Solutions

Marking: **M1** a correct method, **A1** the correct answer, **B1** an independent mark.

Each answer shows the steps, then the **result**.

2.1

- angle of incidence $= 90 - 35 = 55°$
- angle of reflection $=$ **55°**

2.2

- sound needs particles (a medium) to vibrate, and space is a vacuum
- light is an electromagnetic wave, which does not need a medium

2.3

- 20 Hz to 20 000 Hz
- ultrasound is sound above 20 000 Hz, too high for humans to hear

2.4

- $T = 4 \times 0.5 = 2.0$ ms $= 0.0020$ s
- $f = 1 \div 0.0020 =$ **500** Hz

3.1

- light hits the inside surface of the glass at an angle greater than the critical angle
- it is totally internally reflected
- this happens again and again, so the light stays in the fibre even round bends

3.2

- distance travelled $= 1500 \times 0.50 = 750$ m
- this is there and back
- depth $=$ **375** m

3.3

(a) $\sin 40 = 0.643$; $\sin 25 = 0.423$; $n = 0.643 \div 0.423 =$ **1.52**

(b) $\sin c = 1 \div 1.52 = 0.658$; $c =$ **41°**; 50° is greater than the critical angle; so the ray is totally internally reflected

(c) $\sin r = \sin 60 \div 1.52 = 0.866 \div 1.52 = 0.570$; $r = 35°$; this agrees with the measured 35°

(d) points to include:

- place the block on paper and draw round it (K)
- shine a narrow ray from a ray box at the block; mark the ray going in and coming out with crosses (K)
- remove the block, join the points and draw the ray through the block (K)
- draw the normal at the point where the ray enters, at 90° to the surface (K)
- measure i and r from the normal with a protractor (K)
- repeat for several angles of incidence; use a thin ray and a dark room for accuracy (App)

Levels: **5–6** a full, logical answer with correct physics and correct terms; **3–4** several correct points, partly linked; **1–2** one or two relevant points.

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