Multiple choice Questions

Example 1   QLD 2016 Question 7, 1 mark

When a wave moves through a medium there is a net transfer of

A. mass only.

B. energy only.

C. momentum only.

D. mass and energy.

Example 2   QLD 2017 Question 7, 1 mark

Along a transverse wave, there is a net transfer of

A. mass.

B. energy.

C. both mass and energy.

D. neither mass nor energy.

Example 3   QLD 2018 Question 7, 1 mark

In a longitudinal wave, the direction of energy flow

A. is perpendicular to any temporary displacement of mass.

B. is in the same direction as any temporary displacement of mass.

C. depends on the maximum temporary displacement of mass.

D. depends on the phase of the wave.

One end of a long uniform coil-spring is connected to a source which is vibrating perpendicular to the length of the spring with simple harmonic motion. This initially sets up a wave which travels along the spring.

Example 4   1982 Question 37, 1 mark

Which one or more of the following statements is correct?

A. Vibrating particles of the coil have the same frequency of vibration as the source.

B. The velocity of the wave is the same as that of the source at that instant.

C. The particles all vibrate in phase with the source of vibration.

D. All vibrating particles separated by a distance of one wavelength are in phase.

(one or more answers)

The figure below shows a spring on which a simple travelling wave is moving to the right. A scale is visible behind the spring. P is a point on the spring. The line OX shows the undisplaced position of the spring.
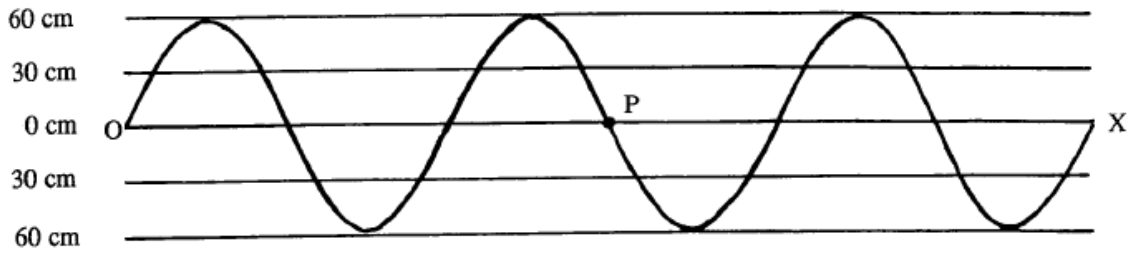

Example 5   1989 Question 33, 1 mark

Which of the statements (**A - E**) below best describes the motion of the point P, at the instant shown below?

A. It is moving to the right.

B. It is momentarily stationary and about to move upwards.

C. It is stationary and will remain stationary.

D. It is moving upwards.

E. It is moving downwards.

A stretched spring, attached to two fixed ends, is compressed on the right end and then released, as shown. The resulting wave travels back and forth between the two fixed ends until it comes to a stop.
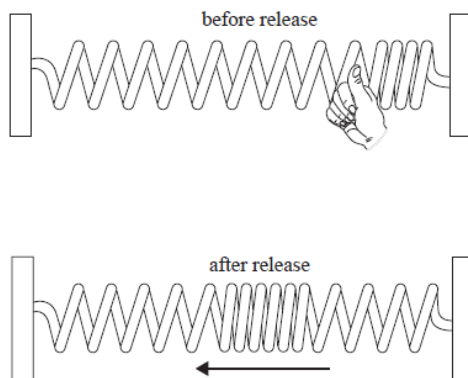

Example 6   2009 Question 2, 2 marks

This wave is best seen as an example of

A.   a transverse wave.

B.   a longitudinal wave.

**C.**   diffraction.

D.   an electromagnetic wave.

The following diagrams represent the variation of air pressure of a sound wave of period T, as a function of distance, at a particular time. Diagram A was recorded at time t = 0. The other diagrams (**B – E**) show the pressure variation at later times.
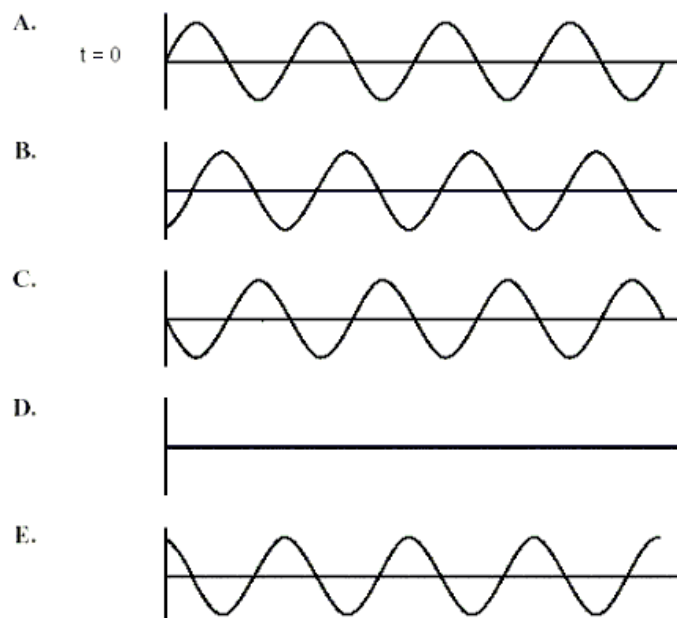
Example 7   2002 Question 3, 2 marks

Write the letters (**A – E**) of the diagrams that correspond to a sound wave travelling to the left at times t = $\frac{T}{4}$, and $\frac{T}{2}$, later than diagram A.

A single pulse on a slinky spring is moving towards the right. The diagram below is a representation of the pulse.
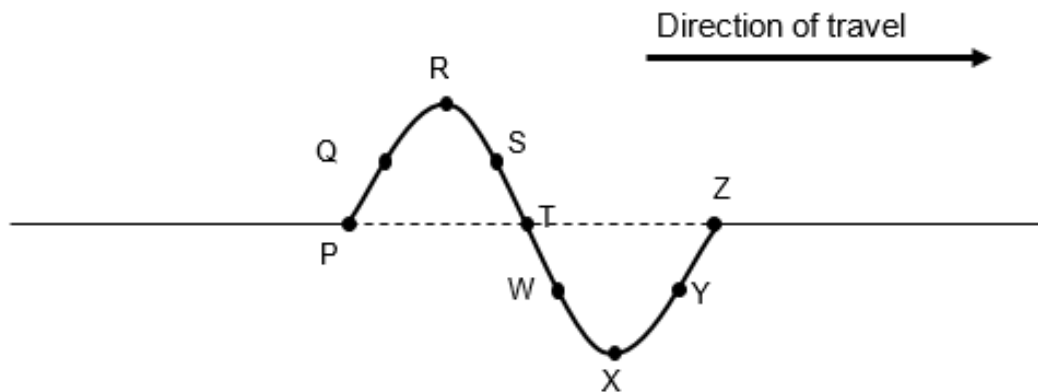
Example 8

Which one of the following best describes the motion at the point X?

