InkPhysics

QUESTION WORKBOOK

Refraction and total internal reflection

Waves · Year 12

AQA 3.3.2.3 · OCR A 4.4.2

10 questions · 29 marks

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SECTION A · Warm-up

A1 Define the refractive index of a material in terms of the speed of light. [2]

A2 Light travels at 2.0×10^{8} m s^{-1} in a glass block. Calculate the refractive index of the glass. [2]

A3 State the two conditions required for total internal reflection to occur. [2]

SECTION B · Standard

B1 A ray of light passes from air into glass of refractive index 1.5 at an angle of incidence of 40°. Calculate the angle of refraction. [3]

B2 Calculate the critical angle for a glass–air boundary where the glass has a refractive index of 1.5. [3]

B3 Light of wavelength 600 nm in air enters glass of refractive index 1.5. Calculate its wavelength and speed in the glass. [3]

B4 A ray of light travels from water (refractive index 1.33) into air, meeting the surface at an angle of incidence of 30° in the water. Calculate the angle of refraction in the air. [3]

SECTION C · Stretch

C1 An optical fibre has a core of refractive index 1.50 and a cladding of refractive index 1.40. Calculate the critical angle at the core–cladding boundary. [4]

C2 A ray inside a glass block (refractive index 1.5) strikes a face at an angle of incidence of 45°. State with a reason whether the ray is totally internally reflected or refracted out of the block. [4]

C3 Describe the structure of a step-index optical fibre and state the purpose of the cladding. [3]