CHAPTERWISE QUESTION

PHYSICS

SET A

WAVE OPTICS

CLASS - XII **Time : 1½ hrs.**

Marks : 35

SECTION - A **8 × 1 = 8**

1. Two identical and coherent sources of light are used in Young's double-slit experiment and resultant intensity at the centre of the screen is found to be I_1. When two identical sources of intensity same as before but incoherent are used for the experiment, then resultant intensity at the centre of the screen is found to be I_2. What is the value of I_1/I_2?

   a) 1 b) 2 c) 4 d) 0.5

2. Contrast of the fringe pattern obtained in Young's double-slit experiment depends on

   a) wavelength b) phase difference between sources

   c) intensity ratio of the sources d) distance between plane of slits and screen

3. In Young's double-slit experiment, coordinate system is selected in such a manner that Y-coordinate of central maximum is 1 cm and the same for 9^{th} maximum is 9 cm. If the entire set-up is immersed in a fluid with refractive index 4/3, then what will be new Y-coordinates of central maximum and 9^{th} maximum?

   a) 1 cm, 9 cm b) 3/4 cm, 27/4 cm c) 4/3 cm, 7 cm d) 1 cm, 7 cm

4. In a standard Young's double-slit experiment set up, two points P and Q are marked on the screen. Path difference corresponding to point P is $\lambda/2$ and for point Q it is $\lambda/4$. Here λ is wavelength of light being used. If I_p and I_Q are the resultant intensities at points P and Q, then I_P/I_Q is

   a) 2 b) 1/2 c) 0 d) infinity

5. A source emitting light of wavelengths λ_1 and λ_2 is used in Young's double-slit experiment. If fourth bright of λ_1 coincides with sixth bright of λ_2, then

   a) $2\lambda_1 = 3\lambda_2$ b) $3\lambda_1 = 2\lambda_2$ c) $4\lambda_1 = 3\lambda_2$ d) $3\lambda_1 = 4\lambda_2$

6. Select best monochromatic source of light.

   a) Bulb b) Candle c) Tube light d) Laser

For question numbers 7-8 two statements are given - one labelled Assertion (A) and the other labelled Reason (R). Select the correct answer to these questions from the codes (a), (b), (c) and (d) as given below.

a) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A).

b) Both Assertion (A) and Reason (R) are true but Reason (R) is not the correct explanation of Assertion (A).

c) Assertion (A) is true but Reason (R) is false.

d) Assertion (A) is false but Reason (R) is true.

7. Assertion (A) : When two light sources are placed near to each other, energy is distributed non-uniformly around them.

   Reason (R) : Light waves from two sources interfere each other and redistribution of energy takes place due to phenomenon of interference.

8. Assertion (A) : According to Huygen's principle, no backward wave-front is possible.

   Reason (R) : Amplitude of secondary wavelet is proportional to $(1+\cos\theta)$ where θ is the angle between the ray at the point of consideration and the direction of secondary wavelet.

SECTION - B **2 × 2 = 4**

9. Why narrow sources are to be used for producing interference?

10. Differentiate between a ray and a wavefront.

OR

What are two assumptions on which Huygens' Principle is based'?

SECTION - C **3 × 3 = 9**

11. Draw interference of light and diffraction pattern of light.

12. Use Huygen's principle to show how a plane wavefront propagates from a denser to rarer medium. Hence verify Snell's law of refraction.

OR

The ratio of the intensities at minima to the maxima in the Young's double slit experiment is 9 : 25. Find the ratio of the widths of the two slits.

13. Is energy conserved in interference? Explain.

SECTION - D **2 × 5 = 10**

14. State the essential condition for diffraction of light to take place.

Use Huygen's principle to explain diffraction of light due to a narrow single slit and the formation of a pattern of fringes obtained on the screen. Sketch the pattern of fringes formed due to diffraction at a single slit showing variation of intensity with angle θ.

15. a) Write three characteristic features to distinguish between the interference fringes in Young's double slit experiment and the diffraction pattern obtained due to a narrow single slit.

b) A parallel beam of light of wavelength 500 nm falls on a narrow slit and the resulting diffraction pattern is observed on a screen 1 m away. It is observed that the first minimum is a distance of 2.5 mm away from the centre. Find the width of the slit.