A   moving up

B   moving down

C   stationary, but about to move up

D   stationary, but about to move down

E   stationary, and will remain stationary

Example 9

Which one of the following best describes the motion at the point Q?

A   moving up

B   moving down

C   stationary, but about to move up

D   stationary, but about to move down

E   stationary, and will remain stationary

Sound is emitted from a loud speaker. About 1 metre from the speaker, a very light spider web is floating freely in the still air as shown below.
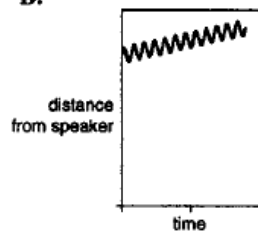

floor
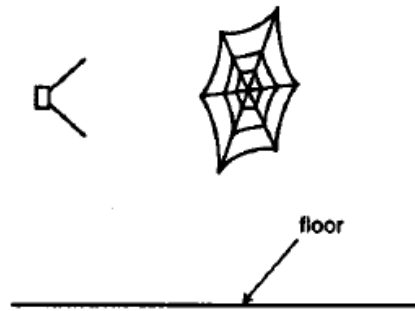
Example 10   1994 Question 1, 1 mark

Which of the graphs (**A - D**) below best illustrates the motion of any point on the spider web as a function of time? Note that the labels on the vertical axes of the graphs are different.
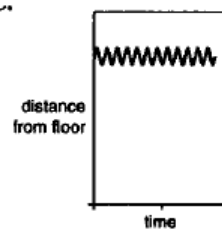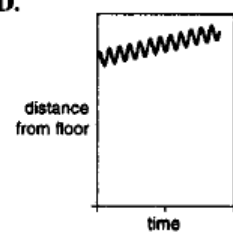

