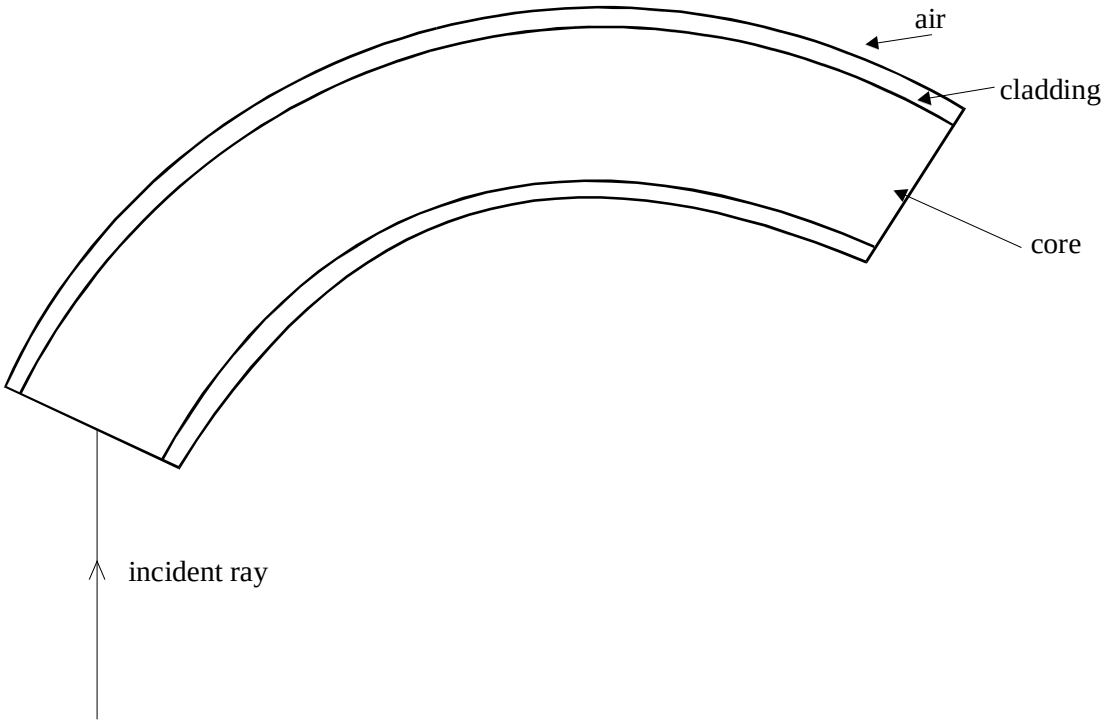
Refraction and Total Internal Reflection – Past Paper Questions

1. (a) The diagram shows a 'step index' optical fibre. A ray of monochromatic light, in the plane of the paper, is incident in air on the end face of the optical fibre as shown in the diagram.



(i) Draw on the diagram the complete path followed by the ray until it emerges at the far end.

(ii) Name the process which occurs as the ray enters the end of the optical fibre.

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(iii) The core has a refractive index of 1.50, clad in a material of refractive index 1.45. Calculate the critical angle of incidence at the core-cladding interface.

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(7)

(b) (i) Give **one** reason why a cladding material is used in an optical fibre.

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(ii) In part (a)(iii), the cladding material has a refractive index of 1.45. Explain why it would be advantageous to use cladding material of refractive index less than 1.45.

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(3)

(c) State **one** use of optical fibres.

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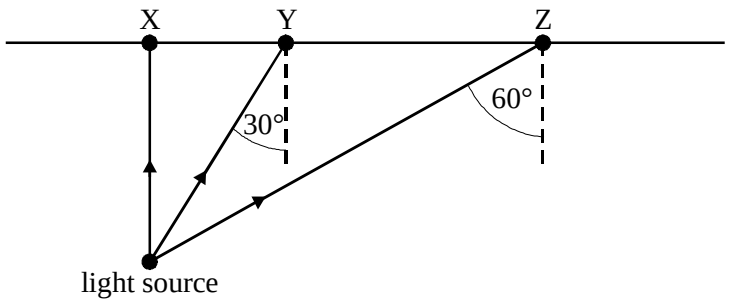
(1)

(Total 11 marks)

2. A small intense light source is 1.5 m below the surface of the water in a large swimming pool, as shown in the diagram.



(i) Complete the paths of rays from the light source which strike the water surface at X, Y and Z.

(ii) Calculate the diameter of the disc through which light emerges from the surface of the water.

speed of light in water = 2.25×10^8 m s^{-1}
speed of light in air = 3.00×10^8 m s^{-1}

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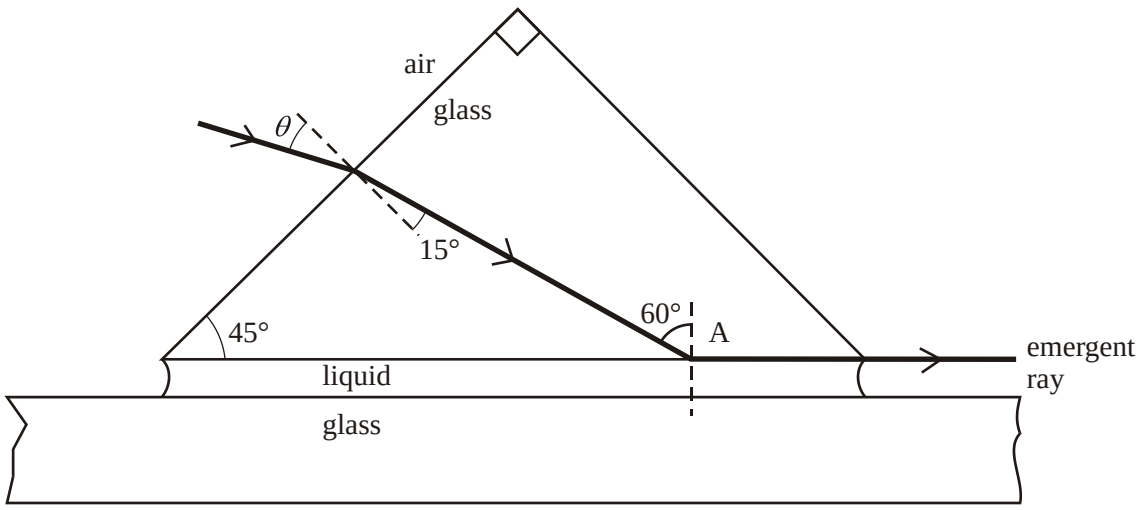
(Total 7 marks)

3. The diagram, which is not to scale, shows the cross-section of a 45° right angled glass prism supported by a film of liquid on a glass table. A ray of monochromatic light is incident on the prism at an angle of incidence θ and emerges along the glass - liquid boundary as shown.
refractive index of glass = 1.5



(a) Calculate the speed of light in the glass.

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(2)

(b) Determine

(i) the angle of incidence, θ,

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(ii) the refractive index of the liquid.

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(5)

(c) The liquid is now changed to one with a lower refractive index. Draw a possible path for the ray beyond the point A and into the air.

(2)
(Total 9 marks)