to level $n_1$is given as $f = \frac{2\pi^2 mk^2 z^2 e^4}{h^3}\left[\frac{1}{n_1{}^2} - \frac{1}{n_2{}^2}\right]$ Given $n_1 = n - 1$, $n_2 = n$, derivation of it $f = \frac{2\pi^2 mk^2 z^2 e^4}{h^3} \frac{(2n-1)}{(n-1)^2 n^2}$	**2 marks**
	For large n, $2n - 1 = 2n$, $n - 1 = n$ and $z = 1$ Thus, $f = \frac{4\pi^2 mk^2 e^4}{n^3 h^3}$ which is same as orbital frequency of electron in n^{th} orbit. $f = \frac{v}{2\pi r} = \frac{4\pi^2 mk^2 e^4}{n^3 h^3}$	**1 mark**
ANS 5	A junction diode allows current to pass only when it is forward biased. So, if an alternating voltage is applied across a diode the current flows only in that part of the cycle when the diode is forward biased. This property is used to rectify alternating voltages and the circuit used for this purpose is called a rectifier.	**1 mark**
	 Circuit Diagram	**1 mark**

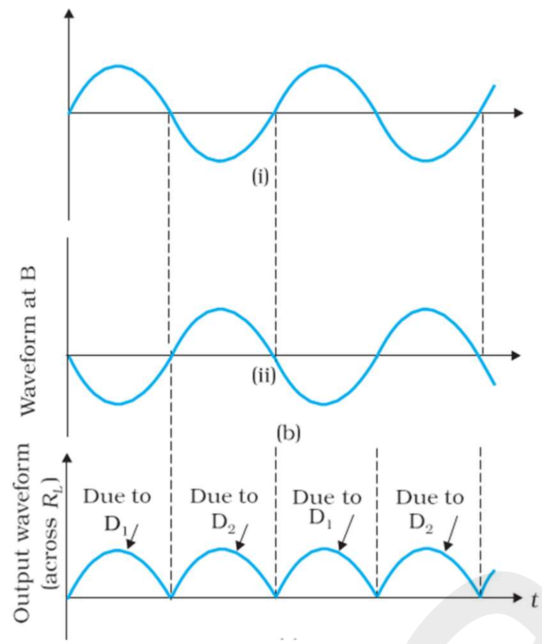
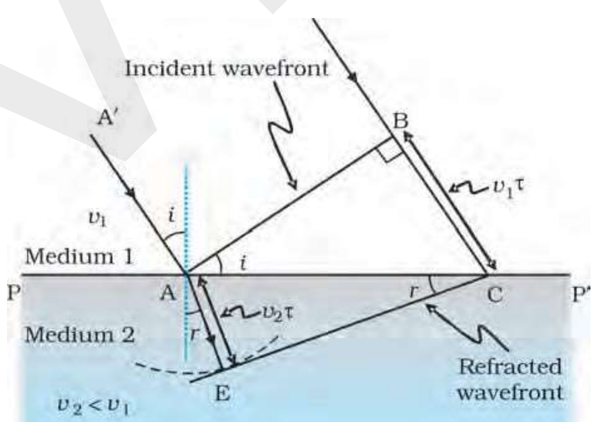
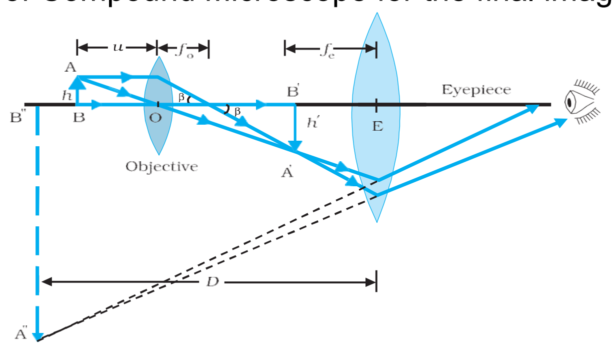
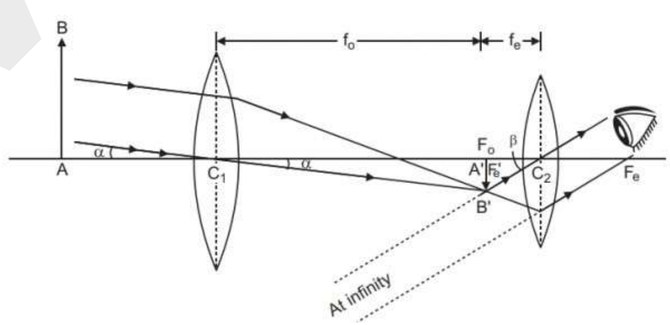
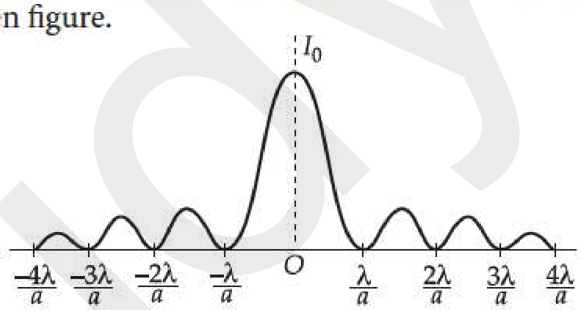
	 Working with input and output waveforms	**1 mark**
ANS 6	Number of atoms present in 2 g of deuterium $= 6 \times 10^{23}$ Number of atoms present in 2.0 Kg of deuterium $= 6 \times 10^{26}$ Energy released in fusion of 2 deuterium atoms $= 3.27$ MeV Energy released in fusion of 2.0 Kg of deuterium atoms $= \frac{3.27}{2} \times 6 \times 10^{26}$ MeV $= 9.81 \times 10^{26}$ MeV $= 15.696 \times 10^{13}$ J Energy consumed by bulb per sec $= 100$ J Time for which bulb will glow $= \frac{15.696 \times 10^{13}}{100}$ s $= 4.97 \times 10^{4} year$	**1 mark** **1 mark** **1 mark**
ANS 7	A locus of points, which oscillate in phase is called a wavefront. **OR** A wavefront is defined as a surface of constant phase.  	**1 mark** **1 mark**

