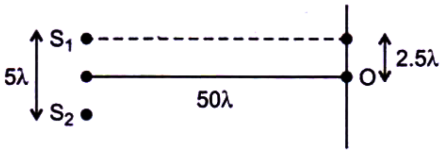
WEEKLY TEST OYM TEST - 20 BALLIWALA
SOLUTION Date 01-09-2019

[PHYSICS]

1

We know that $I_{max} = I_0$



Given that $d = 5\lambda$, Hence $2.5\ \lambda = \frac{d}{2}$

Path diff. $= \frac{dy_n}{D} = \frac{d \times \frac{d}{2}}{10d} = \frac{d}{20} = \frac{\lambda}{4}$

Phase diff. $= 90°$

$$I = I_0 \cos^2\frac{\phi}{2} = \frac{I_0}{2}$$

2.

If new value of distance of screen from double slit be D', then

$$\beta' = \frac{\lambda D'}{d'} = \frac{\lambda D'}{(2d)} = \frac{\lambda D}{d} = \beta$$

or $D' = 2D.$

3.

For first minima,

$$a \sin\theta_1 = \lambda$$

$\therefore$ $a = \frac{\lambda}{\sin\theta_1} = \frac{6200 \times 10^{-10}}{\sin 30°} = 1.24 \times 10^{-6}\,\text{m}$

$= 1.24\,\mu\text{m}.$

4.

Suppose n_1th bright fringe of wavelength λ_1 coincides with n_2th bright fringe of wavelength λ_2. Then,

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

or $$n_1\lambda_1 = n_2\lambda_2$$

or $$\frac{n_1}{n_2} = \frac{\lambda_2}{\lambda_1} = \frac{10,000}{12,000} = \frac{5}{6}$$

Let x be the given distance.

$$\therefore \quad x = \frac{n_1\lambda_1 D}{d}$$

Given that $n_1 = 5, D = 2\text{ m}$,

$d = 2\text{ mm} = 2\times10^{-3}\text{m}$,

$\lambda_1 = 12000\text{Å} = 12000\times10^{-10}\text{m} = 12\times10^{-7}\text{m}$

$$\therefore \quad x = \frac{5\times12\times10^{-7}\times2}{2\times10^{-3}}$$

$$= 6\times10^{-3}\text{m} = 6\text{ mm}$$

Hence, correct answer is (a).

5.

Fringe width, $\beta = \frac{\lambda D}{d}$

where λ is the wavelength of light, D is distance between slits and the screen, d is distance between the two slits.

As the D, d remain the same

$$\beta \propto \lambda$$

or $$\frac{\beta'}{\beta} = \frac{\lambda'}{\lambda}$$

or $$\beta' = \frac{\lambda'\beta}{\lambda}$$

Substituting the given values, we get;

$$\beta' = \frac{4000\text{ Å}\times 3\text{ mm}}{6000\text{ Å}}$$

$$= 2\text{ mm.}$$

6.

Fringe width, $\beta = \frac{\lambda D}{d}$

$$\therefore \quad D = \frac{\beta d}{\lambda} = \frac{4\times10^{-3}\times0.1\times10^{-3}}{4\times10^{-7}} = 1\text{ m.}$$

7.

$$\frac{I_{max.}}{I_{min.}} = \frac{(a_1+a_2)^2}{(a_1-a_2)^2} = \frac{(2+1)^2}{(2-1)^2} = \frac{9}{1}.$$

8.

For maximum intensity on the screen,

$$d \sin\theta = n\lambda$$

or $$\sin\theta = \frac{n\lambda}{d} = \frac{(n)(2000)}{(7000)}$$

$$= \frac{n}{3.5}$$

Since, $\sin\theta \ngtr 1$

$\therefore$ $n = 0, 1, 2, 3$ only.

Thus, only seven maximas can be obtained on both sides of the screen.

9.

$$I = 4I_0 \cos^2\left(\frac{\phi}{2}\right)$$

$$I_0 = 4I_0 \cos^2\left(\frac{\phi}{2}\right)$$

or $$\cos\left(\frac{\phi}{2}\right) = \frac{1}{2}$$

or $$\frac{\phi}{2} = \frac{\pi}{3}$$

or $$\phi = \frac{2\pi}{3} = \frac{2\pi}{\lambda} \cdot \Delta x$$

or $$\frac{1}{3} = \frac{1}{\lambda} \cdot \left(\frac{yd}{D}\right)$$

$$\therefore \quad y = \frac{\lambda}{3\left(\frac{d}{D}\right)} = \frac{6 \times 10^{-7}}{3 \times 10^{-4}} = 2 \times 10^{-3} \text{ m} = 2 \text{ mm.}$$

10.

$$n_1\lambda_1 = n_2\lambda_2$$

$$n\,(7.8 \times 10^{-5}) = (n+1)(5.2 \times 10^{-5})$$

or $$n\,(2.6 \times 10^{-5}) = 5.2 \times 10^{-5}$$

$\therefore$ $n = 2$.

