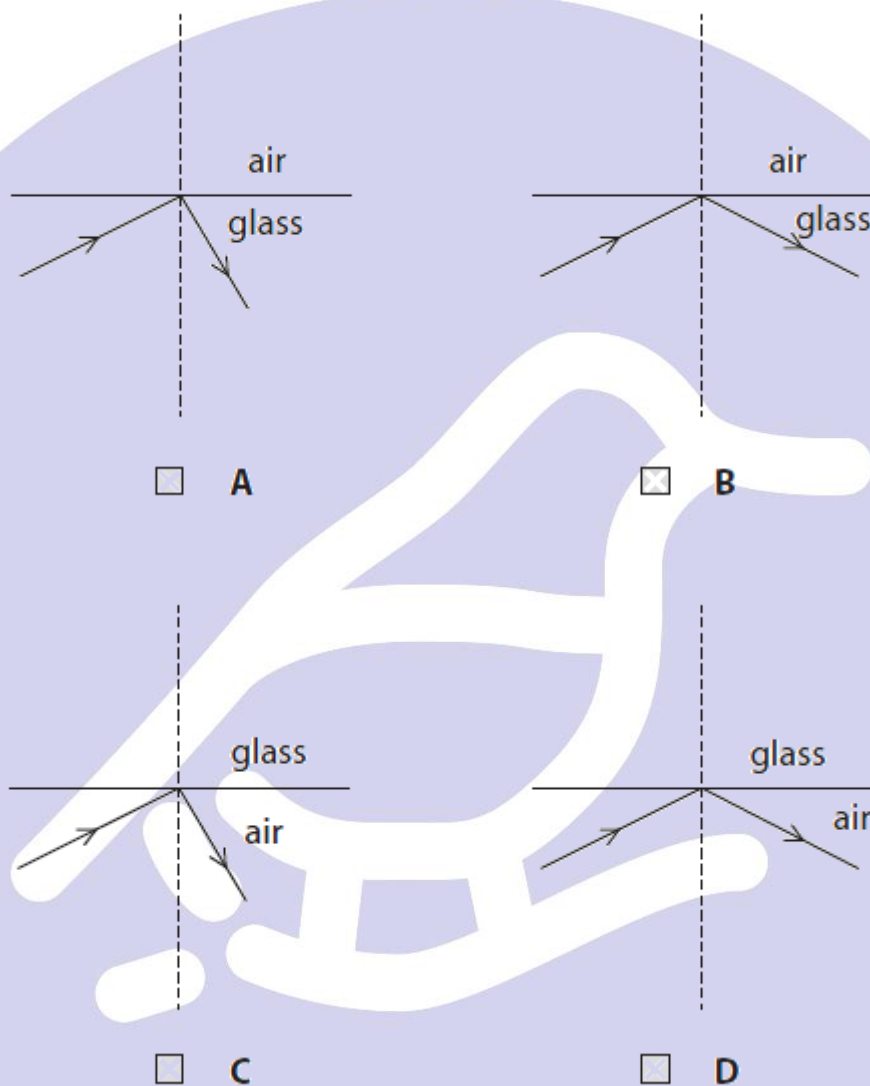


Q1.

Some questions must be answered with a cross in a box (☒). If you change your mind about an answer, put a line through the box (☒) and then mark your answer with a cross (☒).

Which ray diagram shows total internal reflection at an air and glass boundary?

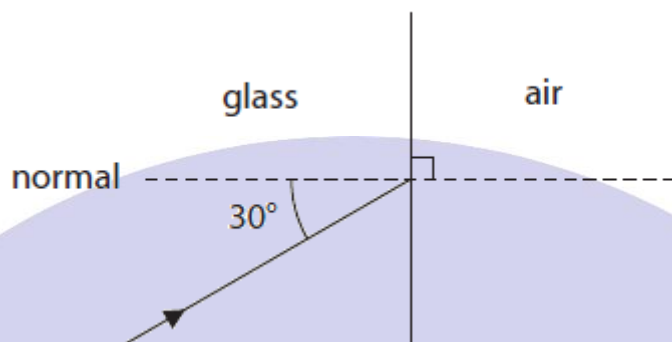
(1)



(Total for question = 1 mark)

Q2.