A.
distance from speaker
time
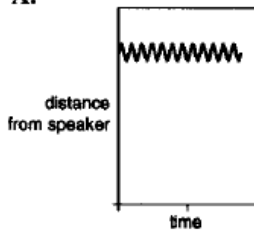
B.
distance from speaker
time

C.
distance from floor
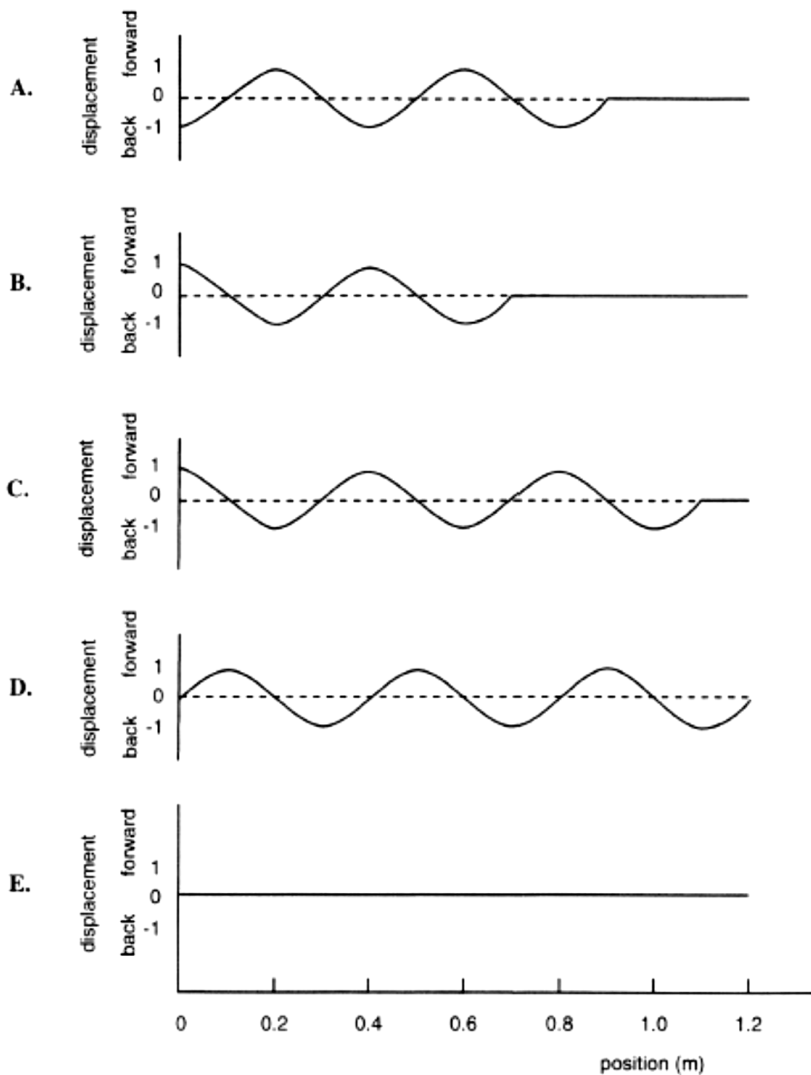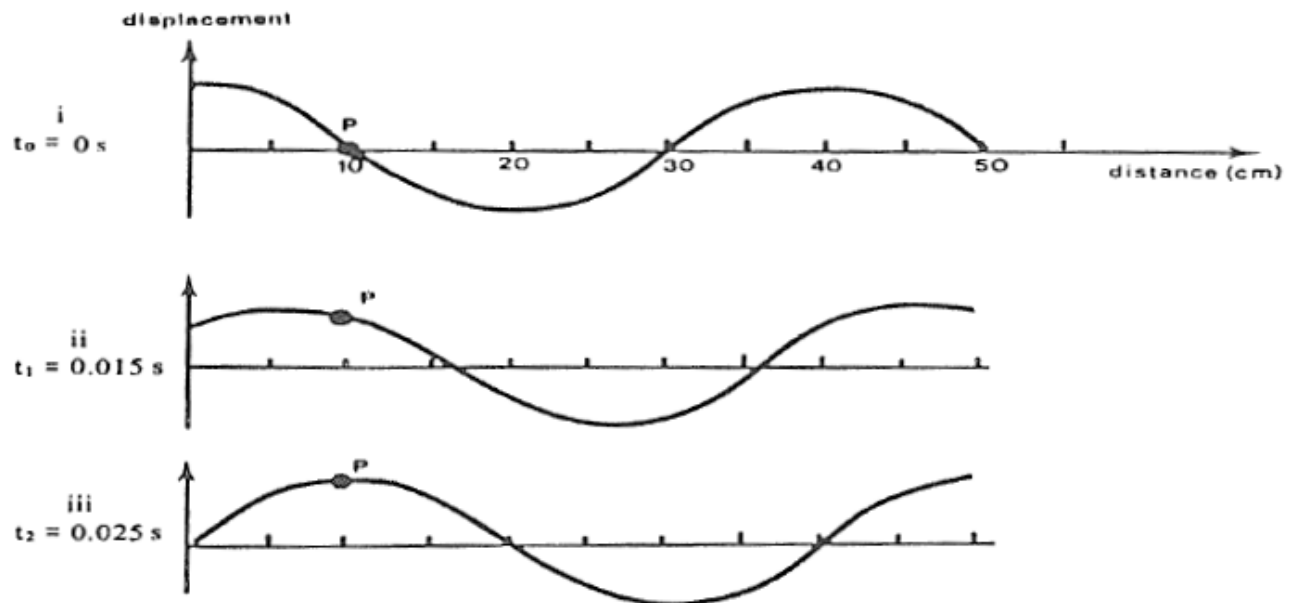time

D.
distance from floor
time

In order to study the compressional nature of sound waves, a student sets up a travelling longitudinal wave on a long 'slinky' spring. One end of the spring is tied to a mechanical vibrator which oscillates the end back and forward at a frequency of 5.0 Hz. The figure below shows the displacement back and forward of each loop of a small section of the spring, at a particular instant of time. The wave is travelling to the right, and in the figure has reached point P. A length scale is plotted below the spring.
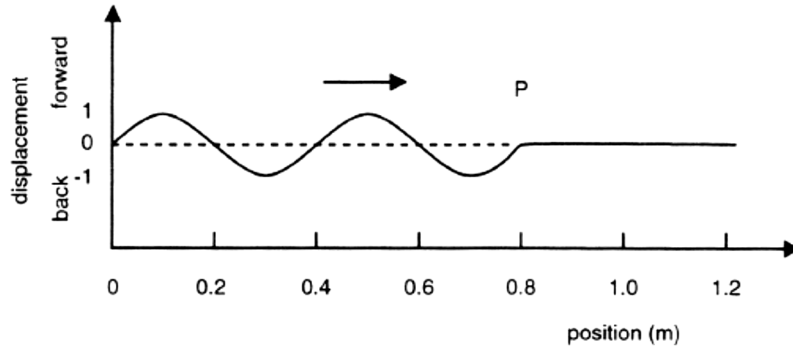
Example 11   1995 Question 3, 1 mark

Which of the diagrams (**A - E**) below, best illustrates the displacement of loops of the spring, for the same section of the spring, one quarter period after the time shown in the figure above? The horizontal and vertical scales are the same in both figures.

The diagram above shows the displacement of points on a string as a function of distance along the string at three different times.

Example 12   1981 Question 43, 1 mark

Use the ANSWER KEY to describe the motion of point P on the string at
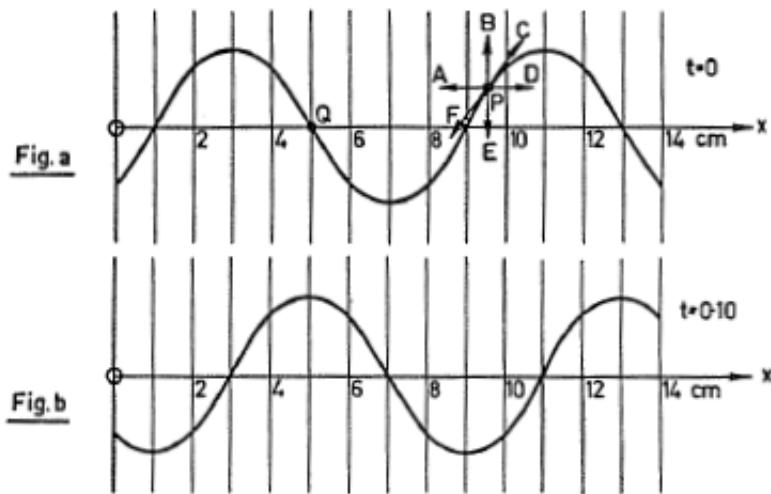
i   time t_0

ii   time t_1

iii   time t_2

ANSWER KEY

A.   It is stationary.

B.   It is moving up at its maximum speed..

C.   It is moving up but not at its maximum speed.

D.   It is moving down with its maximum speed.

E.   It is moving down but not with its maximum speed.

Fig. *a* is a picture of string with a periodic wave moving on it in the +x direction. Fig. *b* shows the same piece of string 0.10 sec later.
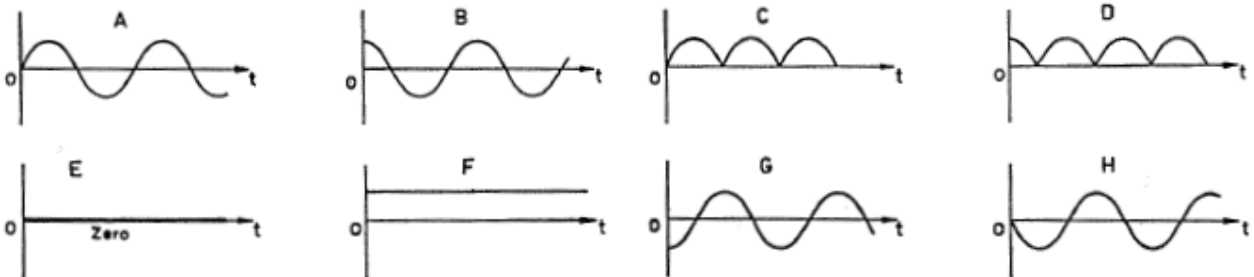

Fig. a

Fig. b

Example 13　1971 Question 56, 1 mark

Which of the arrows on Fig. *a* shows the velocity of point P on the string?
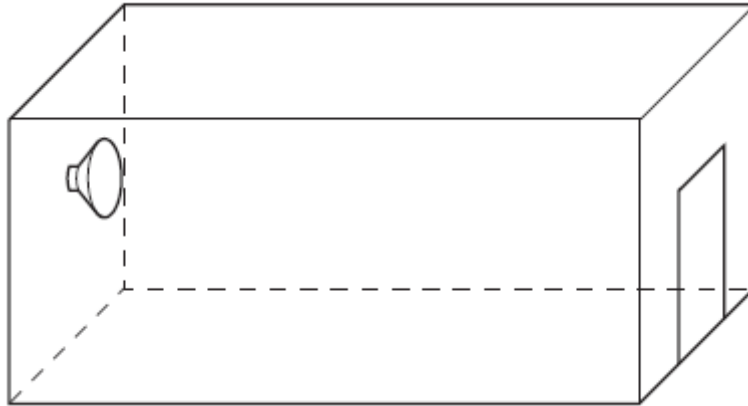
Example 14　1971 Question 57, 1 mark

Which of the following graphs best represents the velocity-time graph of point Q?

