

Exercise walk-through

2.3

Intensity, refraction and polarisation (statements 44–49)

Pearson Edexcel · International A-Level · Physics

Intensity needs an area conversion

- 1 **Convert** $A = 25 \times 10^{-4} = 0.0025 \text{ m}^2$
- 2 **Incident** $P = IA = 800 \times 0.0025 = 2.0 \text{ W}$
- 3 **Useful** $P_{out} = \eta P = 0.20 \times 2.0 = 0.40 \text{ W}$

Decision

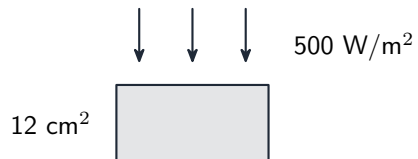
A 0.50 W device cannot run from this useful output.

Frequency and intensity change different things

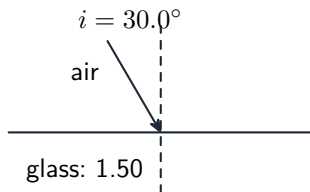
Change	Photon energy	Maximum electron energy
Intensity rises; frequency fixed	Unchanged	Unchanged
Frequency rises	Increases	Increases above threshold

Exercises 2.1·2.2

2.1 A receiver of area 12 cm^2 is perpendicular to radiation of intensity 500 W m^{-2} . Calculate incident power. If its efficiency is 15%, calculate useful power. [3]

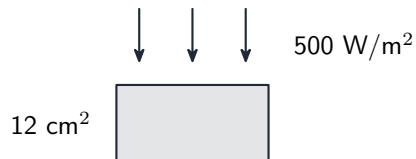


2.2 Light enters glass of index 1.50 from air at 30.0° to the normal. Calculate refraction angle. State what happens to frequency. [3]



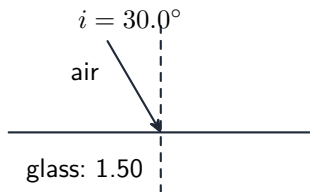
Exercises 2.1·2.2

2.1 A receiver of area 12 cm^2 is perpendicular to radiation of intensity 500 W m^{-2} . Calculate incident power. If its efficiency is 15%, calculate useful power. [3]



2.1 $A = 12 \times 10^{-4} = 0.0012 \text{ m}^2$. $P = IA = 500 \times 0.0012 = 0.60 \text{ W}$. $P_{\text{useful}} = \eta P =$

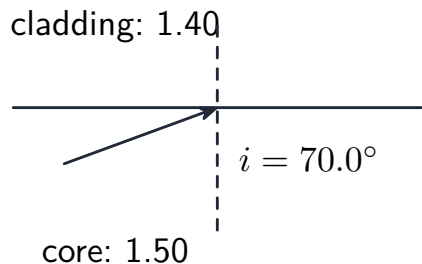
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2.2 Snell's law: $n_1 \sin i = n_2 \sin r$. $r = \sin^{-1}(\sin 30.0^\circ / 1.50) = 19.5^\circ$. Frequency stays constant.

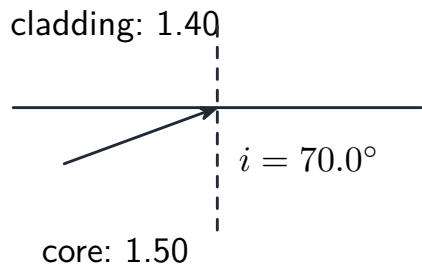
Exercise 2.3

2.3 Light travels from a core of index 1.50 to cladding of index 1.40 at 70.0° incidence. Deduce whether total internal reflection occurs. [3]



Exercise 2.3

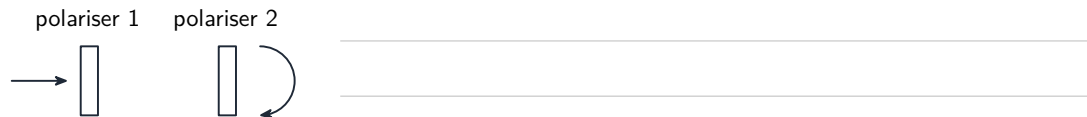
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2.3 $\sin C = n_2/n_1 = 1.40/1.50$, so $C = 69.0^\circ$. Travel is to lower index and $70.0^\circ > C$, so total internal reflection occurs.

Exercises 3.1·3.2

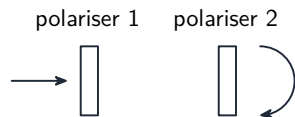
3.1 Unpolarised light passes through two ideal polarisers. Explain how brightness changes when the second rotates through 180° from parallel alignment. Explain what this shows about light. [4]



3.2 Plan a ray-box measurement of the refractive index of a rectangular block. Include ray reconstruction, angle definitions, a graph with its gradient meaning, and two measurement precautions. [6]

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3.1 The first polariser selects one transverse vibration direction. Brightness starts at maximum, reaches minimum at 90° , and returns to maximum at 180° . The second selects a direction perpendicular to the first at the minimum. This supports transverse vibration; longitudinal waves cannot be plane polarised.

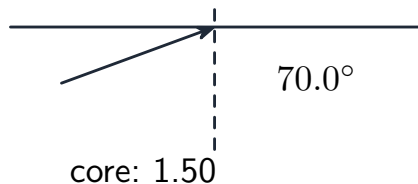
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3.2 Trace the block and mark separated points on incident/emerging rays, then remove the block and join entry/exit points to reconstruct the internal ray. Draw the entry normal and measure i, r from it. Repeat a range of incidence angles. Plot $\sin i$ against $\sin r$; the best-fit gradient is index relative to air. Narrow beam and widely separated marked points or avoiding very small angles reduce direction/percentage uncertainty.

Exercise 3.3

3.3 A fibre core has index 1.50. Its cladding index changes from 1.40 to 1.45. Calculate both critical angles. Deduce the effect on a core ray incident at 70.0° . [4]

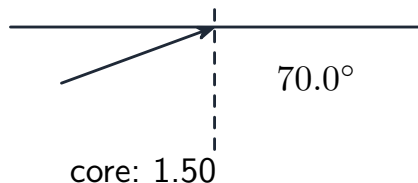
cladding: 1.40 to 1.45



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cladding: 1.40 to 1.45



3.3 $\sin C = n_{clad}/n_{core}$. Initially $C = 69.0^\circ$; finally $C = 75.2^\circ$. The ray initially undergoes total internal reflection, but afterwards $70.0^\circ < C$, so it is no longer totally internally reflected.