TOPIC 12 General Wave Properties

1 A vibrator dipped into water in a ripple tank has a frequency of 6 Hz. The resulting wave has a wavelength of 0.02 m.

What is the speed of the wave?

A 0.2 m/s
B 0.12 m/s
C 3 m/s
D 6 m/s
E 30 m/s N90/I/19

2 Water waves were produced in a ripple tank using a vibrator of frequency 3 Hz. Which of the following values of speed and wavelength could the waves have had?

	speed	*wavelength*
A	1 cm/s	3 cm
B	2 cm/s	1 cm
C	5 cm/s	15 cm
D	6 cm/s	3 cm
E	12 cm/s	4 cm

J91/I/19

3 The table shows examples of transverse and longitudinal waves. Which line in the table is correct?

	transverse	*longitudinal*
A	gamma rays	sound
B	infra-red	radio
C	infra-red	water waves
D	radio	light
E	sound	X-rays

N91/I/19

4 A dolphin emits an ultrasonic wave with a frequency of 150 000 Hz. The speed of the ultrasonic wave in water is 1500 m/s.

What is the wavelength of this wave in water?

A 0.0001 m
B 0.01 m
C 0.1 m
D 10 m
E 100 m N91/I/20

5 Which of the following are examples of a transverse and a longitudinal wave?

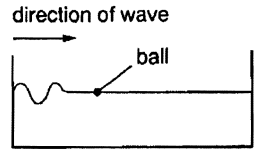
	transverse wave	*longitudinal wave*
A	light	water ripples
B	radio	light
C	radio	sound
D	sound	light
E	water ripples	radio

N92/I/18

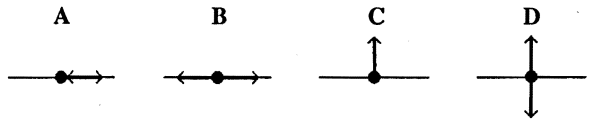
6 A surf-board moves at 5 m/s on the crest of a wave. The distance between wave crests is 10 m. The frequency of the wave motion is

A 0.5 Hz
B 1 Hz
C 2 Hz
D 5 Hz
E 10 Hz J93/I/17

7 The diagram shows a ball floating in a tank of water.



Which diagram shows the movement of the ball when the wave passes?



J94/I/20

8 One end of a long spring is moved backwards and forwards to produce a model of a wave.

What is this type of wave called, and what would be a good example of it?

	type of wave	*example*
A	longitudinal	radio wave
B	longitudinal	sound wave
C	transverse	radio wave
D	transverse	sound wave

J95/I/17

9 A wave source of frequency 1000 Hz emits waves of wavelength 0.1 m.

How long does it take for the waves to travel 2500 m?

A 4s
B 25s
C 40s
D 100s J95/I/18

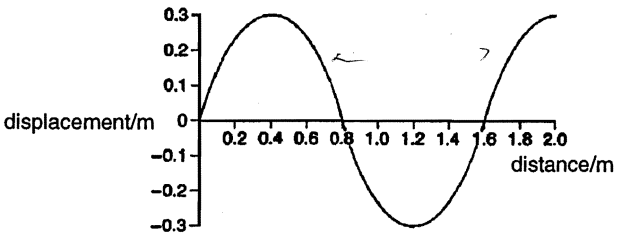
10 Which of the following correctly describes the natures of sound, light and radio waves?

	sound	*light*	*radio*
A	longitudinal	transverse	longitudinal
B	longitudinal	transverse	transverse
C	transverse	longitudinal	longitudinal
D	transverse	longitudinal	transverse

J92/I/18; N96/I/18

11 A long rope is stretched out on the floor. One end of the rope is then shaken.

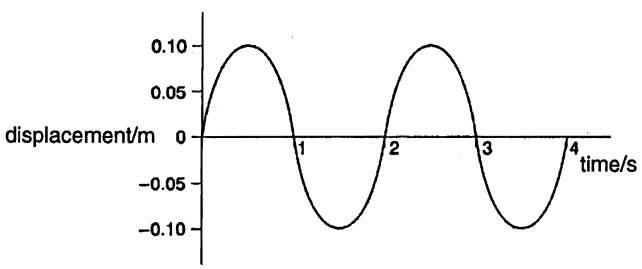
The graph shows the rope at a particular moment in time.



What is the wavelength of the wave motion?