The following information relates to Questions 1 and 2.

A loudspeaker producing a sound of constant frequency of 512 Hz is placed in a room, as shown below.

The speed of sound in air in the room is 330 m s⁻¹.

Example 15   2010 Question 1, 2 marks

Which of the following best gives the wavelength of the sound?

A.   0.33 m

B.   0.64 m

C.   1.55 m

D.   1.69 m

Example 16   2010 Question 2, 2 marks

Which of the following statements best describes the behaviour of air immediately in front of the speaker?

A.   It is moving away from the speaker at 330 m s⁻¹.

B.   It is moving away from the speaker at 512 m s⁻¹.

C.   It is oscillating vertically 512 times per second.

D.   It is oscillating horizontally 512 times per second.

A loudspeaker is emitting sound of a fixed intensity which travels equally in all directions. The figure below shows the pressure variation plotted against distance from the loudspeaker, at a particular instant of time. Take the speed of sound to be 333 m s^{-1}.
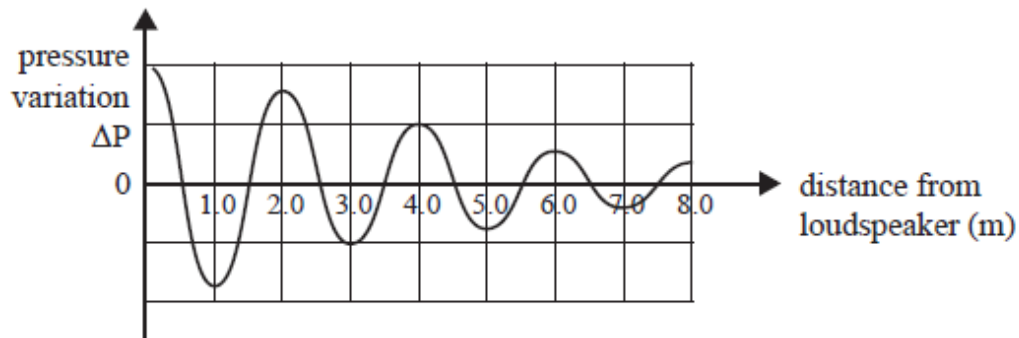
Example 17   2009 Question 3, 2 marks

The frequency of the sound emitted is closest to

A.   111 Hz

B.   133 Hz

C.   167 Hz

D.   333 Hz

Example 18   2001 Question 1, 2 marks (modified)

What is the frequency of this wave?
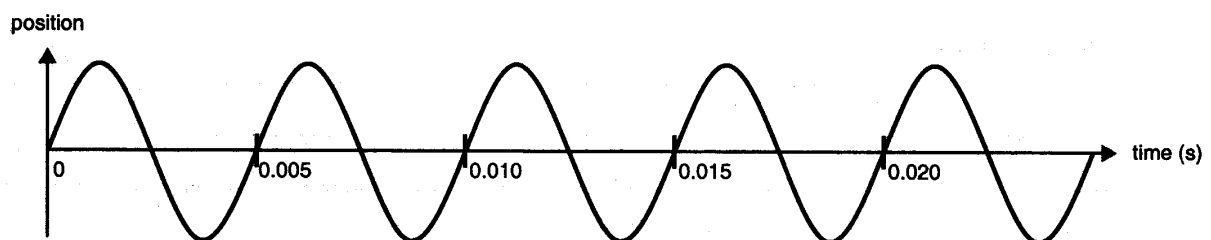
A   0.005 Hz

B   50 Hz

C   100 Hz

D   200 Hz

Example 19   QLD 2009 Question 7, 1 mark

In a ripple-tank experiment, a student produces pulses every tenth of a second. The distance between pulses is 3.0 cm.
In the same depth of water, other pulses are produced every half second. What is the distance between these pulses?

A.   0.067 cm

B.   0.15 cm

C.   0.60 cm

D.   15 cm

A source of straight waves in a ripple tank of uniform depth dips into the water *n* times per second. Waves travel to left and right from the source at a speed of *V* cm sec^{-1}

The source is now made to move to the right at a constant speed of *S* cm sec^{-1} *(S < V)*.

The following Questions, 24 and 25, are concerned with the waves <u>to the right of the moving source, i.e. ahead of it.</u>

Example 20   1966 Question 26, 1 mark

Which of the following diagrams *(A to D)* best represents the position of the wavefronts to the left and the right of the moving source at a particular *time?* (The source has dipped into the water many times since it was made to move at the speed S.)
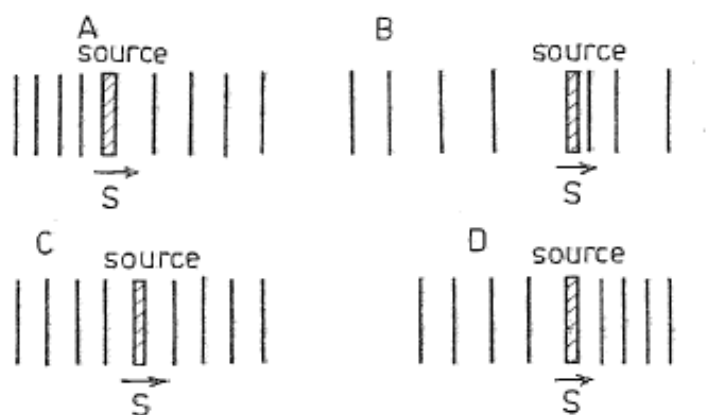
Example 21   1966 Question 27, 1 mark

Which one of the following could be predicted from the above properties of waves produced by a moving source in a ripple tank?

