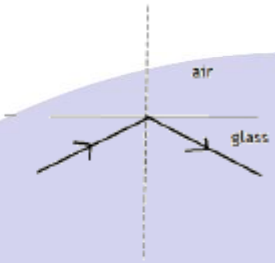
Q1.

Qustion Number	Answer	Mark
	B  **Once DTP redraw image, crop and insert here.** ***A*** *is not correct because the angle of incidence is not equal to the angle of reflection* ***C*** *is not correct because glass is more optically dense than air* ***D*** *is not correct because glass is more optically dense than air*	**(1)** **AO1**

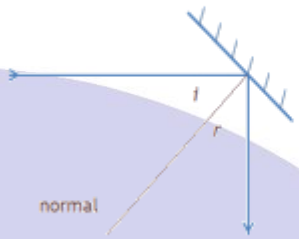
Q2.

Question Number	Answer	Acceptable answers	Mark
(a)	B 		**(1)**

Question Number	Answer	Acceptable answers	Mark
(c)	substitute and evaluate (sin c) = 1/1.7 (sin c) = 0.59 (1) from graph or calculation c = any value between 34° and 38° (1)	 0.588, 0.58, 0.6 full marks for the correct numerical answer without working	**(2)**

(Total marks for question = 8 marks)

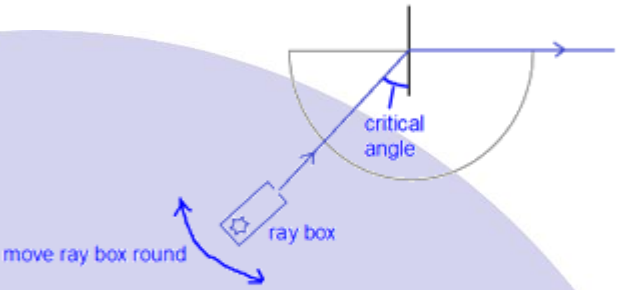
Q3.

Question number	Answer	Additional guidance	Mark
(i)	• normal drawn correctly (1) • angles of incidence and reflection shown correctly (1)		**(2)**

Question number	Answer	Additional guidance	Mark
(ii)	The critical angle must be less than 45° (1)		**(1)**

Question number	Answer	Acceptable answer	Mark
iii)	A reason which links • Total internal reflection in the prism(s) (1) • No light is scattered (1)	No light is lost / no multiple reflections	**(2)**

Q4.

Question Number	Answer	Additional guidance	Mark
	a description to include any **four** from: shine a ray (of light) into the block (1) into block through the curved face along a radius (1) {change angle / move ray(box)} until {the angle of refraction is 90°/ TIR just occurs} (1) **measure** angle of incidence {when refracted angle is 90° / when TIR just occurs} (1) repeat measurement of critical angle (1)	 credit marking points in the diagram if they are clear allow 'calculate' for 'measure' plot angle i against angle r if light only enters block at straight edge, maximum 1 mark (for MP1)	**(4)**

Q5.

	Answer	Mark
(i)	**A** The ray enters along a normal to the edge of the block. **B, C** and **D** are incorrect as these do not explain why the light ray does not change direction.	**(1)** **AO2**

	Answer	Additional guidance	Mark
(ii)	explanation linking: extrapolate / extend the graph/curve (1) (until it reaches) $r = 90°$ (1) read corresponding value of i (1)	Allow annotation on graph: extension of line on graph to at least $r = 90°$ line down from line to x axis and labelled as critical angle	**(3)** **AO2**

Q6.

Question	Answer	Additional guidance	Mark
(i)	any one from the light enters the block at 90° (to the surface of the block) (1) the light enters the block at right angles (to the surface of the block) (1) the light enters the block perpendicular (to the surface of the block) (1) the light enters (the block) along/at the normal (1) the angle of incidence (when light enters block) is 0° (1)		**1** **AO3.3**

Question	Answer	Additional guidance	Mark
(ii)	a description to include three from the following to increase the angle in the glass / angle of incidence (1) observe the refracted beam until the angle of refraction is 90° / the beam is along the edge / the beam just reflects into the glass block / the beams starts to total internally reflect (1) the angle in the glass / angle of incidence is the critical angle (1) repeat and take the average value(1)	accept move ray clockwise if no other mark scored award 1 mark	**3** **AO3.3**

		for move the ray of light	