A 0.3 m **C** 0.8 m
B 0.6 m **D** 1.6 m J97/I/17

12 The diagram shows how displacement varies with time as a wave passes a fixed point.



What is the frequency of this wave?

A 0.25 Hz **C** 1.0 Hz
B 0.50 Hz **D** 2.0 Hz N97/I/19

13 A dipper moving up and down makes waves in a ripple tank.

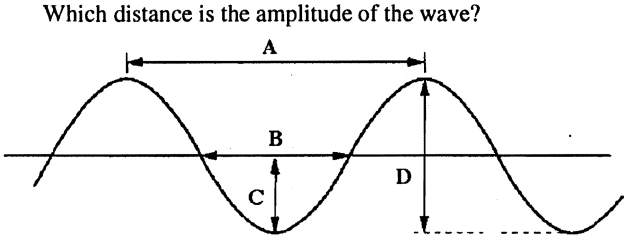
What will happen when the dipper frequency is increased?

A The waves will be closer together.
B The wave peaks will be higher and the troughs lower.
C The waves will move more quickly across the tank.
D The waves will move more slowly across the tank.

N97/I/20

14 The diagram shows a cross-section of a water wave.

Which distance is the amplitude of the wave?



J98/I/17

15 Which type of wave is longitudinal?

A light wave **C** sound wave
B radio wave **D** surface water wave

N98/I/17

16 Which of the following is a correct example of a longitudinal wave and of a transverse wave?

	longitudinal wave	transverse wave
A	light	radio
B	radio	sound
C	sound	X-ray
D	X-ray	light

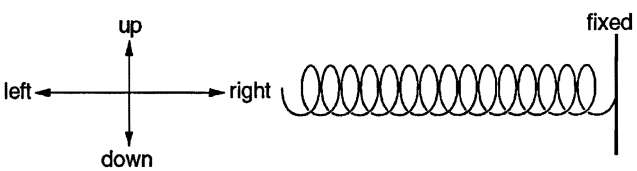
J99/I/17

17 Which of the following is a correct example of a transverse wave and of a longitudinal wave?

	transverse wave	longitudinal wave
A	ripples on water	light
B	ripples on water	sound
C	sound	light
D	sound	ripples on water

N99/I/17

18 A lightly coiled spring is fixed at one end and held by hand at the other.



Which hand movements cause first a compression and then a rarefaction to travel along the spring?

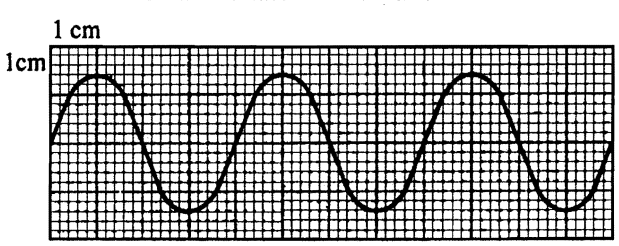
A down then up
B up then down
C left then right
D right then left J2000/I/17

19 Distinguish between *transverse* and *longitudinal* waves, giving an example of each type.

Both sound and light waves of a range of frequencies are encountered. State clearly the change which you would detect with your senses in each case as the frequency alters.

J79/II/9

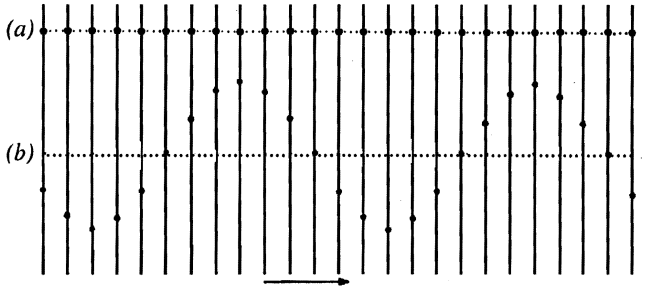
20 A wave is passing across the surface of water in a tank. The diagram, which is drawn full scale, shows a vertical cross-section of the water surface at one instant.



Write down as much information as you can derive from the diagram about the fundamental properties of the wave motion on the surface of the water. N79/I/8

21 A mechanical model used to illustrate wave motion consists of a series of small balls which can be moved. Diagram *(a)* shows the balls, at rest and equidistant from one another, when the model is not in use.

Diagram *(b)* shows the rest positions of the balls at an instant when the model is being used to illustrate a wave motion. The arrow indicates the direction of travel of the wave represented on the model. (The vertical lines are included for your guidance.)

