$= 4 - 1 = 3$

WS-12 for 6th class

T task

① Given $\mu_g = \frac{3}{2}$

$t_a = 4$ sec ; $t_g = ?$

Distance travelled by light in glass = air.

$S_g = S_{air}$

$\Rightarrow V_g t_g = V_a t_a$

$\Rightarrow t_g = \frac{V_a}{V_g} t_a \quad \left[\frac{V_a}{V_g} = \frac{\mu_g}{\mu_a}\right]$

$= \frac{\mu_g}{\mu_a} t_a$

$\Rightarrow t_g = \frac{\frac{3}{2}}{1} \times 4$

$\Rightarrow t_g = 6$ sec.

② Given $\lambda_a = 6000 A^\circ$ $\mu_v = 1$; $\mu_a = 1.0003$

let 'n' be the No. of wavelengths.

Given $n \lambda_{vaccume} = (n+1) \lambda_{air}$

$\Rightarrow \frac{\lambda_{vaccum}}{\lambda_{air}} = \frac{n+1}{n} \Rightarrow \left[\frac{\lambda_v}{\lambda_a} = \frac{\mu_a}{\mu_v}\right] = 1.0003$

$\Rightarrow 1.0003 = \frac{n+1}{n}$

$\Rightarrow 1 + \frac{1}{n} = 1.0003$

$\Rightarrow \frac{1}{n} = 0.0003$

$\Rightarrow n = \frac{1}{0.0003} = \frac{10^4}{3}$

$\therefore$ thickness $x = \lambda_a n$

$x = 6000 \times 10^{-7} \times \frac{10^4}{3}$

$\Rightarrow 2$ mm

Given Distance travelled by the light in medium 1 & 2 is 2:3 ~~same~~.

i.e.) $\frac{x_1}{x_2} = \frac{2}{3}$

we know that $x \propto \frac{1}{\mu}$

$\Rightarrow \frac{\mu_1}{\mu_2} = \frac{x_2}{x_1} = \frac{3}{2}$

(4) Given let 't' be the thickness

Given $t_s = 4cm$; $t_w = 5cm$

$\mu_s = ?$ $\mu_w = \frac{4}{3}$

Also given that

No. of waves in slab = No. of waves in water

$\Rightarrow \left[\frac{distance}{v_s}\right]_{slab} = \left[\frac{distance}{v}\right]_w$

$\Rightarrow \frac{t_s}{v_s} = \frac{t_w}{v_w}$

$\Rightarrow \frac{t_s}{t_w} = \frac{v_s}{v_w}$; we know that $\mu \propto \frac{1}{v}$

$\Rightarrow \frac{\mu_w}{\mu_s} = \frac{v_s}{v_w}$

$\Rightarrow \frac{t_s}{t_w} = \frac{\mu_w}{\mu_s}$

$\Rightarrow \mu_s = \frac{t_w}{t_s}\mu_w \Rightarrow \frac{4}{3} \times \frac{5}{4}$

$\Rightarrow \mu_s = \frac{5}{3} = 1.66$

(5) $\lambda_{vaccum} = 5700 A^\circ$ $\mu_g = \frac{3}{2}$

$\lambda_{glass} = ?$

we know that $\mu \propto \frac{1}{\lambda}$

$\Rightarrow \frac{\lambda_{glass}}{\lambda_{vaccum}} = \frac{\mu_{vaccum}}{\mu_{glass}}$

$\Rightarrow \frac{\lambda_{glass}}{5700} = \frac{1}{3/2} \Rightarrow \lambda_{glass} = 3800 A^\circ$

(6) Given: $\mu_g = 1.5$; $\mu_w = 1.3$; $V_w = 2.25\times10^8$ m/s

we know that $v \propto \frac{1}{\mu}$

$\Rightarrow \frac{V_g}{V_w} = \frac{\mu_w}{\mu_g} \Rightarrow V_g = \frac{\mu_w}{\mu_g} \times V_w$

