

1: Light – Topic questions

Paper 4

The questions in this document have been compiled from a number of past papers, as indicated in the table below.

Use these questions to formatively assess your learners' understanding of this topic.

Question	Year	Series	Paper number
7	2016	June	41
7	2016	March	42
7	2016	November	41

The mark scheme for each question is provided at the end of the document.

You can find the complete question papers and the complete mark schemes (with additional notes where available) on the School Support Hub at www.cambridgeinternational.org/support

- 7 (a) (i)** A ray of light passes through a length of curved optical fibre.

Draw a diagram showing the fibre and the path of the ray of light.

[1]

- (ii)** Describe one use of optical fibres in medicine. You may draw a diagram.

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[3]

(b) Draw a straight line from each wave on the left to the most appropriate speed.

	90 m/s (9×10)
light in air	6000 m/s (6×10^3)
microwaves in a vacuum	100 000 m/s (1×10^5)
	1 000 000 m/s (1×10^6)
sound in steel	300 000 000 m/s (3×10^8)
	60 000 000 000 m/s (6×10^{10})

[3]

(c) The refractive index of a block of glass is 1.5.

Use your value for the speed of light from **(b)** to calculate the speed of light in this block.

speed = [2]

[Total: 9]

7 (a) Explain what is meant by

(i) *total internal reflection*,

.....
.....[1]

(ii) *critical angle*.

.....
.....[1]

(b) Fig. 7.1 shows a ray of light, travelling in air, incident on a glass prism.

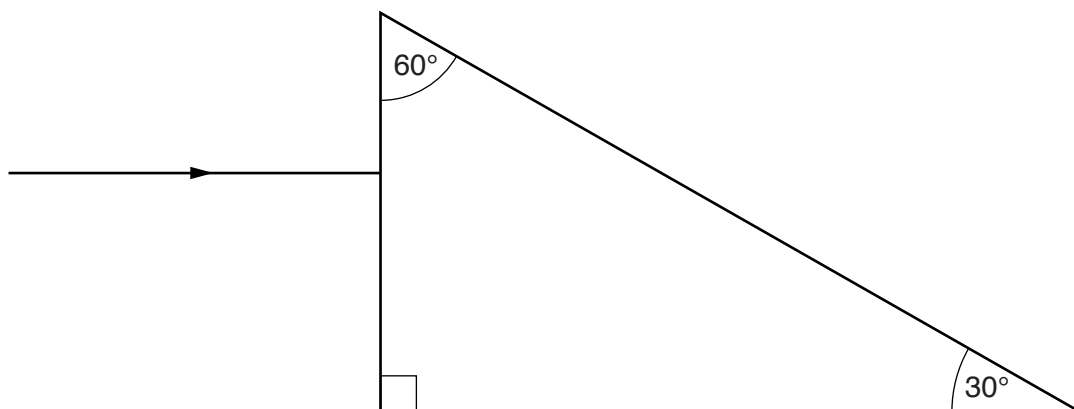


Fig. 7.1

(i) The speed of light in air is 3.0×10^8 m/s. Its speed in the glass is 2.0×10^8 m/s.

Calculate the refractive index of the glass.

refractive index =[2]

- (ii) Show that the critical angle for the glass-air boundary is 42° .

[1]

- (iii) On Fig. 7.1, draw carefully, without calculation, the continuation of the ray through the prism and into the air. [3]

[Total: 8]

