

# Wave Optics – Comprehensive Practice Set

## Young's DSE, Fringe Width, Angular Fringe Width, Wavefronts

NEET Pattern – Set 2

### Key Formulae:

- Fringe Width:  $\beta = \frac{\lambda D}{d}$
  - Angular Fringe Width:  $\theta = \frac{\lambda}{d}$  (in radians)
  - $n^{\text{th}}$  Bright Fringe:  $y_n = \frac{n\lambda D}{d}$
  - $n^{\text{th}}$  Dark Fringe:  $y_n = \frac{(2n - 1)\lambda D}{2d}$
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**Q1.** In Young's double-slit experiment, the angular fringe width is  $0.05^\circ$ . If the wavelength of light used is  $6000 \text{ \AA}$  and the screen is placed  $2 \text{ m}$  from the slits, the slit separation is approximately:

- (a)  $0.69 \text{ mm}$
- (b)  $0.48 \text{ mm}$
- (c)  $0.86 \text{ mm}$
- (d)  $0.34 \text{ mm}$

**Q2.** The angular fringe width in a Young's double-slit experiment is  $2 \times 10^{-3}$  radians. When the whole apparatus is immersed in a liquid of refractive index  $4/3$ , the new angular fringe width becomes:

- (a)  $1.5 \times 10^{-3} \text{ rad}$
- (b)  $2.67 \times 10^{-3} \text{ rad}$
- (c)  $1.33 \times 10^{-3} \text{ rad}$
- (d)  $3 \times 10^{-3} \text{ rad}$

**Q3.** A point source of light produces a wavefront that is:

- (a) Spherical
- (b) Cylindrical
- (c) Plane
- (d) Elliptical

**Q4.** A linear source of light (like a long straight filament lamp) produces a wavefront that is:

- (a) Cylindrical
- (b) Spherical

- (c) Plane
- (d) Parabolic

**Q5.** Light coming from a distant star (effectively at infinity) has a wavefront that is:

- (a) Plane
- (b) Spherical
- (c) Cylindrical
- (d) Conical

**Q6.** In Young's double-slit experiment, the fringe width is  $\beta$ . If the wavelength is increased by 20% and the slit separation is decreased by 25%, the new fringe width becomes:

- (a)  $1.6\beta$
- (b)  $1.2\beta$
- (c)  $0.9\beta$
- (d)  $2\beta$

**Q7.** The ratio of angular fringe width for red light ( $\lambda = 750 \text{ nm}$ ) to that for violet light ( $\lambda = 400 \text{ nm}$ ) in the same YDSE setup is:

- (a) 15 : 8
- (b) 8 : 15
- (c) 3 : 2
- (d) 2 : 1

**Q8.** In a double-slit experiment, the fringe width is 0.5 mm. The distance between the 3rd bright fringe and the 2nd dark fringe on the same side of the central maximum is:

- (a) 1.75 mm
- (b) 2.0 mm
- (c) 1.5 mm
- (d) 2.5 mm

**Q9. Assertion-Reason Type**

**Assertion (A):** In Young's double-slit experiment, if the slit separation is decreased, the fringe width increases.

**Reason (R):** The fringe width is inversely proportional to the slit separation.

- (a) Both A and R are true and R is the correct explanation of A
- (b) Both A and R are true but R is NOT the correct explanation of A
- (c) A is true but R is false
- (d) Both A and R are false

**Q10. Assertion-Reason Type**

**Assertion (A):** No interference pattern is detected when two coherent sources are

infinitely close to each other.

**Reason (R):** The fringe width is inversely proportional to the distance between the two sources.

- (a) Both A and R are true and R is the correct explanation of A
- (b) Both A and R are true but R is NOT the correct explanation of A
- (c) A is true but R is false
- (d) Both A and R are false

**Q11. Assertion-Reason Type**

**Assertion (A):** According to Huygens' principle, no backward wavefront is possible.

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

- (a) Both A and R are true and R is the correct explanation of A
- (b) Both A and R are true but R is NOT the correct explanation of A
- (c) A is true but R is false
- (d) Both A and R are false

**Q12. Assertion-Reason Type**

**Assertion (A):** When a light wave travels from rarer to denser medium, its speed decreases and therefore the energy carried by the wave also decreases.

**Reason (R):** The energy of a wave is proportional to its frequency which remains constant in all media.

- (a) Both A and R are true and R is the correct explanation of A
- (b) Both A and R are true but R is NOT the correct explanation of A
- (c) A is true but R is false
- (d) A is false and R is true

**Q13. Match the Following**

Match the following:

Column I	Column II
(A) Point source	(P) Plane wavefront
(B) Linear source	(Q) Spherical wavefront
(C) Source at infinity	(R) Cylindrical wavefront
(D) Cylindrical lens with point source	(S) Elliptical wavefront

- (a) (A)→(Q), (B)→(R), (C)→(P), (D)→(R)
- (b) (A)→(P), (B)→(Q), (C)→(R), (D)→(S)
- (c) (A)→(Q), (B)→(P), (C)→(R), (D)→(S)
- (d) (A)→(R), (B)→(Q), (C)→(P), (D)→(S)

**Q14. Match the Following**

Match the following for a YDSE setup:

Column I	Column II
(A) Fringe width $\beta$	(P) $\frac{n\lambda D}{d}$
(B) Angular fringe width	(Q) $\frac{\lambda D}{d}$
(C) $n^{\text{th}}$ bright fringe position	(R) $\frac{\lambda}{d}$
(D) $n^{\text{th}}$ dark fringe position	(S) $\frac{(2n-1)\lambda D}{2d}$

- (a) (A)→(Q), (B)→(R), (C)→(P), (D)→(S)  
 (b) (A)→(P), (B)→(Q), (C)→(R), (D)→(S)  
 (c) (A)→(Q), (B)→(R), (C)→(S), (D)→(P)  
 (d) (A)→(R), (B)→(Q), (C)→(P), (D)→(S)

**Q15.** In a Young's double-slit experiment, the intensity at a point where the path difference is  $\lambda/3$  is  $K$ . If  $I_0$  is the maximum intensity, then  $K/I_0$  equals:

- (a)  $3/4$   
 (b)  $1/2$   
 (c)  $1/4$   
 (d)  $1/\sqrt{2}$

**Q16.** The wavefront is defined as a surface in which:

- (a) All points are in the same phase of vibration  
 (b) All points have the same amplitude  
 (c) All points have the same intensity  
 (d) All points are at the same distance from the source

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## Answer Key

- Q1.** (a) 0.69 mm  
**Q2.** (a)  $1.5 \times 10^{-3}$  rad  
**Q3.** (a) Spherical  
**Q4.** (a) Cylindrical  
**Q5.** (a) Plane  
**Q6.** (a)  $1.6\beta$   
**Q7.** (a) 15 : 8  
**Q8.** (a) 1.75 mm  
**Q9.** (a) Both A and R are true and R is the correct explanation of A

- Q10. (a) Both A and R are true and R is the correct explanation of A
- Q11. (a) Both A and R are true and R is the correct explanation of A
- Q12. (d) A is false and R is true
- Q13. (a)  $(A) \rightarrow (Q)$ ,  $(B) \rightarrow (R)$ ,  $(C) \rightarrow (P)$ ,  $(D) \rightarrow (R)$
- Q14. (a)  $(A) \rightarrow (Q)$ ,  $(B) \rightarrow (R)$ ,  $(C) \rightarrow (P)$ ,  $(D) \rightarrow (S)$
- Q15. (a)  $3/4$
- Q16. (a) All points are in the same phase of vibration

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*All the best for your exam preparation!*

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