PHYSICS CLASS XII
CHAPTER – 10 WAVE OPTICS

Q.1. How does the fringe width in Young's double-slit experiment, change when the distance of separation between the slits and screen is doubled?

Ans. Fringe width, $\beta = \frac{D\lambda}{d}$ for given λ and d, $\beta \propto$ D. Fringe width becomes double to that of original one.

Q.2. A parallel beam of monochromatic light falls normally on a single narrow slit. How does the angular width of the principal maximum in the resulting diffraction pattern depends on width of the slit?

Ans. Angular width of principal maxima is inversely proportional to the slit width i.e.,

$$\theta \propto \frac{1}{d} \qquad \left[\because \theta = \frac{2\lambda}{d}\right]$$

where d is the slit width.

Q.3. What should be the order of size of obstacle/aperture for diffraction of light?

Ans. Size of obstacle/aperture should be of the same order as that of wavelength of light.

Q.4. In single slits diffraction pattern, how does the width of the central maximum change when light of smaller wavelength is used?

Address: Plot No 420, Behind Shopprix Mall, Vaishali Sector 5, Ghaziabad – 201010
M: 9999907099, 9818932244 O: 0120-4130999
Website: www.vaishalieducationpoint.com , www.educationsolution.co

Ans. Width of central maximum = $\frac{2\lambda}{d}$, hence width of central maximum decreases when light of smaller wavelength is used.

Q.5. Sound waves cannot be polarized. Why?

Ans. Only transverse waves can be polarized. Since, sound waves are longitudinal, they cannot be polarised.

Q.6. Name two commonly used devices which uses polarised light.

Ans. Sun glass (dark glasses) and Liquid Crystal Display (LCD).

Q.7. If the wavelength of light decreases, then Fresnel distance increases or decreases?

Ans. As Fresnel distance $\propto \frac{1}{\lambda}$, hence, Fresnel distance increases as λ decreases.

Q.8. If the angle between the axis of polariser and the analyser is $45°$, write the ratio of the intensities of original light and the transmitted light after passing through the analyser.

Ans. The intensity of light transmitted by polariser becomes half of intensity of incident unpolarised light. Since, intensity of transmitted light through polariser = $\frac{I^\circ}{2}$.

∴ Intensity of transmitted light by analyser when the angle between the axis of polariser and the anlyser is 45°.

$$I = \left(\frac{I_0}{2}\right) cos^2 45° = \frac{I_0}{2} \times \frac{1}{2} = \frac{I_0}{4}$$

∴ $\frac{I}{I_0} = \frac{1}{4}$

Address: Plot No 420, Behind Shopprix Mall, Vaishali Sector 5, Ghaziabad – 201010
M: 9999907099, 9818932244 O: 0120-4130999
Website: www.vaishalieducationpoint.com , www.educationsolution.co

Q.9. Unpolarised light of intensity I is passed through a polaroid. What is the intensity of the light transmitted by the polaroid?

Ans. The intensity of light transmitted by polariser becomes half of intensity of incident unpolarised light. Since,

intensity of transmitted light through polariser = $\frac{I_0}{2}$.

∴ Intensity of transmitted high by analyser when the angle between the axis of polariser and the anlyser is 45°.

$$I = \left(\frac{I_0}{2}\right) cos^2 45° = \frac{I_0}{2} \times \frac{1}{2} = \frac{I_0}{4}$$

$\therefore \frac{I}{I_0} = \frac{1}{4}$

Q.10. Unpolarised light of intensity I is passed through a polaroid. What is the intensity of the light transmitted by the polaroid?

Ans. Intensity of transmitted light by the Polaroid = $\frac{I}{2}$.

Q.11. A ray of light falls on a transparent slab of m = 1.732. if reflected and refracted rays are mutually perpendicular, what is the angle of incidence?

Ans. 60° using $\tan i_B = \mu = 1.732 = \sqrt{3}$

Q.12. How are resolving power and limit of resolution. Of an optical instruments related?

Ans. Smaller is the limit of resolution., higher is the resolving power.

Q.13. Name one device for producing polarised light.

Ans. Nicol prism or calcite prism.

Address: Plot No 420, Behind Shopprix Mall, Vaishali Sector 5, Ghaziabad – 201010
M: 9999907099, 9818932244 O: 0120-4130999
Website: www.vaishalieducationpoint.com , www.educationsolution.co

Q.14. How does the resolving power of telescope change when the aperture of the objective increased?

Ans. Scattering of sunlight by molecules of earth's atmosphere.

Q.15. Yellow light (λ = 6000 A) illuminates a single slits of 1×10^{-4}m. Calculate the distance between two dark lines on either side to the central maximum, when the diffraction pattern is viewed on a screen kept 1.5 m away from the slit.