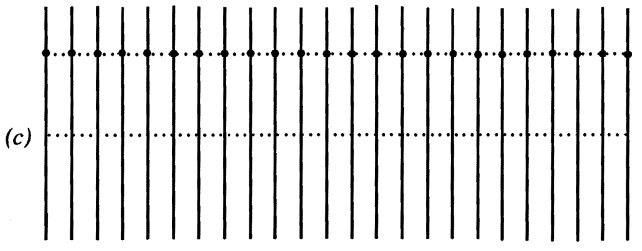


(i) Mark on diagram *(b)* distances equal to the *wavelength* and *amplitude* of the wave motion shown on the model. Label these distances.

How could the *frequency* of the wave be determined?

(ii) Is the wave illustrated in diagram *(b)* a transverse or a longitudinal wave?

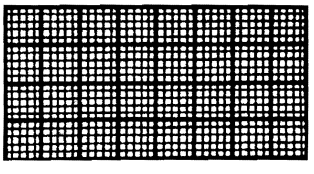
(iii) In the light of your answer, draw in the space below a diagram to show the position of the balls at an instant when the model is used to illustrate the *other* type of wave. (For your guidance the rest positions of the balls when the model is not in use, are reproduced.)



(iv) Which of the uses of the model, illustrated in diagrams *(b)* and *(c)* would be more appropriate to illustrate a sound wave in air? What would the small balls represent in this case?

N80/II/3

22 Transverse waves of wavelength 40 mm and amplitude 15 mm travel across a liquid surface. On the grid below draw a full scale diagram showing a side view of the liquid surface at a particular instant.



If the frequency of vibration of the waves is 12 Hz, calculate the speed at which they travel across the liquid surface.

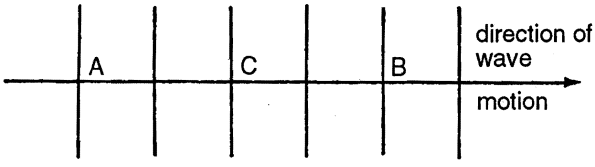
J81/I/6

23 Draw diagrams to show the essential difference between *transverse* and *longitudinal* waves.

Which of these types of wave is associated with the production of *compressions* and *rarefactions* in the medium through which the wave is travelling?

What is the distance from a compression to an adjacent rerefaction, at any instant, in terms of the wavelength of the waves? J82/I/11

24 In the diagram (drawn $^1/_2$ full-scale, as viewed from above), the straight lines represent the positions, at one instant, of successive crests of plane waves travelling on water in the direction shown.

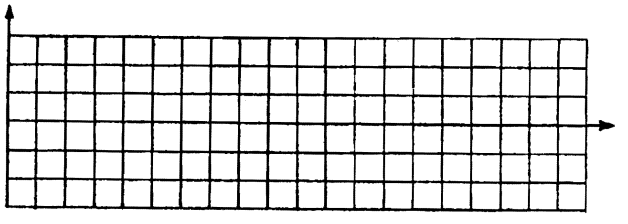


(a) What is

(i) the wavelength of the water waves,

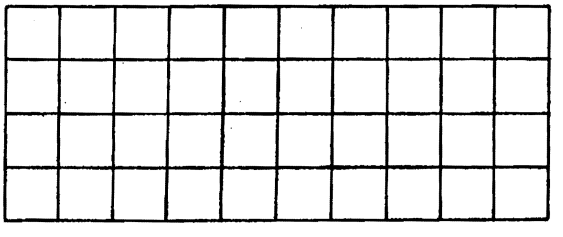
(ii) their speed, their frequency being 4.0 Hz?

(b) On the 5 mm grid below, draw a *full-scale diagram* to show the shape of the water surface between A and B at the instant shown, given that the wave amplitude is 7.5 mm.



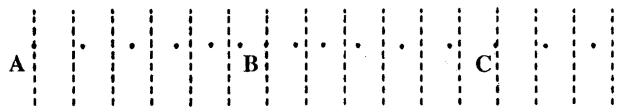
(c) Describe the movement of the water at point C as the wave travels past. N83/II/3 (*a, b & c*)

25 *(a)* Draw on the grid below a *transverse* wave at a particular instant as it travels from left to right. Your wave should be drawn full scale and should have an amplitude of 2.0 cm and a wavelength of 5.0 cm.



(b) Each of the particles in a medium in which a *transverse* wave travels has a similar motion. Describe briefly the motion of one such particle in a medium through which a transverse wave is passing.