(a) The diagram shows a ray of light incident on a boundary between air and glass.

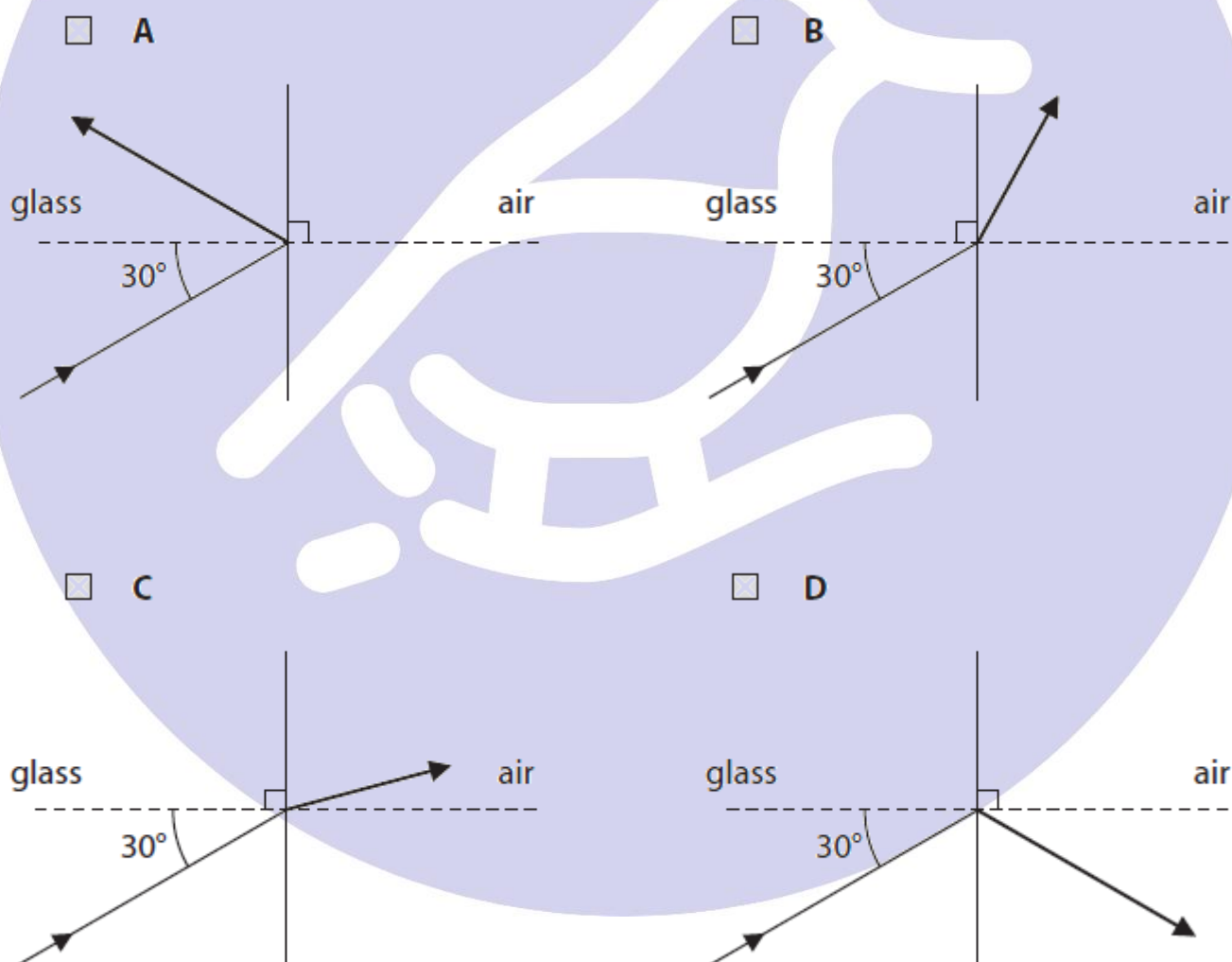


The critical angle for glass in air is 42° .

Which of these diagrams shows the ray of light after it meets the boundary between glass and air?

