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IGCSE PHYSICS 0625 · TOPICAL PAST PAPERS

General Wave Properties

Paper 2 — Theory / Structured Questions (topical compilation)

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1 **(a)** Water waves are transverse waves. Sound is a longitudinal wave.

(i) Describe the difference between transverse waves and longitudinal waves. In your account, draw a diagram of each type of wave. [4]

(ii) Sound contains regions of compression and regions of rarefaction. Describe what is meant by a compression and by a rarefaction. [2]

(b) A ripple tank is used to demonstrate the reflection of water waves.

(i) Draw a labelled diagram of a ripple tank. [2]

(ii) Draw a diagram showing the reflection of waves from a plane barrier in a ripple tank. [2]

(c) Fig. 10.1 shows a water wave passing a floating log. The log is stationary.

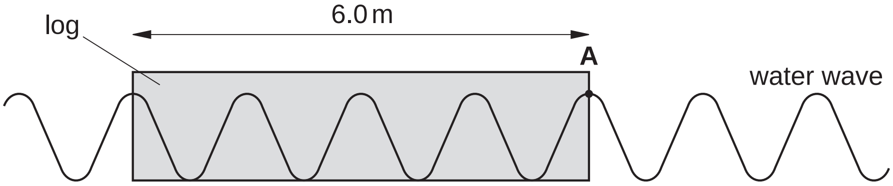


Fig. 10.1

The log is 6.0 m long and 5 complete waves take 10 seconds to pass point **A**.

Determine

(i) the wavelength of the water waves, [1]

(ii) the frequency of the water waves, [2]

(iii) the speed of the water waves. [2]

5054/02/M/J/08/Q10

2 Fig. 4.1 and Fig.4.2 are diagrams of a ripple tank being used to show two properties of waves.

(a) Fig. 4.1 shows wavefronts approaching a barrier in the water.

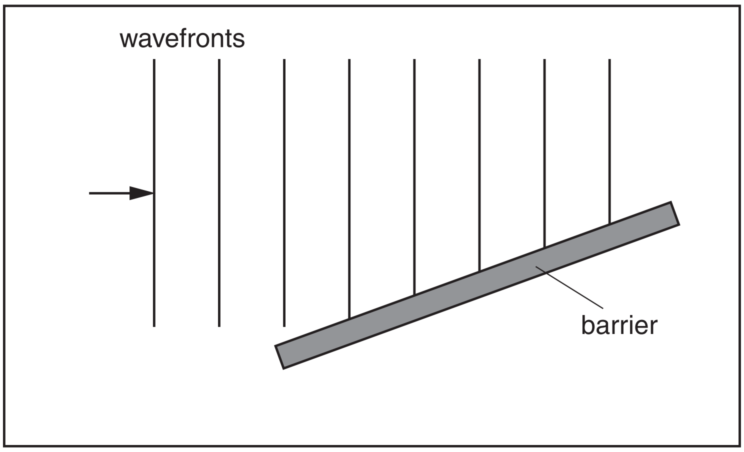


Fig. 4.1

Complete Fig. 4.1 to show the reflection of the wavefronts at the barrier. [2]

(b) Fig. 4.2 shows the wavefronts approaching shallow water above a piece of glass.

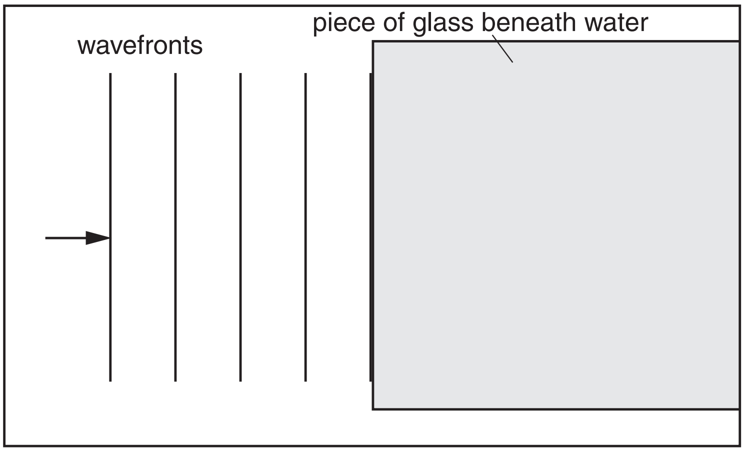


Fig. 4.2

(i) Complete Fig. 4.2 to show the wavefronts in the shallow water. [1]

(ii) As the wave passes into the shallow water, state what, if anything, happens to

1. the wave speed, ...[1]

2. the frequency. ....[1]

5054/21/M/J/10/Q4

3 Fig. 4.1 shows circular wavefronts produced at the centre of a circular ripple tank.

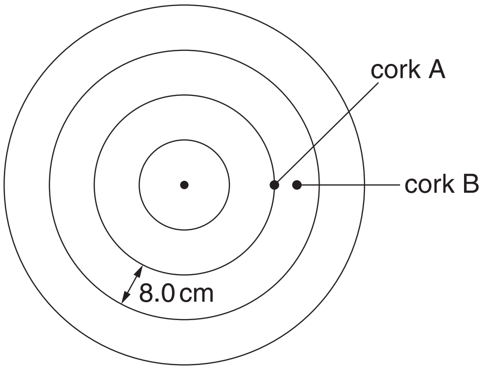


Fig. 4.1

Two corks, A and B, float on the water in the ripple tank. They move up and down on the surface of the water as the wave passes. The wavelength of the wave is 8.0 cm.

Fig. 4.2 shows how the displacement of A varies with time.

