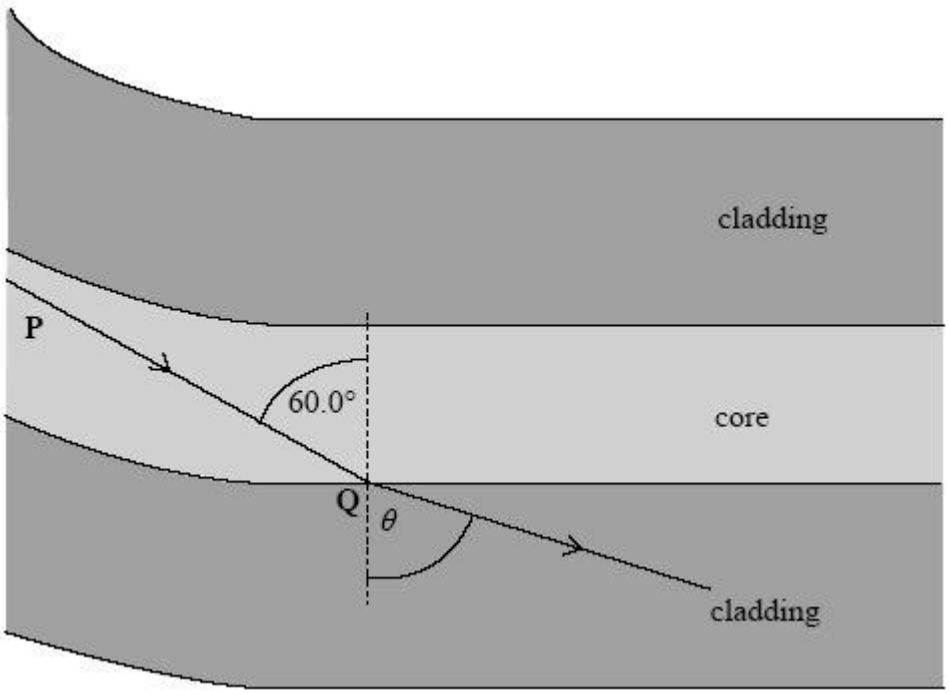
Name of the Student:_____
Max. Marks : 18 Marks **Time : 18 Minutes**

Q1.

An optical fibre used for communications has a core of refractive index 1.55 which is surrounded by cladding of refractive index 1.45.



(a) The diagram above shows a light ray **P** inside the core of the fibre. The light ray strikes the core-cladding boundary at **Q** at an angle of incidence of 60.0°.

(i) Calculate the critical angle of the core-cladding boundary.

answer _____ degrees

(3)

(ii) State why the light ray enters the cladding at **Q**.

_____

_____

(1)

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(iii) Calculate the angle of refraction, θ, at **Q**.

answer _____ degrees

(3)

(b) Explain why optical fibres used for communications need to have cladding.

_____

_____

_____

_____

_____

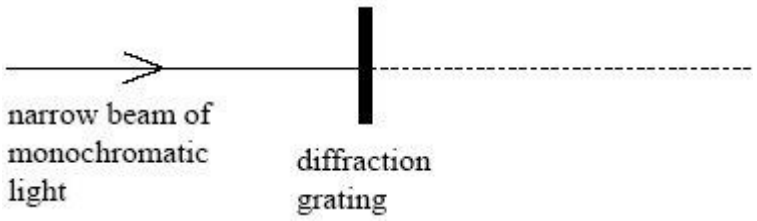
_____

(2)

(Total 9 marks)

Q2.

A narrow beam of monochromatic light of wavelength 590 nm is directed normally at a diffraction grating, as shown in the diagram below.



(a) The grating spacing of the diffraction grating is 1.67×10^{-6} m.

(i) Calculate the angle of diffraction of the second order diffracted beam.

answer _____ degrees

(4)

(ii) Show that no beams higher than the second order can be observed at this wavelength.

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(3)

(b) The light source is replaced by a monochromatic light source of unknown wavelength.
A narrow beam of light from this light source is directed normally at the grating.
Measurement of the angle of diffraction of the second order beam gives a value of 42.1°.

Calculate the wavelength of this light source.

answer _____ m

(2)

(Total 9 marks)

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