# Self Practice Paper (SPP)

**1.** White light is used to illuminate the two silts in a Young's double slit experiment. The separation between the slits is b and the screen is at a distance d (> > b) from the slits. At a point on the screen directly in front of one of the slits, certain wavelengths are missing. Some of these missing wavelengths are :

(1) $\lambda = \frac{b^2}{2d}$ (2) $\lambda = \frac{2b^2}{d}$ (3) $\lambda = \frac{b^2}{3d}$ (4) $\lambda = \frac{2b^2}{3d}$

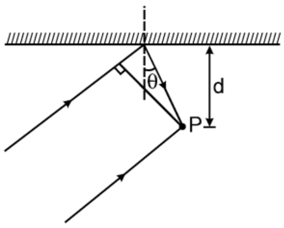
**2.** In a double slit experiment, instead of taking slits of equal widths, one slit is made twice as wide as the other. Then, in the interference pattern **[JEE' 2000 (Screening), 1/35]**

(1) the intensities of both the maxima and the minima increase
(2) the intensity of the maxima increases and the minima has zero intensity
(3) the intensity of the maxima decreases and that of the minima increases
(4) the intensity of the maxima decreases and the minima has zero intensity.

**3.** In the ideal double-slit experiment, when a glass-plate (refractive index 1.5) of thickness t is introduced in the path of one of the interfering beams (wavelength λ), the intensity at the position where the central maximum occurred previously remains unchanged. The minimum thickness of the glass-plate is: **[JEE 2002 Screening, 3/90]**

(1) 2 λ (2) 2 λ/3 (3) λ/3 (4) λ

**4.** A parallel beam of light of wavelength λ is incident on a plane mirror at an angle θ as shown in the figure. With maximum intensity at point P, which of the following relation is correct. **[JEE 2003 Screening, 3/90 ]**




(1) $\cos\theta - \sec\theta = \frac{\lambda}{4d}$ (2) $\cos\theta = \frac{\lambda}{4d}$

(3) $\cos\theta - \sin\theta = \frac{\lambda}{d}$ (4) $\cos\theta = \frac{\lambda}{2d}$

**5.** In a YDSE arrangement composite lights of different wavelengths $\lambda_1$ = 560 nm and $\lambda_2$ = 400 nm are used. If D = 1m, d = 0.1 mm. Then the distance between two completely dark regions is **[JEE 2004 [Screening],3/84 ]**

(1) 4 mn (2) 5.6 mm (3) 14 mm (4) 28 mm

**6.** In Young's double slit experiment maximum intensity is I than the angular position where the intensity becomes $\frac{I}{4}$ is : **[JEE 2005 [Screening] 3/84 ]**

(1) $\sin^{-1}\left(\frac{\lambda}{d}\right)$ (2) $\sin^{-1}\left(\frac{\lambda}{3d}\right)$ (3) $\sin^{-1}\left(\frac{\lambda}{2d}\right)$ (4) $\sin^{-1}\left(\frac{\lambda}{4d}\right)$

## SPP Answers

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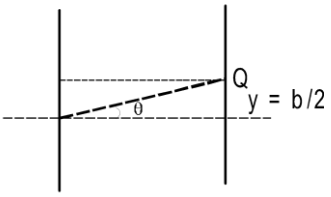
|---|---|---|---|---|---|---|---|---|---|---|---|
| **1.** | (3) | **2.** | (1) | **3.** | (1) | **4.** | (2) | **5.** | (4) | **6.** | (2) |

## SPP Solutions

**1.** 


Clearly at Q, path difference = d sinθ

⇒ $b \sin\theta \approx b\tan\theta \approx \frac{b.y}{d} = \frac{b^2}{2d}$

Now whenever $\frac{b^2}{2d}$ will be odd multiple of $\frac{\lambda}{2}$, those λ's will be having minima at point Q.

⇒ $\frac{b^2}{2d} = \frac{\lambda}{2}, \frac{3\lambda}{2}, \frac{5\lambda}{2}$ .... ⇒ $\lambda = \frac{b^2}{d}, \frac{b^2}{3d}, \frac{b^2}{5d}$ .....

