Topic Specific Questions : Waves : Stationary

Jan 2002 to Jan 2009

4 Which one of the following statements about stationary waves is true?

Q4 Jan 2002

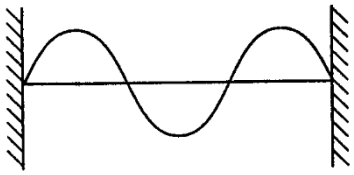
A Particles between adjacent nodes all have the same amplitude.

B Particles between adjacent nodes are out of phase with each other.

C Particles immediately on either side of a node are moving in opposite directions.

D There is a minimum disturbance of the medium at an antinode.

4

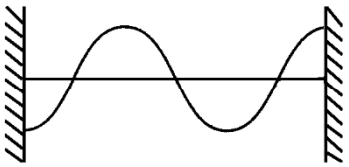


frequency of vibration = 50 Hz

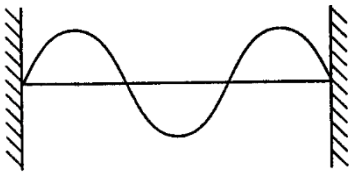
Q4 Jun 2002

The diagram above shows a stationary wave on a stretched string at a time $t = 0$. Which one of the diagrams, **A** to **D**, correctly shows the position of the string at a time $t = 0.010$ s?

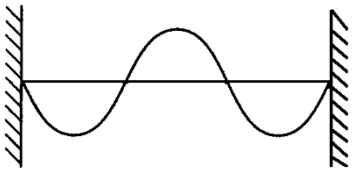
A



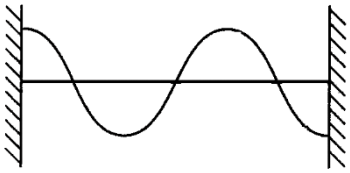
B



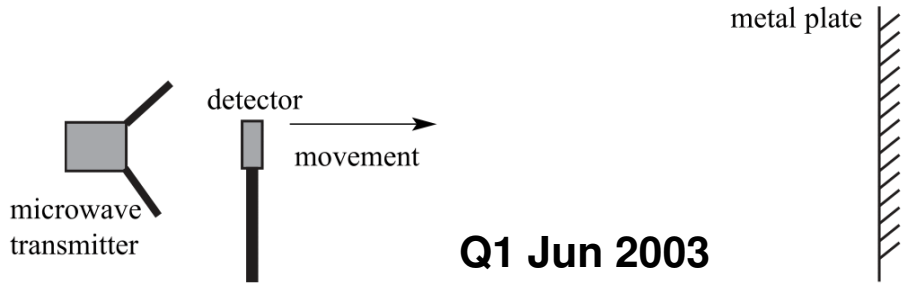
C



D



1



Q1 Jun 2003

A microwave transmitter directs waves towards a metal plate. When a microwave detector is moved along a line normal to the transmitter and the plate, it passes through a sequence of equally spaced maxima and minima of intensity.

(a) Explain how these maxima and minima are formed.

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

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(4 marks)

(b) The detector is placed at a position where the intensity is a minimum. When it is moved a distance of 144 mm it passes through nine maxima and reaches the ninth minimum from the starting point.

Calculate

(i) the wavelength of the microwaves,

.....

.....

(ii) the frequency of the microwave transmitter.

.....

.....

(3 marks)

1 (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.

.....

.....

.....

.....

.....

(2 marks)

Q1 Jan 2004

(b)

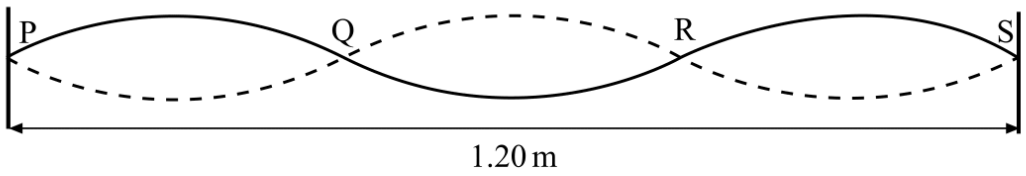


Figure 1

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.

.....

(ii) Calculate the frequency of vibration.

.....

.....

(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.

.....

.....

.....