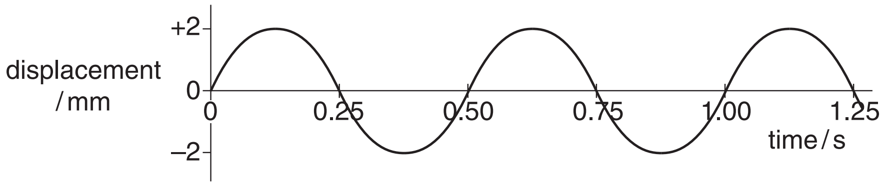


Fig. 4.2

(a) State the amplitude of the vibrations of A as the wave passes.

amplitude = ...[1]

(b) The horizontal distance between A and B is half the wavelength of the wave.

On Fig. 4.2, sketch a graph to show how the displacement of B varies with time. [2]

(c) **(i)** Use Fig. 4.2 to determine the frequency of the wave.

frequency = ...[2]

(ii) The distance between the centre of the ripple tank and its edge is 40 cm.

Determine the time taken by a wavefront to travel from the centre of the tank to the edge.

time = ...[2]

5054/22/M/J/11/Q4

4 Fig. 6.1 shows a wave on the surface of water. The wave is travelling to the right.

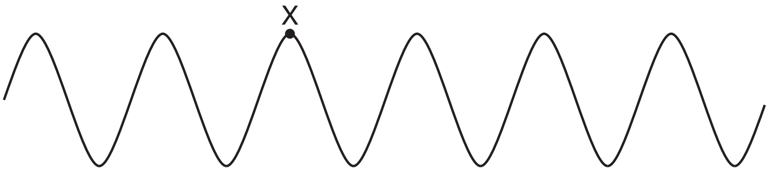


Fig. 6.1 (not to scale)

(a) Describe what is meant by *wave motion*.

....

....

....[2]

(b) On Fig. 6.1, draw an arrow to show the direction of the movement of a water molecule at X. [1]

(c) The frequency of the water wave is 2.0 Hz and the wavelength is 2.5 cm.

(i) Calculate the speed of the wave.

speed = ...[2]

(ii) On Fig. 6.1, mark a distance which shows how far a wavefront at X moves in 1.0 s. Label this distance *D*. [1]

5054/22/M/J/12/Q6

5 Fig. 4.1 shows part of a long rope used by a student to show a transverse wave.

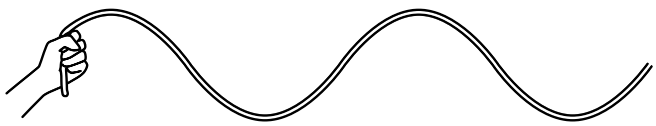


Fig. 4.1

(a) On Fig. 4.1,

(i) mark the direction of movement of the student's hand, [1]

(ii) mark and label the wavelength λ of the wave, [1]

(iii) mark and label the amplitude A of the wave. [1]

(b) Describe how the frequency of the wave is found using a stopwatch.

....

....

....

.... [2]

(c) Using the same rope, the student produces a wave of a longer wavelength than that shown in Fig. 4.1.

State how the student does this.

....

.... [1]

5054/22/M/J/14/Q4

6 Fig. 4.1 shows a wave on a string. The wave is travelling towards the right.

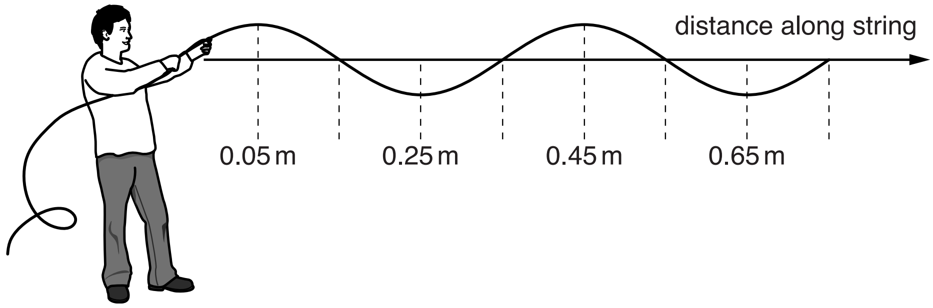


Fig. 4.1

(a) Describe the movement of the particles of the string.

....

....

....

....[2]

(b) Determine the wavelength of the wave.

wavelength = ...[1]

(c) The speed of the wave is 2.0 m / s.

(i) Calculate the frequency of the wave.

frequency = ...[2]

(ii) On Fig. 4.1, draw the string at a time 0.10 s later than the time in Fig. 4.1. [1]

5054/21/M/J/15/Q4

7 Fig. 9.1 shows the wavefronts of a water wave in deep water in a ripple tank.

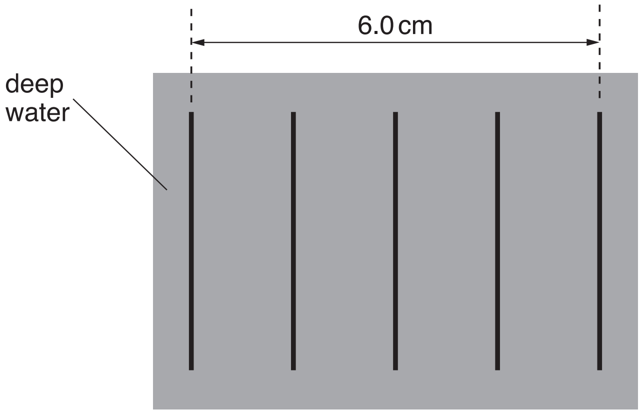


Fig. 9.1

The frequency of the wave in deep water is 5.0 Hz.

(a) Explain what is meant by the *frequency* of a wave.

....

....

.... [2]

(b) **(i)** Determine the wavelength of the wave in deep water.

.... [1]

(ii) Calculate the speed of the wave in deep water.

speed = ... [2]

(c) The wave passes from deep water into shallow water. The speed of the wave is less in shallower water.

