Physics

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Board -	Class - 12	Topic - Wave Optics

1. How does the angular separation of interference fringes change, in Young's experiment, when the distance between the slits is increased?

Ans: when separation between slits (d) is increased, fringe width decreases.

2. How the angular separation of interference fringes in young's double slit experiment change when the distance of separation between the slits and the screen is doubled?

Ans: No effect (or the angular separation remains the same)

3. In double-slit experiment using light of wavelength 600 nm, the angular width of a fringe formed on a distant screen is 0.1^{o}.What is the spacing between the two slits?

Ans: The spacing between the slits is 3.44×10^{-4}m

4. If the path difference produced due to interference of light coming out of two slits for yellow colour of light at a point on the screen be $3\lambda/2$, what will be the colour of the fringe at that point? Give reasons.

Ans: The given path difference satisfies the condition for the minimum of intensity for yellow light, hence when yellow light is used, a dark fringe will be formed at the given point. If white light is used, all components of white light except the yellow one would be present at that point.

5. State two conditions to obtain sustained interference of light. In Young's double slit experiment, using light of wavelength 400 nm, interference fringes of width X are obtained. The wavelength of light is increased to 600 nm and the separation between the slits is halved.
In order to maintain same fringe with, by what distance the screen is to be moved? Find the ratio of the distance of the screen in the above two cases.

Ans: Ratio-3:1

6. Two narrow slits are illuminated by a single monochromatic source. Name the pattern obtained on the screen. One of the slits is now completely covered. What is the name of the pattern now obtained on the screen? Draw intensity pattern obtained in the two cases. Also write two differences between the patterns obtained in the above two cases.

7. In Young's double-slit experiment a monochromatic light of wavelength λ, is used. The intensity of light at a point on the screen where path difference is λ is estimated as K units. What is the intensity of light at a point where path difference is $\lambda/3$?

Ans: K/4

8. A beam of light consisting of two wavelengths, 650 nm and 520 nm, is used to obtain interference fringes in a Young's double-slit experiment.

a) Find the distance of the third bright fringe on the screen from the central maximum for wavelength 650 nm.
b) What is the least distance from the central maximum where the bright fringes due to both the wavelengths coincide?

Ans: (a) $1950\frac{D}{d}$ (b) $2600\frac{D}{d}$

9. A narrow monochromatic beam of light of intensity I is incident a glass plate. Another identical glass plate is kept close to the first one and parallel to it. Each plate reflects 25% of the incident

light and transmits the reaming. Calculate the ratio of minimum and maximum intensity in the interference pattern formed by the two beams obtained after reflection from each plate.

Ans: 1:49

10. In a two slit experiment with monochromatic light, fringes are obtained on a screen placed at some distance D from the slits. If the screen is moved 5×10^{-2}m towards the slits, the charge in fringe width is 3×10^{-5}m. If the distance between the slit is 10^{-3}m. Calculate the wavelength of the light used.

Ans: 600nm

11. Two Sources of Intensity I and 4I are used in an interference experiment. Find the intensity at points where the waves from two sources superimpose with a phase difference (i) zero (ii) $\frac{\pi}{2}$ (iii) π

Ans: (i) 9I (ii)5I (iii) I

12. What are coherent sources of light? Two slits in Young's double slit experiment are illuminated by two different sodium lamps emitting light of the same wavelength.
Why is no interference pattern observed?
Obtain the condition for getting dark and bright fringes in Young's experiment. Hence write the expression for the fringe width.
If S is the size of the source and its distance from the plane of the two slits, what should be the criterion for the interference fringes to be seen?

Ans: (c) $\frac{S}{d} < \frac{\lambda}{a}$

13. What are coherent sources? Why are coherent sources required to produce interference of light? Give an example of interference of light in everyday life. In Young's double slit experiment, the two slits are 0.03 cm apart and the screen is placed at a distance of 1.5 m away from the slits. The distance between the central bright fringe and fourth bright fringe is 1 cm. Calculate the wavelength of light used.

Ans: 500 nm

14. What is interference of light? Write two essential conditions for sustained interference pattern to be produced on the screen. Draw a graph showing the variation of intensity versus the position on the screen in Young's experiment when
a) both the slits are opened and
b) one of the slit is closed. What is the effect on the interference pattern in Young's double slit experiment when: (i) Screen is moved closer to the plane of slits? (ii)Separation between two slits is increased. Explain your answer in each case.

15. Why a coloured spectrum is seen, when we look through a muslin cloth and not in other clothes?

Ans: Muslin cloth is made of very fine threads and as such fine slits are formed. White light passing through these silts gets diffracted giving rise to colored spectrum. The central maximum is white while the secondary maxima are coloured. This is because the positions of secondary maxima (except central maximum) depend on the wavelength of light. In a coarse cloth, the slits formed between the threads are wider and the diffraction is not so pronounced. Hence no such spectrum is seen.

16. A parallel beam of light of wavelength 600 nm is incident normally on a slit of width a. If the distance between the slits and the screen is 0.8 m and the distance of 2nd order maximum from the centre of the screen is 15 mm, calculate the width of the slit.

Ans: 6.4×10^{-4}mm

17. Why light ways do not diffracted around buildings, while radio waves diffract easily?

Ans: For diffraction to take place the wave length should be of the order of the size of the obstacle. The radio waves (particularly short radio waves) have wave length of the order of the size of the building and other obstacles coming in their way and hence they easily get diffracted. Since wavelength of the light waves is very small, they are not diffracted by the buildings.

18. Draw the diagram showing intensity distribution of light on the screen for diffraction of light at a single slit. How is the width of central maxima affected on increasing the

a) Wavelength of light used
b) Width of the slit?
c) What happens to the width of the central maxima if the whole apparatus is immersed in water and why?

19. State the condition under which the phenomenon of diffraction of light takes place. Derive an expression for the width of central maximum due to diffraction of light at a single slit. A slit of width a is illuminated by a monochromatic light of wavelength 700 nm at normal incidence. Calculate

the value of a for position of

a) first minimum at an angle of diffraction of 30°
b) first maximum at an angle of diffraction of 30°

Ans: (a) 1400nm (b) 2100 nm

20. At what angle of incidence should a light beam strike a glass slab of refractive index $\sqrt{3}$, such that the reflected and the refracted rays are perpendicular to each other?

Ans: 60°

21. What is an unpolarized light? Explain with the help of suitable ray diagram how an unpolarized light can be polarized by reflection from a transparent medium. Write the expression for Brewster angle in terms of the refractive index of denser medium.

22. The critical angle between a given transparent medium and air is denoted by i_c. A ray of light in air medium enters this transparent medium at an angle of incidence equal to the polarizing angle (i_p). Deduce a relation for the angle of refraction (r_p) in terms of r_p.

23. What is meant by polarization of a wave? How does this phenomenon help us to decide whether a given wave is transverse or longitudinal in nature?