1. Given :

Path difference = 85.6λ

Path difference = 425×10^{-7} m

To find : λ.

Solution :

Path difference = $85.5\lambda = (86 - \frac{1}{2})\lambda$.

∴ The point is the 86th dark band.

$425 \times 10^{-7} = 85.5\lambda$.

$\therefore \lambda = \frac{425}{855} \times 10^{-7}$

$= \frac{85}{171} \times 10^{-5}$

$= \text{A.l} \begin{bmatrix} \log 85 \\ -\log 171 \end{bmatrix} \times 10^{-7}$

$= \text{Al}\,[1.9294 - 2.2330] \times 10^{-7}$

$= \text{Al}\,[\bar{1}.6964] \times 10^{-7}$

$= 4.971 \times 10^{-8}$.

$\boxed{\lambda = 4971\ \text{Å}.}$

2. Given :-

path difference is 13λ.

To Find : $\lambda = ?$

Solution :

Path difference $= 13\lambda$.

$\therefore$ The path difference is $= n\lambda$.

$\therefore$ point is bright.

$\therefore$ path difference $= 0.0078 \times 10^{-3}$ m.

$= 78 \times 10^{-7}$ m.

$\therefore 78 \times 10^{-7} = 13\lambda$.

$\therefore \lambda = \frac{78 \times 10^{-7}}{13}$

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

$\therefore \lambda = 6000 \text{ Å}$

3. Given :

$D = 80\ cm = 80 \times 10^{-2}\ m.$

$d = 0.25\ mm = 0.25 \times 10^{-3}$

$\lambda = 6000\ A^{\circ} = 6 \times 10^{-7}\ m.$

To Find : $x_2 = ?$

Solution :

$$x_2 = \frac{2\lambda D}{d}$$

$$= \frac{2 \times 6 \times 10^{-7} \times 80 \times 10^{-2}}{0.25 \times 10^{-3}}$$

$$= \frac{12 \times 8}{0.25} \times 10^{-5}$$

$$= 3.84\ mm.$$

$\therefore x_2 = 3.84\ mm.$

4. Given :

$X_{30} = 8mm = 8 \times 10^{-3} m.$

To Find : X_{30} bright

X_{30} dark.

Solution :

$$X = \frac{n\lambda D}{d}$$

$$8 \times 10^{-3} = \frac{20\lambda D}{d}$$

$$\therefore \frac{\lambda D}{d} = \frac{8 \times 10^{-3}}{20}$$

$$\therefore \frac{\lambda D}{d} = 4 \times 10^{-4} \quad \text{---------- (1)}$$

Now, $X_{30} = \frac{30\lambda D}{d}$

$= 30 \times 4 \times 10^{-4}$ [Using (1)]

$= 12 \times 10^{-3} m.$

$X_{30} = 12 mm$ — bright band.

$X_{30} = \frac{(2n-1)\lambda D}{2d}$

$= \frac{59}{2} \times 4 \times 10^{-4}$

$= 118 \times 10^{-4}$

$X_{30} = 11.8 mm$ — dark band

(i) X_{30} bright $= 12 mm$

(ii) X_{30} dark $= 11.8 mm$

Date : _____

Name : _____

Std. : _____ Roll No. : _____ Subject : _____ Marks : _____

5. Given :

$x_1 = 32 \times 10^{-5}$ m.

$\lambda_1 = 6400 \text{ Å} = 64 \times 10^{-8}$ m

$\lambda_2 = 4800 \text{ Å} = 48 \times 10^{-8}$ m.

To Find : $x_1 - x_2$

Formula : $x = \frac{\lambda D}{d}$ [D and d are constants].

Solution :

$x \propto \lambda$.

$\therefore \frac{x_1}{x_2} = \frac{\lambda_1}{\lambda_2}$

$x_2 = \frac{x_1 \lambda_2}{\lambda_1}$

$= \frac{32 \times 10^{-5} \times 48 \times 10^{-3}}{64 \times 10^{-8}}$

$= 24 \times 10^{-5}$ m.

$\therefore x_1 - x_2 = (32 - 34) \times 10^{-5}$

$= 8 \times 10^{-5}$

$= 0.008 \times 10^{-2}$ m.

