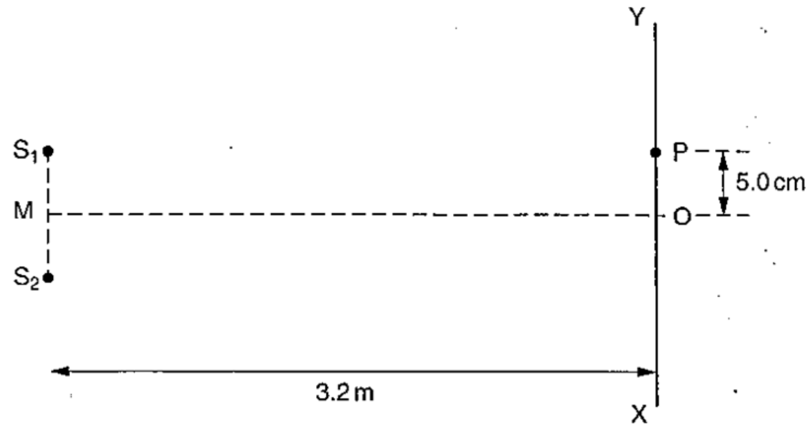
Q1:NOV 2001 P2

For Examiner's Use

5 (a) State what is transferred by a *progressive* wave.

....[1]

(b) Two microwave sources S_1 and S_2 are situated as shown in Fig. 5.1. The waves emitted by the two sources are in phase and are polarised in the same plane.



(not to scale)

Fig. 5.1

A microwave detector is placed on a line XY which is parallel to, and 3.2 m from, the line joining S_1 and S_2. M is the midpoint of the line joining S_1 and S_2. The line from M perpendicular to the line S_1S_2 meets XY at O. The detector produces an output which is proportional to the displacement of the wave.

With only S_1 switched on, the change with time of the detector output measured at P, a distance of 5.0 cm from O, is as shown in Fig. 5.2.

The waveform detected at P for S_2 only is also shown on Fig. 5.2.

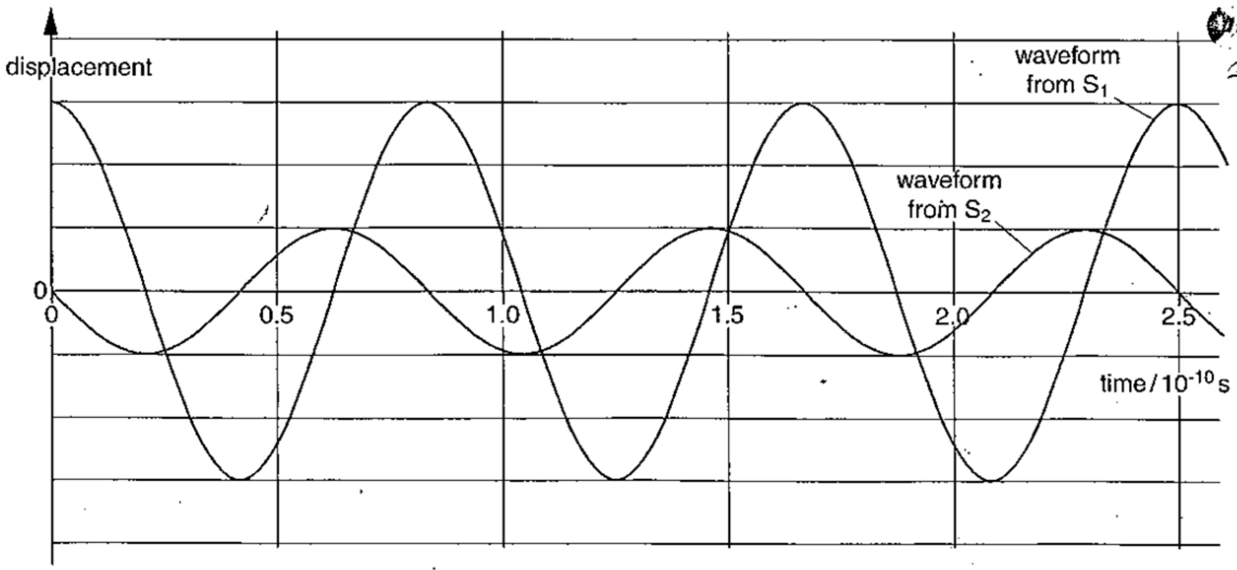


Fig. 5.2

(iii) S_1 and S_2 are switched on together, with the emitted waves in phase. The detector is moved from P along the line OY, in the direction away from O. State and explain the approximate distance that the detector must be moved before the intensity is a maximum, given that there is no maximum between O and P.