	Diagram Proof $n_1 \sin i = n_2 \sin r$ (Derivation) This is the Snell's law of refraction.	**1 mark**
ANS 8 (a)	Diagram of Compound Microscope for the final image formed at D:  	**$1\frac{1}{2}$ marks**
(b)	$m_o = 30, f_o = 1.25\text{ cm}, f_e = 5\text{ cm}$ when image is formed at least distance of distinct vision, $D = 25\text{cm}$ Angular magnification of eyepiece $m_e = \left(1 + \frac{D}{f_e}\right) = 1 + \frac{25}{5} = 6$ Total Angular magnification, $m = m_o m_e \Rightarrow m_o = \frac{m}{m_e} = \frac{30}{6} = 5$ As the objective lens forms the real image, $m_o = \frac{v_o}{u_o} = -5 \Rightarrow v_o = -5u_o$ using lens equation, $u_o = -1.5\text{ cm}, v_o = -5 \times (-1.5)\text{cm} = +7.5\text{ cm}$ Given $v_e = -D = -25\text{ cm}, f_e = +5\text{ cm}, u_e = ?$ using again lens equation $u_e = \frac{25}{6}$ Thus, object is to be placed at 1.5 cm from the objective and separation between the two lenses should be $L = v_o + \mathrm{I}u_e\mathrm{l} = 11.67\text{ cm}$	**1/2 mark** **1/2 mark** **1/2 mark**
	OR	
ANS 8 (a)	Ray diagram of astronomical telescope when image is formed at infinity.  	**$1\frac{1}{2}$marks**