11.

$$I = 2I_0(1 + \cos\delta)$$

When path difference = λ, then phase difference

$$\delta = \frac{2\pi}{\lambda} \times \text{path diff.} = 2\pi$$

$$\therefore \quad I_1 = 2I_0(1 + \cos 2\pi) = 4I_0 = K \qquad \text{...(i)}$$

When path difference = $\lambda/4$, then phase difference

$$\delta = \frac{2\pi}{\lambda} \times \frac{\lambda}{4} = \frac{\pi}{2}$$

$$\therefore \quad I_2 = 2I_0\left(1 + \cos\frac{\pi}{2}\right) = 2I_0 = \frac{K}{2}.$$

12.

13.

$$7\beta_1 = d_1 = 7\frac{\lambda_1 D}{d} \quad \text{and} \quad 7\beta_2 = d_2 = 7\frac{\lambda_2 D}{d}$$

$$\therefore \quad \frac{d_1}{d_2} = \frac{\lambda_1}{\lambda_2}.$$

14.

Given, $\beta = 1\text{ mm} = (D\lambda/d)$

Distance of 1st bright fringe from the centre,

$$x_n = 2n\left(\frac{D\lambda}{2d}\right)$$

For first bright fringe, $n = 1$

So, $$x_1 = 2\left(\frac{D\lambda}{2d}\right) = \frac{D\lambda}{d} = 1\text{ mm}.$$

15.

$\lambda = 5000\text{ Å}$, $d = 0.2$ mm and $D = 200$ cm

$$x_n = 2n\left(\frac{D\lambda}{2d}\right)$$

$$\therefore \quad x_3 = 2\times 3\left(\frac{D\lambda}{2d}\right)$$

$$= \frac{3\times 200\times 5000\times 10^{-8}}{0.2\times 10^{-1}}\text{ cm} = 1.5\text{ cm}.$$

[CHEMISTRY]

24. (*a*) : For the same aryl group, *b.p.* increases as the size of the halogen increases. Thus, C_6H_5I has the highest *b.p.*

25. (*c*) : Boiling point decreases with branching. Therefore, option (*c*) is wrong.

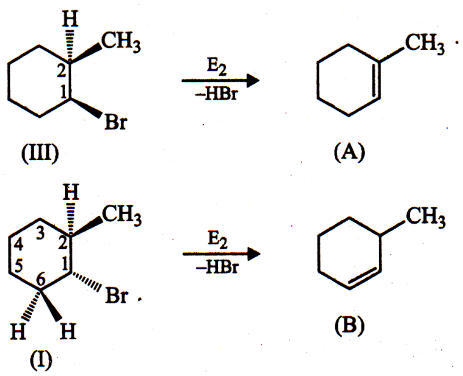
26. (*d*) : Being strained cyclopropane ring readily opens up to form only *n*-propyl bromide. In contrast, reaction (*a*) gives a mixture of *n*-propyl and isopropyl bromides, reaction (*b*) gives isopropyl bromide while reaction (*c*) does not occur at all.

27. (*d*) : As the size of the alkyl group increases, the S_N2 reactivity decreases. Further, C–Cl bond is stronger and more difficult to cleave than C–Br bond. Thus, option (*d*) is correct.

28. (*d*) : 3-Methyl-3-bromohexane is a 3° alkyl halide and hence undergoes solvolysis (nucleophilic substitution reaction with the solvent) by S_N1 mechanism. Since S_N1 reactions do not involve inversion, therefore, option (*d*) is *incorrect* while all other options are correct.

29. (*b*) : During the reaction between the optically active alcohol and *p*-toluenesulphonic acid, the C–O bond to the chiral centre is not broken. Instead O–H bond is broken. As a result the configuration of the alcohol is retained in the tosylate (A). However, when tosylate (A) is

30. (*b*) : In E_2 reactions, *trans*-elimination occurs. Since in compound (III), there is a *trans*-H-atom on C_2 carbon carrying the CH_3 group, therefore elimination occurs readily to give stable alkene (A).



In compound (I), *trans*-H is not available on C_2 but there is a *trans*-H available on C_6, therefore, elimination occurs on the other side to give less stable alkene (B). Compound (II), however, does not have a *trans*-H on either side (*i.e.*, C_2 or C_6), therefore, E_2 reaction does not occur. Thus, option (*b*) is correct.