....

....

....

....

....[3]

(iv) Make an estimate of the separation of the sources S_1 and S_2.

separation = ... m [2]

Q2:JUN 2003 P2

4 (a) State three conditions that must be satisfied in order that two waves may interfere.

1. ....

2. ....

3. .... [3]

(b) The apparatus illustrated in Fig. 4.1 is used to demonstrate two-source interference using light.

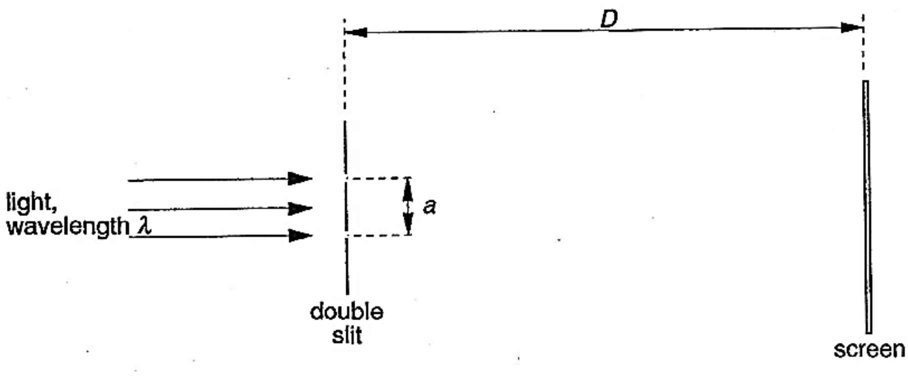


Fig. 4.1 (not to scale)

The separation of the two slits in the double slit arrangement is a and the interference fringes are viewed on a screen at a distance D from the double slit. When light of wavelength λ is incident on the double slit, the separation of the bright fringes on the screen is x.

(i) 1. Suggest a suitable value for the separation a of the slits in the double slit.

....

2. Write down an expression relating λ, a, D and x.

.... [2]

(ii) Describe the effect, if any, on the separation and on the maximum brightness of the fringes when the following changes are made.

1. The distance D is increased to $2D$, keeping a and λ constant.

separation: ....

maximum brightness: ....

2. The wavelength λ is increased to 1.5λ, keeping a and D constant.

separation: ....

maximum brightness: ....

3. The intensity of the light incident on the double slit is increased, keeping λ, a and D constant.

separation: ....

maximum brightness: .... [7]

Q3:JUN 2010 P2

4 (a) State *the principle of superposition* of waves.

____

____

____ [2]

(b) Superposition of light waves results in the production of a pattern of alternate bright and dull fringes.

State three conditions necessary for the production of the pattern of fringes.

(c) In Young's double slit experiment, light of wavelength 7×10^{-7}m was used. Given that the slit separation and the slit-to-screen distance were 0.30 mm and 1.00 m respectively, determine the fringe separation.

separation = ______________

[2]

Q4:JUN 2013 P2

4 **(a)** Explain what is meant by *monochromatic light.*

____

____ [1]

(b) A parallel beam of monochromatic light of wave length 650 nm is directed normally at a diffraction grating which has 600 lines per mm.

Determine

(i) the slit spacing,

slit spacing = ______________

(ii) the highest order number,

highest order number = ______________

(iii) the angle of diffraction for the highest order.