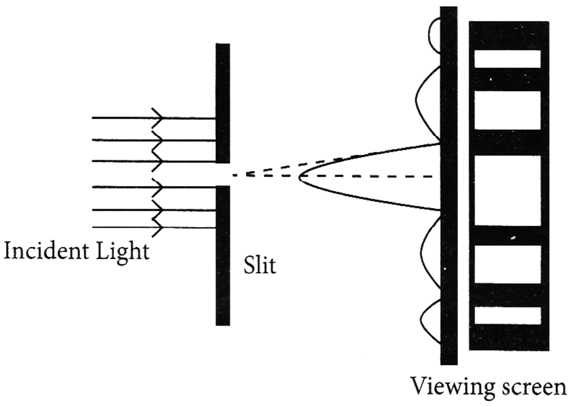
SECTION - E

Case Study

16. When light from a monochromatic source is incident on a single narrow slit, it gets diffracted and a pattern of alternate bright and dark fringes is obtained on screen, called "Diffraction Pattern" of single slit. In diffraction pattern of single slit, it is found that

I) Central bright fringe is of maximum intensity and the intensity of any secondary bright fringe decreases with increase in the order.

II) Central bright fringe is twice as wide as any other secondary bright or dark fringe.



i) A single slit of width 0.1 mm is illuminated by a parallel beam of light of wavelength $6000\,\mathring{A}$ and diffraction bands are observed on a screen 0.5 m from the slit. Find the distance of the third dark band from the central bright band. **2**

OR

In Fraunhofer diffraction pattern, slit width is 0.2 mm and screen is at 2 m away from the lens. If wavelength of light used is $5000\,\mathring{A}$ then find the distance between the first minimum on either side the central maximum.

ii) A diffraction pattern is obtained by using a beam of red light. What will happen, if the red light is replaced by the blue light? **1**

iii) What should be the size of the obstacle to observe diffraction? **1**

CHAPTERWISE QUESTION

PHYSICS

SET B

WAVE OPTICS

CLASS - XII **Time : 1½ hrs.**

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SECTION - A **8 × 1 = 8**

1. If entire Young's double-slit experiment set-up is immersed in water, then

   a) fringe width will remain unaffected b) fringe width will increase

   c) fringe width will decrease d) experiment cannot be performed in water

2. What is the shape of wavefront from distant source of light?

   a) Planar b) Spherical c) Cylindrical

   d) Depends on shape of the source

3. There are two points on same wavefront by a distance $\lambda/2$. What will be the phase difference between these two points?

   a) π b) $\pi/2$ c) $\pi/4$ d) 0

4. In Young's double-slit experiment, two coherent sources of different intensities are used to make interference pattern. Ratio of the maximum to minimum intensity of pattern is found to be 25. What will be the ratio of intensities of sources?

   a) 625 : 1 b) 9 : 4 c) 25 : 1 d) 5 : 1

5. Two identical coherent sources are used to perform interference experiment. Intensity of light at the point of maxima is found to be I_0. If one of the slits is closed, then what will be intensity of light at the same point?

   a) I_0 b) $4I_0$ c) $I_0/4$ d) $2I_0$

6. Angular width (θ) of central maximum of diffraction pattern of a single slit does not depend upon

   a) distance between slit and screen b) wavelength of light used

   c) width of the slit d) frequency of light used

For question numbers 7-8 two statements are given - one labelled Assertion (A) and the other labelled Reason (R). Select the correct answer to these questions from the codes (a), (b), (c) and (d) as given below.

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c) Assertion (A) is true but Reason (R) is false.

d) Assertion (A) is false but Reason (R) is true.

7. Assertion (A) : Energy is created in constructive interference and energy is destroyed in destructive interference.

Reason (R) : There is maximum intensity at the point of constructive interference and minimum intensity at the point of destructive interference.

8. Assertion (A) : When light ray is refracted in some other medium, then its frequency remains unchanged.

Reason (R) : Incident ray, refracted ray and normal are coplanar.