A. The intensity of the light from a moving source varies inversely as the square of the distance from the source.

B. The frequency of light changes as it passes from one medium to another.

C. The observed colour of light from a moving source depends on the speed of the source relative to the observer;

D. The fact that sunlight is made up of different colours is caused by the sun's motion through space.


Example 22   QLD 2018 Question 7, 1 mark

In a longitudinal wave, the direction of energy flow

A. is perpendicular to any temporary displacement of mass.

B. is in the same direction as any temporary displacement of mass.

C. depends on the maximum temporary displacement of mass.

D. depends on the phase of the wave.

Example 23   QLD 2010 Question 5, 1 mark

The diagram shows a water wave moving to the right.
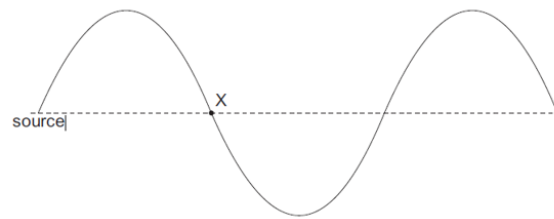
At this instant, the direction of motion of point X is best described as

A. upward.

B. downward.

C. to the right.

D. momentarily at rest.

Example 24   QLD 2010 Question 6, 1 mark

A wave of frequency 500 Hz travels between points A and B, a distance of 2000 m, in 5.00 s. What is its wavelength?

A. 0.08

B. 0.8

C. 1.0

D. 10

Example 25   QLD 2011 Question 7, 1 mark

An ocean wave travelling at 3.50 m s^{-1} with a period of 0.800 s moves towards an area of shallow water where the wave slows to 1.75 m s^{-1}. The frequency of the wave in the shallow water is

A. 0.40 Hz

B. 0.8 Hz

C. 1.0 Hz

D. 1.25 Hz

Example 26   QLD 2011 Question 8, 1 mark

The speed of sound (V m s^{-1} in air can be found using the equation

$$V = 322 + 0.6 \ T$$

Where T is temperature in degrees Celsius. When the temperature is below 0^0 C, the speed of sound will be

A. greater than 322 m s^{-1}

B. less than 322 m s^{-1}

C. equal to 322 m s^{-}

D. equal to 0 m s^{-1}

Example 27   QLD 2014 Question 9, 1 mark

If water waves enter a shallower medium, which of the following will occur?

A.   The frequency will decrease, but the wavelength will increase.

B.   The frequency will increase, but the wavelength will decrease.

C.   The frequency will remain the same, but the wavelength will increase.

D.   The frequency will remain the same, but the wavelength will decrease.

Example 28   NSW 1998 Question 15, 1 mark

As shown in the diagram, a tube contains three different substances: helium, water and aluminium. A source, at the base of the tube, emits sound waves.
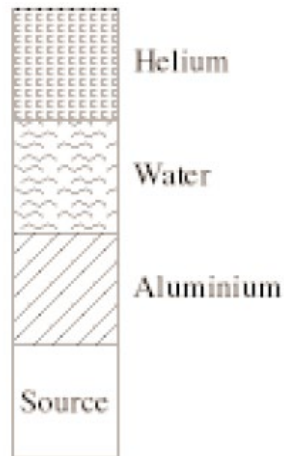
Which of the following is true?

A.   The sound waves travel with the same frequency in all the substances.

B.   The sound waves travel with the same wavelength in all the substances.

C.   The sound waves travel with the same velocity in all the substances.

D.   The sound waves travel with the same amplitude in all the substances.

Vanessa is using a computer to model the behaviour of sea waves in harbours. The computer shows wave crests as lines and shows the direction of wave travel by an arrow.
The figure below represents this situation.
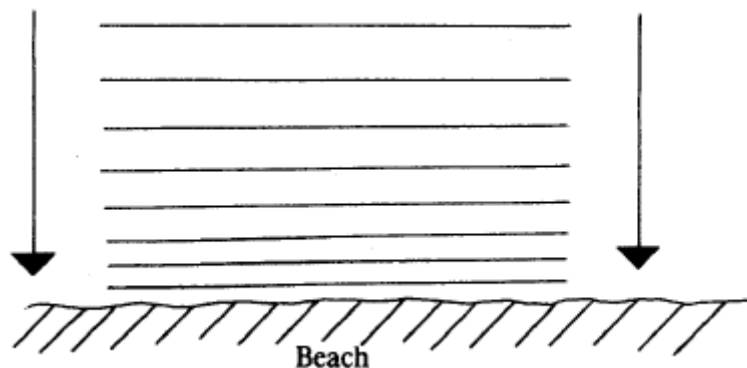
Example 29   1987 Question 45, 1 mark

Which of the descriptions (**A - D**) below of the changes to the waves as they approach the beach is correct?

	Speed	Wavelength	Frequency
A.	Constant	Decreasing	Increasing
B.	Decreasing	Decreasing	Constant
C.	Decreasing	Increasing	Constant
D.	Decreasing	Decreasing	Increasing

The axes of polarization of two perfect polarizers are perpendicular to each other, as shown below.
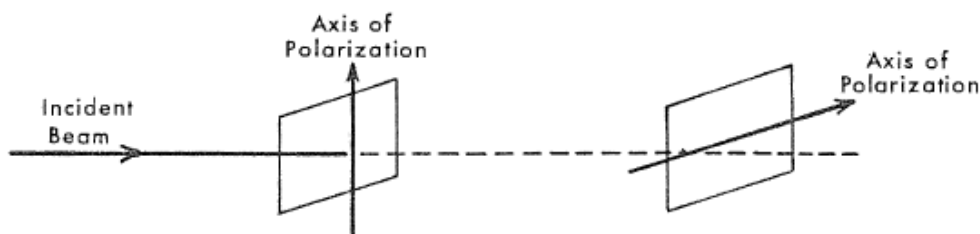

Example 30   1977 Question 74, 1 mark

Which of the following statements correctly describes the effect of the polarizers on the beam?

A.   The transmitted light will be unpolarized.

B.   The light transmitted by the first polarizer will be stopped by the second.

C.   The light transmitted by the first polarizer will also be transmitted by the second.

D.   Light transmitted through the first polarizer will be de-polarized by the second one.

A beam of light passes through two polarisers. The second polariser has a transmission axis at an angle of 30° to that of the first polariser. The intensity of the light beam before and after the second polariser is I_0 and I_B respectively.
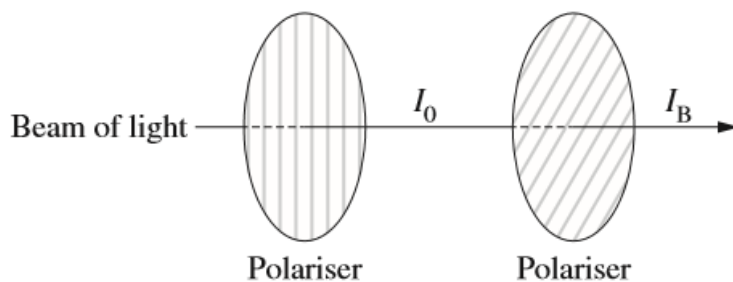
Example 31   2019 NSW Question 10, 1 mark

Which row of the table correctly identifies the value of $\frac{I_B}{I_0}$ and the model of light demonstrated by this investigation?