Q5:NOV 2013 P2

3 Distinguish between a stationary wave and a progressive wave with reference to:

(i) the wave profile

(ii) the phase difference between neighbouring particles

(iii) the amplitude of vibrating particles

[6]

Q6:JUN 2014 P2

3 (a) Explain the terms:

(i) *diffraction*

(ii) *superposition*

[2]

(b) State **two** conditions needed for an observable interference pattern.

____

____

____ [2]

(c) **Fig. 3.1** shows laser light passing through a double slit.

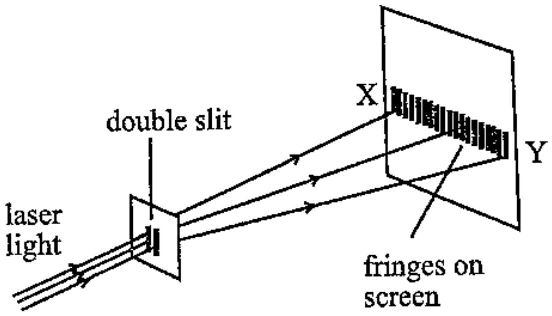


Fig. 3.1

(i) State what would happen to the positions of X and Y when the doubleslit is rotated through 90°.

____

(ii) Explain what would happen to the positions of X and Y when the double slit is replaced by a 1 m wide door.

____

____

____ [3]

Q7:NOV 2014 P2

4 Coherent sources of light produce an observable interference pattern.

(a) Explain the term *coherent sources.*

____

____

____ [1]

(b) A plane diffraction grating having k lines per unit length is illuminated normally by a source of monochromatic light of wavelength λ.

Given the grating equation as $\sin\theta = nk\lambda$, state the significance of

(i) n,

____

____

(ii) θ.

____

____ [2]

Q8:NOV 2003 P3

3 (a) State the principle of superposition. [2]

(b) (i) What is meant by the term *interference*?

(ii) State **three** conditions that are essential to obtain observable interference effects with light. [5]

(c) A diffraction grating with 500 lines per mm is used to examine the light from a cadmium lamp. It is found that the first order red light emerges at an angle of 18.78° and the first order blue light at an angle of 13.89° as shown in **Fig. 3.1**.

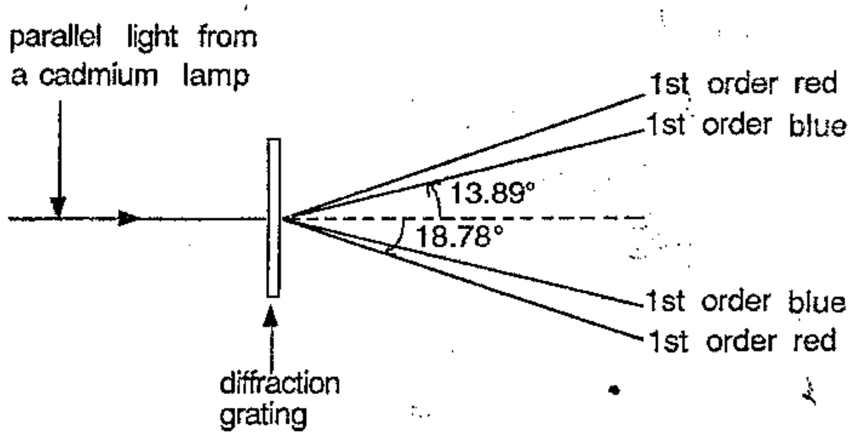


Fig. 3.1

(i) Calculate

1 the wavelengths of the two colours,
2 the angles at which the second order spectral lines will be observed,
3 the maximum number of fringes obtained by each colour.

(ii) Without any further calculation, draw a sketch to show the whole pattern observed. [11]

(d) Suggest **two** reasons why such a spectrum described in **(c)** is usually observed in the first order. [2]

Q9:NOV 2006 P3

3 (a) (i) Explain what is meant by the terms *transverse wave* and *phase difference.*

(ii) Sketch on the same axes graphs showing **two** transverse waves of the same wavelength and amplitude with a phase difference of $\frac{\pi}{4}$ rad. [5]

(b) (i) Explain the term *interference.*

(ii) **Fig. 3.1** was used to study the interference pattern of two sound waves coming from twins shouting the same message at the same time.

