InkPhysics

QUESTION WORKBOOK

Interference and Young's double slit

Waves · Year 12

AQA 3.3.2.1 · CIE 8.3.1, 8.3.2, 8.3.3, 8.3.4
OCR A 4.4.3(a)(i), 4.4.3(c), 4.4.3(d), 4.4.3(e), 4.4.3(f), 4.4.3(g)(i)

19 questions · 57 marks

NAVY SCREEN EDITION

inkphysics.co.uk/physics/ · youtube.com/@InkPhysics

SECTION A · Warm-up

A1 State the condition, in terms of path difference, for constructive and for destructive interference. [2]

A2 Explain what is meant by two sources being coherent. [2]

A3 State the double-slit fringe-spacing equation and name each quantity in it. [2]

A4 The fringe pattern produced in a double-slit experiment is too cramped to measure accurately. State two changes to the arrangement, without changing the light source, that would increase the fringe spacing. [2]

A5 In one version of Young's experiment, a single narrow slit is placed between a lamp and the double slits. Explain why the light leaving the two slits is coherent. [2]

A6 A point on the screen in a double-slit experiment is 2.5 wavelengths further from one slit than from the other. State and explain what is seen at this point. [2]

SECTION B · Standard

B1 In a double-slit experiment, light of wavelength 600 nm illuminates slits 0.50 mm apart, and the screen is 1.5 m away. Calculate the fringe spacing. [3]

B2 A double-slit pattern has a fringe spacing of 2.4 mm on a screen 2.0 m from slits 0.40 mm apart. Calculate the wavelength of the light. [3]

B3 Light of wavelength 650 nm produces fringes 1.3 mm apart on a screen 1.2 m from the slits. Calculate the slit separation. [3]

B4 In a double-slit experiment using 600 nm light, state the path difference at the second bright fringe from the centre, giving your answer in micrometres. [2]

B5 Two loudspeakers connected to the same signal generator emit sound of frequency 850 Hz in phase. The speed of sound in air is 340 m s^{-1}. A listener stands at a point where the distances to the two speakers differ by 0.60 m. Deduce what the listener hears at this point. [3]

B6 In a double-slit experiment, a student measures the distance across 8 fringe spacings as 21.6 mm to reduce the uncertainty. The slit separation is 0.40 mm and the screen is 1.8 m from the slits. Calculate the wavelength of the light. [3]

B7 A teacher wants double-slit fringes at least 4.0 mm apart so a class can see them. The laser wavelength is 633 nm and the slit separation is 0.30 mm. Calculate the minimum distance needed between the slits and the screen. [3]

SECTION C · Stretch

C1 In a double-slit experiment, 500 nm light and a screen distance of 2.0 m give fringes with slits 0.25 mm apart. Calculate the fringe spacing, then state and calculate the new spacing if the slit separation is halved. [4]

C2 Explain why coherent, monochromatic light is needed to see clear double-slit fringes, and describe the central fringe seen when white light is used instead. [4]

C3 Explain why a stable interference pattern is not seen when light from two separate lamps overlaps. [3]

C4 Green light of wavelength 546 nm from a filtered mercury lamp passes through double slits of separation 0.45 mm. The screen is 2.2 m from the slits. Show that the fringe spacing is about 2.7 mm. Go on to determine the number of bright fringes seen within the central 2.0 cm of the pattern, centred on the middle bright fringe. [4]

C5 A student has a laser of wavelength 650 nm, and the bench allows a maximum slit-to-screen distance of 1.4 m. Two slit pairs are available.
Slit pair P: separation 0.30 mm, slit width 0.10 mm.
Slit pair Q: separation 0.60 mm, slit width 0.10 mm.
The student needs a fringe spacing of at least 2.0 mm to measure it reliably with a ruler. Deduce which slit pair the student should use. [4]

C6 A student is given a laser of unknown wavelength, a double-slit slide with the slit separation 0.50 mm printed on it, a ruler, a tape measure and a screen. Describe how the student should determine the wavelength of the laser light. Include the measurements taken, how the wavelength is calculated from them, two ways of keeping the uncertainty small, and one relevant safety precaution. [6]