Ans. Given, λ = 6000 A = 6×10^{-7}m and d = 1×10^{-4} m

Separation between slit and screen D = 1.5 m

∴ The separation between two dark lines on either side of the central maxima = fringe width of central maxima

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

∴ Central maxima width = $\frac{2D\lambda}{d}$

$$= \frac{2\times1.5\times6\times10^{-7}}{1\times10^{-4}} = 18 \times 10^{-3}m = 18\text{mm}$$

Q.16. How does an unpolarised light gets polarised when passed through a polaroid? Two polaroids are set in crossed position. A third polaroid is placed between the two making an angle θ with the pass axis of the first polaroid. Write the expression for the intensity of light transmitted from the second polaroid. In what orientations will the transmitted intensity be

(i) minimum

(ii) maximum

Address: Plot No 420, Behind Shopprix Mall, Vaishali Sector 5, Ghaziabad – 201010
M: 9999907099, 9818932244 O: 0120-4130999
Website: www.vaishalieducationpoint.com , www.educationsolution.co

Ans. When an unpolarised light beam is incident on a polaroid then only those vibration of electric vector which are parallel to crystallographic axis of polaroid are transmitted through polaroid and other vibrations are being absorbed by it. This selective absorption of electric field vector which are not parallel to axis is termed as dichroism and hence plane polarised light is produced by polaroid.

If I_0 be the intensity of unpolarised light on the first polaroid P_1, then the intensity of unpolarised light on the first polaroid P_1, then the intensity of polarised light becomes $\frac{I_0}{2}$.

∴ The intensity of transmitted light from

(a) Polaroid P_3 whose pass axis make an angle θ with P_1 is given by = $\frac{I_0}{2}(cos^2\theta)$

(b) Polaroid P_2 such that the angle between P_3 and P_2 is (90° - θ) is given by

$$= \left(\frac{I_0}{2}cos^2\theta\right)[\cos(90° - \theta]^2$$

$$= \frac{I_0}{2}cos^2\theta sin^2\theta$$

Transmitted intensity from P_2 is

(i) minimum when P_1 and P_2 have their pass axis perpendicular to each other.

(ii) maximum when angle between pass axis of P_1 and P_2 is 45°.

Q.17. Ravi is using yellow in a single slit diffraction experiment with slit width of 0.6 mm. The teacher replaces yellow light by X-ray. Now he is not able to

Address: Plot No 420, Behind Shopprix Mall, Vaishali Sector 5, Ghaziabad – 201010
M: 9999907099, 9818932244 O: 0120-4130999
Website: www.vaishalieducationpoint.com , www.educationsolution.co

observe the diffraction pattern. He feels sad. Again the teacher replaces X-rays. The teacher now explain the facts about the diffraction.

(i) Which value is displayed by the teacher?

(ii) Give the necessary condition for the diffraction.

Ans. (i) The teacher displays the quality of the knowledge of the phenomenon and the conditions under which it occurs. In producing the diffraction pattern again, he demonstrates compassion, kindness towards the child and eagerness to share the knowledge.

(ii) The necessary condition for diffraction is that the slit width should be less than wavelength of light.

Q.18. Ramu and Somu were going to their friend's house by walk. It was a sunny day in the afternoon. It was very hot. Ramu was finding it very difficult to see around him. He had to strain his eyes to see. Suddenly, Somu took his cooling glasses from his pocket and asked him to wear them and later, Ramu advised Ramu on the necessity of wearing sun glasses during season.

(i) What are the values shown by Somu?

(ii) Name the phenomenon based on which cooling glasses reduce the glare.

(iii) What is the resultant intensity of light if both polariser and analyser are rotated through same angle?

Ans. (i) Caring, sharing, concern

(ii) Polarisation

Address: Plot No 420, Behind Shopprix Mall, Vaishali Sector 5, Ghaziabad – 201010
M: 9999907099, 9818932244 O: 0120-4130999
Website: www.vaishalieducationpoint.com , www.educationsolution.co

(iii) No change in intensity of light

Q.19. Two boys on their way from school were discussing seriously about something. They both were blowing soap bubble and were thrilled to watch the expanding bubble with spectacular colour rings. Shweta, a class XII student, was watching them for a long time, walking behind them. Suddenly, she realised that the kids did not look at the traffic in that junction area. She rushed to them and instructed them to be cautious while on the road. She also explained the importance of traffic rules and told them that obeying traffic rules not only makes us safe but also others safe.

(i) What are the values highlighted by Shweta?

(ii) Why are colours formed on bubbles?

Ans. (i) Obeying road rules, alertness, concern in otherslife, clarity of knowledge.

(ii) Due to superposition of incident and reflected waves of white light by thin film (interference)

Address: Plot No 420, Behind Shopprix Mall, Vaishali Sector 5, Ghaziabad – 201010
M: 9999907099, 9818932244 O: 0120-4130999
Website: www.vaishalieducationpoint.com , www.educationsolution.co