

Endoscope - Medical Physics Option

1. Bundles of optical fibres are described as either *coherent* or *non-coherent*.

(a) Describe how the fibres are arranged in each type of bundle and explain how the different designs determine their optical characteristics.

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(2)

(b) State an application for each type of bundle.

application of *coherent* bundle

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application of *non-coherent* bundle

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(2)

(c) (i) Give **two** advantages of a bundle consisting of fibres of very small diameter over a bundle consisting of larger fibres.

advantage 1

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advantage 2

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(ii) Give **two** reasons why a glass cladding is used around the central core of each fibre in a coherent bundle.

reason 1

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reason 2

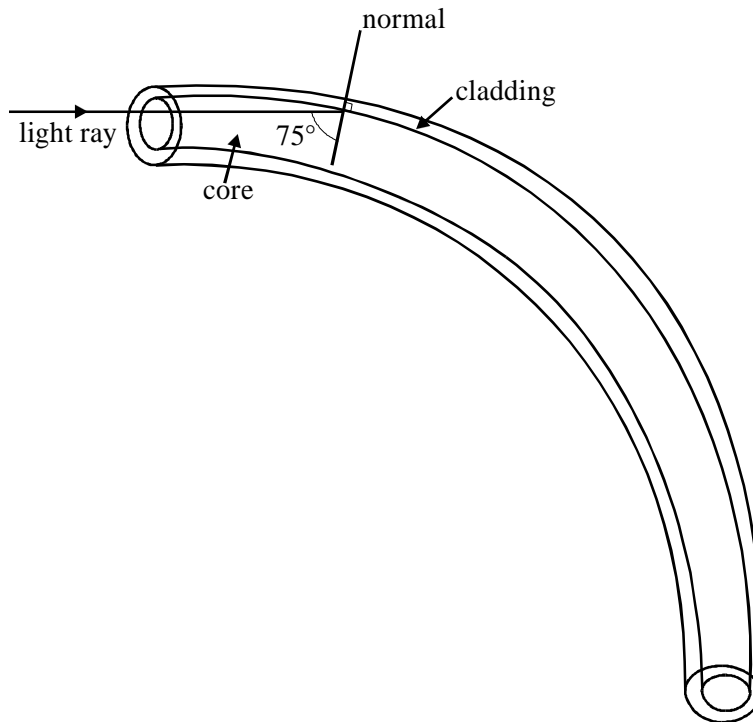
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(4)

(Total 8 marks)

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2. The diagram shows a glass optical fibre with a central core of refractive index 1.55 and a surrounding cladding of refractive index 1.40.



- (a) Calculate the critical angle, C , for the boundary between these two types of glass.

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(3)

- (b) Complete the path of the light ray shown in the diagram.

(2)

- (c) State and explain whether the following changes in the optical fibre would increase or decrease the probability of light escaping from the fibre.

- (i) increasing the refractive index of the cladding

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- (ii) bending the fibre into a tighter curve

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(3)
(Total 8 marks)

3. An endoscope uses coherent and non-coherent optical fibre bundles.

- (i) Describe the difference in structure between coherent and non-coherent bundles.

You may be awarded marks for the quality of written communication in your answer.

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- (ii) State the use of:

the coherent bundle

the non-coherent bundle

- (iii) The fibres in the coherent bundle have very small diameters. State **two** advantages of using small diameter fibres.

advantage 1

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advantage 2

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(Total 6 marks)

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4. (a) State and explain **two** physical properties of the light produced by a laser which makes it different from the light produced by a filament lamp.

property 1.....

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property 2.....

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(3)

- (b) An endoscope may use light from a filament lamp and light from a laser.

State

- (i) the use of the light from a filament lamp,

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- (ii) a use of the light from a laser.

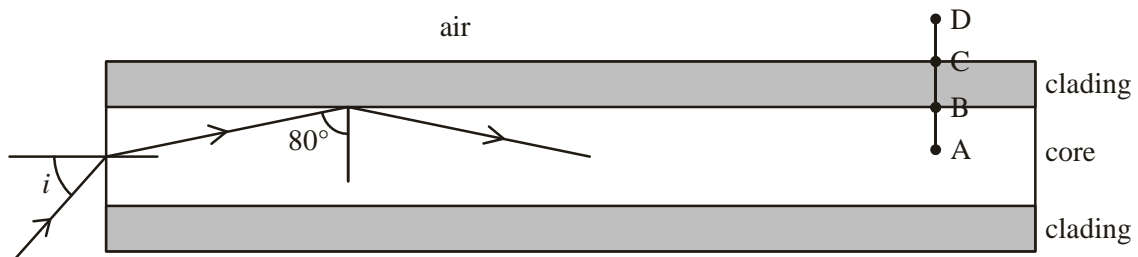
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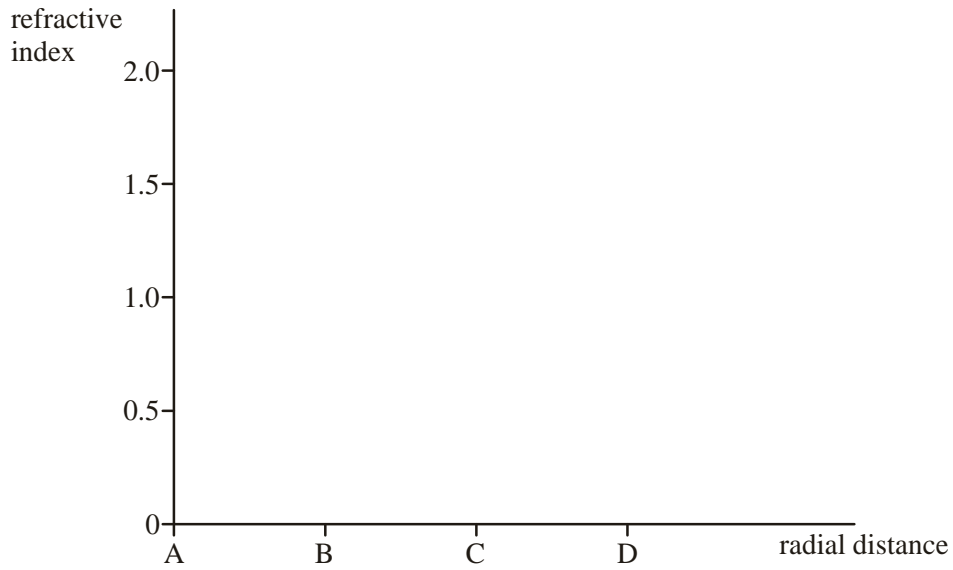
(2)

- (c) The figure below shows a cross-section through an optical fibre used in an endoscope. The core is made from glass of refractive index 1.5.



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- (i) Complete the graph below to show how the refractive index changes with radial distance along the line ABCD in the figure above.



- (ii) Calculate the value of the angle of incidence, i , shown in the figure above.

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(4)
(Total 9 marks)