Past Paper Questions – Waves Name ……

1. Explain the differences between an undamped progressive transverse wave and a stationary transverse wave, in terms of (i) amplitude, (ii) phase and (iii) energy transfer.

(i) amplitude

progressive wave .....

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stationary wave .....

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(ii) phase

progressive wave .....

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stationary wave .....

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(iii) energy transfer

progressive wave .....

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stationary wave .....

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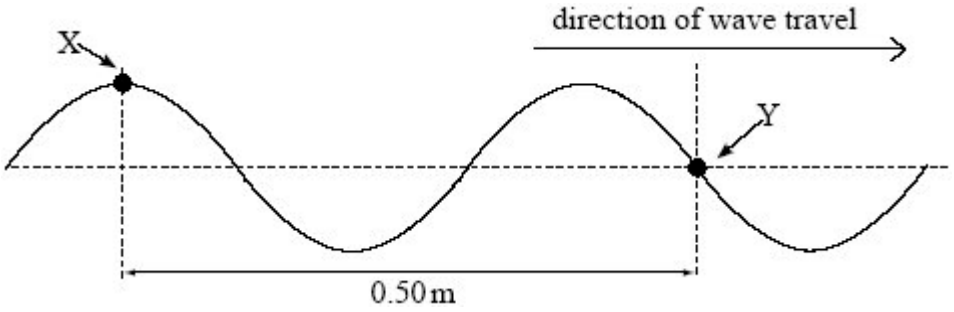
(Total 5 marks)

2. (a) The diagram below represents a progressive wave travelling from left to right on a stretched string.



(i) Calculate the wavelength of the wave.

answer ..... m

(1)

(ii) The frequency of the wave is 22 Hz. Calculate the speed of the wave.

answer.....m s^{-1}

(2)

(iii) State the phase difference between points X and Y on the string, giving an appropriate unit.

answer .....

(2)

(b) Describe how the displacement of point Y on the string varies in the next half-period.

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(2)

(Total 7 marks)

3. (a) For a sound wave travelling through air, explain what is meant by *particle displacement, amplitude* and *wavelength.*

Particle displacement.....

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amplitude .....

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wavelength.....

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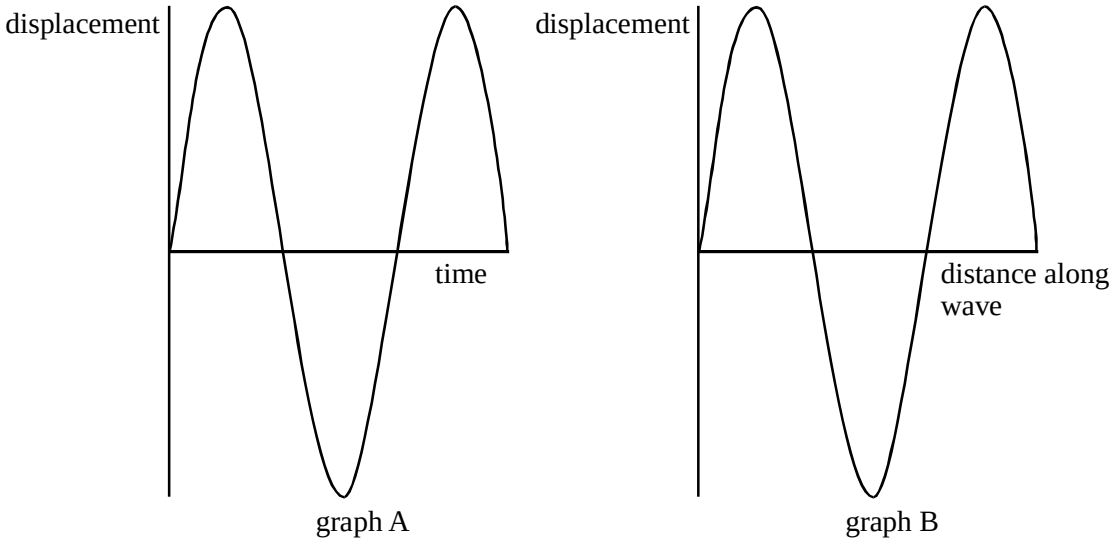
(4)

(b)



Graph A shows the variation of particle displacement with **time** at a point on the path of a progressive wave of constant amplitude.

Graph B shows the variation of particle displacement with **distance** along the same wave at a particular instant.

(i) Show on graph A

(1) the wave amplitude, *a*,

(2) the period, *T*, of the vibrations providing the wave.

(ii) Show on graph B

(1) the wavelength of the wave, λ,

(2) two points, P and Q, which are always $\pi/2$ out of phase.

(4)
(Total 8 marks)

4. (a) State the conditions that are necessary for the formation of a stationary wave.

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

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(2)

(b)

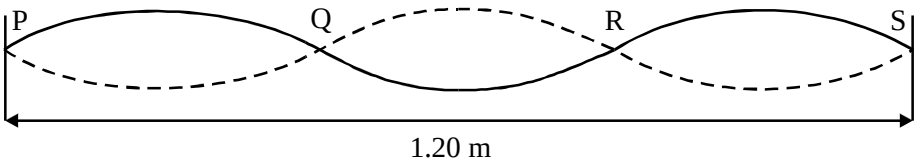

Figure 1

The diagram represents a stationary wave on a stretched string. The continuous line shows the position of the string at a particular instant when the displacement is a maximum. P and S are the fixed ends of the string. Q and R are the positions of the nodes. The speed of waves on the string is 200 m s^{-1}.