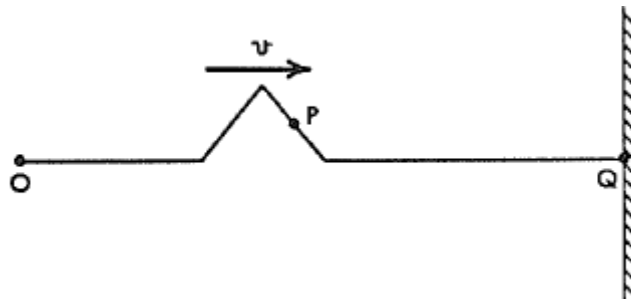|	Value of $\frac{I_B}{I_0}$	Model of light demonstrated
A.	0.750	Wave model
B.	0.750	Particle model
C.	0.866	Wave model
D.	0.866	Particle model

Extended answer questions

A domestic microwave oven operates at a frequency of 2.45 GHz.

Example 32   2019 TAS Question 16a, 1 mark

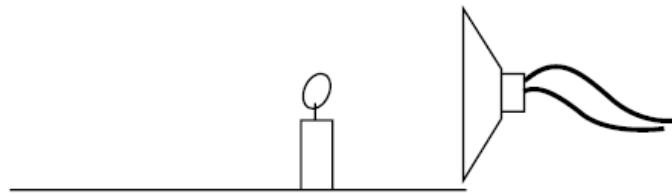Calculate the wavelength of the microwave emission.

A mark is painted on the string at point P.

Example 33   1977 Question 38, 1 mark

What is the velocity, *v*, of the mark P in the direction OQ when the mark is in the position shown in the diagram?

A burning candle is placed on a table in front of a loudspeaker as shown

When the loudspeaker emits sound with a frequency of 10 Hz, the flame of the candle moves towards and away from the loudspeaker with a frequency of 10 Hz.

Example 34   2003 Question 1, 2 marks

Explain the reasons for the movement of the candle flame.

Two students, Pat and Morgan, are discussing an experiment to test the nature of sound waves. They imagine a loudspeaker with a dust particle sitting motionless in front of it, and consider what will happen to the particle when the speaker is turned on.


dust particle
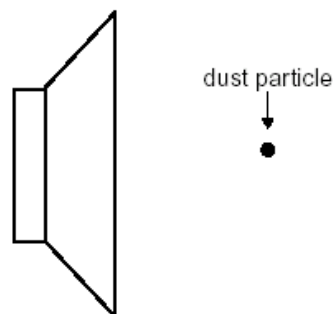
Pat says that since there is energy transferred by the wave, the particle will gain energy. A succession of little impulses will push the particle continuously away from the speaker. Morgan agrees that energy is carried by the wave. However, the result of the pressure variations will cause the dust particle to move back and forth about its original position.

Example 35   2002 Question 2, 2 marks

Circle the name of the person whose prediction is more nearly correct.   Pat / Morgan

Explain the logic of your choice.

A student produces two different types of travelling waves by shaking the end of a long slinky spring. The figure below shows snapshots of parts of the waves at an instant of time.

each division represents 20 cm
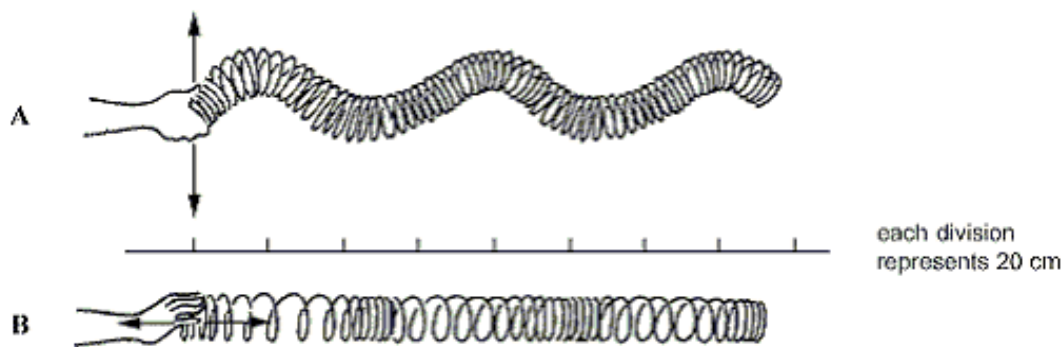
Example 36   1998 Question 1, 1 mark

Estimate the wavelength of travelling wave A.

Ashley and Pat have a method for determining the speed of sound. Ashley beats a drum at a rate of exactly two beats per second. Pat then walks away from Ashley along the street until the sound of the drum is heard at the precise instant Ashley is seen to hit the drum. The distance from the drum to Pat at this point is 167 m.

### Example 37   2002 Question 1, 2 marks

What is the calculated speed of sound? Your answer must be given to 3 sig. figs.

Kylie is rehearsing for a concert. She sings a pure note of a single frequency. The time between successive compressions of the sound wave arriving at her ears is 5 ms.
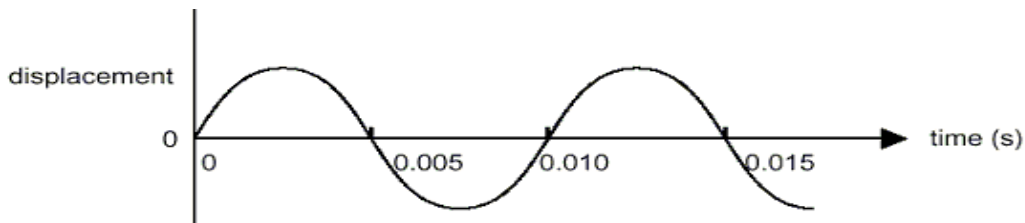
Example 38   2000 Question 4, 1 mark

What is the frequency of the sound?

A loudspeaker consists of a cardboard cone that acts as a diaphragm which is moved backwards and forwards to produce a travelling sound wave in air. Such a speaker is mounted on a wall as shown below.
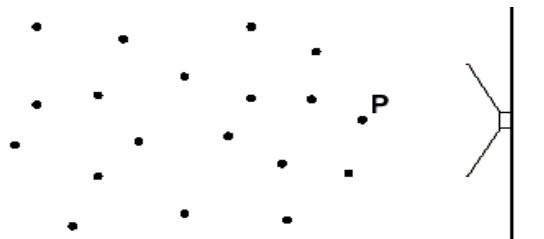
The figure below shows the horizontal displacement of the speaker cone as a function of time.