Put a cross (X) in the box next to your answer.

(1)



(b) The optical fibre cable in an endoscope has a refractive index of 1.70.

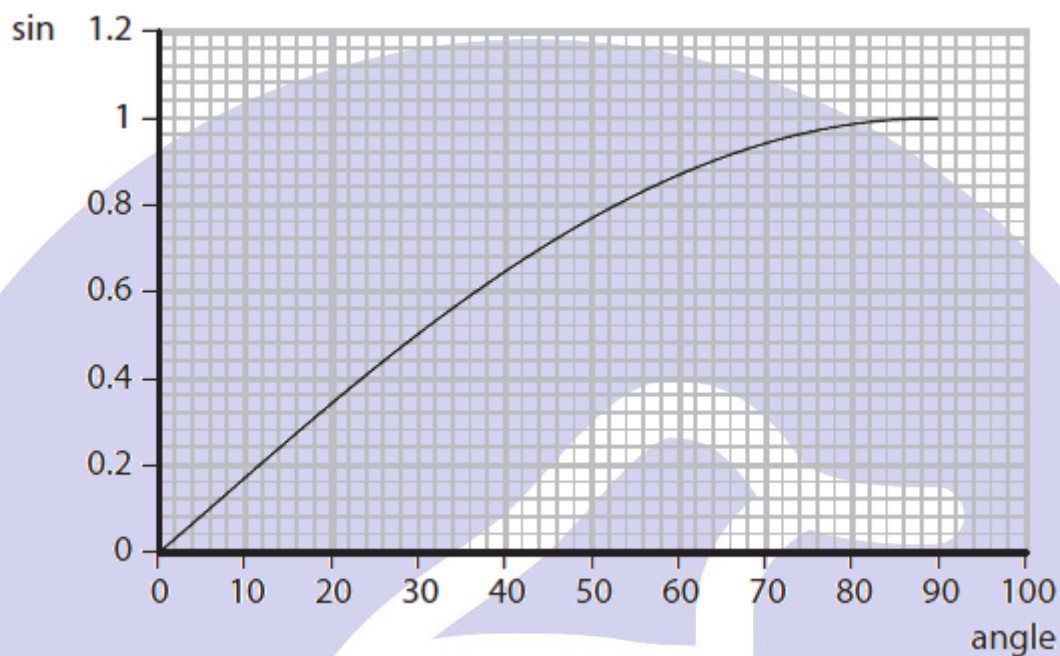
The critical angle for a material can be calculated using the equation

$$\sin c = \frac{1}{n}$$

where c is the critical angle

and n is the refractive index

The graph shows the relationship between an angle and the sine of the angle.



Use the equation and the graph to calculate the critical angle for the optical fibre.

(2)

critical angle =°

(Total for Question = 3 marks)

Q3.

A student investigates how light is reflected from a plane mirror.

Figure 4 shows part of the student's investigation.