$\therefore x_1 - x_2 = 0.008$ cm.

6. Given :

$\lambda_1 = 6500\,A^\circ = 65 \times 10^{-8}\,m$

$\lambda_2 = 5500\,A^\circ = 55 \times 10^{-8}\,m$

$D = 1\,m$

$d = 10^{-3}\,m$

To Find : $x_1 - x_2$

Formula : $x_1 - x_2$

Solution :

$x = \frac{\lambda D}{d}$ [D and d are constants]

$\therefore x_1 = \frac{\lambda_1 D}{d}$ $\quad x_2 = \frac{\lambda_2 D}{d}$

$\therefore x_1 - x_2 = (\lambda_1 - \lambda_2)\frac{D}{d}$

$= (65 - 55) \times 10^{-8} \times \frac{1}{10^{-3}}$

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

$= 10^{-4}\,m.$

$\therefore x_1 - x_2 = 0.1\,mm.$

7. Given :

$\lambda = 5200\,\text{Å} = 52 \times 10^{-8}\,m$

$x_1 - x_2 = 13 \times 10^{-5}\,m$

$D_1 - D_2 = 5 \times 10^{-1}\,m.$

To Find : d.

Solution :

$$x_1 = \frac{\lambda D_1}{d} \qquad x_2 = \frac{\lambda D_2}{d}$$

$$\therefore x_1 - x_2 = (D_1 - D_2)\frac{\lambda}{d}$$

$$\therefore d = \frac{5 \times 10^{-1} \times 52 \times 10^{-8}}{13 \times 10^{-5}}$$

$$= 20 \times 10^{-4}$$

$$= 0.02 \times 10^{-2}\,m$$

$$\therefore d = 0.02\,cm.$$

8. Given :

$D = 6 \times 10^{-1}$ m

$\lambda = 5460\ A^{\circ} = 546 \times 10^{-9}$ m.

$d = 3 \times 10^{-3}$ m.

To Find : $(x_2 - x_1)$, $(x_1 - x_2)$

Solution :

When distance is increased,

i) $x_2 - x_1 = \lambda D \left(\frac{1}{d_1} - \frac{1}{d_2}\right)$

$= 546 \times 60 \times 10^{-9} \times 10^{-2} \left(\frac{1}{3} - \frac{1}{4}\right) \times 10^{-3}$

$= 546 \times 600 \times 10^{-8} \times \frac{1}{12}$

$= 2730 \times 10^{-8}$

$= 2.73 \times 10^{-8}$ mm

ii) $x_1 - x_D = \frac{xD}{d_2} - \frac{xD}{d_1}$

$= xD \left(\frac{1}{d_2} - \frac{1}{d_1}\right)$

$= 546 \times 60 \times 10^{-11} \left(\frac{1}{2} - \frac{1}{3}\right) \times 10^{3}$

$= 546 \times 10 \times 10^{-8} \times \frac{1}{6}$

$= 5.46 \times 10^{-2}$ mm.

9. Given :

$D = 1\,m$

$\lambda = 42 \times 10^{-8}\,m$

$d = 2 \times 10^{-3}\,m$

$x_n = 42 \times 10^{-4}\,m$

To Find : Point is bright or dark.

Solution :

$$x_n = \frac{p\lambda D}{d}$$

$$p = \frac{42 \times 10^{-4} \times 2 \times 10^{-3}}{42 \times 10^{-8} \times 1}$$

$$= 2 \times 10$$

$$p = 20$$

$\therefore n = p = 20$

$\therefore$ Point is 20th bright band.

10. Given :

$x_{10} - x_2 = 12 \times 10^{-4}\ m$

$D = 1\ m\ (80 + 20\ cm)$

$d_1 = 45 \times 10^{-4}\ m$

$d_2 = 2 \times 10^{-3}\ m$

To Find : λ

Solution :