(c) The full-scale diagram represents the positions of particles of a medium at a particular instant whilst a *longitudinal* wave, travelling from left to right, passes through the medium. Before the wave arrived the particles were all 1.0 cm apart, i.e. each was on one of the dotted lines in the diagram. At the instant shown, the particles A, B and C are passing through their original undisturbed positions.



By making measurements on the diagram, write down

(i) the *wavelength* of the wave

(ii) the *amplitude* of the wave motion

J87/II/3 (*a, b* & *c*)

26 *(a)* Distinguish between *transverse* and *longitudinal* waves.

Give an example of each type of wave. [4]

N87/II/3*(a)*

27 Transverse waves are produced in a long rope by securing one end of the rope to a wall and then moving the other end from side to side by hand. The frequency of the waves is 2 Hz.

(a) What does the term "transverse" mean? [1]

(b) Explain the meaning of the expression "the frequency is 2 Hz". [2]

(c) What determines the amplitude of the waves produced? [1] J88/I/8

28 *(a)* **A, B, C** and **D** in Fig. 1 represent particles in a medium through which waves are passing continuously in the direction indicated by the arrow.

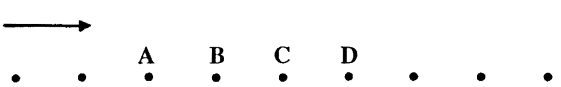


Fig. 1

Describe the motion of the particles **A, B, C** and **D** when the wave is (i) transverse and (ii) longitudinal. [4]

(b) (i) Draw a full-scale diagram of a transverse wave of wavelength 40 mm and amplitude 15 mm. Your diagram should represent the wave at a particular instant and should show at least two wavelengths.

(ii) Calculate the speed of the wave you have drawn if its frequency is 150 Hz. [6]

J89/II/9

29 Fig. 2 shows a student setting up waves on a long elastic cord. The student's hand makes one complete up-and-down movement in 0.40 s, and in each up-and-down movement the hand moves through a height of 0.30 m. The wavelength of the waves on the string is 0.80 m.

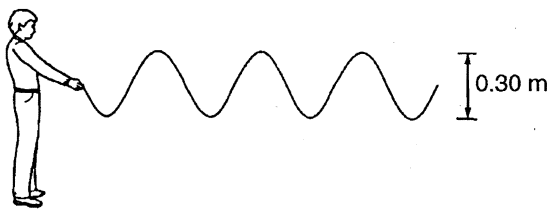


Fig. 2

For this wave, determine *(a)* the amplitude, *(b)* the frequency, and *(c)* the speed. [4] J90/II/4

30 *(a)* Fig. 3.1 shows the graph of the variation of the displacement of a wave with distance along the wave at a particular time.

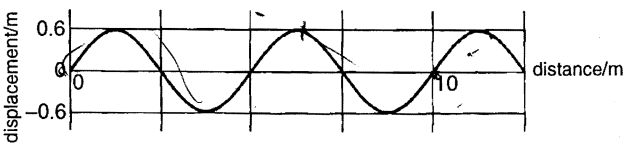


Fig. 3.1

State values for

(i) the amplitude of the wave

(ii) the wavelength of the wave [2]

(b) Fig. 3.2 shows the graph of the variation of the displacement of the same wave with time at a particular point along the wave.

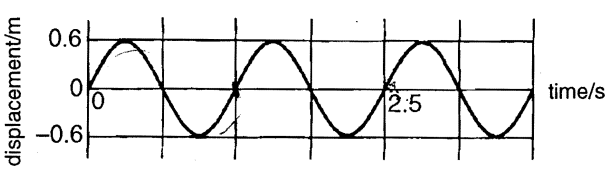


Fig. 3.2

State values for

(i) the time for one complete cycle

(ii) the frequency of the wave [2]

(c) Calculate the speed of the wave drawn in Figs. 3.1 and 3.2. [3]

N92/II/4

31 *(a)* Figure 4.1 is a graph of the variation of *d*, the displacement (*y*-axis), with *s*, the distance from the vibrator (*x*-axis), for ripples on the surface of water in a ripple tank.

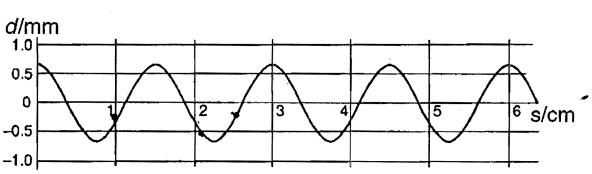


Fig. 4.1

Determine

(i) the amplitude of the ripples,

(ii) the wavelength of the ripples. [2]

(b) Figure 4.2 is a graph of the variation with time t of the vertical displacement d of the ripple tank vibrator.