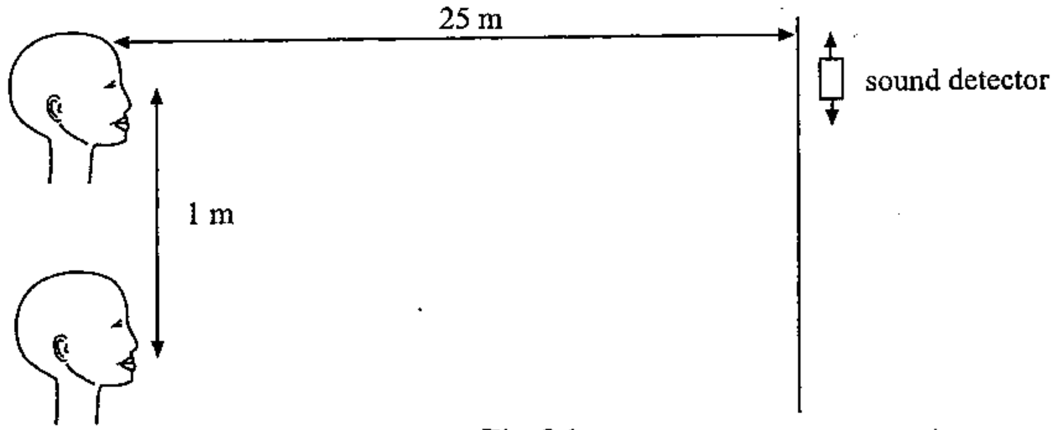


Fig. 3.1

Describe and explain what is received by the detector.

(iii) In the second experiment only one of the twins shouted as in **Fig 3.2**.

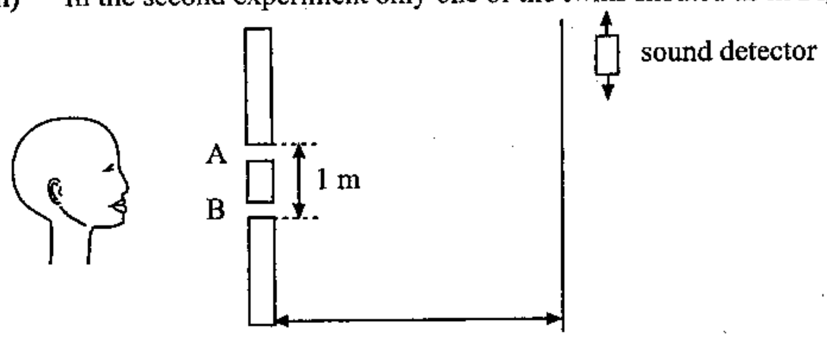


Fig. 3.2

If sound reaches the detector through opening **A** and **B**, describe what is received up the detector.

(iv) State and explain the effect on the interference pattern in **b(iii)** if the sound waves pass through a vertical plane polariser before reaching the sound proof wall. [10]

(c) **Fig. 3.3** shows a stationary wave produced by a string fixed at both ends.

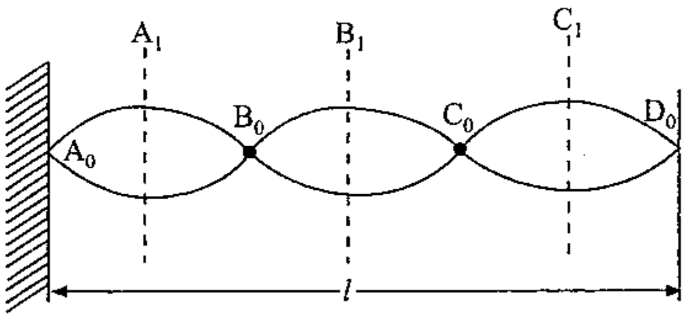


Fig. 3.3

(i) Write down the positions of the **three** antinodes shown.

(ii) Determine the wavelength of the wave in terms of length, l.