(i) State the wavelength of the waves on the string.

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(ii) Calculate the frequency of vibration.

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(iii) Draw on the diagram the position of the string 3.0 ms later than the position shown. Explain below how you arrive at your answer.

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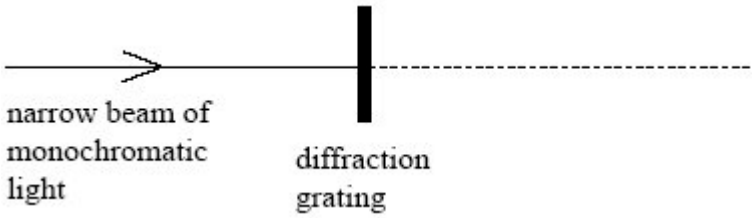
(5)
(Total 7 marks)

5. 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.

(3)

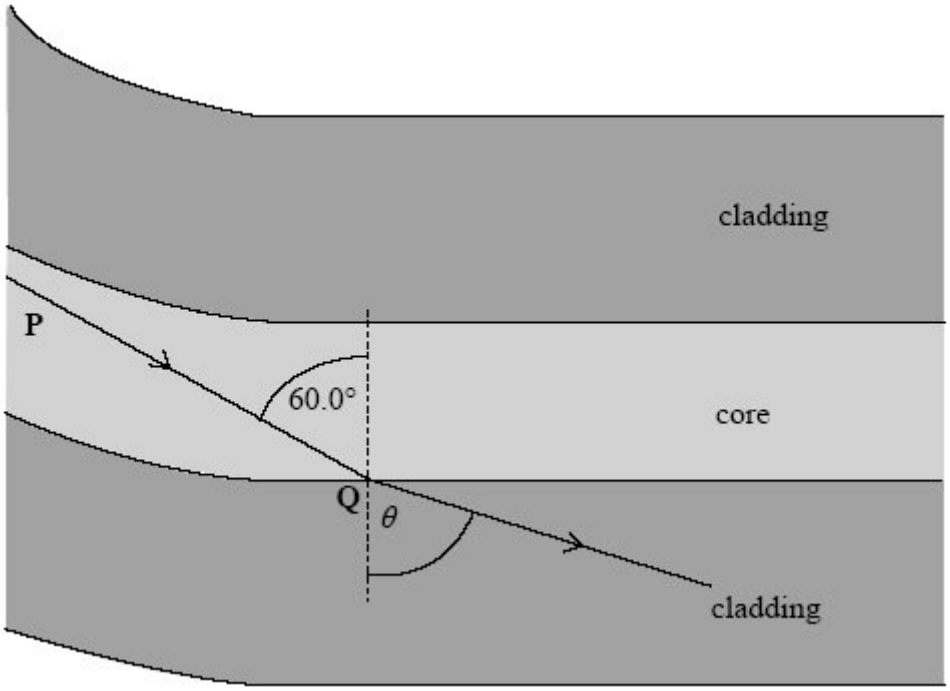
(b) The light source is replaced by a monochromatic light source of unknown wavelength.
A narrow beam of light from this light source is directed normally at the grating.
Measurement of the angle of diffraction of the second order beam gives a value of 42.1°.

Calculate the wavelength of this light source.

answer ..... m

(2)
(Total 9 marks)

6. 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**.

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(1)

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

answer ..... degrees

(3)

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

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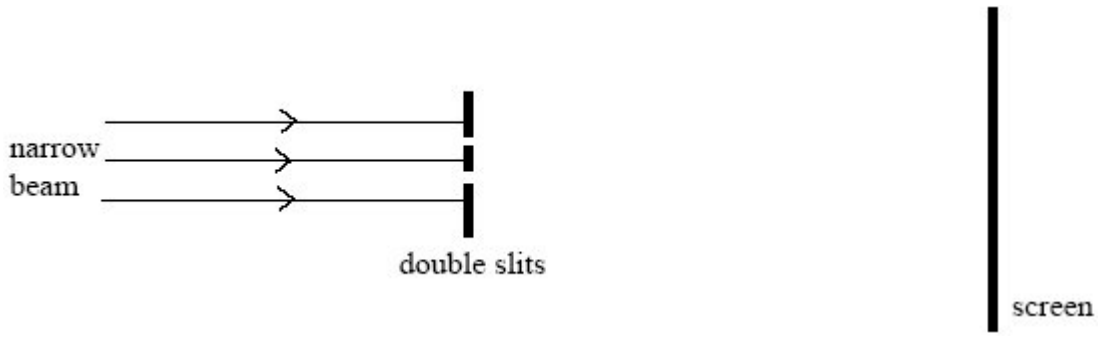
(2)

(Total 9 marks)

7. A narrow beam of monochromatic red light is directed at a double slit arrangement. Parallel red and dark fringes are seen on the screen shown in the diagram above.



(a) (i) Light passing through each slit spreads out. What is the name for this effect?

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(1)

(ii) Explain the formation of the fringes seen on the screen.

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(4)

(iii) The slit spacing was 0.56 mm. The distance across 4 fringe spacings was 3.6 mm when the screen was at a distance of 0.80 m from the slits. Calculate the wavelength of the red light.

Answer ..... m

(4)

(b) Describe how the appearance of the fringes would differ if white light had been used instead of red light.

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(3)

(Total 12 marks)