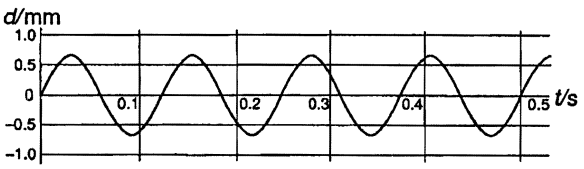


Fig. 4.2

Determine

(i) the period of oscillation of the vibrator,

(ii) the frequency of the vibrator. [3]

(c) Use your answers to *(a)* and *(b)* to determine the speed of the ripples.

Speed = ... [3]

J94/II/4

32 Fig. 5 shows an arrow which indicates the direction of travel of a wave in a medium. **A** is a particle of the medium that is in the path of the wave.

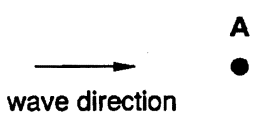


Fig. 5

(a) Draw diagrams to show how the particle **A** *moves* when the wave is

(i) a transverse wave,

(ii) a longitudinal wave.

(b) A transverse wave has a wavelength of 50 mm, a frequency of 40 Hz and an amplitude of 20 mm.

(i) State what is meant by the *frequency* of the wave.

(ii) Draw a full-scale diagram of the wave at one instant, showing two complete wavelengths.

(iii) Calculate the speed of the wave.

(iv) Give **two** examples of a transverse wave. [7]

**(c)* Describe an experiment that you could perform to measure the speed of sound in air.

In your account, you should

(i) draw a labelled diagram of the apparatus you would use,

(ii) describe how the experiment is performed,

(iii) state the readings that are taken,

(iv) show how the readings are used to calculate the speed of sound. [6]

N98/II/11

33 Fig. 6.1 shows a ripple tank being used to investigate waves on water.

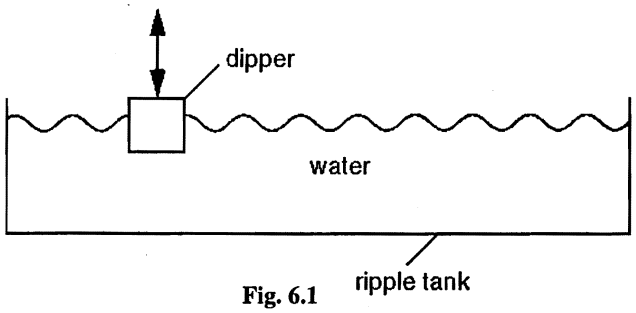


Fig. 6.1

Fig. 6.2 full scale

The dipper moves up and down 20 times in one second. Fig. 6.2 shows, to full scale, a sideways view of the wave on the surface of the water at one instant.

(a) (i) Determine the wavelength of the wave in Fig. 6.2.

(ii) Calculate the speed of the water wave. State clearly the equation you use. [4]

(b) The dipper is now made to move up and down 40 times in one second. The speed of the water wave is unchanged.

(i) On Fig. 6.2, draw the sideways view of the new wave.

(ii) State the value of the new wavelength of the wave. [2]

J2000/II/7

ANSWERS

1. **B**	2. **E**	3. **A**	4. **B**	5. **C**
6. **A**	7. **D**	8. **B**	9. **B**	10. **B**
11. **D**	12. **B**	13. **A**	14. **C**	15. **C**
16. **C**	17. **B**	18. **D**		

22. 0.48 m/s

24. *(a)* (i) 20 mm (ii) 80 m/s

25. *(c)* (i) 12 cm (ii) 0.7 cm

(d) (i) 14 mins

28. *(b)* (ii) 6 m/s

29. *(a)* 0.15 m *(b)* 2.5 Hz

(c) 2 m/s

30. *(a)* (i) 0.6 m (ii) 5 m

(b) (i) 1.25 s (ii) 0.80 Hz

(c) 4 m/s

31. *(a)* (i) 0.7 mm (ii) 1.5 cm

(b) (i) $^1/_8$ s (ii) 8 Hz

(c) 12.0 cm/s

32. *(b)* (iii) 20 m/s

33. *(a)* (i) 3 cm (ii) 60 cm/s

(b) (ii) 1.5 cm