(5 marks)

1

Q1 Jun 2005

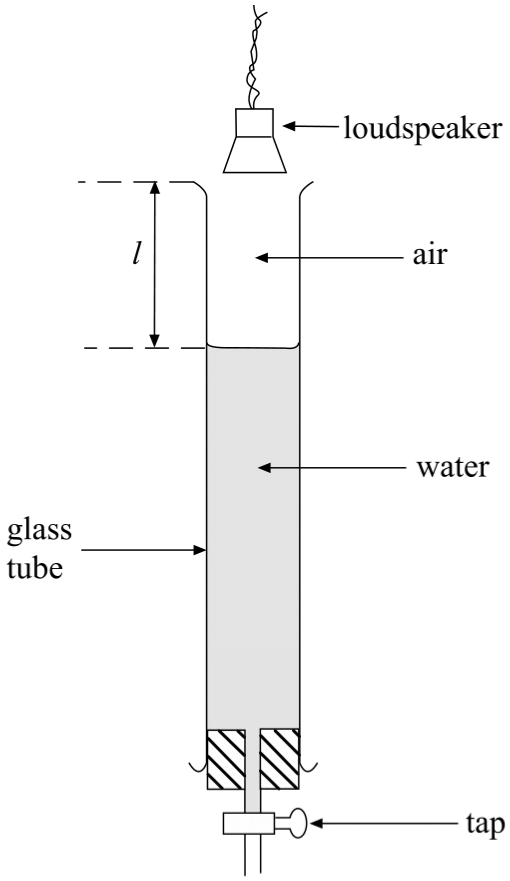


Figure 1

Much of this question is beyond year 12 work and relies on Y13 work some bits are not even covered in Y13

A small loudspeaker emitting sound of constant frequency is positioned a short distance above a long glass tube containing water. When water is allowed to run slowly out of the tube, the intensity of the sound heard increases whenever the length l (shown in **Figure 1**) takes certain values.

(a) Explain these observations by reference to the physical principles involved.

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

.....

.....

.....

.....

.....

.....

.....

.....

.....

(4 marks)

(b) With the loudspeaker emitting sound of frequency 480 Hz, the effect described in part (a) is noticed first when l = 168 mm. It next occurs when l = 523 mm.

Use both values of l to calculate

(i) the wavelength of the sound waves in the air column,

.....

.....

(ii) the speed of these sound waves.

.....

.....

(4 marks)

3 Stationary waves are set up on a length of rope fixed at both ends. Which one of the following statements is true?

A Between adjacent nodes, particles of the rope vibrate in phase with each other.
B The mid point of the rope is always stationary.
C Nodes need not necessarily be present at each end of the rope.
D Particles of the rope at adjacent antinodes always move in the same direction.

Q3 Jun 2004

4 Which line, **A** to **D**, in the table gives a correct difference between a progressive wave and a stationary wave?

Q4 Jan 2005

	progressive wave	**stationary wave**
A	all the particles vibrate	some of the particles do not vibrate
B	none of the particles vibrate with the same amplitude	all the particles vibrate with the same amplitude
C	all the particles vibrate in phase with each other	none of the particles vibrate in phase with each other
D	some of the particles do not vibrate	all the particles vibrate in phase with each other

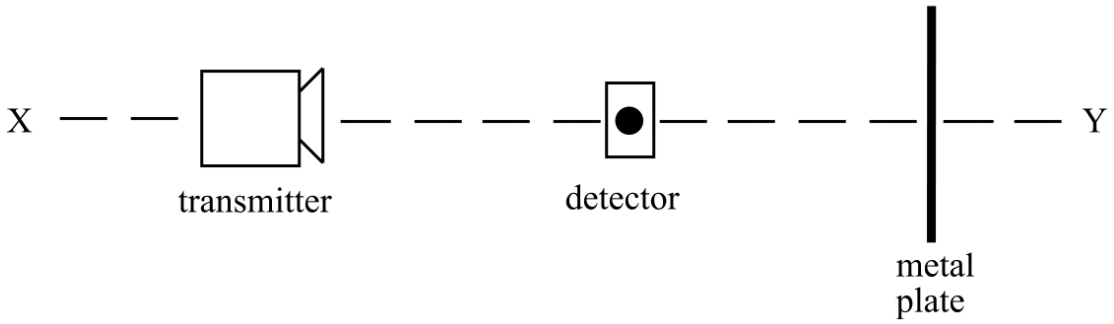
4 A stationary wave is formed by two identical waves of frequency 300 Hz travelling in opposite directions along the same line. If the distance between adjacent nodes is 0.60 m, what is the speed of each wave?

A $180\,m\,s^{-1}$
B $250\,m\,s^{-1}$
C $360\,m\,s^{-1}$
D $500\,m\,s^{-1}$

Q4 Jan 2006

4 A microwave transmitter is used to direct microwaves of wavelength 30 mm along a line XY. A metal plate is positioned at right angles to XY with its mid-point on the line, as shown.

Q4 Jun 2006



When a detector is moved gradually along XY, its reading alternates between maxima and minima. Which one of the following statements is **not** correct?

A The distance between two minima could be 15 mm.
B The distance between two maxima could be 30 mm.
C The distance between a minimum and a maximum could be 30 mm.
D The distance between a minimum and a maximum could be 37.5 mm.

