



WAVE OPTICS

Class 12 - Physics

Time Allowed: 1 hour and 30 minutes

Maximum Marks: 45

1. How will the intensity of maxima and minima, in the Young's double experiment change, if one of the two slits is covered by a transparent paper which transmits only half of light intensity? [1]
2. Using Huygens' principle, draw a ray diagram showing the propagation of a plane wave refracting at a plane surface separating two media. Also verify Snell's law of refraction. [1]
3. Two slits are made one millimeter apart and the screen is placed one meter away. What should the width of each slit be to obtain 10 maxima of the double slit pattern within the central maximum of the single slit pattern? [1]
4. Write the conditions on path difference under which (i) constructive (ii) destructive interference occur in Young's double slit experiment. [1]
5. Thin films, such as a layer of oil on water, show beautiful colours when illuminated by white light. Name the phenomenon involved. [1]
6. A small piece of stone is dropped into a pond of still water. What is the shape of the wavefront? [1]
7. Sketch the wavefronts corresponding to diverging rays. [1]
8. Draw a diagram to show refraction of a plane wavefront incident on a convex lens and hence draw the refracted wavefront. [1]
9. The light of wavelength 600 nm is incident normally on a slit of width 3 mm. Calculate the linear width of the central maximum on a screen kept 3 m away from the slit. [1]
10. Why do thick films not show interference effects? [1]
11.
 - a. The interference pattern is not observed in Young's double slit experiment when the two sources S_1 and S_2 are far apart. Explain. [3]
 - b. Mention the conditions for the two sources to be coherent.
 - c. What is the effect on the interference pattern in a Young's double slit experiment, if the source of wavelength λ is replaced by another source of wavelength 1.5λ , with the interference pattern still observable?
12. Explain by drawing a suitable diagram that the interference pattern in a double-slit is actually a superposition of single-slit diffraction from each slit. [3]
Write two basic features that distinguish the interference pattern from those seen in a coherently illuminated single slit.
13. A plane wavefront is propagating from a rarer into a denser medium. Use Huygens principle to show the refracted wavefront and verify Snell's law. [3]
14. A plane wavefront is incident on a surface separating two media of refractive indices n_1 and $n_2 (> n_1)$. With the help of a suitable diagram, explain its propagation from the rarer to denser medium. Hence, verify Snell's law. [3]
15. Compare the interference pattern observed in Young's double slit experiment with single slit diffraction pattern, pointing out two distinguishing features. [3]
16. You have learned in the text how Huygens' principle leads to the laws of reflection and refraction. Use the same [5]

principle to deduce directly that a point object placed in front of a plane mirror produces a virtual image whose distance from the mirror is equal to the object distance from the mirror.

17. a. State Huygen's principle. Using this principle draw a diagram to show how a plane wavefront incident at the interface of the two media gets refracted when it propagates from a rarer to a denser medium. Hence verify Snell's law of refraction. [5]
- b. When monochromatic light travels from a rarer to a denser medium, explain the following, giving reasons:
- Is the frequency of reflected and refracted light the same as the frequency of incident light?
 - Does the decrease in speed imply a reduction in the energy carried by the light wave?
18. a. Derive the relation $a \sin \theta = \lambda$ for the first minimum of the diffraction pattern produced due to a single slit of width a using light of wavelength λ . [5]
- b. State with reason, how the linear width of central maximum will be affected if (i) monochromatic yellow light is replaced with red light, and (ii) distance between the slit and the screen is increased.
- c. Using the monochromatic light of same wavelength in the experimental set-up of the diffraction pattern as well as in the interference pattern where the slit separation is 1 mm, 10 interference fringes are found to be within the central maximum of the diffraction pattern. Determine the width of the single slit, if the screen is kept at the same distance from the slit in the two cases.
19. i. Using Huygens's construction of secondary wavelets explains how a diffraction pattern is obtained on a screen due to a narrow slit on which a monochromatic beam of light is incident normally. [5]
- ii. Show that the angular width of first diffraction fringe is half that of the central fringe.
- iii. Explain why the maxima at $\theta = \left(n + \frac{1}{2}\right) \frac{\lambda}{a}$ become weaker and weaker with increasing n .