$\Rightarrow V_g = \frac{1.3}{1.5} \times 2.25\times10^8$ m/sec

$\Rightarrow V_g = 1.95\times10^8$ m/sec

(7) Given wavelength of light in air

$\lambda_a = 6000 A^\circ$; $\mu_{medium} = 1.5 = \frac{3}{2}$

we know $\lambda \propto \frac{1}{\mu}$

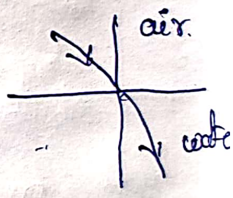
$\Rightarrow \frac{\lambda_m}{\lambda_a} = \frac{\mu_a}{\mu_m}$

$\Rightarrow \lambda_m = \frac{\mu_a}{\mu_m}\lambda_a = \frac{1}{3/2} \times 6000$

$\Rightarrow \lambda_m = \frac{2}{3} \times 6000 = 4,000 A$

(8) $\lambda = 589\ nm = 589\times10^{-9}$ m.

From the relation



$v = f\lambda$

$f = \frac{v}{\lambda}$

$\Rightarrow f = \frac{\frac{9}{4}\times10^8}{589\times10^{-9}}$

$\Rightarrow f = \frac{9}{4\times589}\times10^{17}$

$\Rightarrow f = 3.8\times10^{14}\ Hz$.

$V_m = \frac{c}{\mu_m}$

$\Rightarrow V_m = \frac{3\times10^8}{4/3}$

$\Rightarrow V_m = \frac{9}{4}\times10^8$ m/sec

(9) $f = 5\times10^{14}$ Hz ; $\lambda = 450\times10^{-9}$ m

$V_L = f\lambda$

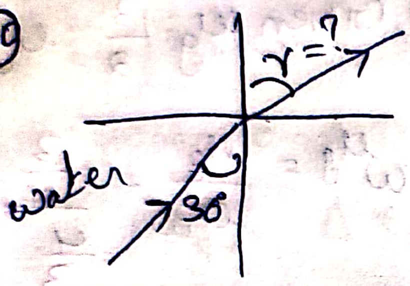
$= 5\times10^{14}\times450\times10^{-9}$

$\Rightarrow 222\times10^6$ m/s

$\mu_m = \frac{c}{V} = \frac{3\times10^8}{222\times10^6}$

$= 1.35$

(15)



$\mu_w = \frac{4}{3}$; $\mu_g = \frac{3}{2}$.

According to Snell's law

$_w\mu_g = \frac{\sin i}{\sin r}$

$\Rightarrow \frac{\mu_g}{\mu_w} = \frac{\sin 30}{\sin r}$.

$\Rightarrow \frac{\frac{3}{2}}{\frac{4}{3}} = \frac{1}{2\sin r}$

$\Rightarrow \frac{9}{8} = \frac{1}{2} \sin r$

$\Rightarrow \sin r = \frac{9}{4}$

$\Rightarrow r = 26°$

(16) Given thickness of glass $t_g = 6$ cm

" " water $t_w = 2$ cm.

Also given No. of waves in 6 cm of glass = 2 cm of water

$N_g = N_w$.

$\Rightarrow \frac{t_g}{\lambda_g} = \frac{t_w}{\lambda_w}$

$\Rightarrow t_g = \frac{\lambda_g}{\lambda_w} t_w$

$\Rightarrow t_g = \frac{\mu_w}{\mu_g} t_w$

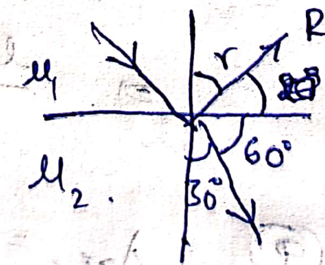
we know $\mu \propto \frac{1}{\lambda}$

$\Rightarrow \frac{\mu_g}{\mu_w} = \frac{\lambda_w}{\lambda_g}$

$\Rightarrow t_g$ $6 = \frac{\frac{4}{3}}{\mu_g} \times 2$

$\Rightarrow \mu_g = \frac{4}{9}$.