Example 39   1997 Question 1, 1 mark

What is the **frequency** of the sound?

Example 40   1997 Question 2, 1 mark

In the air are fine dust particles which are floating at rest. After the loudspeaker is turned on, the particles will be forced to move by the pressure variations associated with the sound wave.

For the dust particle at point P, directly in front of the loudspeaker, which of the statements (**A – D**) below best describes its motion?

A.   It vibrates vertically up and down at the frequency of the sound wave.

B.   It vibrates horizontally backwards and forwards at the frequency of the sound wave.

C.   It moves horizontally forwards, travelling with the sound wave.

D.   It remains at rest.

Example 41   1997 Question 3, 1 mark

Explain the reason for your choice in Question 2.

During a concert, a flute produces sound of a single frequency. A microphone placed near the flute, connected to a cathode ray oscilloscope, shows that the air pressure varies with time as shown below.
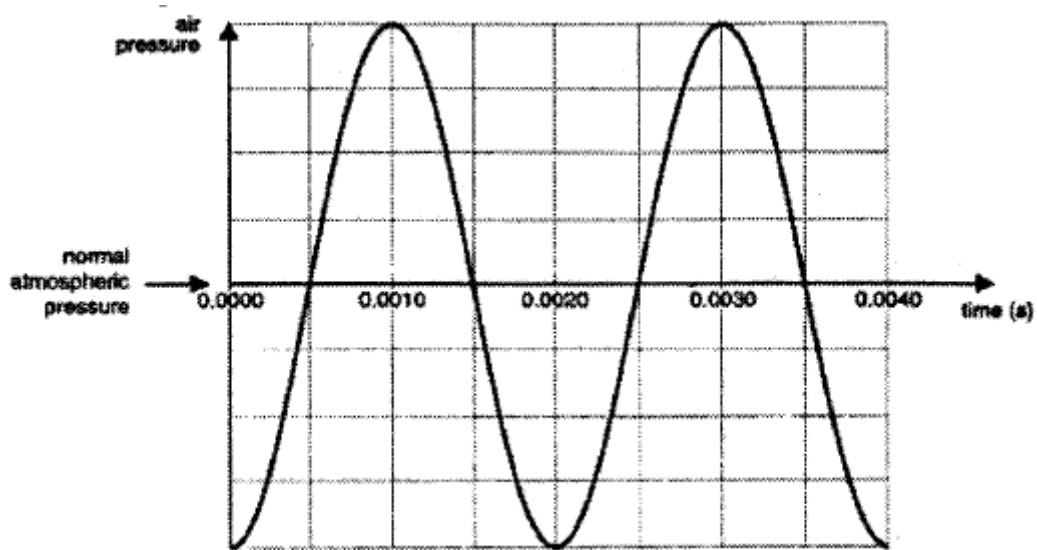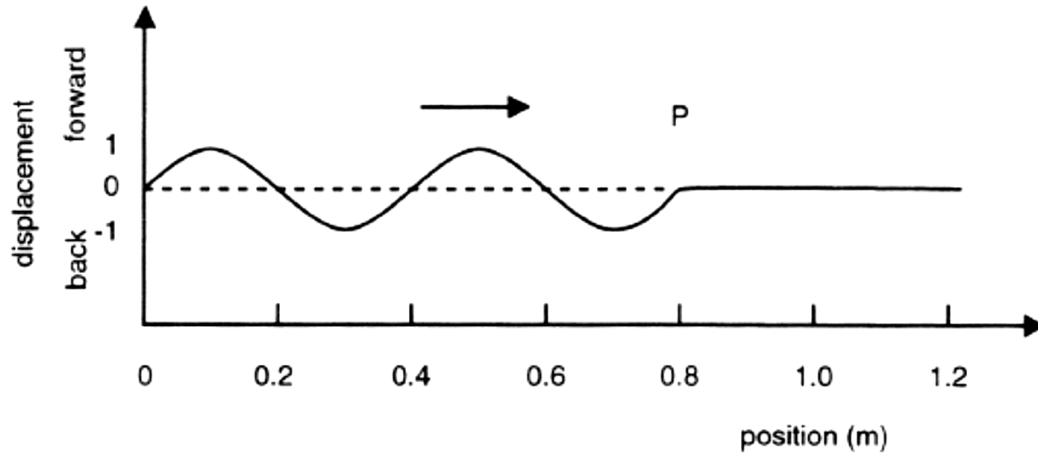

Example 42   1996 Question 1, 1 mark

What is the frequency of the sound produced by the flute?

Example 43   1996 Question 2, 1 mark

What is the speed of sound in the hall? (The wavelength is 0.70 m.)

In order to study the compressional nature of sound waves, a student sets up a travelling longitudinal wave on a long 'slinky' spring. One end of the spring is tied to a mechanical vibrator which oscillates the end back and forward at a frequency of 5.0 Hz. The figure below shows the displacement back and forward of each loop of a small section of the spring, at a particular instant of time. The wave is travelling to the right, and in the figure has reached point P. A length scale is plotted below the spring.


position (m)

Example 44   1995 Question 1, 1 mark

What is the period of the wave?

Example 45   1995 Question 2, 1 mark

What is the speed of the wave along the spring?