$$x_{10} - x_2 = \frac{8\lambda D}{d}$$

$$d = \sqrt{d_1 d_2}$$

$$= \sqrt{9 \times 10^{-6}}$$

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

$$\therefore x_{10} - x_2 = \frac{8\lambda D}{d}$$

$$12 \times 10^{-4} = \frac{8\lambda \times 1}{3 \times 10^{-3}}$$

$$\therefore \lambda = \frac{36 \times 10^{-7}}{8}$$

$$= 45 \times 10^{-7}$$

$$\therefore \lambda = 4500\ A^{\circ}$$

11. Given :

$x_9 - x_2 = x_{12} - x_3$

$\lambda_1 = 5680\ \text{Å}$

To Find : $\lambda_2 = ?$

Formula : $x_n = \frac{n\lambda D}{d}$

Solution : $x_9 - x_2 = x_{12} - x_3$

$[9-2]\frac{\lambda_1 D}{d} = [12-3]\frac{\lambda_2 D}{d}$

$\lambda_2 = \frac{(9-2)\lambda_1}{(12-3)}$

$\lambda_2 = \frac{7}{9}\lambda_1$

$= \frac{7}{9} \times 5680$

$\therefore \lambda_2 = 4418\ \text{Å}$

12. Given :

$x_1 = 1.23 \times 10^{-5}$

$x_2 = 1.8 \times 10^{-5}$

$\lambda = 6000\,\text{Å} = 6 \times 10^{-7}\,m$

To Find : $n = ?$

point is bright or dark = ?

Solution :

$\Delta x = x_2 - x_1$

$= (1.8 - 1.23) \times 10^{-5}$

$= 0.57 \times 10^{-5}$

From the formula,

$\frac{\Delta x}{\lambda} = \frac{0.57 \times 10^{-5}}{6 \times 10^{-7}} = 0.095 \times 10^{2}$

$\frac{\Delta x}{\lambda} = 9.5$

Now, path difference $= 9.5\,\lambda = 19\,\frac{\lambda}{2}$

Since path difference is odd multiple of $\frac{\lambda}{2}$

∴ point is dark.

Now, $(2n-1)\,\frac{\lambda}{2} = 19\,\frac{\lambda}{2}$

$2n - 1 = 19$

$2n = 20$

$n = 10$

Ans :- The point is dark & $n = 10$.

13. Given :

$d = 2 \times 10^{-3}$ m

$\lambda_1 = 7 \times 10^{-7}$ m

$\lambda_2 = 9 \times 10^{-7}$ m

$D = 2$ m

To Find : minimum distance

Solution :

$x_{n_1} = x_{n_2}$

$\therefore \frac{n_1 \lambda_1 D}{d} = \frac{n_2 \lambda_2 D}{d}$

$\therefore \frac{n_1}{n_2} = \frac{\lambda_2}{\lambda_1} = \frac{9}{7}$.

$\therefore n_1 = 9, \quad n_2 = 4$

$x = \frac{n_1 \lambda_1 D}{d} = \frac{9 \times 7 \times 10^{-7} \times 2}{2 \times 10^{-3}}$

$= 63 \times 10^{-4}$

$= 6.3$ mm.

$\therefore$ Minimum distance = 6.3 mm

14. Given :

$\lambda_1 = 6 \times 10^{-7}\ m$

$\lambda_2 = 48 \times 10^{-8}\ m$

x_n coincides with $(n+1)$

To Find : n.

Solution :

For $x_n = \frac{n\lambda_1 D}{d} = \frac{n \times 6 \times 10^{-7} \cdot D}{d}$ ——— (1)

For $x_{n+1} = \frac{(n+1)\lambda_2 D}{d} = \frac{(n+1)\, 48 \times 10^{-8} D}{d}$ ——— (2)

$n \times 6 \times 10^{-7} = (n+1) \times 4.8 \times 10^{-7}$

$\therefore 6n = 4.8n + 4.8$

$\therefore 1.2n = 4.8$

$\therefore n = 4$

15. Given :

R.P. $= 2.5 \times 10^{-5}$ rad

$\lambda = 546 \times 10^{-9}$ m

To Find : $dx = ?$

Formula : $R.P = \frac{1}{dx}$

Solution :

$$dx = \frac{1.2\lambda}{D.}$$

$$= \frac{(1.22) \times 5.46 \times 10^{-7}}{1.2}$$

$= 5.5551 \cdot$

$= 5.551 \times 10^{-7} \cdot$

$\therefore dx = 5.551 \times 10^{-7} \cdot$

16. Given :

$dx = 2.5 \times 10^{-5}$ radians.