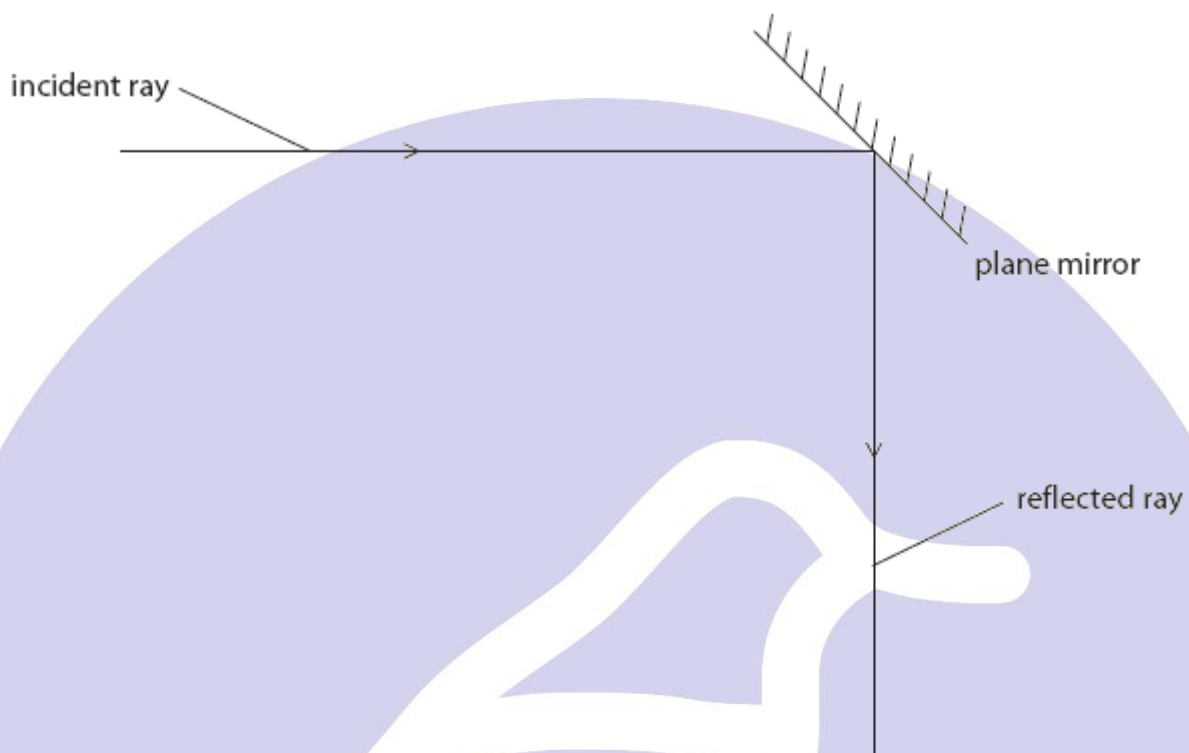


Figure 4

(i) Complete the diagram to show

- the normal
- the angle of incidence (i) and the angle of reflection (r).

(2)

(ii) Figure 5 shows a ray of light travelling through a 45° -glass prism.

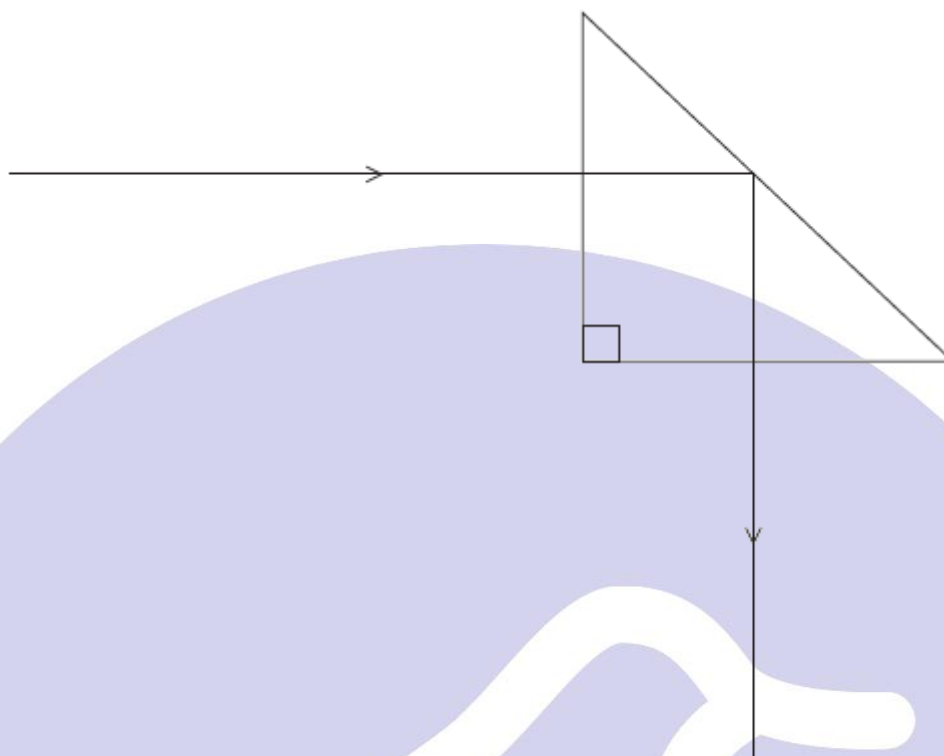


Figure 5

State what can be deduced from this diagram about the value of the critical angle for glass.