(i) State and explain how this affects the wavelength of the wave.

....

....

.... [2]

(ii) The wave in deep water shown in Fig. 9.2 travels towards the right and enters the shallow water at an angle. The wave refracts.

Fig. 9.2

On Fig. 9.2, draw the wavefronts in the shallow water. [3]

(d) Sound is also a wave.

(i) Describe one difference between a sound wave and a water wave.

....

....

....

.... [2]

5054/22/M/J/15/Q9

8 **(a)** Light is a transverse wave. The direction of vibration is perpendicular to the direction of transfer of the energy.

Complete the table of Fig. 5.1 to show the direction of vibration and the type of wave associated with a sound wave and with a wave on the surface of water in a ripple tank.

wave	direction of vibration	type of wave
light	perpendicular to the direction of transfer of the energy	transverse
sound		
water		

[2]

Fig. 5.1

(b) A wave travels along a rope. Fig. 5.2 shows how the height of one point on the rope varies with time as the wave passes.

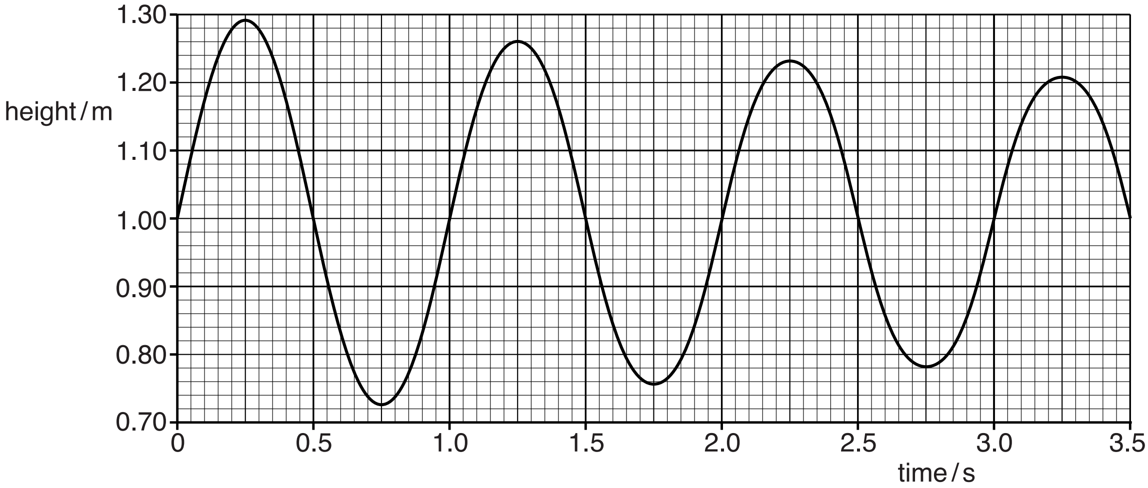


Fig. 5.2

(i) Determine the amplitude of the vibration at time = 0.25 s.

....[1]

(ii) Describe how the graph shows that the frequency of the wave is constant.

....

....[1]

5054/21/M/J/16/Q5

9 **(b)** Fig. 10.2 shows wavefronts in a ripple tank. They move in the direction of the arrow.

The wave hits the boundary between two regions and the wave slows down as it enters the shaded region.

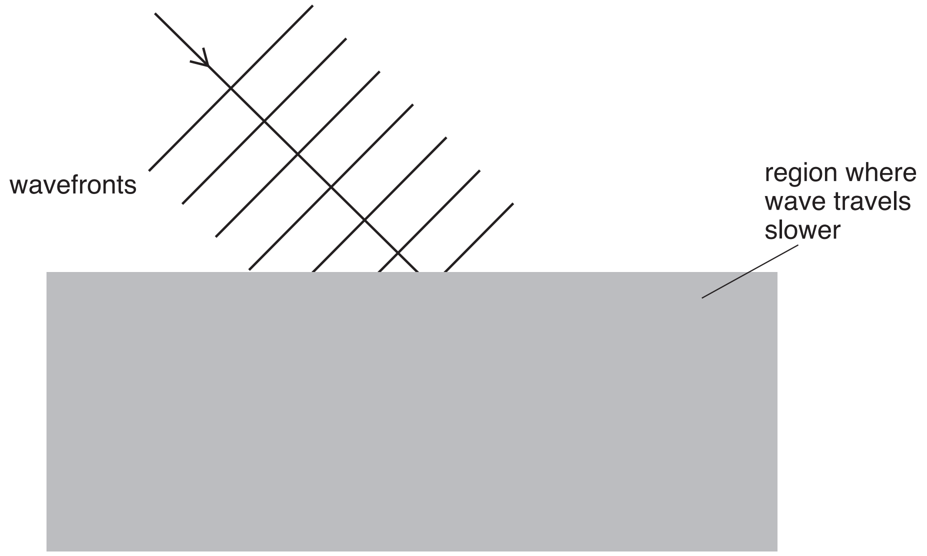


Fig. 10.2

(i) State what is meant by *wavefront*.

....

....[2]

(ii) Both reflection and refraction occur at the boundary.

1. On Fig. 10.2, draw the reflected wavefronts. [1]

2. On Fig. 10.2, draw the refracted wavefronts. [2]

5054/21/M/J/17/Q10

10 A water wave is produced in a ripple tank.

(a) (i) Draw a diagram of a ripple tank and describe how it is used to produce and observe the wave.

....

....

....

....

....

....

....[4]

(ii) The water wave in the ripple tank transfers energy.

Describe how to show that there is a transfer of energy.

....

....

....

