CBSE QUESTIONS PAPER SOLUTION – 2022 (55-3-2)

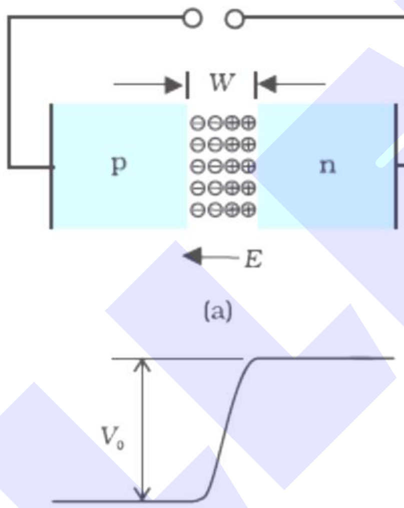
SUBJECT: PHYSICS

TERM-II

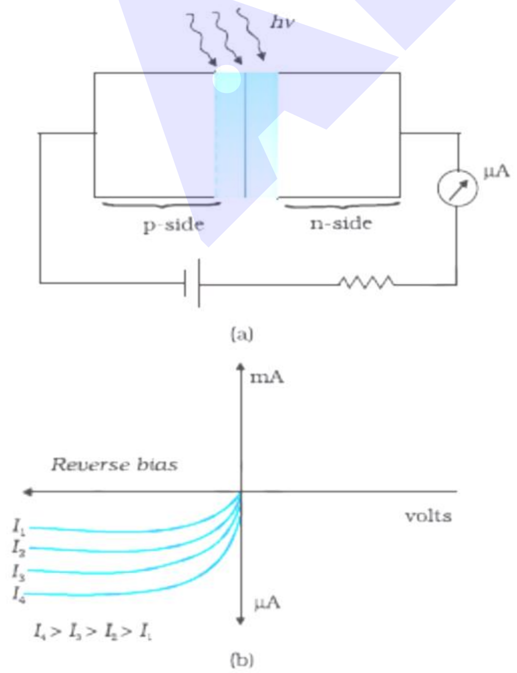
SOLUTION

SECTION - A

1. The loss of electrons from the n-region and the gain of electron by the p-region causes a difference of potential across the junction of the two regions. The polarity of this potential is such as to oppose further flow of carriers so that a condition of equilibrium exists. Figure shows the p-n junction at equilibrium and the potential across the junction. The n-material has lost electrons, and p-material has acquired electrons. The n-material is thus positive relative to the p material. Since this potential tends to prevent the movement of electron from the n region into the p region, it is often called a barrier potential.



2 (a).



(b). The photocurrent is directly proportional to the intensity of light this can be used for measuring the intensity of incident light.

3(a). (i) The below table gives a few differences between isotopes and isobars.

Isotopes	Isobars
The mass number are different	The mass number are same
Atomic numbers are the same	Atomic numbers are different

(ii) No, because the different mass numbers A_1 and A_2 may be due to different atomic numbers or different neutron numbers. Only in the case where atomic number is the same would the two nuclei be isotopes of the same element.

OR

3(b). (i) Metal should be photo- sensitive.

(ii) For a given photosensitive material, threshold frequency is the minimum frequency of radiation that is required for photoelectric emission from the material.

SECTION – B

4.(a) Energy $E = h\nu$

$$\nu = \frac{E}{h} = \frac{6.5\times10^{-19}}{6.63\times10^{-34}} = 0.98\times10^{15} = 9.8\times10^{14}\text{Hz}$$

