Diffraction & Interference PPQs Name .....

1. (a) A helium-neon laser produces monochromatic light of wavelength 632.8 nm which falls normally on a diffraction grating. A first order maximum is produced at an angle of 18.5° measured from the normal to the grating.

Calculate

(i) the number of lines per metre on the grating,

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(ii) the highest order which is observable.

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(6)

(b) When the grating is used with a different monochromatic source, the first order maximum is observed at an angle of 17.2°

Calculate the wavelength of this second source.

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(2)
(Total 8 marks)

2. (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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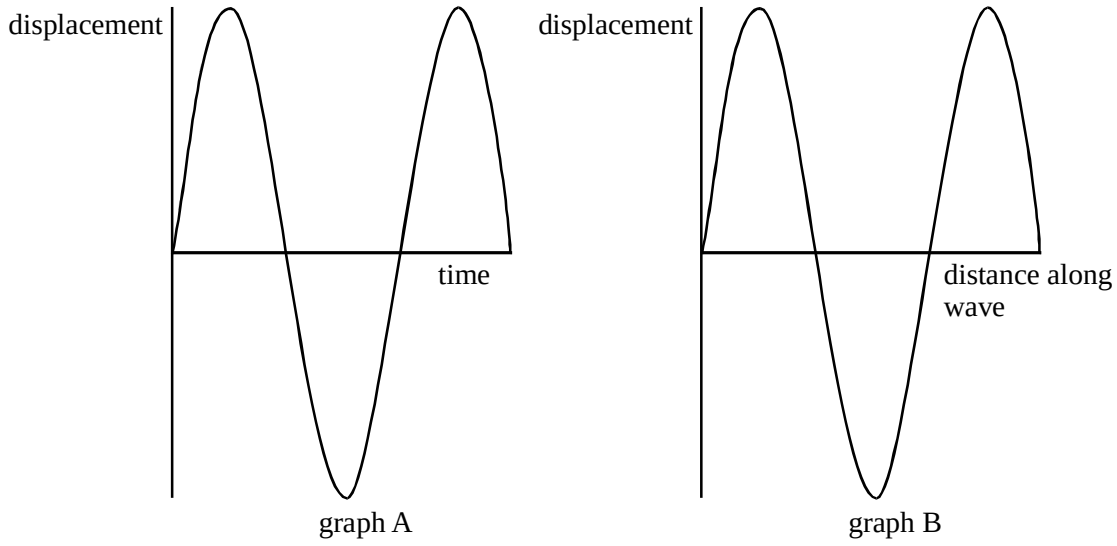
(4)

(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.

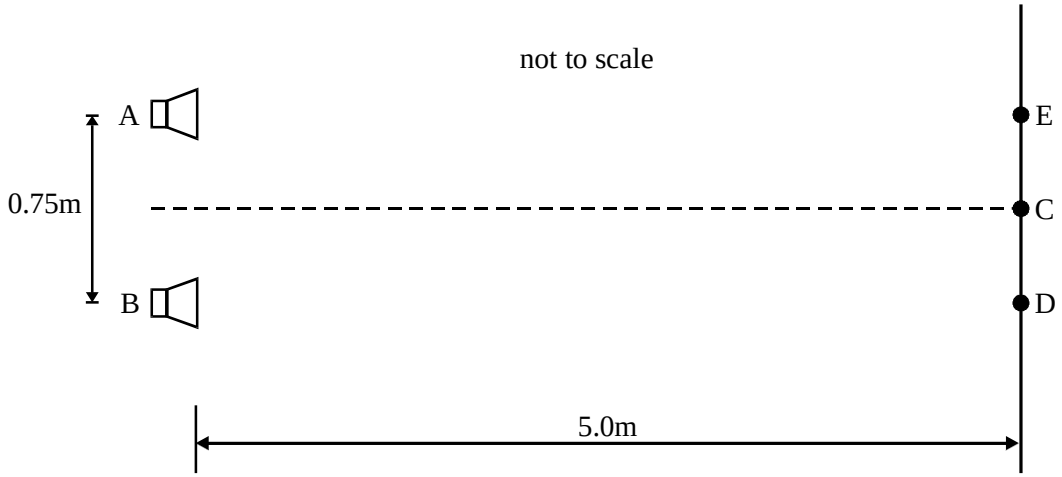
(ii) Show on graph B

(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)

3. The diagram shows two identical loudspeakers, A and B, placed 0.75 m apart. Each loudspeaker emits sound of frequency 2000 Hz.



