



ANSWER BOOK

Interference and Young's double slit

Waves · Year 12

AQA 3.3.2.1 · CIE 8.3 · OCR A 4.4.3

10 questions · 30 marks

NAVY EDITION

SECTION A · Warm-up

- A1** Constructive interference: path difference = $n\lambda$. Destructive interference: path difference = $(n + \frac{1}{2})\lambda$, where n is an integer. [2]
- A2** Coherent sources have the same frequency (and wavelength) and keep a constant phase difference between them over time. [2]
- A3** $w = \lambda D/s$, where w is the fringe spacing, λ the wavelength, D the distance from the slits to the screen, and s the slit separation. [2]

SECTION B · Standard

- B1** $w = \lambda D/s = (600 \times 10^{-9} \times 1.5)/(0.50 \times 10^{-3}) = 1.8 \text{ mm}$. [4]
- B2** $\lambda = ws/D = (2.4 \times 10^{-3} \times 0.40 \times 10^{-3})/2.0 = 480 \text{ nm}$. [3]
- B3** $s = \lambda D/w = (650 \times 10^{-9} \times 1.2)/(1.3 \times 10^{-3}) = 0.60 \text{ mm}$. [3]
- B4** Second bright fringe: path difference = $2\lambda = 2 \times 600 \text{ nm} = 1200 \text{ nm} = 1.2 \mu\text{m}$. [3]

SECTION C · Stretch

- C1** $w = \lambda D/s = (500 \times 10^{-9} \times 2.0)/(0.25 \times 10^{-3}) = 4.0 \text{ mm}$. Halving s doubles w ($w \propto 1/s$), giving 8.0 mm. [4]
- C2** Coherence keeps the phase difference between the two beams constant, so the bright and dark fringes stay in fixed positions; a single wavelength gives one fringe spacing so the fringes are sharp. With white light the central fringe is white (all wavelengths meet in phase there), with coloured fringes either side that quickly overlap and wash out. [4]
- C3** The two lamps are incoherent: they emit light with a randomly and rapidly changing phase difference. The positions of constructive and destructive interference shift far too quickly to be seen, so the pattern averages out to uniform brightness. [3]