7 Fig. 7.1 shows a box ABCD.

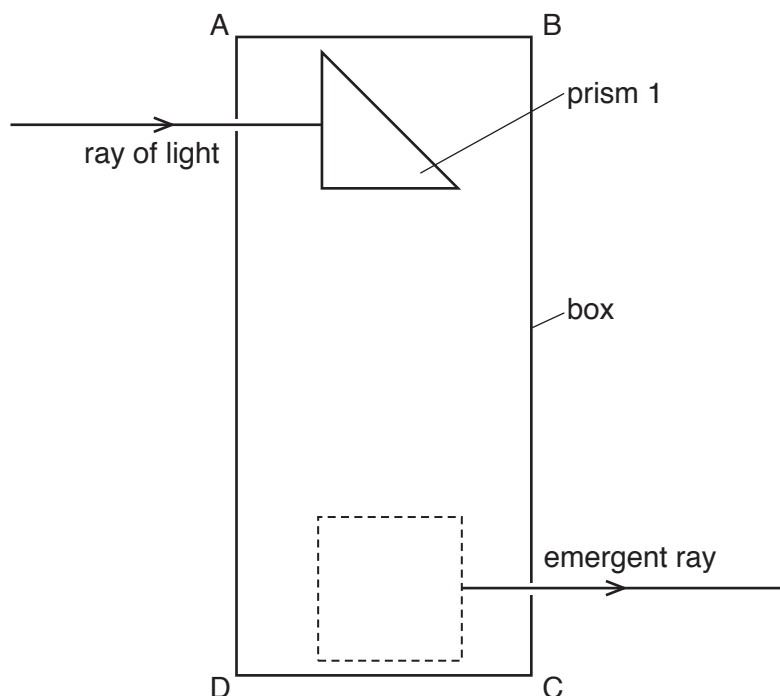


Fig. 7.1

The box contains two identical glass prisms, one of which is shown. Light incident on prism 1 undergoes total internal reflection within the glass.

- (a) (i) On Fig. 7.1, complete the path of the ray of light through prism 1. [2]
- (ii) On Fig. 7.1, draw a second prism inside the dashed square, positioned so that the light reflects inside the glass and emerges from the box as shown. Complete the path of the ray. [2]
- (b) Select the statements that correctly describe the necessary conditions for the light to undergo total internal reflection. Tick **two** boxes.

- ☐ The angle of incidence in the glass is less than the critical angle of light in the glass.
- ☐ The angle of incidence in the glass is greater than the critical angle of light in the glass.
- ☐ The angle of reflection in the glass is equal to the angle of refraction.
- ☐ The speed of light in the glass is greater than the speed of light in air.
- ☐ The speed of light in the glass is equal to the speed of light in air.
- ☐ The speed of light in the glass is less than the speed of light in air.

[2]

[Total: 6]

Question	Answer	Mark
7 (a) (i)	sketch of <u>curved</u> optic fibre with light ray undergoing at least one total internal reflection	B1
7 (a) (ii)	light travels down (optic) fibres into or out of body	B1
	to examine internal organ / part	B1
	light travels both ways into and out of body	B1
	OR	
7 (a) (ii)	to destroy (cancerous) cells	(B1)
	by heating	(B1)
	OR	
	endoscope / fibre bundle inserted into body	(B1)
7 (b)	to view internal organ body part OR for keyhole surgery	(B1)
7 (b)	Light in air: 3×10^8 m / s	B1
	Microwaves in vacuum: 3×10^8 m / s	B1
	Sound in steel: 6000 m / s	B1
7 (c)	$n = \text{speed in air} / \text{speed in glass (or rearranged)}$	C1
	OR $1.5 = 3 \times 10^8 / \text{speed in glass (or rearranged)}$	A1
	2.0×10^8 m / s	
		Total: 9
7 (a) (i)	reflection <u>in a more dense material</u> where there is no refracted ray owtte OR all light in a more dense material is reflected owtte	B1
7 (a) (ii)	e.g. the greatest angle of incidence (in the material) at which refraction occurs	B1
	OR the angle of incidence (in the material) at which the refracted B1 ray travels along the boundary / angle of refraction is 90°	
	OR the angle of incidence / (in the material) above which total internal reflection occurs	
7 (b) (i)	(refractive index =) speed of light in air / speed of light in glass	M1
	OR $3.0 \times 10^8 / 2.0 \times 10^8$	A1
	= 1.5	
7 (b) (ii)	$\sin c = 1 / n$ OR $1 / 1.5$ seen ($c = 42^\circ$)	B1
7 (b) (iii)	no change of direction at first face	B1
	total internal reflection at hypotenuse with $i = r$ by eye	B1
	refraction with r greater than i at lower face	B1
		Total: 8

Question	Answer	Mark
7 (a) (i)	ray continues through first face, without bending, to sloping face ray reflected vertically down at sloping face	M1 A1
7 (a) (ii)	prism drawn with correct orientation in square correct reflection to produce emergent ray	M1 A1
7 (b)	tick in box 2 tick in box 6	B1 B1
		Total: 6

Notes about the mark scheme are available separately.