....[2]

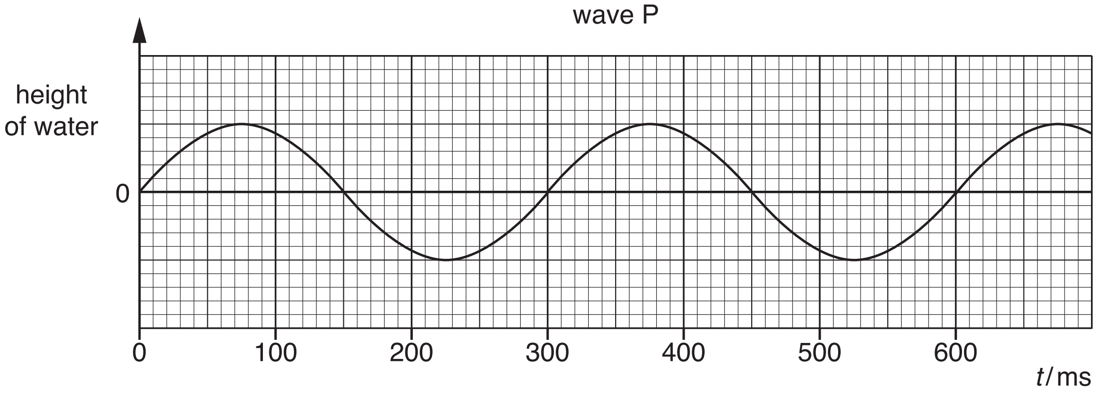
(iii) State what is meant by a *wavefront*.

....

....

....[2]

(b) Fig. 11.1 shows the variation with time *t* of the height of water at the same place in the tank for two waves P and Q. The height is sometimes above and sometimes below the mean level which is marked as 0.



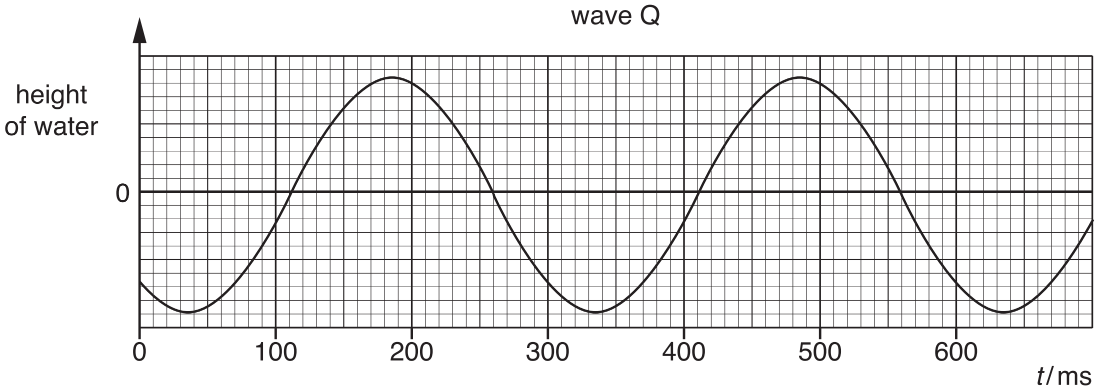


Fig. 11.1

(i) State one difference and one similarity of the two waves.

difference ....

....

similarity ....

....
[2]

(ii) The speed of the water wave is 0.20 m / s.

Determine

1. the frequency of wave P,

frequency = ...[3]

2. the wavelength of wave P.

wavelength = ...[2]

5054/21/M/J/18/Q11

11 A microwave signal from a transmitter on the Earth's surface is sent up to a satellite in orbit and is then immediately transmitted back to Earth.

(a) A pulse of microwaves from the transmitter is received back at the transmitter 0.24 s later.

The speed of microwaves is 3.0×10^8 m / s.

Calculate the distance from the transmitter on the Earth to the satellite.

distance = ... [2]

(b) The microwave signal is used in a telephone system that produces sound.

Waves are described as longitudinal or transverse. Some waves are also electromagnetic.

(i) Place ticks (✓) in the table in Fig. 5.1 to show whether microwaves and sound waves are longitudinal or transverse and to show whether they are electromagnetic.

	longitudinal	transverse	electromagnetic
microwaves			
sound			

[2]

Fig. 5.1

(ii) A longitudinal wave contains a compression.

Describe what is meant by a *compression*.

....

....

....[1]

5054/22/M/J/18/Q5

12 In Fig. 10.1 the vertical lines represent the crests of a wave in a ripple tank.

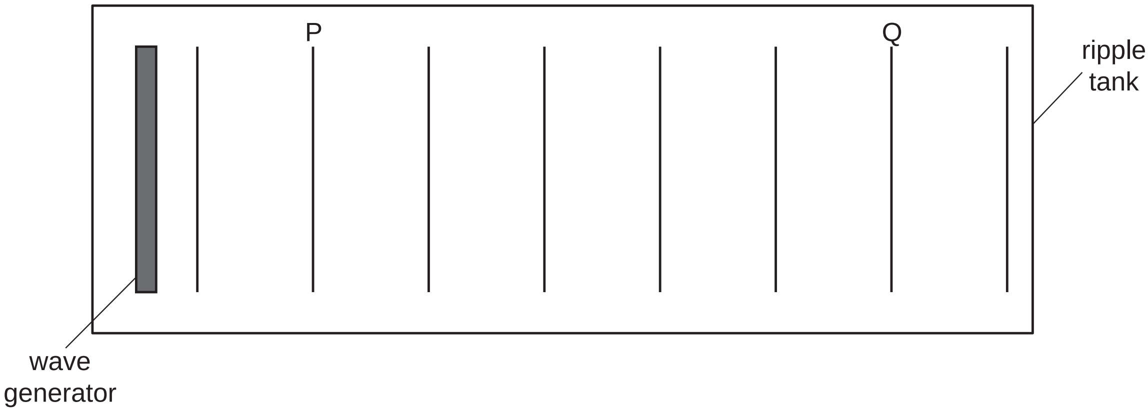


Fig. 10.1

Fig. 10.1 is drawn to scale, with 1.0 cm on the diagram representing 4.0 cm in the tank.