(17)



$\therefore 90 - \angle r + 60 = 90$

$\Rightarrow \angle r = 60° \Rightarrow \angle i = 60°$

Because angle of incidence and angle of reflection are same.

(15) (i) $v_m = \frac{c}{\mu_m} = \frac{3 \times 10^8}{1.4}$

$v_m = 2.143 \times 10^8$ m/sec

(ii) $v_{Diamond} = \frac{c}{\mu_D}$

Given $\mu_D = 2.4$

$v_D = \frac{3 \times 10^8}{2.4}$

$v_D = 1.25 \times 10^8$ m/sec

(iii) ${}_g\mu_D = \frac{\mu_D}{\mu_g} = \frac{2.4}{1.4}$

$= 1.71$

are same.

Task

① Given time taken by light in glass $t_g = 10^{-9}$ sec

$\mu_g = 1.5$; thickness = ?

$\Rightarrow$ time = $\frac{\text{distance}}{\text{speed}}$ (or) $\frac{\text{thickness of medium}}{\text{speed in that medium}}$

$\Rightarrow t = \frac{x}{v_m} = \frac{x}{\frac{c}{\mu_g}} \Rightarrow x = t \times \frac{c}{\mu_g}$

$= 10^{-9} \times \frac{\cancel{3} \times 10^8}{\frac{\cancel{3}}{2}} \rightarrow 2 \times 10^{-1} m$

$\Rightarrow x = 0.2 m$

② We know that distance = speed × time.

$\Rightarrow$ distance travelled by light in air = medium. [water]

$v_a t_a = v_m t_m$

$\Rightarrow 3 \times 10^8 \times 9 \times 10^{-6} = \frac{c}{\mu_m} t_m$

$\Rightarrow 9 \times 10^3 = \frac{3 \times 10^8}{\frac{4}{3}} \times t_m$

$\Rightarrow t = 12 \times 10^{-6}$ sec

$= 12 \mu$ sec.

(3)

$\mu_g = \frac{3}{2}$; $x_g = 90cm \to t_1$

$\mu_\omega = \frac{4}{3}$; $x_\omega = 90cm \to t_2$

$time = \frac{distance}{V_m}$

$\Rightarrow t_g = \frac{x_g}{\frac{c}{\mu_g}} \Rightarrow \frac{x_g \mu_g}{c}$

$\Rightarrow t_\omega = \frac{x_\omega \mu_\omega}{c}$

$\therefore t_g - t_\omega = \frac{x_g \mu_g}{c} - \frac{x_\omega \mu_\omega}{c}$

$= \frac{1}{c}\left[90\times10^{-2}\times\frac{3}{2} - 90\times10^{-2}\times\frac{4}{3}\right]$

$\Rightarrow \frac{90\times10^{-2}}{3\times10^8}\left[\frac{3}{2}-\frac{4}{3}\right]$

$\Rightarrow 3\times10^{-9}\left[\frac{1}{6}\right]$

$\Rightarrow 0.5\times10^{-9} = 5\times10^{-10}$ sec.

(4) Given $\mu_g = 1.5$.

velocity of light in medium

$V_m = \frac{c}{\mu_m} = \frac{3\times10^8}{1.5}$

$V_m = 2\times10^8$ m/sec

(5) Given $\mu_g = 1.5$.