To Find : R.P = ?

Formula : $R.P = \frac{1}{dx}$

Solution :

$$R.P = \frac{1}{dx}$$

$$= \frac{1}{2.5 \times 10^{-5}}$$

$\therefore RP = 4 \times 10^{4}$

Date : _____

Name : _____

Std. : _____ Roll No. : _____ Subject : _____ Marks : _____

17] Data :

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

Path difference :

$P = 0.0075$ mm $= 7.5 \times 10^{-6}$ m

$Q = 0.0015$ mm $= 1.5 \times 10^{-6}$ m

To Find : no. of bright and dark bands between P and Q = ?

Solution :

Path difference (point P) : $n\lambda$.

$\therefore n \times \lambda = 7.5 \times 10^{-6}$

Or, $n = \frac{7.5 \times 10^{-6}}{\lambda}$

$= \frac{7.5 \times 10^{-6}}{6000 \times 10^{-10}} = 12.5$

$\therefore$ Path difference $= 25 \times \left(\frac{\lambda}{2}\right)$

Point P is dark as the path difference is odd integral multiple of $\lambda/2$.

Path difference (point Q) : $n\lambda$

$\therefore n \times \lambda = 1.5 \times 10^{-6}$

$\therefore n = \frac{1.5 \times 10^{-6}}{6000 \times 10^{-10}} = 2.5$

$\therefore$ path difference $= 5 \times \left(\frac{\lambda}{2}\right)$

Point Q is dark as the path difference is integral multiple of $\lambda/2$.

No. of bright bands between P and Q
$= (25+5)/2 = 30/2 = 15$ nos.

No. of dark bands between P and Q
$15 - 1 = 14$ nos.

18] Data :

1st. Case : $\lambda_y = 5600$ A.U.

Observed yellow bright band = p.

2nd case : $\lambda_v = 4000$ A.U

Observed violet bright band = p+2.

To find : value of p = ?

Solution :

We have $x_n = \frac{n\lambda D}{d}$ (bright band)

1st case : Distance pth. band :

$x_p = \frac{p \times 5600 \times D}{d}$

2nd case : Distance (p+2)th band :

$x_{(p+2)} = \frac{(p+2) \times 4000 \times D}{d}$

Since, $x_{(p+2)} = x_p$ we get,

$\frac{(p+2) \times 4000 \times D}{d} = \frac{p \times 5600 \times D}{d}$

Or, $5(p+2) = 7p$.

Or, $p = 5$.

19] Data :

1st case : $\lambda = 6560 \times 10^{-10}$ m.

Observed bright band = 7th.

2nd case : Wave length (unknown light) = λ'

Observed ~~light~~ bright band = 8th.

To Find : $\lambda' = ?$

Solution :

$$x_n = n \times \frac{\lambda D}{d}$$

1st case : $x_7 = \frac{7\lambda D}{d}$

2nd case : $x_8 = \frac{8\lambda' D}{d}$

Since,

$$x_7 = x_8$$

$$\therefore \frac{8\lambda' D}{d} = \frac{7\lambda D}{d}$$

$$\text{Or, } \lambda' = \frac{7\lambda}{8} = \frac{7 \times 6560}{8}$$

$$= 5740 \text{ A.U.}$$

20] Data :

(i) Path difference (for waves at x and y) = 0;
phase difference $\phi = 0$

(ii) Path difference for waves at x and $y = \frac{\lambda}{4}$;
phase difference $\phi = \frac{\pi}{2}$

To find : $\frac{I_R}{I'_R} = ?$

Solution :

From the relation :

$I_R = I_1 + I_2 + 2\sqrt{I_1 I_2}\cos\phi$

When phase difference $\phi = 0$

$I_R = I + I + 2\sqrt{I \cdot I}\cos 0°$.

$= I + I + 2I = 4I$ . . . . (1)

When phase difference $\phi = \frac{\pi}{2}$.

$I'_R = I + I + 2\sqrt{I \cdot I}\cos\frac{\pi}{2}$.

$= I + I = 2I$ . . . . (2)

Taking ratio of eqn (1) and (2) :

$\frac{I_R}{I'_R} = \frac{4I}{2I} = \frac{2}{1}$