A crest takes 2.0 s to travel from P to Q.

(a) **(i)** Determine the wavelength of the wave in the ripple tank.

wavelength = ... [2]

(ii) Define the term *frequency*.

....

.... [2]

(iii) Determine the frequency of the wave.

frequency = ... [1]

(iv) The wave generator is a bar of wood.

Describe how it is used to produce the wave shown.

....

....

.... [2]

(v) Some water in the ripple tank is removed. The water becomes less deep. No other change is made.

State how the change in depth affects the wavelength and the speed of the wave.

speed ....

wavelength ....
[1]

5054/21/M/J/19/Q10

13 **(a)** Fig. 4.1 shows a wave on a rope and Fig. 4.2 shows a wave on a spring. Both waves are moving in the direction shown by the arrows.

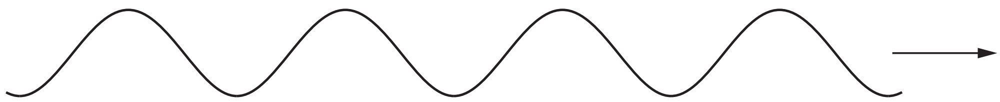


Fig. 4.1

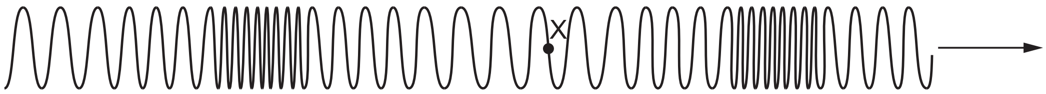


Fig. 4.2

(i) State the name of each of the two types of wave shown.

Fig. 4.1 ....

Fig. 4.2 ....
[1]

(ii) On Fig. 4.1, draw a wave which has a smaller frequency than the wave shown. [1]

(iii) Describe the movement of point X on the spring in Fig. 4.2 as the wave passes.

....

.... [1]

5054/21/M/J/21/Q4

14 **(a)** Fig. 10.1 shows a water wave moving from shallow into deep water. The wavefronts shown represent the crests of the wave.

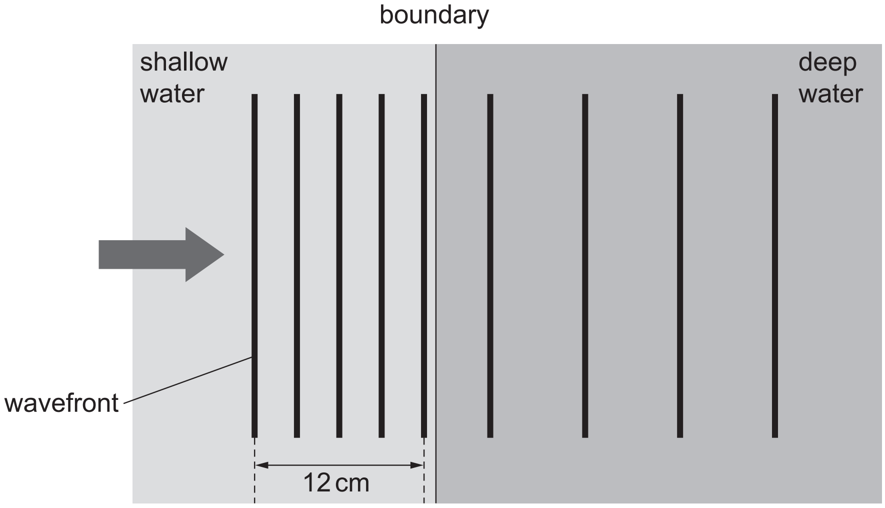


Fig. 10.1 (not to scale)

The water wave is made by dipping a wooden bar up and down in the water. The bar makes 10 complete up and down movements in 5.0 s.

(i) Determine the wavelength of the wave in the shallow water.

wavelength = ... [1]

(ii) Calculate the frequency of the wave produced.

frequency = ... [2]

(iii) Determine the speed of the water wave in the shallow water.

speed = ... [2]

(iv) On Fig. 10.2, draw lines to show what happens to the wavelength, the frequency and the speed of the water wave as it enters the deep water.

One line has been drawn for you.

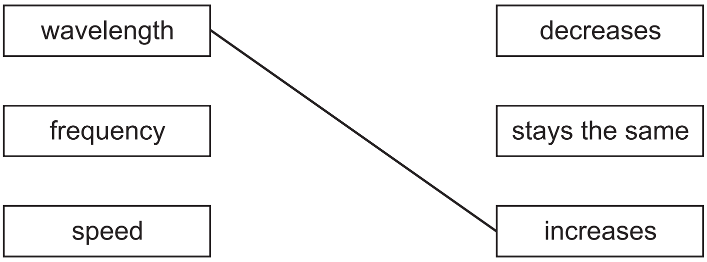


Fig. 10.2

[1]

(v) The direction of the boundary is now altered. The water wave now enters the deep water from the shallow water at an angle, as shown in Fig. 10.3.