(1)

(iii) Give a reason why high quality optical instruments use prisms instead of mirrors to reflect light.

(2)

(Total for question = 5 marks)

Q4.

Figure 3 shows a semicircular glass block.

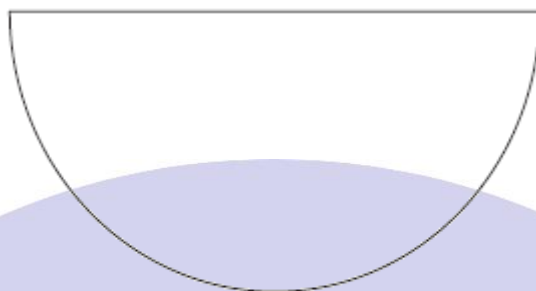


Figure 3

Describe how a student could use the semicircular glass block and other apparatus to determine the critical angle for a glass-air boundary.

You should add to the diagram in Figure 3 to help with your answer.

(4)

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(Total for question = 4 marks)

Q5.

Answer the question with a cross in the box you think is correct ☐. If you change your mind about an answer, put a line through the box ☐ and then mark your new answer with a cross ☐

A student does an experiment to determine the critical angle for glass.

The student shines a ray of light into a semicircular glass block and measures the angles i and r , as shown in Figure 14.

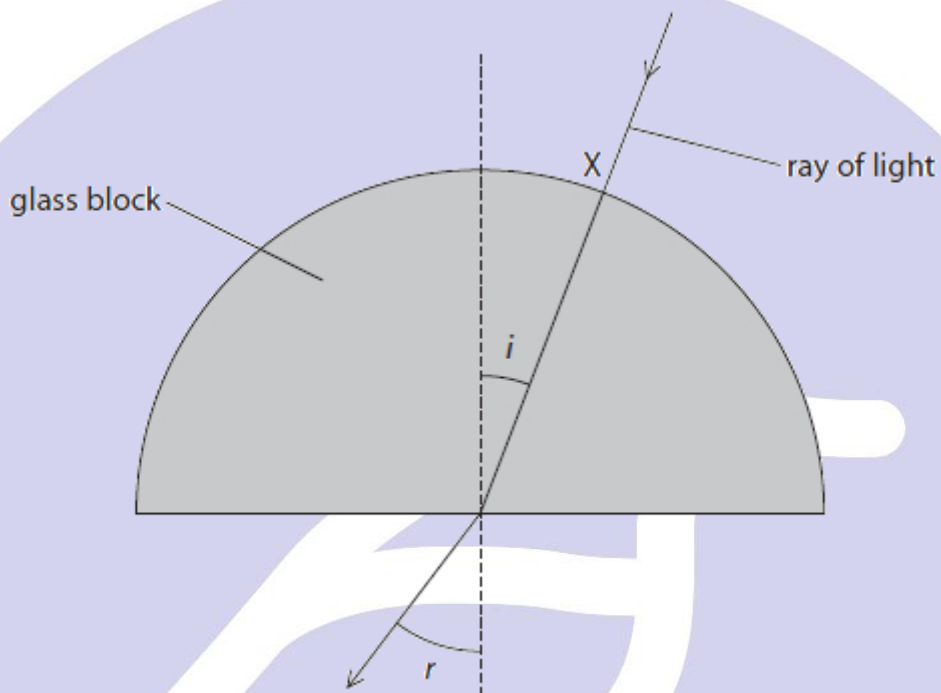


Figure 14

- (i) The ray of light does not change direction when it enters the glass block at point X.

Which of these **explains** why the ray of light does not change direction when it enters the glass block at point X.

- ☐ A The ray enters along a normal to the edge of the block.
- ☐ B The ray enters at right angles to a normal to the edge of the block.
- ☐ C The ray speeds up as it enters the glass.
- ☐ D The ray slows down as it enters the glass.

(1)

(ii) The student repeats the procedure for different values of angle i .

Figure 15 is a graph of the student's results.

