



ANSWER BOOK

Diffraction and the single slit

Waves · Year 12

AQA 3.3.2.2 · CIE 8.2 · OCR A 4.4.1

9 questions · 25 marks

NAVY EDITION

SECTION A · Warm-up

- A1** Diffraction is the spreading of a wave as it passes through a gap or around an obstacle. The spreading is greatest when the gap width is about the same size as the wavelength. [2]
- A2** A bright central maximum with much dimmer maxima either side. The central fringe is twice as wide as the others and far brighter; the outer fringes decrease in brightness with distance from the centre. [2]
- A3** The fringes spread out: the central maximum (and all the fringes) become wider. [2]

SECTION B · Standard

- B1** Diffraction is significant when the gap is comparable to the wavelength. Sound wavelengths are of the order of the door width (about a metre), so sound diffracts strongly; the wavelength of light is around 10^{-7} m, far smaller than the doorway, so its diffraction is negligible. [3]
- B2** Red light has a longer wavelength than blue, so it diffracts more. The fringes, including the central maximum, become wider and more spread out for red than for blue. [3]
- B3** The central maximum is white (all wavelengths overlap there). The side maxima are spread into colours, with blue/violet closest to the centre and red furthest out, because longer wavelengths diffract more; the fringes overlap and become less distinct further out. [3]
- B4** Most of the light energy passes near the straight-through direction, giving the central fringe its high intensity. It spans the region between the first minima on either side, which is twice the spacing of the outer fringes, so it is also twice as wide. [3]

SECTION C · Stretch

- C1** The narrower slit produces the wider central maximum, because narrower gaps diffract more. However, a narrower slit lets less light through, so although its pattern is more spread out, the overall pattern is dimmer than that from the wider slit. [3]
- C2** Laser light is monochromatic (single wavelength) and coherent, so the diffracted waves keep a constant phase relationship and the same fringe positions. This gives a sharp, well-defined pattern of a single colour rather than a blurred, overlapping one. [3]