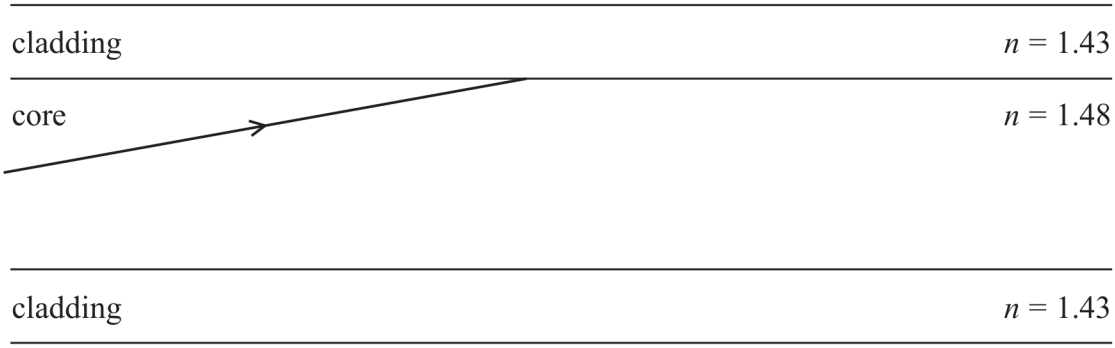
16 An optical fibre consists of a core material surrounded by a material of lower refractive index called cladding.

A ray of light approaches the boundary between the core and the cladding, as shown.



(a) (i) Show that the critical angle for light incident on the boundary between the core and cladding is about 75°.

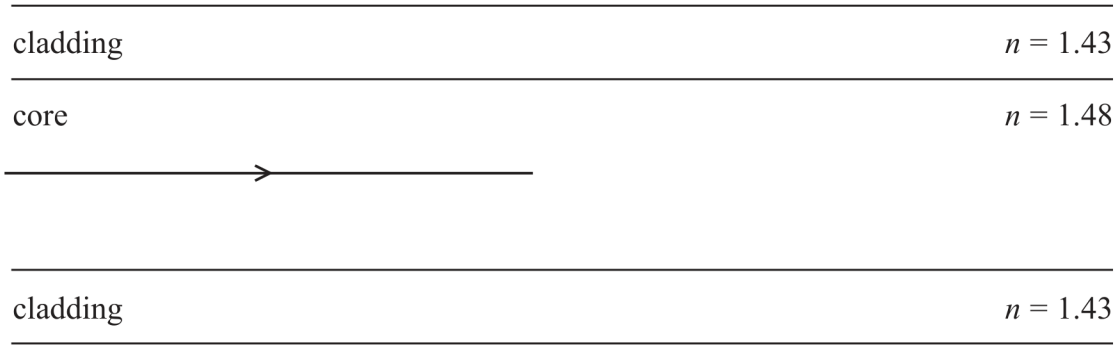
(3)

(ii) Explain what will happen to the ray of light after it meets the boundary between the core and cladding.

The diagram is drawn to scale and you should use a measurement taken from the diagram.

(3)

(b) The path of another ray of light through the core of the optical fibre is shown.



(i) Calculate the time taken for light to travel in a straight line along 70.0 km of this optical fibre.

(3)

Time taken = ...

(ii) Light may escape from the core into the cladding when the optical fibre is curved.

A student suggests that using cladding with a lower refractive index would lead to less light escaping from the core.

Explain why the student's suggestion is correct.

(2)

(Total for Question 16 = 11 marks)