DPP

DAILY PRACTICE PROBLEMS

Class : XIIth
Date :

Solutions

Subject : PHYSICS
DPP No. : 9

Topic :- WAVE OPTICS

1 **(d)**

By using $f_p = \frac{r^2}{(2p-1)\lambda}$

For first HPZ $r = \sqrt{f_p \lambda} = \sqrt{0.6 \times 6000 \times 10^{-10}}$

$= 6 \times 10^{-4} m$

2 **(d)**

For liquid A

$L_1 = 20$ cm, $\theta_1 = 38°$;concentration $= C_1$

Specific rotation $a_1 = \frac{\theta_1}{L_1 C_1} = \frac{38°}{20 \times C_1}$

Similarly, for liquid B

$L_2 = 30$ cm, $\theta_2 = -24°$, concentration $= C_2$

Specific rotation $a_2 = \frac{\theta_2}{L_2 C_2} = \frac{(-24°)}{30 \times C_2}$

The mixture has 1 part of liquid A and 2 parts of liquid B,

$\therefore C_1' : C_2' = 1:2$

$\theta = \{a_1 C_1' + a_2 C_2'\} l$

$$= \left\{\frac{38°}{20 \times C_1} \times \frac{C_1}{3} + \frac{(-24°)}{30 \times C_2} \times \frac{2C_2}{3}\right\} \times 30$$

$= 19° - 16° = 3°$

Thus, the optical rotation of mixture is $+3°$ in right had direction.

3 **(b)**

$$c = \frac{E}{B} \Rightarrow B = \frac{E}{c} = \frac{18}{3 \times 10^8} = 6 \times 10^{-8} T$$

4 **(a)**

For an electromagnetic wave

Velocity $c = \frac{1}{\sqrt{\mu_0 \varepsilon_0}} = 3 \times 10^8 ms^{-1}$

Air acts almost as vacuum

$\therefore a = 3$ approximately

5 **(c)**

Here, $\sin = \theta = \left(\frac{y}{D}\right)$

So, $\Delta\theta = \frac{\Delta y}{D}$

Angular fringe width $\theta_0 = \Delta\theta$(width $\Delta y = \beta$)

$\theta_0 = \frac{\beta}{D} = \frac{D\lambda}{d} \times \frac{1}{D} = \frac{\lambda}{d}$

$\theta_0 = 1° = \pi/180$ rad

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

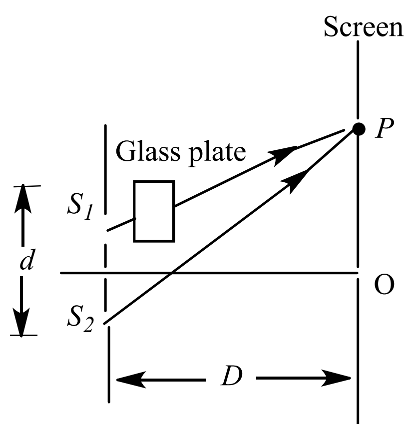
$$d = \frac{\lambda}{\theta_0} = \frac{180}{\pi} \times 6 \times 10^{-7}$$

$= 3.44 \times 10^{-5}$m

$= 0.03$ mm

6 **(b)**

When a thin glass plate of thickness t is placed over one of the slits, then lateral displacement is given by



$$x = \frac{(\mu - 1)tD}{d}$$

Given, $\mu = 1.5, t = 0.06 \text{ mm} = 6 \times 10^{-5} \text{ m}$

$D = 2 \text{ m}, d = 1 \text{ mm} = 1 \times 10^{-3} \text{ m}$

Putting the values in the above relation, we get

$$x = \frac{(1.5 - 1) \times 6 \times 10^{-5} \times 2}{1 \times 10^{-3}}$$

$$= 0.5 \times 12 \times 10^{-2} = 0.06 \text{ m} = 6\text{cm}$$

7 **(d)**

To see interference, we need two sources with the same frequency and with a constant phase difference. In the given waves,

$X_1 = a_1 \sin \omega t$

And $X_4 = a_1 \sin(\omega t + \delta)$

Have a constant phase difference δ, so interference is possible between them.