(b) Work function $\phi_0 = 2.14$ eV

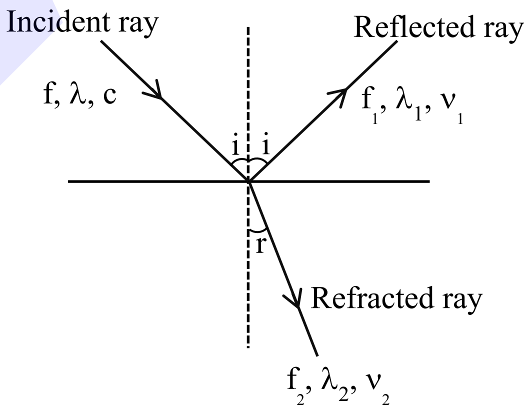
Energy of photon in eV

$$E = \frac{6.5\times10^{-19}}{1.6\times10^{-19}} = 4.06\ eV$$

$$KE_{max} = E - \phi_0$$

$$KE_{max.} = 4.06 - 2.14 = 1.92\text{ eV}$$

5. Given: $\lambda = 600$ nm , $n_W = \frac{4}{3} = 1.33$



Frequency of incident ray

$$C = f\lambda \Rightarrow f = \frac{c}{\lambda} = \frac{3\times10^8}{600\times10^{-9}}$$

$$\boxed{f = 5\times10^{14}\,Hz}$$

Reflected ray	**Refracted ray**
Wavelength $(\lambda_1) = 600$ nm	Wavelength $\lambda_2 = \frac{n_1\lambda_1}{n_2} = \frac{1\times600}{\frac{4}{3}} = 450$ nm
Frequency $(f_1) = 5\times10^{14}$Hz	Frequency $(f_2) = 5\times10^{14}$Hz (Constant)
Speed $(v_1) = 3\times10^8$ m/s	Speed: $V_2 = \frac{C}{n_w}$ $V_2 = \frac{3\times10^8}{4/3}$ $V_2 = 2.25\times10^8$ m/s

6. (a) (i) In radar system $\Rightarrow$ microwaves

In water purifies $\Rightarrow$ UVrays

In remote switches in TV $\Rightarrow$ Infrared rays

(ii) Microwaves are produced by special vacuum tubes (Klystrons, Magnetrons and Gunn diodes)

(iii) UV radiation in produced in welding arc and the sun is an important source of ultraviolet light.

(iv) Infrared waves are produced by hot bodies and molecules.

OR

(b) (i) Two sources are said to be coherent if-

(1) These produces waves of same frequency with

(2) Constant or zero phase difference

(ii) Interference is the result of superposition of secondary wavelets from two different slits while diffraction results due to superposition of secondary wavelets from different parts of the same source slit.

In interference pattern all maxima are equally bright while in case of diffraction maxima are of decreasing intensity.

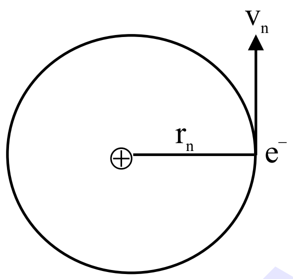
7. Bohr's postulate:

Electron revolves around the nucleus in those orbits for which the angular momentum is an integral multiple of $h/2\pi$.

$$mvr = \frac{nh}{2\pi}$$

Speed of e^- in n^{th} orbit

For hydrogen radius of n^{th} orbit is given by $r_n = \frac{\varepsilon_0 n^2 h^2}{\pi m e^2}$



From Bohr's Postulate

$$m v_n r_n = \frac{nh}{2\pi}$$

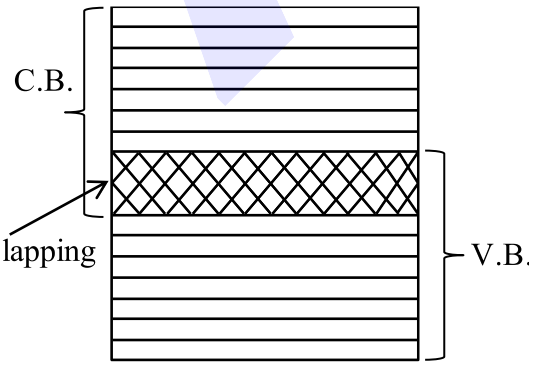
$$m v_n \left(\frac{\varepsilon_0 n^2 h^2}{\pi m e^2}\right) = \frac{nh}{2\pi}$$