(b)	(i) In normal adjustment : Magnifying power. $m = f_o/f_e = (140/5) = 28$ (ii) When the final image is formed at the least distance of distinct vision (25 cm) : $m = \frac{f_o}{f_e}\left(1 + \frac{f_e}{D}\right) = (28 \times 1.2) = \mathbf{33.6}$	**½ mark** **1 mark**
ANS 9 **(a)** **(b)** **(c)**	$\lambda = 2000\ \text{Å} = (2000 \times 10^{-10})\text{m}$ $W_o = 4.2\text{eV}$ $h = 6.63 \times 10^{-34}\text{JS}$ Using Einstein's photoelectric equation $\text{K.E.} = (6.2 - 4.2)\ \text{eV} = 2.0\ \text{eV}$ The energy of the emitted electrons does not depend upon intensity of incident light; hence the energy remains unchanged. For this surface, electrons will not be emitted as the energy of incident light (6.2 eV) is less than the work function (6.5 eV) of the surface.	 **1 mark** **1 mark** **1 mark**
ANS 10	Given $a_{\mu_g} = 1.5$ Focal length of the given convex lens when it is placed in air is $f = +20\text{ cm}$ Refractive index of the given medium with respect to air is $a_{\mu_m} = 1.25$ New focal length of the given convex lens when placed in a medium is f' $\frac{1}{f} = \left(a_{\mu_g} - 1\right)\left[\left(\frac{1}{R_1}\right) + \left(\frac{1}{R_2}\right)\right]$ ------(A) $\frac{1}{f'} = \left(m_{\mu_g} - 1\right)\left[\left(\frac{1}{R_1}\right) + \left(\frac{1}{R_2}\right)\right]$ ------(B) Dividing (A) by (B), we get $\frac{f'}{f} = \frac{\left(a_{\mu_g} - 1\right)}{\left(m_{\mu_g} - 1\right)} = \frac{(1.5 - 1)}{(1.2 - 1)} = \frac{0.5}{0.2} = \frac{5}{2} = 2.5$ $f' = 2.5f = (2.5 \times 20)\text{cm} = +50\text{cm}$ as $m_{\mu_g} = \frac{\mu_g}{\mu_m} = \frac{1.5}{1.25} = 1.2$ New focal length is positive. The significance of the positive sign of the focal length is that given convex lens is still converging in the given medium.	**1/2 mark** **1/2 mark** **1 mark** **1/2 mark** **1/2 mark**
ANS 11. **(a)**	Microwaves are suitable for the radar system used in aircraft	

  (b) (c)	navigation. Range of frequency of microwaves is 108 Hz to 1011 Hz. If the Earth did not have atmosphere, then there would be absence of greenhouse effect of the atmosphere. Due to this reason, the temperature of the earth would be lower than what it is now. An e.m. wave carries momentum with itself and given by P = Energy of wave(U)/ Speed of the wave(c) = U/c when it is incident upon a surface it exerts pressure on it.	**1 mark** **1 mark** **1 mark**
	OR	
ANS. 11 (a)	The total intensity at a point where the phase difference is $\emptyset$, is given by $I = I_1 + I_2 + 2\sqrt{I_1 I_2}\, COS\ \emptyset$. Here I_1 and I_2 are the intensities of two individual sources which are equal. When $\emptyset$ is 0, $I = 4I_1$. When $\emptyset$ is 90°, I = 0 Thus intensity on the screen varies between $4I_1$ and 0.	**2 marks**
ANS. 11 (b)	Intensity distribution as function of phase angle, when diffraction of light takes place through coherently illuminated single slit The intensity pattern on the screen is shown in the given figure.  Width of central maximum $= \frac{2D\lambda}{a}$,	**1 mark**
ANS 12. (a) **(b)**	**Ans (i)** Refraction, Total internal reflection **Ans iii)** $\sin^{-1}(\frac{3}{4})$ $a_{\mu_\omega} = \frac{1}{\text{Sin C}}$ $\Rightarrow \sin C = \frac{1}{a_{\mu_\omega}} \quad \Rightarrow C = \sin^{-1}\left(\frac{1}{a_{\mu_\omega}}\right)$	**1 mark** **1 mark**

(c)	**Ans (iv)** $n_1 > n_2$ The refractive index of the core should be greater than the refractive index of the cladding.	1 mark
(d)	**Ans (iv)** increases $_{l}\mu_{d} = \frac{1}{\text{Sin C}} = \frac{\mu_d}{\mu_l}$, $_{\omega}\mu_{d} = \frac{1}{\text{sin C}'} = \frac{\mu_d}{\mu_\omega}$ $\mu_l > \mu_\omega$ Thus $C > C'$	1 mark
(e)	**Ans (ii)** $0 < i < 60°$, $_{1}\mu_{2} = \frac{1}{\text{Sin C}'}$ $\text{Sin C}' = \frac{1.44}{1.68} = 0.8571$ $\Rightarrow C' = 59°$ Total internal reflection will occur if the angle $i' > i'_c$, i.e., if $i' > 59^o$ or when $r < r_{max'}$ where $r_{max} = 90^o – 59^o = 31^o$. Using Snell's law, $\frac{\text{Sin}\, i_{max}}{\text{Sin} r_{max}} = 1.68$ or $Sin\ i_{max} = 1.68 \times Sin\ r_{max}$ $= 1.68 \times \sin 31^o = 1.68 \times 0.5150 = 0.8662$ $\therefore\ i_{max} = 60^o$ Thus all incident rays which make angles in the range $0 < i < 60^o$ with the axis of the pipe will suffer total internal reflections in the pipe.	1 mark