8 feb 2022 PHYSICS

Q1 2 straight and narrow parallel slit 1mm apart are illustrated by a monochromatic light. frindes formed on the screen held at a distance of 100cm from slit are 0.5mm apart. What is the wavelength of the light.

Sol. given, $2d = 1mm$

$\beta = 0.5mm$

$D = 1m$

$$\lambda = \frac{\beta \times 2d}{D}$$

$$= \frac{0.5\times10^{-3} \times 1\times10^{-3}}{1}$$

$$= 0.5\times10^{-6}$$

$$= 5000\times10^{-10} m$$

$$= 5000 \mathring{A}.$$

Q2 A biprism is placed 5cm apart from a slit illuminated by sodium light (5890 Å) The width of the fridge obtained on the screen 75cm from the biprism is 9.424×10^{-2} cm. What is the distance b/w the 2 coherant source.

Sol. given

$\beta = 9.424\times10^{-2} cm$

$D = 0.75m + 0.05m = 0.8m$

$\lambda = 5890 \times10^{-10} m$

$$2d = \frac{\lambda D}{\beta}$$

$$= \frac{5890 \times 10^{-10} \times 8 \times 10^{-1}}{9.424 \times 10^{-2} \times 10^{-2}}$$

$$= \frac{47120}{9424} \times 10^{-11} \times 10^{4} \times 10^{3}$$

$$= 5 \times 10^{-4}$$

$$= 5 \times 10^{-4} m$$

$$= 0.5 \times 10^{-3} m$$

$$= 0.5 mm.$$

Q3. The central frindge of the interference produced by the light of wavelength 6000 Å is shifted to the position of 5th bright frindge by introducing a thin glass plate of refractive index 1.5. Calculate the thickness of the plate.

Sol. given

$$\mu = 1.5$$

$$\lambda = 6000 Å$$

$$S = 5\beta.$$

$$S = \frac{D}{2d}(\mu - 1)t$$

$$5\beta = \frac{\beta}{\lambda}(1.5 - 1)t$$

$$\frac{5\lambda}{0.5} = t$$

$$10\lambda = t$$

$$t = 10 \times 6000 Å$$

$$t = 6 \times 10^{-6} m.$$

Q4 A thin sheet of glass having a RI of 1.5 and 6 micron thickness introduced in path of interfering beam in a biprism arrangement. shifting the central fringe to a position normally occupied by 5th. find wavelength

Sol

$$S = \frac{\beta}{\lambda}(\mu - 1)t$$

$$5\beta = \frac{\beta}{\lambda}(1.5-1) \times 6 \times 10^{-6}$$

$$\lambda = \frac{0.5 \times 6 \times 10^{-6}}{10 \times 5}$$

$$\lambda = 6 \times 10^{-7}$$

$$\lambda = 6000 \times 10^{-10} m$$

$$\lambda = 6000 \text{ Å}.$$

Q5 A parallel beam of light of wavelength 5890 Å is incident on a thin glass plate of refractive index 1.5 such that the angle of refraction into the plate is 60°. Calculate the smallest thickness of the glass plate which will appear dark by the reflection.

Sol.

$$2\mu t \cos r = n\lambda$$

$$2 \times 1.5 \times t \cos 60^\circ = 1 \times 5890 \times 10^{-10}$$

$$t = \frac{5890 \times 10^{-10}}{1.5 \times \cancel{1.732}}$$

$$t = \frac{3926.6}{\cancel{1.732}} \times 10^{-10}$$

$$t = \cancel{2267} \; 3.926 \times 10^{-7} m.$$

Q6 A soap film of R.I 4/3 and of thickness 1.5×10^{-4} cm is illuminated by white light incident at the angle of 45° the light reflected by it is examined by spectroscope it is found a dark band corresponding to the wavelength of 5×10^{-5} cm. Calculate the order of interference band.

Sol.

$$2\mu t \cos r = n\lambda$$

given $i = 45°$

$$\mu = \frac{\sin i}{\sin r}$$

$$\mu = \frac{1}{\sqrt{2} \sin r}$$

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

$$\sin r = \frac{3}{4\sqrt{2}}$$

$$\cos r = \sqrt{1 - \sin^2 r}$$

$$= \sqrt{1 - \frac{9}{32}}$$

$$= \sqrt{\frac{32-9}{32}}$$

$$= \sqrt{\frac{23}{32}}$$

$$= \frac{\sqrt{23}}{4\sqrt{2}}$$

$$\cancel{2} \times \frac{\cancel{4}}{\cancel{3}} \times 1.\cancel{5} \times 10^{-4} \times \frac{\sqrt{23}}{\cancel{4}\sqrt{2}} = n \times 5 \times 10^{-5}$$

$$\frac{\sqrt{23}}{\sqrt{2}} \times 10^{-4} = n \times 5 \times 10^{-5}$$

$$\frac{\sqrt{23}}{\sqrt{2}} \times 2 = n$$

$$n = \sqrt{46}$$

$$n \approx 7$$

Q7. Fringes of equal thickness are observed in a thin glass wedge of RI = 1.52 The fringe spacing is 1mm & wavelength of light is 5893 Å. Calculate the angle of wedge in secs of an arc.

Sol

we know that

$$\beta = \frac{\lambda}{2\mu\alpha}$$

$$\alpha = \frac{\lambda}{2\mu\beta}$$

given $\mu = 1.52$

$\lambda = 5893\,Å$

$\beta = 1 \times 10^{-3}\,m$

$$\alpha = \frac{5893 \times 10^{-10}}{1.52 \times 10^{-3} \times 2}$$

$$\alpha = \frac{3876.9 \times 10^{-7}}{2}$$

$$\alpha = \frac{3.8769 \times 10^{-4}}{2}$$

$\alpha \approx 40$ seconds of an arc.

Q8 A light of $\lambda = 5500\,Å$ falls normally on a slit of width $2\,2 \times 10^{-5}$ cm. Calculate the angular position of first 2 minima on the either side of central maxima.

Sol. $(e+\cancel{d})\sin\theta = \pm n\lambda$

$$\sin\theta_n = \frac{n\lambda}{e}$$

$$\sin\theta = \frac{5500\times10^{-10}\,m}{22\times10^{-5}\times10^{-2}\,m}$$

$$\sin\theta = 0.25$$

$$\theta = \sin^{-1}(0.25)$$

$$\theta = 14°29'.$$

for second order $n=2$

$$\sin\theta_2 = \frac{2\lambda}{e}$$

$$= 2\times(0.25) = 0.5$$

$$\theta_2 = \sin^{-1}(0.5) = 30°$$

Q In a Newton's ring experiment the diameter of the 10th ring change from 1.4 cm to 1.2 cm when a liquid is introduced between the lens & the plate. Calculate the R.I. of the liquid.

$$(D_{10})^2 = \frac{4\times10\lambda R}{\mu}$$

for air $\mu = 1$

$$(D_{10})^2 = 4\times10\times\lambda\times R$$

$$\mu = \frac{(D_{10})^2}{(D'_{10})^2}$$

$$= \left(\frac{1.40}{1.27}\right)^2$$

$$\mu = 1.36$$