5 Two long pipes produce stationary waves at their fundamental frequency. Pipe X, of length l, is closed at one end. Pipe Y, which is open at both ends, produces vibrations of the same frequency as pipe X. What is the length of pipe Y?

A $\frac{l}{4}$

B $\frac{l}{2}$

C $2l$

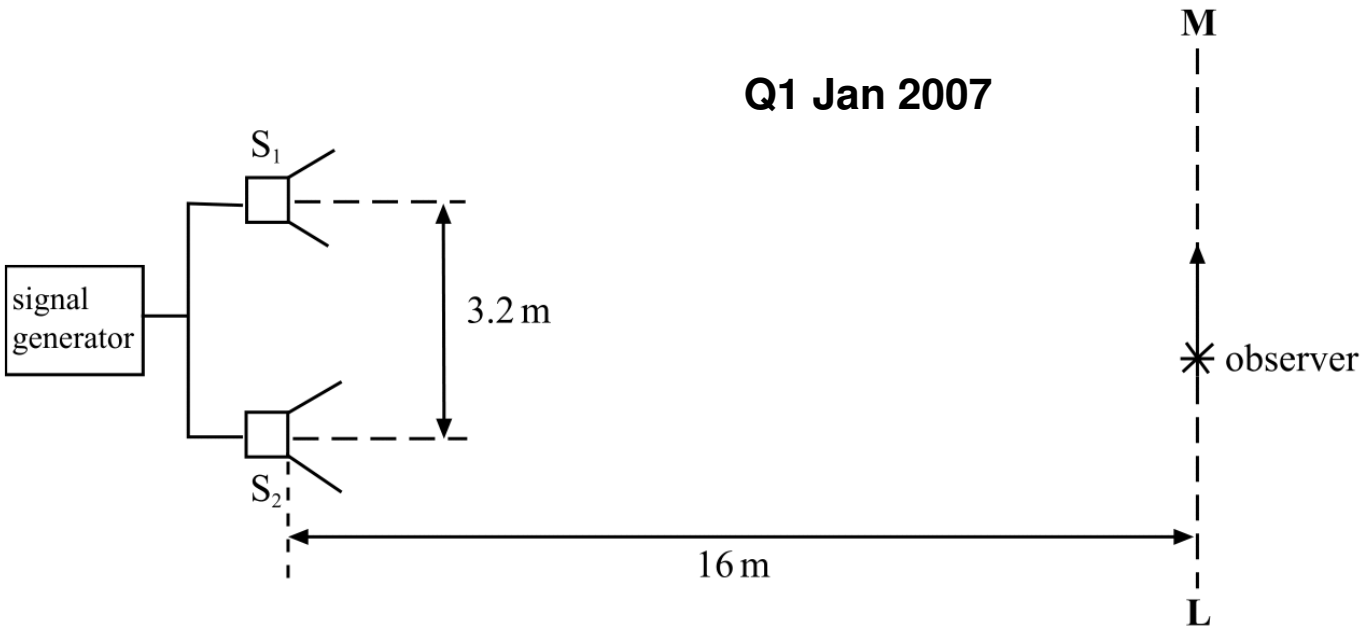
D $4l$

Q5 Jan 2007

Much of this question is beyond year 12 work and relies on Y13 work some bits are not even covered in Y13

1 (a) Two identical loudspeakers, S_1 and S_2, are connected to the same signal generator so that each produces a sound wave of frequency 850 Hz. They are arranged in the open air, as shown in **Figure 1**, with their centres 3.2 m apart. An observer who walks along the line **LM**, 16 m away from the loudspeakers, notices that there are minima of sound every 2.0 m.

Figure 1



Calculate

(i) the wavelength of the sound waves,

.....

.....

.....

(ii) the speed of sound in the air.

.....

.....

.....

(2 marks)

(b) You may be awarded additional marks to those shown in brackets for the quality of written communication in your answers.

(i) The sound waves from the loudspeakers in part (a) produce interference effects. Light waves from two separate small monochromatic light sources of the same frequency do not produce observable interference effects. Explain why the loudspeakers are able to produce interference effects but the light sources do not.

.....

.....

.....

.....

.....

.....

.....

(ii) Describe and explain how interference effects may be produced from a single monochromatic light source using appropriate additional equipment.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(5 marks)

3 (a) Distinguish between the *nodes* and *antinodes* that can be seen when stationary waves are formed on a vibrating string.

.....

.....

.....

.....