$\lambda = 9000A^\circ$; $\lambda_g = ?$

we know that $\mu \propto \frac{1}{\lambda}$

$\Rightarrow \frac{\lambda_g}{\lambda_a} = \frac{\mu_a}{\mu_g}$

$\Rightarrow \frac{\lambda_g}{9000} = \frac{1}{1.5}$

$\Rightarrow \lambda_g = 6000\ A^\circ$

(6) $time = \frac{distance}{speed}$

$t_1 = \frac{x}{\frac{c}{\mu}} = \frac{\mu x}{c}$

(7) Given $\mu_g = \frac{3}{2}$; $\mu_\omega = \frac{4}{3}$

$_\omega\mu_g = \frac{\mu_g}{\mu_\omega} = \frac{\frac{3}{2}}{\frac{4}{3}} = \frac{9}{8}$

(8) $\mu_g = 1.5$ $\quad V_g = 2\times10^8$ m/sec

$\mu_L = ?$ $\quad V_L = 2.5\times10^8$ m/sec.

since $\mu \propto \frac{1}{V} \Rightarrow \frac{\mu_L}{\mu_g} = \frac{V_g}{V_L}$

$\Rightarrow \frac{\mu_L}{1.5} = \frac{2\times10^8}{2.5\times10^8}$

$\Rightarrow \frac{\mu_L}{1.5} = \frac{2}{2.5}$ $\quad \Rightarrow \mu_L = 1.2$

(9) $\lambda_{air} = 7200A^\circ$; $\mu_g = 1.5 = \frac{3}{2}$

we know $\lambda \propto \frac{1}{\mu}$

$\frac{\lambda_g}{\lambda_{air}} = \frac{\mu_a}{\mu_g}$ $\Rightarrow \lambda_g = \frac{\mu_a}{\mu_g}\lambda_{air}$

$= \frac{7200}{\frac{3}{2}} = 4800A^\circ$

(10) thickness of medium = distance travelled by the light in medium = 4 mm

$= 4\times10^{-3}$ m

$\mu_g = 1.5$

$\Rightarrow time = distance / V_m$

$\Rightarrow \frac{x\,\mu_m}{c} = \frac{4\times10^{-3}\times1.5}{3\times10^8}$

$\Rightarrow 2\times10^{-11}$ sec.

(15) $_\omega\mu_g = \frac{9}{8}$

$\Rightarrow \frac{\mu_g}{\mu_\omega} = \frac{9}{8}$

$\Rightarrow \frac{\lambda_\omega}{\lambda_g} = \frac{9}{8}$

$\Rightarrow \lambda_\omega = \frac{9}{8}\lambda_g$

$\Rightarrow \lambda_\omega = \frac{9}{8}\times4000 \Rightarrow 4500A^\circ$

(16) Given optical path of light is same in glass and liquid

$\Delta x_g = \Delta x_L$

$\Rightarrow t_g \times \mu_g = t_L \times \mu_L$

$\Rightarrow 4 \times \cancel{1.5} = \overset{3}{\cancel{4.5}} \times \mu_L$

$4 = 3\mu_L$

$\Rightarrow \mu_L = \frac{4}{3}$.

(17) we know that $\mu \propto \frac{1}{v} \Rightarrow \frac{\mu_d}{\mu_r} = \frac{v_r}{v_d}$

(i) $\Rightarrow$ Given $\frac{\mu_d}{\mu_r} = 1.125$.

$\Rightarrow \frac{V_r}{V_d} = 1.125 \Rightarrow V_r = 1.125\, V_d$

Also given $V_d \sim V_r = 0.25 \times 10^8$ m/s

$\Rightarrow V_d - 1.125 V_d = 0.25 \times 108$ m/sec

$\Rightarrow V_d (0.125) = 0.25 \times 10^8$

$\Rightarrow V_d = 2 \times 10^8$ m/sec

(17) (ii) $V_r = 1.125\, V_d$

$V_r = 1.125 \times 2 \times 10^8$

$= 2.25 \times 10^8$ m/sec

(iii) $\mu_d = \frac{c}{V_d}$

$\mu_r = \frac{\mu_d}{1.125} = \frac{c}{V_d\, 1.125} = \frac{3 \times \cancel{10^8}}{2 \times \cancel{10^8} \times 1.125}$

$\mu_r = \frac{1.5}{1.125} = 1.333$