(iii) Describe how the stationary wave is formed. [5]

Q10:JUN 2007 P3

3 (d) (i) Explain the term *coherent.*

(ii) Identical transmitters A and B separated 0.02 m and 1.5 m away from the screen PQ as shown in Fig. 3.1, emit microwaves of wavelength 30 mm.

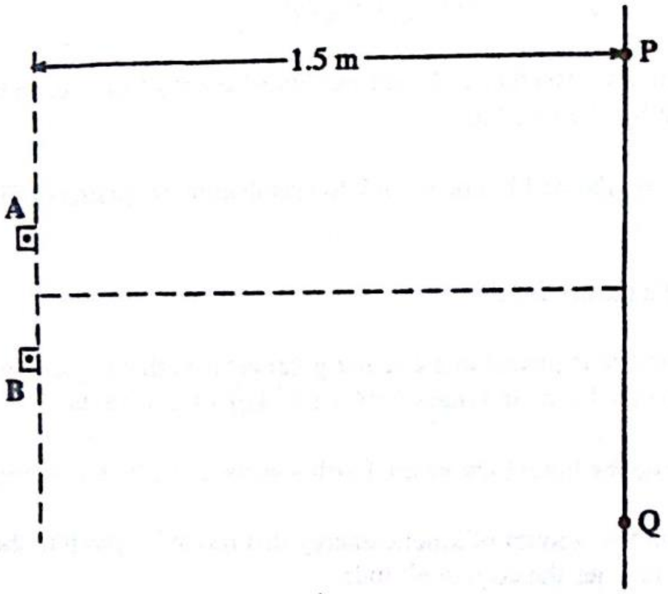


Fig. 3.1

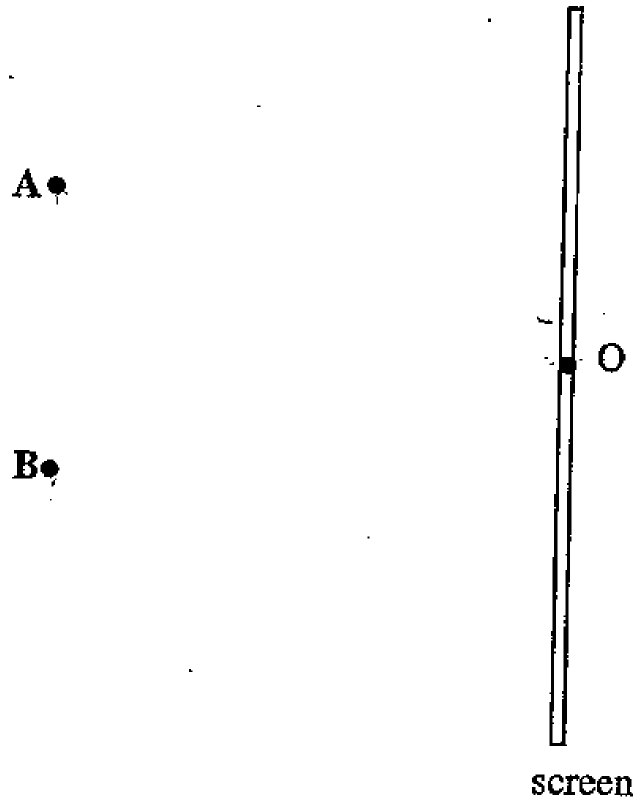
1. Explain how the interference pattern detected along PQ is formed.

2. Calculate the separation between adjacent maxima. [5]

Q11:NOV 2008 P3

2 (a) State **two** properties of electromagnetic waves. [1]

(b) A and B in Fig. 2.1 are microwave transmitters, emitting waves that have a phase difference of π radians. O is the centre of a screen which is equidistant from A and B.



(i) Suggest a wavelength of microwaves and hence deduce a value for the separation of **A** and **B**.

(ii) State and explain what is expected to be detected at **O**.

(iii) Given that the screen is 2.50 m from sources **A** and **B**, use your values in **(i)** to calculate the separation of any two consecutive minima. [7]

(c) Explain whether it is feasible to make observations from your calculations in **(b)(iii)**. [2]

Q12:NOV 2011 P3

2 (a) State any **two** conditions for the establishment of a stationary wave, using two separate sound waves. [2]

(b) Distinguish between the motion of air molecules in a stationary wave and a progressive wave with reference to their phases, amplitudes, frequencies and kinetic energies. [4]

(c) (i) State one similarity between **Radio** and **TV** waves.