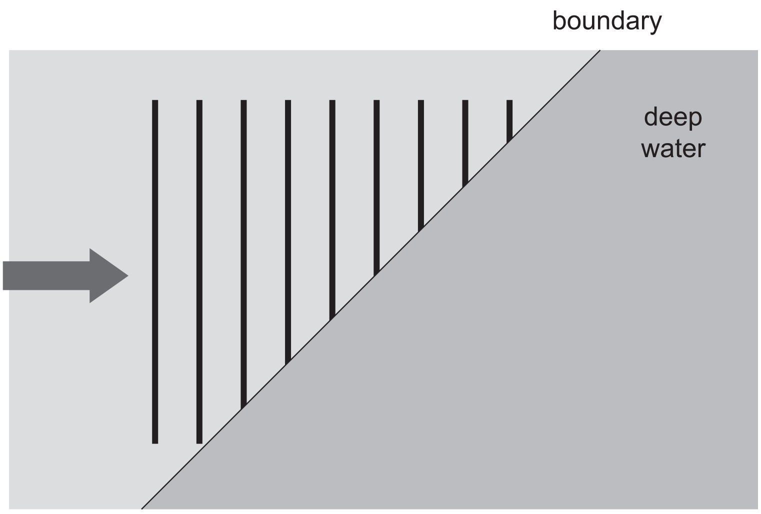


Fig. 10.3

On Fig. 10.3, draw the wavefronts in the deep water. [3]

5054/22/M/J/21/Q10

15 **(a)** Fig. 8.1 shows a ripple tank and the crests of the water wave that is produced in it.

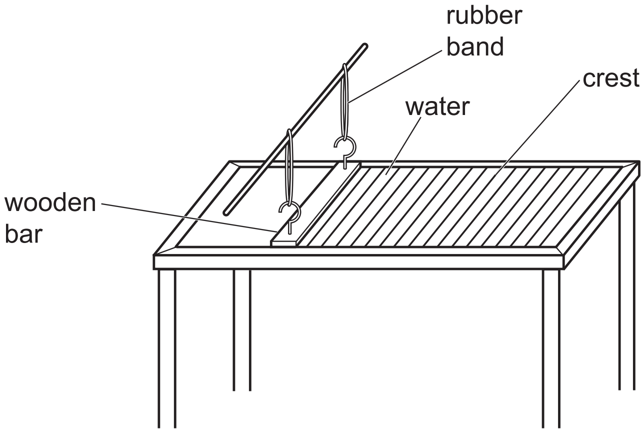


Fig. 8.1

The frequency of the water wave is 2.0 Hz and its amplitude is 3.0 mm.

(i) Calculate the number of crests produced in 1.5 s.

number = ... [1]

(ii) The height of the wave is measured from the level of the undisturbed surface of the water. The height of the wave at one point is 0 at time = 0.

On Fig. 8.2, draw a graph to show how the height of the wave at this point varies with time.

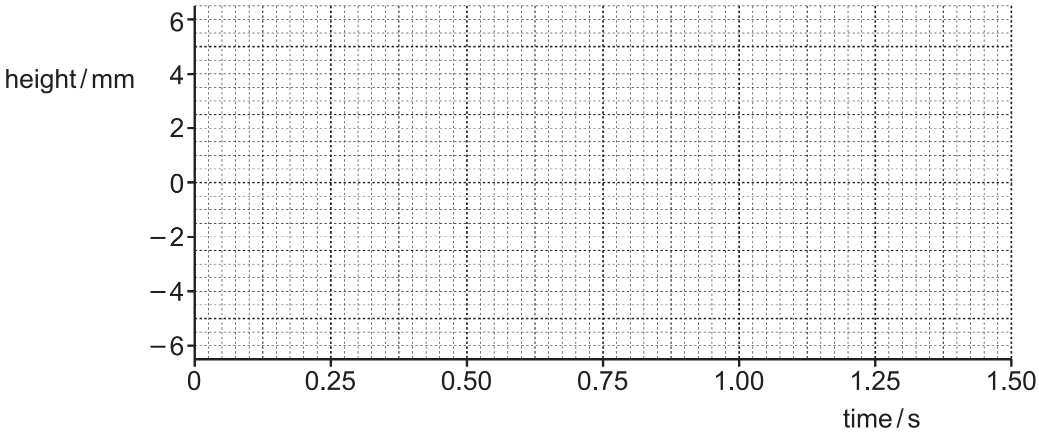


Fig. 8.2

[2]

(b) **(i)** The frequency of the wave is increased.

Describe how the apparatus shown in Fig. 8.1 is adjusted so that the frequency of the wave is increased.

....

.... [1]

(ii) State what happens to the speed and wavelength of the wave as the frequency increases.

speed ....

wavelength ....
[2]

(c) The apparatus shown in Fig. 8.1 can be used to demonstrate refraction.

(i) State the additional apparatus needed to demonstrate refraction.

.... [1]

(ii) Draw on Fig. 8.3 to show the refraction of the water wave.

Label a boundary where the refraction occurs.

Fig. 8.3

[3]

5054/22/M/J/22/Q8

16 Fig. 5.1 shows part of a long, thin spring used to demonstrate a transverse wave.

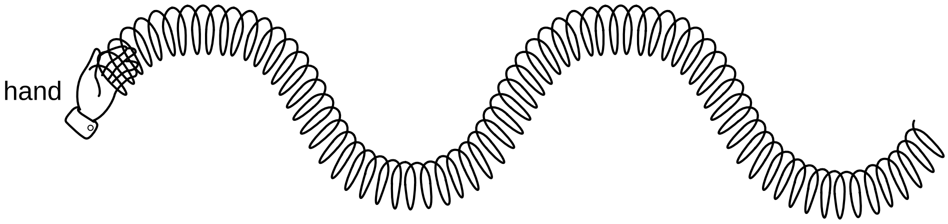


Fig. 5.1

The wave shown in Fig. 5.1 has a frequency of 4.0 Hz.

(a) **(i)** On Fig. 5.1, mark the direction the hand must move to make a transverse wave. [1]

(ii) Describe how the hand must move to make a transverse wave of frequency 4.0 Hz.

....

....

