FREE REVISION PACK

Refraction & Total Internal Reflection

AQA A-level Physics · 7407 / 7408 · Specification 3.3.2.3

Easy Medium Hard **Multiple choice · past-paper questions**

7	7	≈ 10 min
QUESTIONS	TOTAL MARKS	SUGGESTED TIME*

Contents

Q	LEVEL	FOCUS	SOURCE	MARKS
1	Easy	Refractive index from a change of speed	AQA June 2018 · A-level Paper 1 · Q18	1 mark
2	Easy	Speed of light in glass	AQA June 2016 · AS Paper 2 · Q17	1 mark
3	Easy	What changes from air into glass?	AQA June 2019 · AS Paper 2 · Q20	1 mark
4	Medium	Angle of refraction into glass	AQA June 2017 · AS Paper 2 · Q24	1 mark
5	Medium	Path of a ray in a glass block	AQA June 2018 · AS Paper 2 · Q15	1 mark
6	Medium	What the cladding of an optical fibre does	AQA June 2024 · AS Paper 2 · Q21	1 mark
7	Hard	Time along a fibre with a thinner core	AQA June 2018 · AS Paper 2 · Q16	1 mark

Key ideas to have ready

- Refractive index $n = c / c_s$. Snell's law: $n_1 \sin\theta_1 = n_2 \sin\theta_2$, with angles measured from the normal.
- Entering a denser medium, speed and wavelength decrease; frequency (and photon energy) stay the same.
- Critical angle: $\sin\theta_c = n_2 / n_1$. Total internal reflection happens when light in the denser medium meets the boundary at more than θ_c.
- Optical fibres: the cladding has a lower refractive index than the core, protects the core and reduces signal loss.

How to use this pack

1. The questions are grouped into levels (Easy, Medium and Hard). Work through them in order, and check your answers at the end of each level before moving on.
2. Every question is multiple choice with one correct answer. Write down your working anyway; that is how you find mistakes.
3. The separate mark scheme uses the same numbers and explains every answer.

Levels are based on how students did in AQA's examiner reports where that information exists, plus our own difficulty rating. *About 1.5 minutes per question.

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Easy

Definitions and one-step ideas. Most students get these right.

Questions 1–3

Only **one** answer per question is allowed. For each question, completely fill in the circle alongside the appropriate answer.

AQA June 2018 · A-level Paper 1 · Q18

1 An electromagnetic wave enters a fibre-optic cable from air. On entering the cable, the wave slows down to three-fifths of its original speed.

What is the refractive index of the core of the fibre-optic cable?

[1 mark]

A 0.67 ⬭

B 1.33 ⬭

C 1.50 ⬭

D 1.67 ⬭

AQA June 2016 · AS Paper 2 · Q17

2 What is the speed of light in glass of refractive index 1.42?

[1 mark]

A $4.26 \times 10^{7}\ \text{m s}^{-1}$ ⬭

B $2.11 \times 10^{8}\ \text{m s}^{-1}$ ⬭

C $3.00 \times 10^{8}\ \text{m s}^{-1}$ ⬭

D $4.73 \times 10^{8}\ \text{m s}^{-1}$ ⬭

AQA June 2019 · AS Paper 2 · Q20

3 Which characteristics of monochromatic light change when the light passes from air into glass?

[1 mark]

A Speed, wavelength and frequency. ⬭

B Speed and frequency only. ⬭

C Speed and wavelength only. ⬭

D Wavelength and frequency only. ⬭

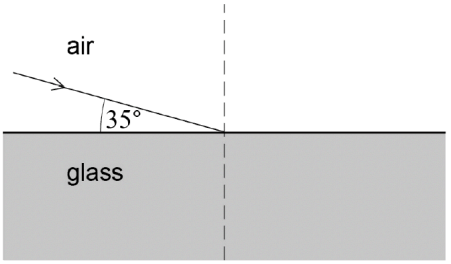
Medium

Two or three steps. Roughly a third to a half of students get these right.

Questions 4–6

AQA June 2017 · AS Paper 2 · Q24

4 The diagram shows a ray of light travelling in air and incident on a glass block of refractive index 1.5



What is the angle of refraction in the glass?

[1 mark]

A 22.5° ⬭

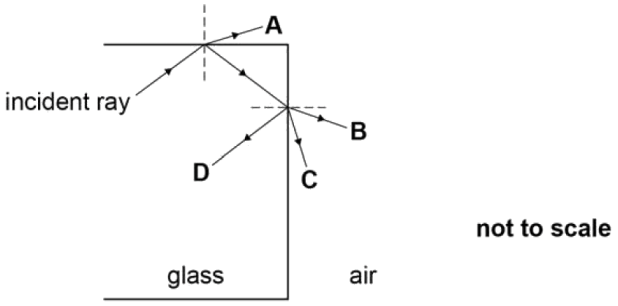
B 23.3° ⬭

C 33.1° ⬭

D 59.4° ⬭

AQA June 2018 · AS Paper 2 · Q15

5 A ray of light is incident on a glass–air boundary of a rectangular block as shown.



not to scale

The refractive index of this glass is 1.5
The refractive index of air is 1.0
The angle of incidence of the light at the first glass–air boundary is 44°

What is the path of the ray of light?

[1 mark]

A ⬭

B ⬭

C ⬭

D ⬭

AQA June 2024 · AS Paper 2 · Q21

6 The cladding of a step-index optical fibre

[1 mark]

A must not be transparent. ⬭

B must have a higher refractive index than the core. ⬭

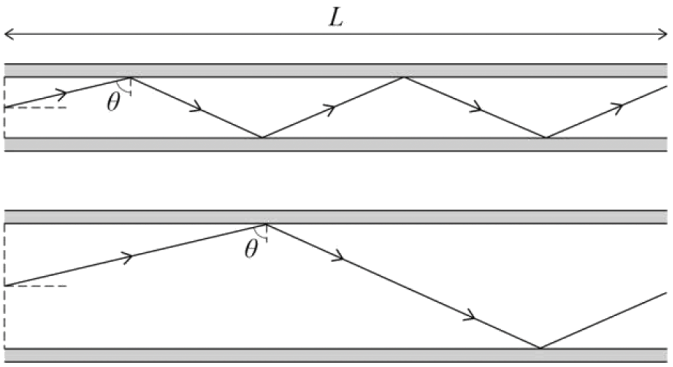
C reduces signal loss. ⬭

D reduces material dispersion. ⬭

Hard Several steps, often with a trap built in. Fewer than 3 in 10 students get these right. **Question 7**

AQA June 2018 · AS Paper 2 · Q16

7 Rays of light are incident at the same angle θ on the core–cladding boundary of optical fibres **P** and **Q**.
The cores of **P** and **Q** have the same refractive index n.
P and **Q** are the same length L.
The core diameter of **P** is half that of **Q**.



The time for the ray to travel along optical fibre **P** is

$$\frac{nL}{c\sin\theta}$$

where c is the speed of light in a vacuum.

What is the time for the ray to travel along optical fibre **Q**?

[1 mark]

A $\frac{nL}{c\sin\theta}$ ⬭

B $\frac{nL}{2c\sin\theta}$ ⬭

C $\frac{2nL}{c\sin\theta}$ ⬭

D $\frac{4nL}{c\sin\theta}$ ⬭

End of questions. Check your answers with the matching mark scheme. More free packs and 1-to-1 tuition: **www.getbetteratphysics.co.uk**