Point C is on a line midway between the speakers and 5.0 m away from the line joining the speakers. A listener at C hears a maximum intensity of sound. If the listener then moves from C to E or D, the sound intensity heard decreases to a minimum. Further movement in the same direction results in the repeated increase and decrease in the sound intensity.
speed of sound in air = 330 m s^{-1}

(a) Explain why the sound intensity

(i) is a maximum at C,

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(ii) is a minimum at D or E.

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(4)

(b) Calculate

(i) the wavelength of the sound,

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(ii) the distance CE.

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(4)
(Total 8 marks)

4. (a)

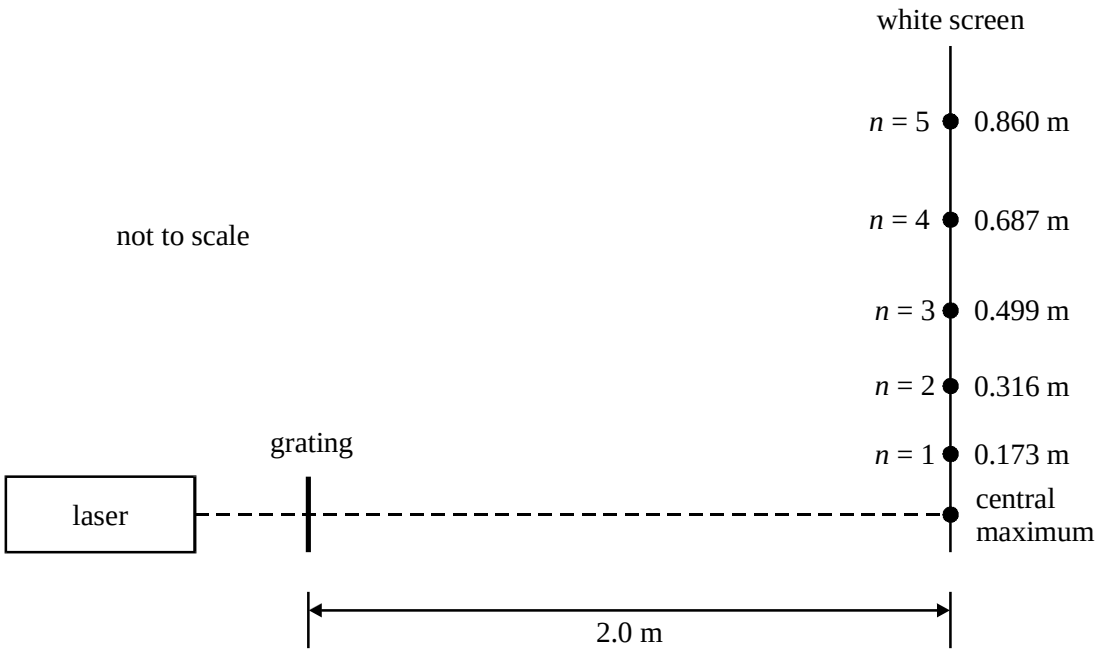

figure 1

In a laboratory experiment, monochromatic light of wavelength 633 nm from a laser is incident normal to a diffraction grating. The diffracted waves are received on a white screen which is parallel to the plane of the grating and 2.0 m from it. Figure 1 shows the positions of the diffraction maxima with distances measured from the central maximum.

By means of a graphical method, use all these measurements to determine a mean value for the number of rulings per unit length of the grating.

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(Allow one sheet of graph paper)

(6)

(b) Describe and explain the effect, if any, on the appearance of the diffraction pattern of

(i) using a grating which has more rulings per unit length,

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(ii) using a laser source which has a shorter wavelength,

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(iii) increasing the distance between the grating and the screen.

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(6)

(Total 12 marks)