SECTION - B **2 × 2 = 4**

9. Sketch the refracted wave front emerging from a convex lens if a plane wave front is incident normally on it.

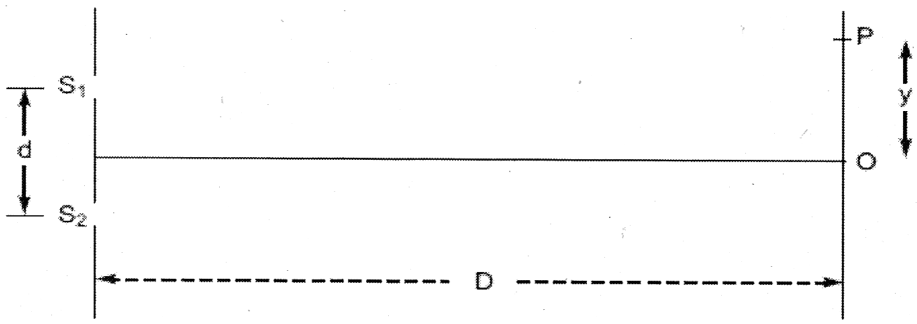
10. What is the ratio of slit widths when the amplitudes of light waves from them have a ratio 3 : 1?

OR

Radio waves can diffract easily around a window but not light waves. Give reason.

SECTION - C **3 × 3 = 9**

11. The intensity at the central maxima (O) in a Young's double slit experiment is I_0. If the distance OP equals one-third of the fringe width of the pattern, show that the intensity at point P would be $I_0/4$.



12. How will the angular separation and visibility of fringes in Young's double slit experiment change when (i) screen is moved away from the plane of the slits and (ii) width of the source slit is increased?

13. In a Young's double slit experiment the two parallel slits are made 1 mm apart and screen is placed 1m away. What is the fringe separation when blue green light of wavelength 500 nm is used?

OR

Two wavelength of sodium light 590 nm and 596 nm are used, in turn, to study the diffraction taking placed at a single slit of aperture 2×10^{-4} m. The distance between the slit and screen is 1.5 m. Calculate the separation between the positions of first maxima of diffraction pattern obtained in the two cases.

SECTION - D **2 × 5 = 10**

14. a) Define wavefront. Use Huygens' principle to verify the laws of refraction.

    b) How is linearly polarised light of obtained by the process of scattering of light? Find the Brewster angle for air - glass interface, when the refractive index of glass = 1.5.

15. a) Define a wavefront. How is it different from a ray?

    b) Depict the shape of a wavefront in each of the following cases.

       i) Light diverging from point source.

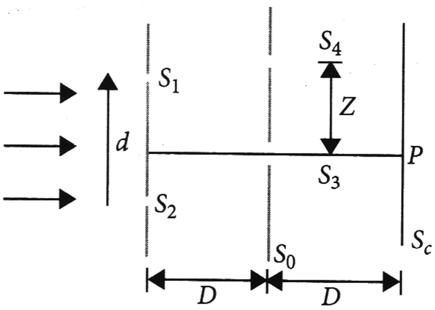
       ii) Light emerging out of a convex lens when a point source is placed at its focus.

       iii) Using Huygen's construction of secondary waveless, draw a diagram showing the passage of a plane wavefront from a denser into a rarer medium.

SECTION - E

Case Study

16. Consider the situation shown in figure. The two slits S_1 and S_2 placed symmetrically around the central line are illuminated by monochromatic light of wavelength λ. The separation between the slits is *d*. The light transmitted by the slits falls on a screen S_0 place at a distance *D* from the slits. The slits S_3 is at the central line and the slit S_4 is at a distance from S_3. Another screen S_c is placed a further distance *D* away from S_c.

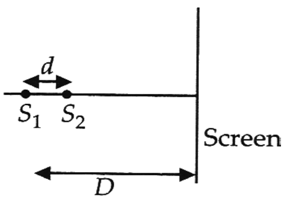


i) Find the path difference if $z = \frac{\lambda D}{2d}$. **2**

OR

Find the ratio of the maximum to minimum intensity observed on S_c if $z = \frac{\lambda D}{d}$

ii) Two coherent point sources S_1 and S_2 are separated by a small distance 'd' as shown in figure. How will be the fringes obtained on the screen. **1**



iii) In the case of light waves from two coherent sources S_1 and S_2. What will be constructive at an arbitary point P, if the path difference $S_1P - S_2P$? **1**