(ii) 1. State how the wavelength of TV waves may differ from that of Radio waves.

2. Explain how the difference in **(ii)** 1. may result in a good radio reception **but** a poor TV reception for areas near hills. [4]

Q13:NOV 2012 P3

3 (a) Give a simple description of the production of X-rays. [4]

(b) State the approximate wavelength of

(i) the visible,

(ii) the X-ray,

region of the electromagnetic spectrum. [2]

(c) (i) Give a reason why laser light is ideal for diffraction and interference in double slit experiments.

(ii) In the diffraction pattern of a single slit the separation between the the first minimum on one side and the first minimum on the other side is 5.2 mm. The distance of the screen from the slit is 80.0 cm and the wavelength of the light used is 546 nm.

Calculate the width of the slit.

[4]

Q14:NOV 2014 P3

1 (c) (i) Describe the term *coherence in waves.*

(ii) Explain why interference effects are not observable in light from two close stars.

[3]

(d) In a Young's double slit experiment using a laser of wavelength 638 nm, the screen is placed 2.5 m from the double slit.

(i) If the slit separation is 0.50 mm, calculate the distance between fringes.

(ii) State **two** ways of increasing the distance between fringes.

Q15:JUN 2016 P3

1 (d) (i) State the **three** properties of coherent wave sources that produce an observable interference pattern.

(ii) Explain the term *destructive interference*.

[5]

4 (a) Distinguish between *interference* and *diffraction*. [2]

(b) (i) Describe how stationary waves are produced.

(ii) Two loudspeakers placed 50 m apart facing each other are connected to a signal generator that produces sound of frequency 160 Hz. A microphone is connected to a C.R.O and moved from one speaker to the other detecting nodes and antinodes. The speed of sound in air is 320 ms^{-1}.

Calculate the number of nodes and antinodes detected.

[6]

(c) Describe the effect of interference and the effect of diffraction in the action of a grating. [2]

Q16:NOV 2016 P3

1 (c) (i) State *the principle of superposition.*

(ii) **Fig. 1.2** shows a pair of loudspeakers 1.5 m apart and 7 m away from the line **AYZ**. The loudspeakers are emitting sound of frequency 1 320 Hz and speed of 330 m/s. A listener moving from **A** to **Z** hears a minimum sound at **A** and **Z**, and a maximum sound at **Y**.

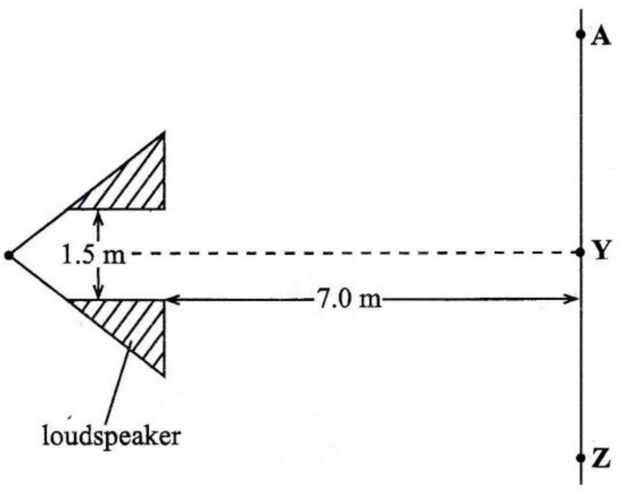


Fig. 1.2

Calculate the distance between **A** and **Z**.

[5]

2 (a) An equation for a progressive wave in a string is given by the expression:

$$Y = 2\times10^{-3}\sin[600t - 20X]$$

A series of such waves are transmitted along a stretched string fixed at one end. The waves reflected at the fixed end without loss of energy and superposition occurs in the string.

(i) Write an equation for the reflected wave.