$$v_n = \frac{e^2}{2\varepsilon_0 h^n}$$

$$\boxed{v_n \propto \frac{1}{n}}$$

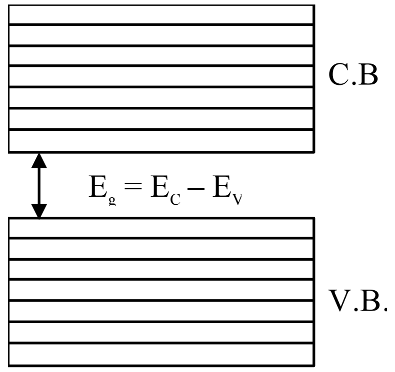
8. Energy band diagrams

Conductors



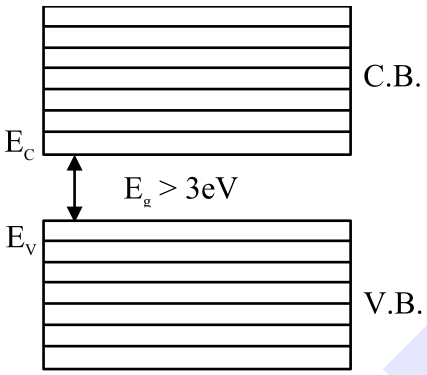
For Conductor $E_g = 0$

Semiconductors



For Conductor $E_g < 3eV$

Insulators



For Insulator $E_g > 3eV$

Conduction band determines the electrical conductivity of solid.

On increasing the temperature of semiconductor electrical conductivity increases. Because when we increase temperature, some of the covalent bond got broken and e-hole pairs are generated.

9. Energy of proton = 4.1 MeV, Z = 82

(i) Speed of a proton

$$\frac{1}{2} m_P v_p^2 = 4.1 \times 10^6 \times 1.6 \times 10^{-19}$$

$$v_p^2 = \frac{2 \times 4.1 \times 1.6 \times 10^{-13}}{1.67 \times 10^{-27}}$$

$$= 7.85 \times 10^{14}$$

$$\boxed{v_p^2 = 2.8 \times 10^7 \, m/s}$$

(ii) Distance of closest approach

$$K.E = \frac{ke(ze)}{r_0}$$

$$r_0 = \frac{KZe^2}{r_0} = \frac{9 \times 10^9 \times 82 \times (1.6 \times 10^{-19})^2}{4.1 \times 10^6 \times 1.6 \times 10^{-19}}$$

$$r_0 = 288 \times 10^{-16}$$

$$\boxed{r_0 = 2.9 \times 10^{-14} m}$$

10. Spacing between fringes in double slit experiment is given by $\boxed{\beta = \frac{\lambda D}{d}}$

Where, $\lambda \Rightarrow$ Wavelength of light

$d \Rightarrow$ Slit separation

$D \Rightarrow$ Distance between slit and screen

(i) On increasing 'd' fringe width decreases

(ii) $\lambda_{red} > \lambda_{blue}$, So 'β' decreases

(iii) When whole apparatus is immersed in oil of refractive index 1.2, then wavelength decreases.

$$\lambda' = \frac{\lambda}{1.2}$$

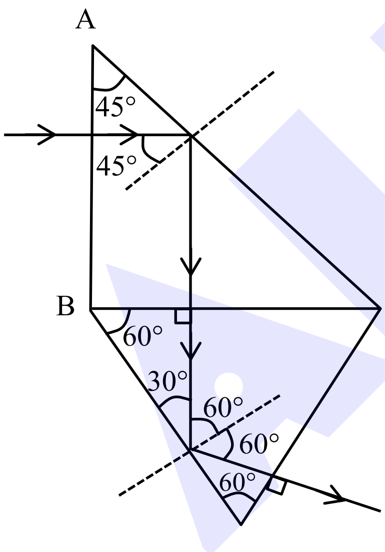
$$\beta' = \frac{\lambda' D}{d} \Rightarrow \boxed{\beta' = \frac{\beta}{1.2}}$$

It means fringe width decreases.

11. (a) (i) Light ray should travel from denser to rarer medium.

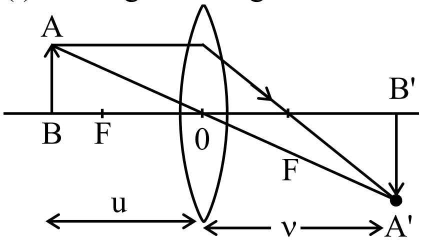
(ii) Angle of incidence should be greater than critical angle ($i > i_c$).

