

Wave Optics — CBSE Pattern Test 2

Class 12 Physics · 90 minutes · 40 marks · Sections A–D with answer key · Narayan Gurukul Academy

Test 2 — CBSE Pattern (90 minutes, 40 marks)

Class 12 Physics · Wave Optics · Narayan Gurukul Academy (ClassApna)

General Instructions: (1) This paper has four sections — Section A (1×10), Section B (2×4), Section C (3×4) and Section D (5×2) — total 40 marks. Time allowed: 90 minutes.

(2) All questions are compulsory. No overall choice is given; internal choice, where allowed, is clearly marked.

(3) For MCQ questions choose the single correct option; for VSA answers write a single line.

(4) Take $g = 10 \text{ m/s}^2$. All symbols carry their usual meaning. Use of a calculator is not permitted.

Section A — MCQ & VSA ($10 \times 1 = 10$ marks)

- The wavefront from a distant source is
 - plane
 - spherical
 - cylindrical
 - conical
- At a bright fringe, the path difference is
 - an integral multiple of λ
 - an odd multiple of $\lambda/2$
 - zero only
 - always $\lambda/4$
- If the whole apparatus is immersed in water, the fringe width
 - decreases
 - increases
 - remains the same
 - becomes zero
- The condition for a secondary maximum in single-slit diffraction is
 - $a \sin \theta = (2m+1)\lambda/2$
 - $a \sin \theta = m\lambda$
 - $a \sin \theta = m\lambda/2$
 - $a \sin \theta = 0$
- Brewster's law states that at polarising incidence, $\tan i_p =$
 - n
 - $1/n$
 - n^2
 - $\sqrt{n}$
- A polaroid is used to
 - produce polarised light
 - produce interference
 - produce diffraction
 - disperse light
- In Young's double-slit experiment, the fringe width is directly proportional to
 - the wavelength of light

- (B) the slit separation
 - (C) $1/D$
 - (D) the intensity
8. Diffraction is the bending of light around
- (A) the edges of an obstacle
 - (B) a prism
 - (C) a lens
 - (D) a mirror
9. What is a wavefront?
10. What is polarisation of light?

Section B — Short Answer I ($4 \times 2 = 8$ marks)

11. In a YDSE the fringe width in air is 0.4 mm. Find the fringe width in water ($n = 4/3$).
12. A single slit of width 0.2 mm is illuminated by 600 nm light. Find the angular width of the central maximum.
13. Light is incident at the polarising angle on a medium of refractive index 1.5. Find the polarising angle.
14. State how the fringe width changes when the wavelength is decreased in YDSE.

Section C — Short Answer II ($4 \times 3 = 12$ marks)

15. State Huygens' principle and use it to prove the laws of reflection.
16. Distinguish between interference and diffraction.
17. Describe the diffraction of light at a single slit and derive the expression for the width of the central maximum.
18. What is polarisation? Explain how a polaroid produces polarised light and describe polarisation by scattering.

Section D — Long Answers ($2 \times 5 = 10$ marks)

19. What is polarisation of light? Explain polarisation by reflection, derive Brewster's law, and use it to show that the reflected and refracted rays are perpendicular at the polarising angle.
20. State Huygens' principle. Use it to derive the laws of reflection and refraction, and explain why the frequency of light remains unchanged on refraction.

Answer Key (Marking Scheme)

- Q1 — (A) plane. Q2 — (A) an integral multiple of λ . Q3 — (A) decreases. Q4 — (A) $a \sin \theta = (2m+1)\lambda/2$.
- Q5 — (A) n . Q6 — (A) produce polarised light. Q7 — (A) the wavelength of light. Q8 — (A) the edges of an obstacle.
- Q9 — The locus of all points in a medium that are in the same phase of vibration.
- Q10 — The restriction of the vibrations of light to a particular plane.
- Q11 — $\beta' = \beta/n = 0.3$ mm.
- Q12 — $\theta = \lambda/a = 3 \times 10^{-3}$ rad.
- Q13 — $i_p = \tan^{-1} 1.5 \approx 56.3^\circ$.
- Q14 — β is directly proportional to λ , so decreasing λ decreases β .
- Q15 — Secondary wavelets from the incident wavefront; the reflected envelope gives the law of reflection with $i = r$.
- Q16 — Interference: superposition of two wavefronts from coherent sources; diffraction: superposition of secondary wavelets from the same wavefront.

Q17 — $a \sin \theta = m\lambda$ gives minima; central maximum width = $2\lambda D/a$.

Q18 — A polaroid transmits only the component along its axis, so unpolarised light becomes polarised; scattering by molecules also polarises light (glare from the sky).

Q19 — At the polarising angle the vibration parallel to the plane of incidence is not reflected; Snell's law with $i_p + r = 90^\circ$ gives $\tan i_p = n$, so reflected and refracted rays are perpendicular.

Q20 — Huygens' construction gives $i = r$ for reflection and $\sin i / \sin r = n$ for refraction; the frequency is set by the source and is unchanged, only the speed and wavelength change in the medium.