.... [2]

(b) The speed of the wave is 0.80 m/s. Calculate its wavelength.
State clearly the formula that you use.

wavelength = ……………….. [3]

(c) State what must be done to double the wavelength of the wave on the spring.

....

....

....[1]

054/02 O/N/04/Q5

17 A student produces wavefronts in a ripple tank to demonstrate refraction, as shown in Fig. 3.1. He places a sheet of glass under the water on the right-hand side of the tank. The arrows show the directions of movement of the wavefronts.

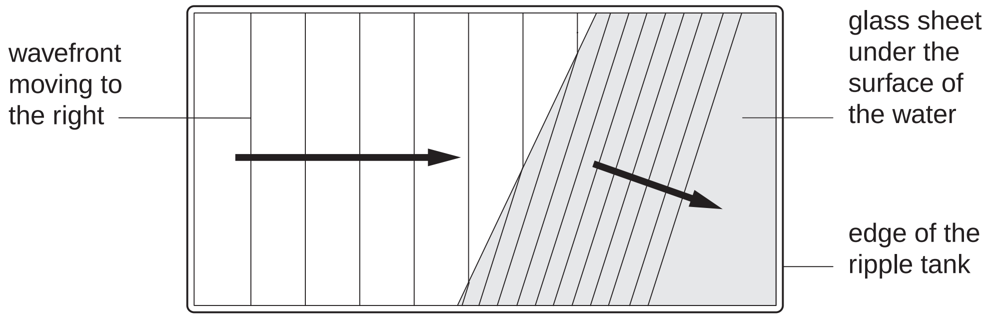


Fig. 3.1

(a) State what is meant by a *wavefront*.

....

....

.... [1]

(b) State what happens to each of the following quantities as the wavefronts change direction.

(i) wavelength ....

.... [1]

(ii) speed ....

.... [1]

(iii) frequency ....

.... [1]

5054/02/O/N/05/Q3

18 A water wave of frequency 3.6 Hz is generated in a ripple tank. Fig. 5.1 is a scale diagram that shows the wavefronts travelling from deep water to shallow water in the ripple tank. A length of 1.0 cm on the diagram represents 8.0 cm in the ripple tank.

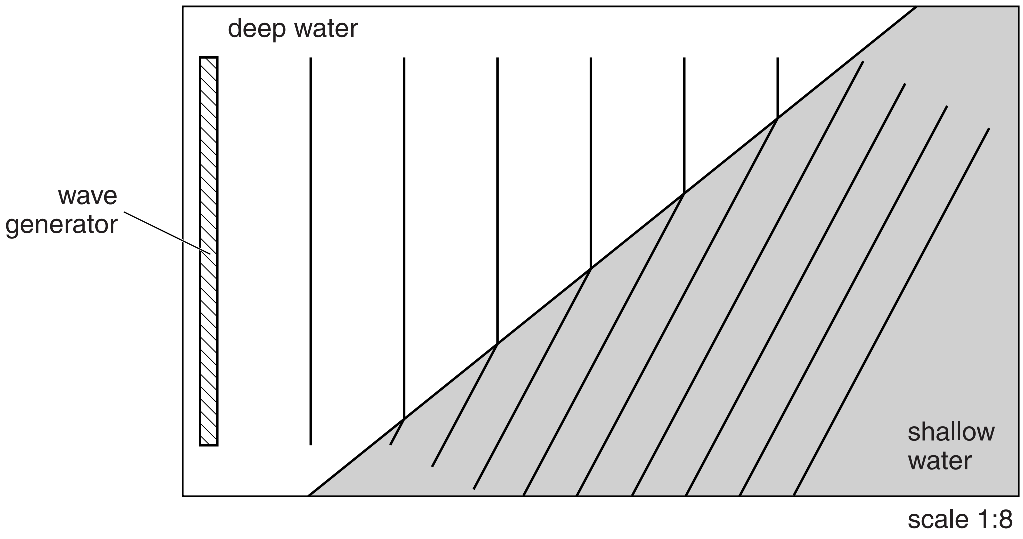


Fig. 5.1

(a) **(i)** Using measurements from Fig. 5.1, determine the wavelength of the wave in the deep water.

wavelength = ... [2]

(ii) Calculate the speed of the wave in the deep water.

speed = ... [2]

(b) As the wave passes into the shallow water, state what happens to

(i) the frequency,

.... [1]

(ii) the speed.

.... [1]

5054/21/O/N/12/Q5

19 Ripple tanks are often used to illustrate wave motion.

(a) Describe what is meant by *wave motion* in a ripple tank.

....

....

....[2]

(b) When describing wave motion, state what is meant by

(i) *frequency*,

....[1]

(ii) *wavelength*.

....

....[2]

(c) A water wave in a ripple tank strikes a barrier. Fig. 4.1 shows some wavefronts of the incident wave.

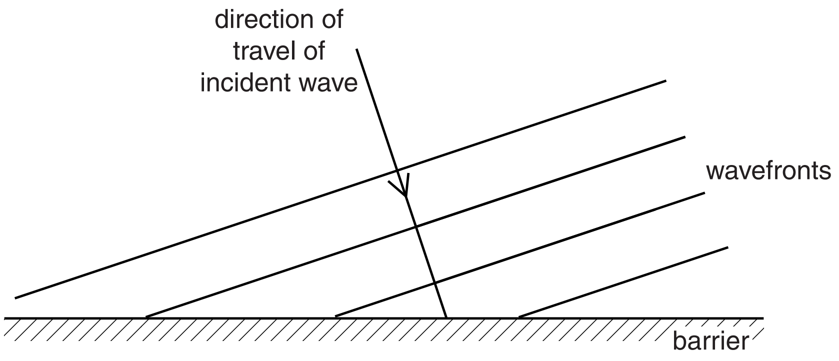


Fig. 4.1

The water wave hits the barrier and is reflected. Three of the wavefronts in Fig. 4.1 have already hit the barrier. The reflected parts of these wavefronts are not shown.