(b)



OR

(a) (i) For negative magnification object is placed beyond the focus:

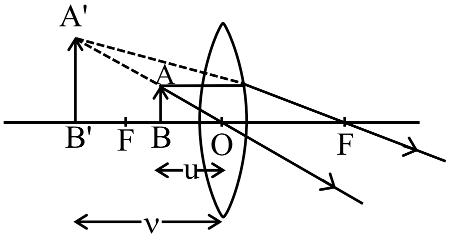


$m = \frac{v}{u}$

using sign convention

$$\boxed{m = -\frac{v}{u}}$$

(ii) For positive magnification object is placed between focus and optical centre.

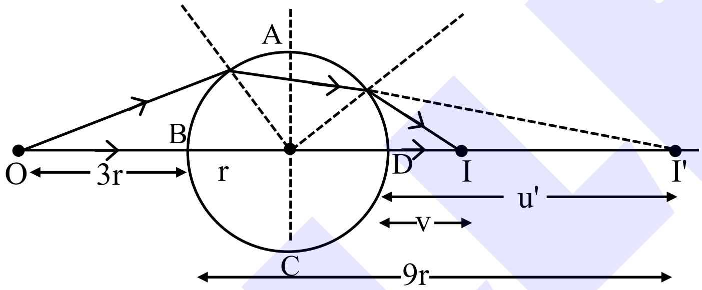


$m = \frac{v}{u}$

Using sign convention $m = \frac{-v}{-u}$

$m = \frac{v}{u}$

(b)



Refraction through spherical surface ABC

$$\frac{n_2}{v'} - \frac{n_1}{u} = \frac{n_2 - n_1}{R} \qquad \left\{ \begin{array}{l} \text{Refractive index of glass} = 3/2 \\ u = -3r \end{array} \right.$$

$$\frac{\frac{3}{2}}{v'} - \frac{1}{(-3r)} = \frac{\left(\frac{3}{2} - 1\right)}{r}$$

$$\frac{3}{2v'} = \frac{1}{2r} - \frac{1}{3r} \Rightarrow \boxed{v' = 9r}$$

Refraction through spherical surface ADC

For refracting surface ADC, image I' acts as a virtual object and I is final image

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

$$\frac{1}{v} - \frac{1.5}{u'} = \frac{1 - 1.5}{-r} \quad (u' = 9r - 2r = 7r)$$

$$\frac{1}{v} - \frac{1.5}{7r} = \frac{0.5}{r}$$

$$\frac{1}{v} = \frac{1}{2r} + \frac{1.5}{7r}$$

$$\frac{1}{v}=\frac{1.5}{7r}+\frac{0.5}{r}=\frac{1.5+3.5}{7r} \Rightarrow \boxed{v=\frac{7r}{5}}$$

Distance of final image from 'B'

$$=\frac{7r}{5}+2r=\frac{17r}{5}=3.4r$$

SECTION – C

12. **(I)** B

(II) A

(III) D

(IV) D

Hint : $M = M_0 \times M_e$

$= 10 \times 20 = 200$

(V) C

Sol. $f_0 = 1.2$ cm, $f_e = 3.0$ cm

$u_0 = -1.25$ cm, $V_0 = ?$

Using lens formula

$$\frac{1}{f_0}=\frac{1}{v_0}-\frac{1}{u_0}$$

$$\frac{1}{1.2}=\frac{1}{v_0}+\frac{1}{1.25}$$

$$\frac{5}{6}=\frac{1}{V_0}+\frac{4}{5}$$

$$\frac{1}{V_0}=\frac{5}{6}-\frac{4}{5}$$

$$\frac{1}{V_0}=\frac{25-24}{30}=\frac{1}{30} \Rightarrow \boxed{V_0=30cm}$$

When final image is formed at infinity then magnifying power

$$M=\frac{V_0}{|u_0|}\left(\frac{D}{fe}\right)$$

$$=\frac{30}{1.25}\left(\frac{25}{3}\right) \Rightarrow \boxed{M=200}$$