**2.** In interference we know that

$I_{max} = \left(\sqrt{I_1} + I_2\right)^2$ and $I_{min} = \left(\sqrt{I_1} \sim I_2\right)^2$

Under normal conditions (when the widths of both the slits are equal)

$I_1 \approx I_2 = I$ (say)

∴ $I_{max} = 4I$ and $I_{min} = 0$

When the width of one of the slits is increased. Intensity due to that slit would increase, while that of the other will remain same. So let :

$I_1 = I$ and $I_2 = \eta I$ $(\eta > 1)$

Then $I_{max} = I(1+\sqrt{\eta})^2 > 4I$ and $I_{min} = I(\sqrt{\eta}-1)^2 < 0$

∴ Intensity of both maximum and minima is increased.

**3.** Path difference due to slab should be integral multiple of λ or

$\Delta x = n\lambda$

or $(\mu - 1)\, t = n\lambda$ n = 1, 2, 3, ....

or $t = \frac{n\lambda}{\mu - 1}$

For minimum value of t, n = 1

∴ $t = \frac{n\lambda}{\mu-1} = \frac{\lambda}{1.5-1} = 2\lambda$

**4.** PR = d

PO = d secθ

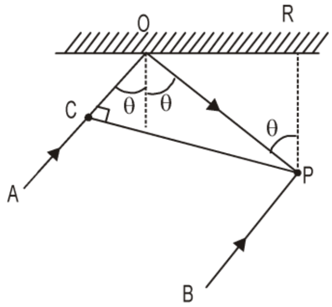
And CO = PO cot 2θ = d cos 2θ

path difference between the two rays is,

$\Delta\phi = \pi$ (one is reflected, while another is direct)

Therefore condition for constructive interference should be

$\Delta x = \frac{\lambda}{2}, \frac{3\lambda}{2}$ .....




or $\quad d \sec\theta (1 + \cos 2\theta) = \frac{\lambda}{2}$

or $\quad \left(\frac{d}{\cos\theta}\right)(2 \cos^2 \theta) = \frac{\lambda}{2}$

or $\quad \cos \theta = \frac{\lambda}{4d}$

**5.** Let nth minima of 400 nm coincides with m th minima of 560 nm, then

$$(2n - 1)\left(\frac{400}{2}\right) = (2m - 1)\left(\frac{560}{2}\right) \quad \text{or} \quad \frac{2n-1}{2m-1} = \frac{7}{5} = \frac{14}{10} = \text{.........}$$

i.e. 4th minima of 400 nm coincides with 3rd minima of 560 nm.
Location of this minima is,

$$Y_1 = \frac{(2\times 4 - 1)(1000)(400\times 10^{-6})}{2\times 0.4} = 14 \text{ mm}$$

Next 11th minima of 400 nm will coincide with 8th minima of 560 nm.
Location of this minima is,

$$+Y_2 = \frac{(2\times 11 - 1)(1000)(400\times 10^{-6})}{2\times 0.1} = 42 \text{ mm}$$

∴ Required distance = $Y_2 - Y_1$ = 28 mm
Hence, the correct option is (4).

**6.** Intensity of one slit = $\frac{I}{4}$

∴ $\quad \frac{I}{4} = \frac{I}{4} + \frac{I}{4} + 2\frac{I}{4}\cos\phi \quad \Rightarrow \quad \cos\phi = -\frac{1}{2} \quad \Rightarrow \quad \phi = \frac{2\pi}{3}$

Also $\quad \frac{\phi}{2\pi} = \frac{\Delta}{\lambda} \quad \Rightarrow \quad \Delta = \frac{2\pi}{3\times 2\pi}\times\lambda = \frac{\lambda}{3}$

∴ $\quad d \sin\theta = \frac{\lambda}{3} \quad \Rightarrow \quad \sin\theta = \frac{\lambda}{3d} \quad \Rightarrow \quad \theta = \sin^{-1}\left(\frac{\lambda}{3d}\right)$