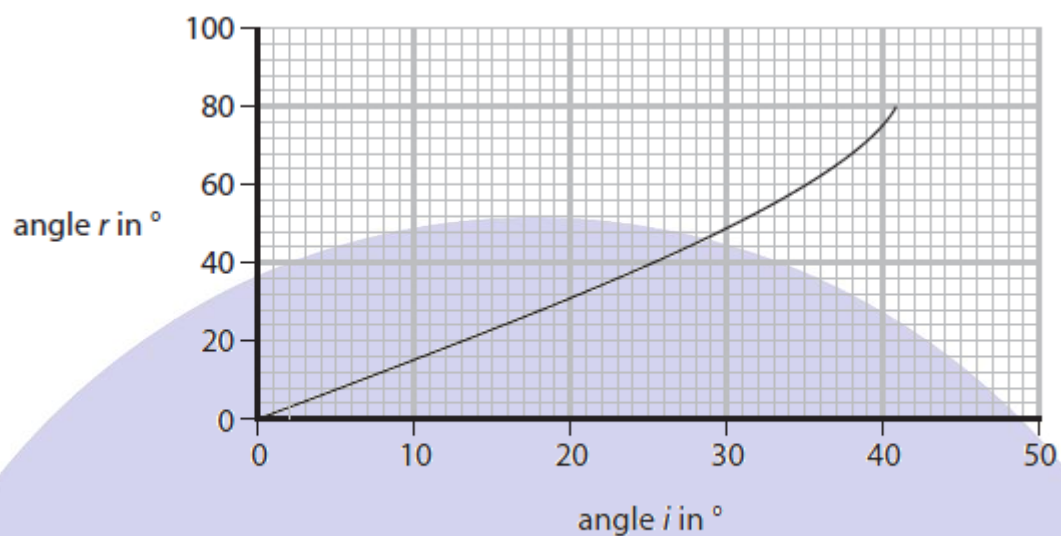


Figure 15

Describe how the student should use the graph in Figure 15 to determine the critical angle for glass.

(3)

(Total for question = 4 marks)

Q6.

Figure 9 shows a ray of light from a ray box passing through a semi-circular glass block.

A student uses the apparatus in Figure 9 to determine the critical angle for glass.

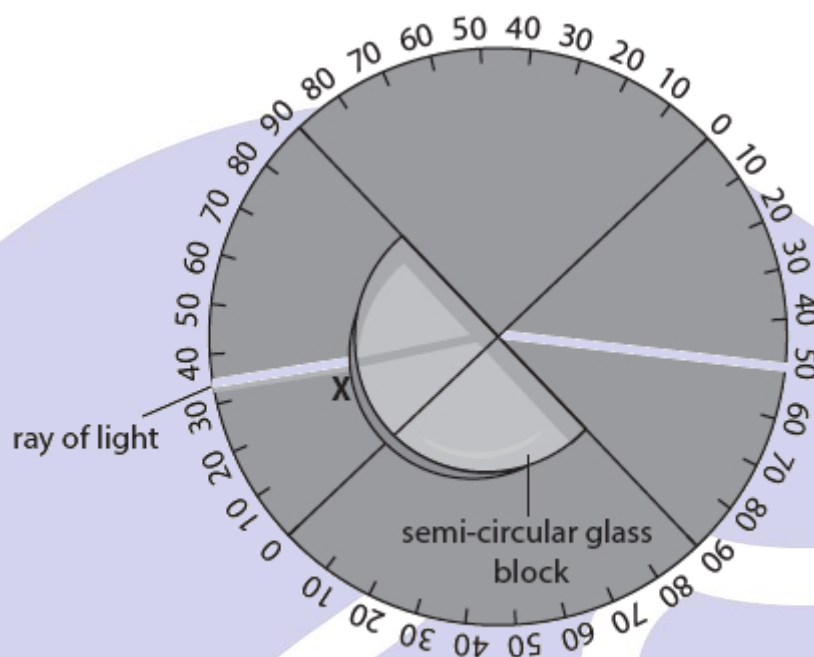


Figure 9

- (i) State why the ray of light does not change direction as it enters the glass block at X.

(1)

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- (ii) Describe how the critical angle for glass can be determined using the apparatus shown in Figure 9.

(3)

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(Total for question = 4 marks)