On Fig. 4.1, draw the reflected parts of these three wavefronts. [3]

5054/21/O/N/14/Q4

20 Some waves are longitudinal and some waves are transverse.

(a) State how a longitudinal wave differs from a transverse wave.

....

.... [1]

(b) A vibrating rod produces a water wave in a ripple tank. Fig. 9.1 shows the crests of the wave passing into the right-hand section of the tank where the depth of the water is different from the depth in the rest of the tank.

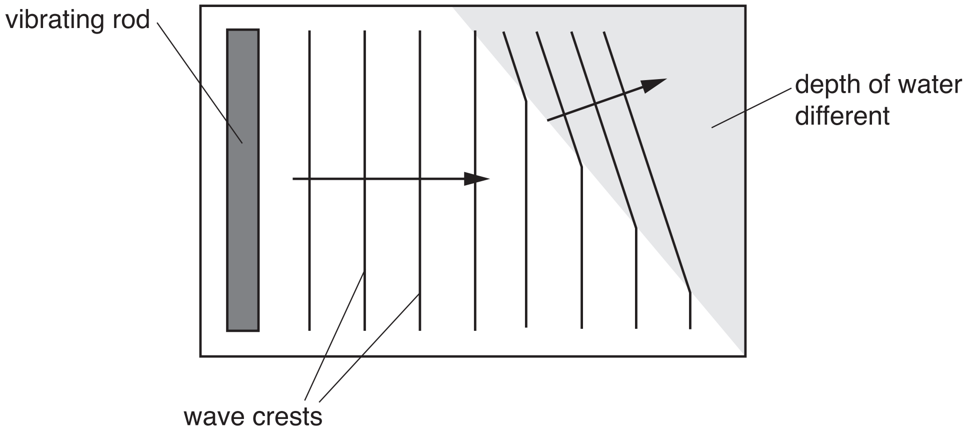


Fig. 9.1

The arrows on Fig. 9.1 show the direction of travel of the wave in the two sections of the ripple tank.

(i) In the left-hand section of the tank, the wavelength of the wave is 0.019 m and it travels at 0.17 m/s.

Calculate the frequency of the wave.

frequency = ... [2]

(ii) State what happens to the frequency of the wave, as it passes into the right-hand section of the tank.

.... [1]

(iii) Using Fig. 9.1, state and explain what happens to the speed of the wave as it passes into the right-hand section of the tank.

....

....

.... [2]

5054/21/O/N/18/Q9

21 Both sound and ultrasound are waves that travel in solids, liquids and gases.

(b) Sound and ultrasound are longitudinal waves that consist of compressions and rarefactions.

(i) Explain what is meant by a wave and describe how a longitudinal wave differs from a transverse wave.

....

....

....

....

.... [3]

(ii) Fig. 9.1 represents a longitudinal wave of frequency 25 000 Hz travelling in oil.

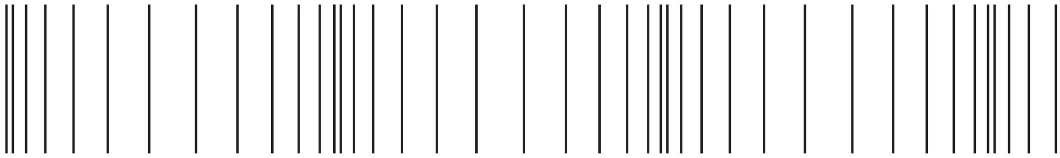


Fig. 9.1 (full scale)

1. On Fig. 9.1, mark two points at the centre of two different rarefactions and label each one R. [1]

2. On Fig. 9.1, draw a double-headed arrow to indicate a distance that is equal to one wavelength of the wave. [1]

3. Measure the length of the arrow drawn on Fig. 9.1 and use it to determine the speed of the wave in oil.

speed = ... [2]

(c) A sound wave travelling in a liquid, passes into air.

(i) State what happens to the speed of the sound wave as it enters the air.

.... [1]

(ii) The wave in the liquid travels towards the surface at an angle. Fig. 9.2 shows the centres of the compressions of the sound wave in the liquid.

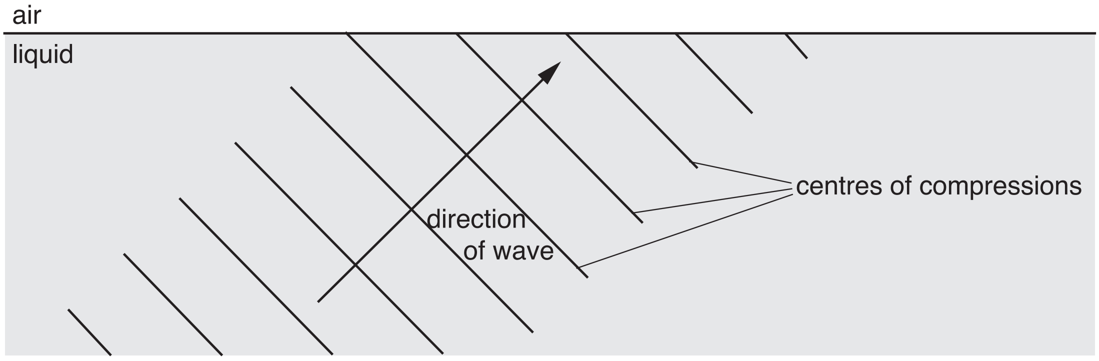


Fig. 9.2

Some compressions shown have reached the liquid-air boundary. The parts of these compressions in the air are not shown on Fig. 9.2.

On Fig. 9.2, draw the parts of these compressions that are in the air. [3]

5054/22/O/N/18/Q9