GET BETTER AT PHYSICS · MARK SCHEME

Refraction & Total Internal Reflection: tiered multiple choice

AQA A-level Physics · 7407 / 7408 · Specification 3.3.2.3 · 7 questions · 7 marks

1 mark per correct letter | Worked reasoning for every question | **How students did** = from AQA examiner reports, where available

Answer key

Q1	Q2	Q3	Q4	Q5	Q6	Q7
D	B	C	C	D	C	A

Easy

Questions 1–3

1 **D**

Refractive index from a change of speed · AQA June 2018 · A-level Paper 1 · Q18

$n = c / c_s$. The speed falls to 3/5 of c, so $n = 1 \div (3/5) = 5/3 = 1.67$.

Watch out: 0.67 (A) is upside down: refractive indices are greater than 1.

How students did: 89.2% of students got this right in June 2018.

2 **B**

Speed of light in glass · AQA June 2016 · AS Paper 2 · Q17

$c_s = c / n = 3.00 \times 10^8 \div 1.42 = 2.11 \times 10^8$ m s^{-1}.

How students did: 85% of students got this right in June 2016.

3 **C**

What changes from air into glass? · AQA June 2019 · AS Paper 2 · Q20

The light slows down, and because the frequency is fixed by the source, the wavelength gets shorter too ($\lambda = v / f$). Speed and wavelength change; frequency doesn't.

How students did: About 57% of students got this right in June 2019.

Medium

Questions 4–6

4 **C**

Angle of refraction into glass · AQA June 2017 · AS Paper 2 · Q24

The 35° is measured from the surface, so the angle of incidence is 90 − 35 = 55°. sin r = sin 55° ÷ 1.5 = 0.546, so r = 33.1°.

Watch out: Angles in Snell's law are measured from the normal. Using 35° gives 22.5° (A).

How students did: In June 2017 almost 60% of students chose A.

5 **D**

Path of a ray in a glass block · AQA June 2018 · AS Paper 2 · Q15

$\sin \theta_c = 1 / 1.5$, so $\theta_c = 41.8°$. At the first boundary 44° > 41.8°, so the light is totally internally reflected. It then meets the perpendicular face at 90 − 44 = 46°, also above θ_c, so it is reflected again: path D.

Watch out: Work out the critical angle first, then compare it with the angle at each face.

How students did: 38.1% of students got this right in June 2018.

6 **C**

What the cladding of an optical fibre does · AQA June 2024 · AS Paper 2 · Q21

The cladding protects the core from scratches and stops light crossing between touching fibres, which reduces signal loss.

> **Watch out:** The cladding must have a **lower** refractive index than the core (B is wrong), and it reduces modal, not material, dispersion.

How students did: In June 2024 this was one of the less successful questions, and a wrong answer was the most popular choice.

Hard

Question 7

7 **A**

Time along a fibre with a thinner core · AQA June 2018 · AS Paper 2 · Q16

For the same angle θ the ray zigzags at the same angle in both fibres. A narrower core means more, shorter zigzags, but the total path length is still L / sin θ. With the same n, the speed is the same, so the time is the same: nL / (c sin θ).

> **Watch out:** The core diameter changes how often the ray reflects, not the total distance travelled.

How students did: 24% of students got this right in June 2018.

End of mark scheme. Answers from AQA's published keys; explanations written for this pack. AQA material is © AQA. More free packs and 1-to-1 tuition: **www.getbetteratphysics.co.uk**

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