(2 marks)

(b) **Figure 3**

Q3 Jun 2007

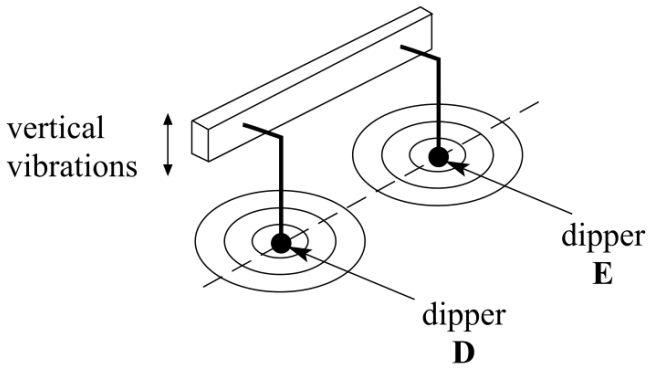


Figure 3 shows two dippers, **D** and **E**, mounted on the same vibrating beam. The dippers touch the surface of the shallow water in a ripple tank. When the beam vibrates, waves travel outwards in all directions on the surface of the water from each dipper.

Explain why a stationary wave will be formed on the surface of the water along the line joining **D** and **E**.

You may be awarded additional marks to those shown in brackets for the quality of written communication in your answer.

.....

.....

.....

.....

.....

.....

.....

.....

(4 marks)

(c) When the beam vibrates at a certain frequency, the distance between two adjacent nodes along the line between **D** and **E** is 12 mm. When the frequency of vibration is increased by 2.0 Hz, the distance between two adjacent nodes is decreased to 10 mm.

Calculate

(i) the frequency at which the beam vibrated originally,

.....

.....

.....

.....

.....

(ii) the speed at which the waves travelled on the surface of the water.

.....

.....

.....

(4 marks)

Q1 Jan 2008

1 (a) (i) State **two** conditions which have to be satisfied for the formation of a stationary wave.

.....

.....

.....

.....

(ii) When a stationary wave is formed on a string that is stretched between two fixed points, what additional condition concerning the length of the string must be satisfied?

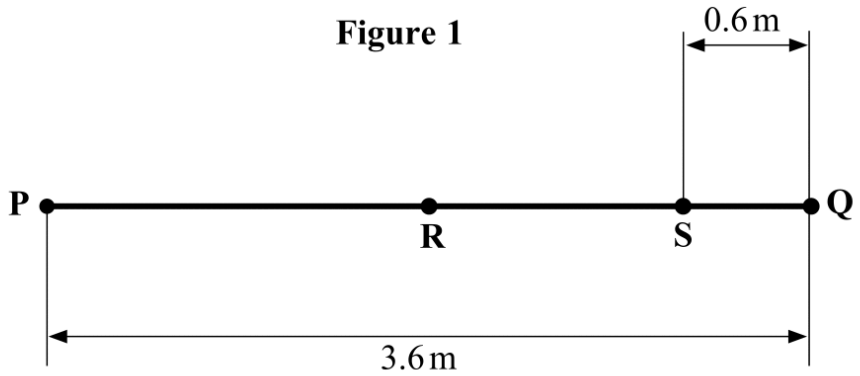
.....

.....

(3 marks)

(b) **Figure 1** shows the undisturbed position of a string stretched between the two points, **P** and **Q**, which are 3.6 m apart. The string is vibrated transversely at a frequency of 30 Hz, causing waves to travel along it at a speed of 72 m s^{-1}.

Figure 1



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

.....

.....

(ii) Draw on **Figure 1** the appearance of the stationary wave formed under these conditions.

(iii) Compare the vibrations of the mid-point **R** of the string with those of point **S**, which is 0.6 m from **Q**, with reference to amplitude, frequency and phase.

.....

.....

.....

.....

.....

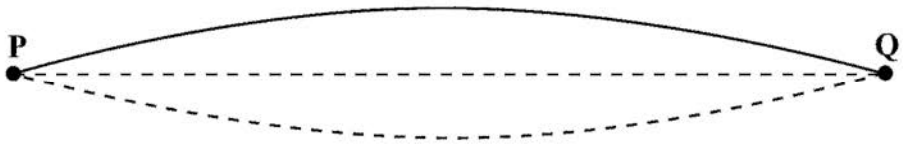
.....

(4 marks)

Q5 Jan 2009

5 **Figure 4** represents a stationary wave formed on a steel string fixed at **P** and **Q** when it is plucked at its centre.

Figure 4



5 (a) Explain why a stationary wave is formed on the string.

.....

.....

.....

.....

.....

(3 marks)

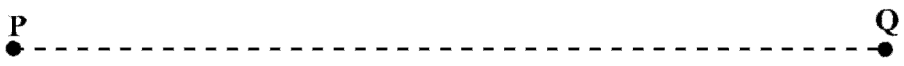
5 (b) (i) The stationary wave in **Figure 4** has a frequency of 150 Hz. The string **PQ** has a length of 1.2 m.
Calculate the wave speed of the waves forming the stationary wave.

Answer ..... $m s^{-1}$

(2 marks)

5 (b) (ii) On **Figure 5**, draw the stationary wave that would be formed on the string at the same tension if it was made to vibrate at a frequency of 450 Hz.

Figure 5



(2 marks)