(ii) Describe how these waves satisfy conditions for the production of a stationary wave.

(iii) Derive an equation for the resultant wave using the principle of superposition.

[5]

(b) A damping material is placed at the fixed end of the string in **2(a)** so that the incident progressive waves are absorbed.

Find the

(i) wavelength of the progressive wave in **a(i)**,

(ii) maximum speed of a particle in the string.

[4]

(c) Explain why an external agent is always required to maintain a stationary wave in a stretched string. [1]

Q17:JUN 2017 P3

4 (a) State the condition for two sources to be coherent. [1]

(b) Two sources of red light, S_1 and S_2 were set up as in **Fig. 4.1**.

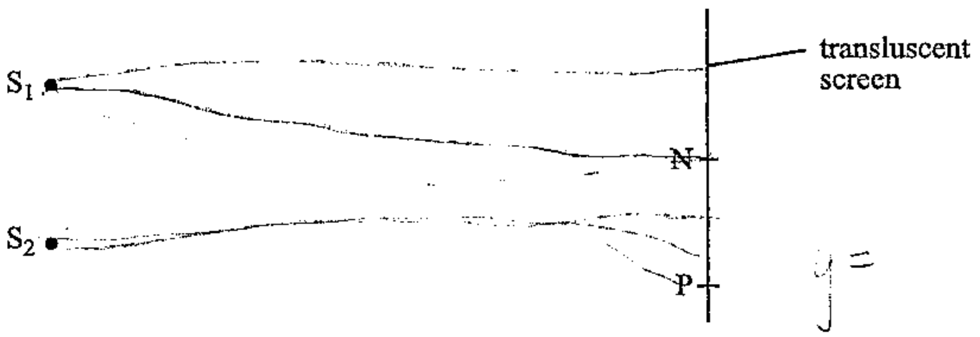


Fig. 4.1

(i) N is a point where $S_1N = S_2N$. State what is observed at N.

(ii) The wavelength of red light is 6.8×10^{-7} m.

Find the frequency for S_1 and S_2.

(iii) At point P_1, $S_1P = 5.0 \times 10^{-6}$ m and $S_2P = 3.3 \times 10^{-6}$ m.

1. Calculate the number of wavelengths in the path difference between S_1P and S_2P.

2. Using the answer to **(b)(iii)**1, determine what is observed at P.

[7]

(c) Explain why light from two head lamps of a car does not give a distinct interference pattern. [2]

Q18:JUN 2018 P3

4 (a) State how coherence is achieved in order to observe interference of

(i) water waves in a ripple tank,

(ii) light waves in a double slit experiment. [2]

(b) **Fig.4.1** illustrates the positions of dust particles disturbed by a sound wave.

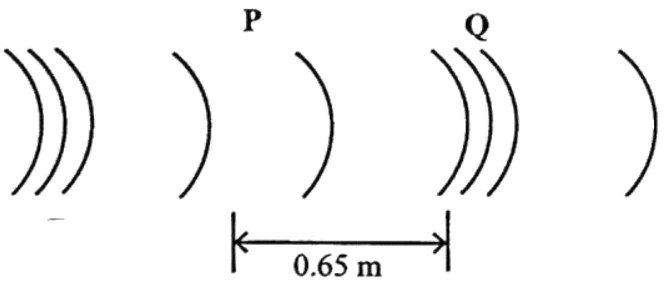


Fig.4.1

(i) Name the regions **P** and **Q.**

(ii) Determine the wavelength of the sound wave. [3]

(c) **Fig.4.2** shows monochromatic yellow light falling normally on a diffraction grating with 500 lines per millimetre and yellow spots are observed on a rule 2.00 m away.