For $X_1 = a_1 \sin \omega t$

And $X_2 = a_2 \sin 2\omega t$

Frequency is not equal and there is no constant phase difference.

For $X_1 = a_1 \sin \omega t$

And $X_3 = a_1 \sin \omega_1 t$,

Frequency is different and there is no constant phase difference.

8 **(a)**

Intensity, $I_0 = I_1 + I_2 + 2\sqrt{I_1 I_2}$

If $I_1 = I_2 = I$(Let)

Then $I_0 = 4I$

When one slit is covered then $I_2 = 0$

$$\therefore I_0' = I = \frac{I_0}{4}$$

10 **(a)**

For interference phase difference must be constant

11 **(d)**

$$\beta = \frac{\lambda D}{d} = \frac{600 \times 10^{-9} \times 2}{1 \times 10^{-3}} = 12 \times 10^{-4}\ \text{m}$$

So, distance between the first dark fringes on either side of the central bright fringe

$= 2\beta$

$= 2 \times 12 \times 10^{-4}\ \text{m}$

$= 24 \times 10^{-4}\ \text{m}$

$= 2.4\ \text{mm}$

12 **(a)**

$\omega = 6 \times 10^8$

$$k = \frac{\omega}{v} = \frac{6 \times 10^8}{3 \times 10^8} = 2m^{-1}$$

13 **(d)**

If shift is equivalent to n fringes then

$$n = \frac{(\mu - 1)t}{\lambda} \Rightarrow n \propto t \Rightarrow \frac{t_2}{t_1} = \frac{n_2}{n_1} \Rightarrow t_2 = \frac{n_2}{n_1} \times t$$

$$t_2 = \frac{20}{30} \times 4.8 = 3.2mm$$

14 **(c)**

Doppler shift (Source moving towards observer)

$$\lambda' = \lambda\left(1 - \frac{V}{C}\right)$$

$$5400\text{Å} = 6200\text{Å}\left(1 - \frac{V}{C}\right)$$

$$V = \left[1 - \frac{54}{62}\right]C = 3.9 \times 10^7 \text{approx}$$

15 **(b)**

The optical path between any two points is proportional to the time of travel.

The distance traversed by light in a medium of refractive index μ in time t is given by

$d = vt$ ……….(i)

Where v is velocity of light in the medium. The distance traversed by light in a vacuum in this time.

$\Delta = ct$

$= c\,.\frac{d}{v}$ $[From\ Eq.(i)]$

$$= d\frac{c}{v} = \mu d \qquad (ii)$$

(Since, $\mu = \frac{c}{v}$)

This distance is the equivalent distance in vacuum and is called optical path.

Here, optical path for first ray $= n_1 L_1$

Optical path for second ray $= n_2 L_2$

Path difference $= n_1 L_1 - n_2 L_2$

Now, phase difference

$= \frac{2\pi}{\lambda} \times$ path difference

$$= \frac{2\pi}{\lambda} \times (n_1 L_1 - n_2 L_2)$$

16 **(c)**

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

$$\Rightarrow t = \frac{\lambda}{(\mu - 1)} = \frac{\lambda}{(1.5 - 1)} = 2\lambda$$

17 **(c)**

The number of fringes on either side of centre C of screen is

$$n_1 = \left[\frac{AC}{\beta}\right] = \left[\frac{0.5}{0.021}\right] = [23.8] = 23$$

$\therefore$ Total number of fringes

$= 2n_1 +$ fringe at centre

$= 2n_1 + 1 = 2 \times 23 + 1$

$= 46 + 1 = 47$

In Young's experiment, the number of fringes should be odd.

18 **(a)**

When unpolarised light is made incident at polarizing angle, the reflected light is plane polarized in a direction perpendicular to the plane of incidence.
Therefore $\vec{E}$ in reflected light will vibrate in vertical plane with respect to plane of incidence

ANSWER-KEY										
Q.	1	2	3	4	5	6	7	8	9	10
A.	D	D	B	A	C	B	D	A	A	A
Q.	11	12	13	14	15	16	17	18	19	20
A.	D	A	D	C	B	C	C	A	B	B