WJEC England Physics AS-level

2.6 Refraction

Flashcards

What is the approximate refractive index of air?

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1

When light enters a more optically dense medium does it bend towards or away from the normal?

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Towards the normal.

When does total internal reflection occur?

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When light is at a boundary to a **less** optically dense medium and the angle of incidence is greater than the critical angle.

What is the purpose of the cladding in a step index optical fibre?

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- Protects core from scratches which would allow light to escape and degrade the signal.
- Allows TIR as it has a lower refractive index than the core.

How does signal degradation by absorption in an optical fibre affect the received signal?

How does signal degradation by absorption in an optical fibre affect the received signal?

Part of the signal's energy is absorbed by the fibre so its amplitude is reduced.

State the advantages of optical fibres over traditional copper wires.

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- Signal can carry more information as light has a high frequency.
- No energy lost as heat.
- No electrical interference.
- Cheaper.
- Very fast.

What path does a light ray take when the angle of incidence is equal to the critical angle?

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It goes along the boundary ie. the angle of refraction is 90°.

What formula can be used to find the critical angle for 2 materials whose refractive indices are known?

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$\sin C = n2/n1$ where $n1 > n2$

C = critical angle

n1 = refractive index of material 1

n2 = refractive index of material 2

Find the critical angle of a water to air boundary if water has a refractive index of 1.33.

Find the critical angle of a water to air boundary if water has a refractive index of 1.33.

$\sin C = n2/n1 \quad n2 = \text{air} = 1 \quad n1 = \text{water} = 1.33$

$C = \sin^{-1}(1/1.33)$

$C = 48.8°$

Using snell's law of refraction, find the angle of refraction in a material with RI=1.53 when the angle of incidence is 32° from a material with RI=1.23.

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$$n_1 \sin i = n_2 \sin r$$

$$1.23 \sin 32 = 1.53 \sin r$$

$$\sin r = 1.23 \sin 32 / 1.53$$

$$\sin r = 0.426 \qquad r = 25.2°$$

Glass has a refractive index of 1.5, water has a refractive index of 1.33, which is more optically dense?

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Glass.

What formula is used to determine the refractive index of a material?

What formula is used to determine the refractive index of a material?

$$n = c/v$$

n = refractive index

c = speed of light in vacuum, 3×10^8 m/s

v = speed of light in material

What are multimode fibres?

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Multimode fibres are just fibres which have multiple paths of light travelling within them. Since different paths are taken, the modes (the individual paths) have varying propagation velocities. This means that the signal does not arrive at the same time and appears distorted which is called multimode dispersion. Shorter distances should be used with multimode fibres such that the effect of this is smaller. Also, you cannot have too many modes in the fibre otherwise the multimode dispersion effect will become exaggerated and so the rate of data transfer is limited.

What are monomode fibres?

What are monomode fibres?

These are optical fibres which have only a single mode which is parallel to the wire (through the centre). These have higher data transfer rates and can transfer data over much longer distances because there is little multimode dispersion (resulting from the single light ray and smaller core).