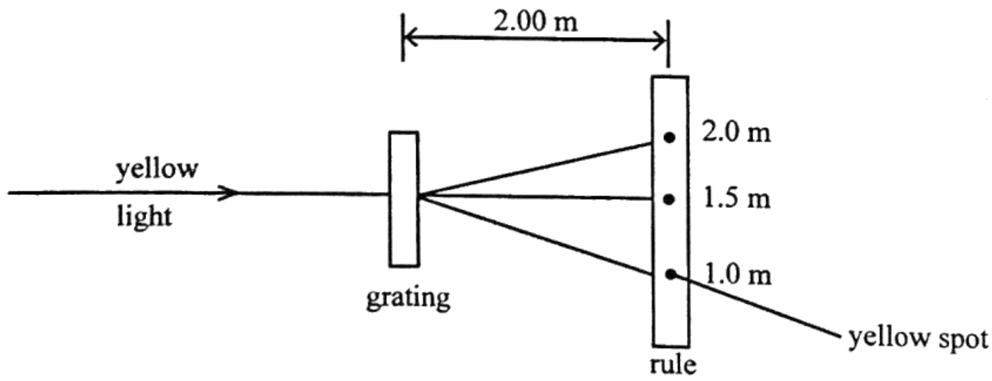


Fig.4.2

Calculate the wavelength of the light. [3]

(d) State and explain **one** use of lasers in Clinical therapy. [2]

Q19:NOV 2018 P3

2 **(b)** **(i)** State the *principle of superposition.*

(ii) Explain how progressive waves can be made to produce a stationary wave.

(iii) Explain why it is impossible to produce an observable interference pattern with two car headlights connected to the same battery. **[6]**

(d) **(i)** Explain the difference between the fringes produced by a grating and those produced by a pair of slits for the same light.

(ii) Using a pair of slits of separation 0.50 mm and red light of wavelength 546 nm, ten clear fringes are observed on a screen that is 0.80 m away from the slits.

Calculate the width of the ten fringes. **[4]**

Q20:2018 SPEC P3

2 (b) (i) 1. Draw a labelled diagram showing apparatus required to determine the wavelength of red light using a pair of slits.

2. Give estimates for slit separation and slit to screen distance from the diagram in (i)1.

(ii) Explain the part played by diffraction in the production of fringes.

(iii) Use the estimate values in **(b)(i)** to calculate fringe separation for light of wavelength 590 nm.

[8]

Q21:JUN 2019 P3

(b) (i) Explain what is meant by

1. *constructive interference*,

2. *coherence*.

(ii) **Fig. 2.1** shows sources, A and B, producing waves of wavelength, λ. The waves superpose at O, P and Q on the screen.

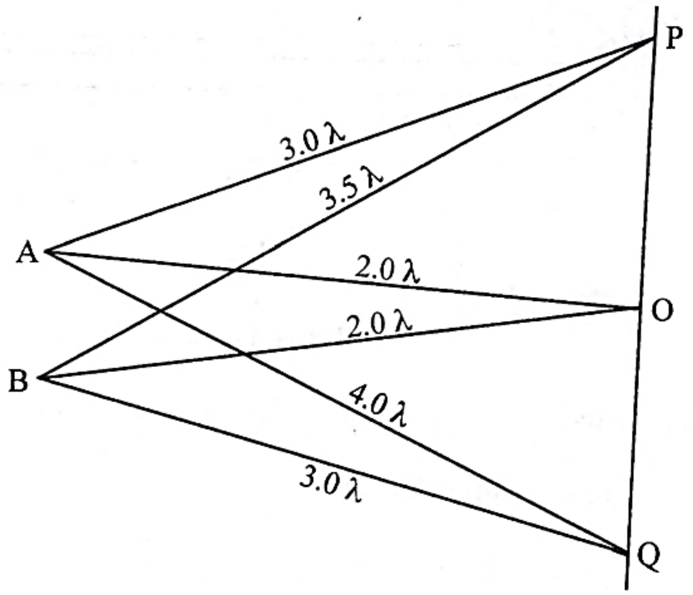


Fig. 2.1

State and explain the effects produced at O, P and Q.

[9]

Q22:NOV 2017 P3

(d) **(i)** State **one** similarity and **one** difference between interference and diffraction patterns.

(ii) Visible light, of wavelength 500 nm, is made to fall on a grating. The maximum number of observable bright fringes from the central bright fringe is 3.

Calculate the number of lines per metre on the grating. [6]