Sound is transmitted through air as a longitudinal wave. A sound wave consists of regions of air pressure which are alternately slightly higher and slightly lower than normal. At one particular instant, the pressure variations of a sound wave a long way from its source are shown below.
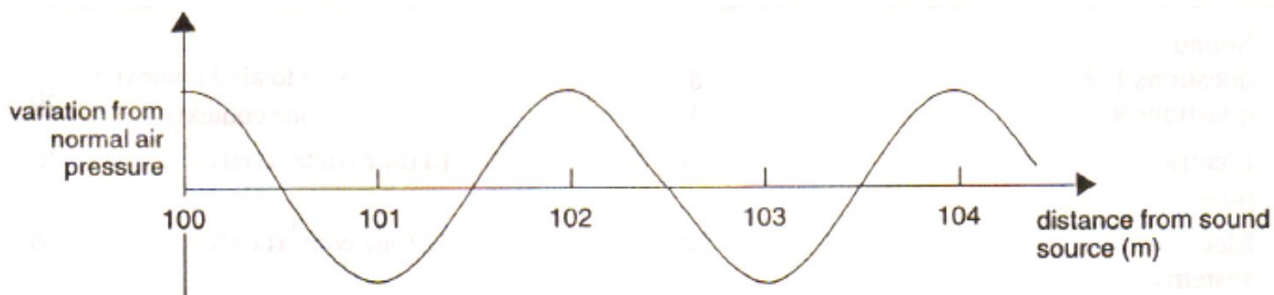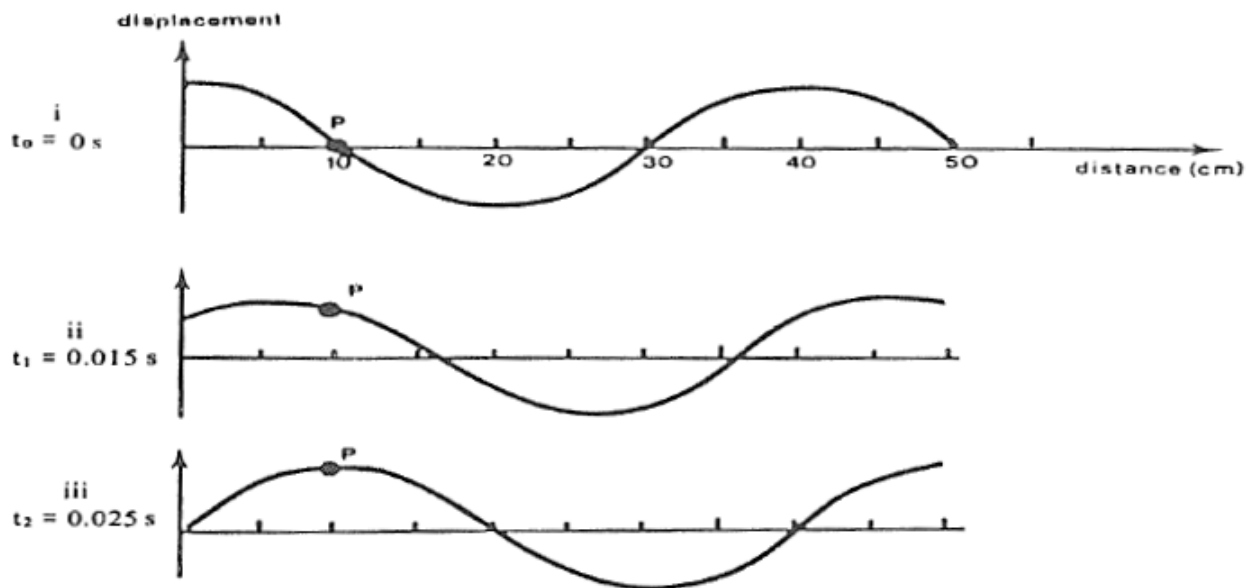

Example 46   1993 Question 1, 1 mark

What is the frequency of the sound wave shown above?
Assume that the speed of sound is 340 m s^{-1}.

Example 47   1993 Question 3, 1 mark

The wave is travelling to the right. Sketch the pressure variation for the same wave, one quarter of a period later.

The diagram above shows the displacement of points on a string as a function of distance along the string at three different times.

Example 48   1981 Question 40, 1 mark
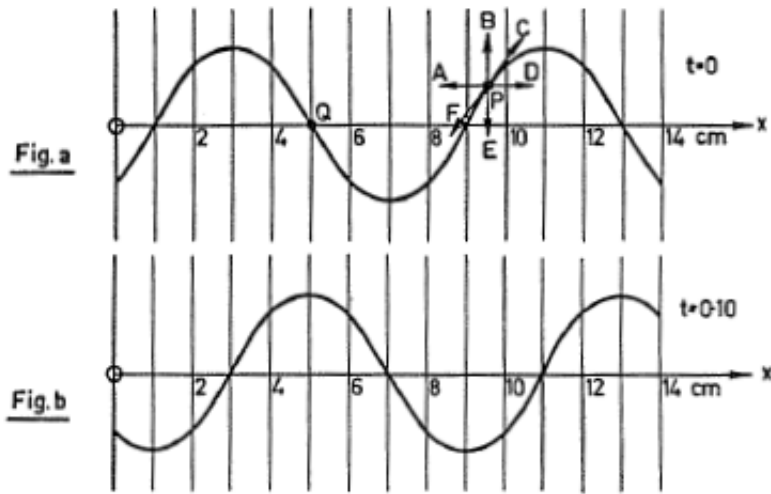
What is the wavelength of the wave?

Example 49   1981 Question 41, 1 mark

What is the lowest possible frequency of the wave consistent with the diagrams?

Example 50   1981 Question 42, 1 mark

i. What is the speed of the wave on the string consistent with this frequency?
ii. What is its direction (left or right)?

Fig. *a* is a picture of string with a periodic wave moving on it in the +x direction. Fig. *b* shows the same piece of string 0.10 sec later.

Example 51　1971 Question 53, 1 mark

What is the smallest velocity of the wave consistent with this information?

Example 52　1971 Question 54, 1 mark

What is the frequency of the wave corresponding to this velocity?

Example 53　1971 Question 55, 1 mark

What is the next highest velocity of the wave consistent with the information on the diagram?

A man stands at the centre of a very long coil spring resting on a smooth bench. Each half-second he gives the spring a sideways "flick" which sends pulses travelling away from him in both directions.

Example 54   1967 Question 44, 1 mark

If V is the velocity of the pulses in the spring, what is the separation x of successive crests on the spring?

Now the man walks beside the spring with a speed S ($<V$) and again flicks the spring every half-second.

Example 55   1967 Question 45, 1 mark

What is the distance d travelled by the man in the time interval between successive flashes?

Example 56   1967 Question 46, 1 mark

In terms of _x and d only_ give an expression for the distance between successive pulses travelling along the spring _ahead_ of the man.

Example 57   1967 Question 47, 1 mark

In terms of _x and d only_ give an expression for the distance between successive pulses travelling along the spring _behind_ of the man.

The man wishes to produce a set of pulses whose separation is $\frac{1}{3}$x. He could do this by flicking the spring every half-second whilst moving forward with a speed S given by

$$S = kV$$

Example 58   1967 Question 48, 1 mark

What is the numerical value of k?

A source of straight waves in a ripple tank of uniform depth dips into the water n times per second. Waves travel to left and right from the source at a speed of V cm sec^{-1}

The source is now made to move to the right at a constant speed of S cm sec^{-1} $(S < V)$.

The following Questions, 22 to 25, are all concerned with the waves <u>to the right of the moving source, i.e. ahead of it.</u>

Example 59   1966 Question 22, 1 mark

At what speed u (in cm sec^{-1}) will these waves travel?

Example 60   1966 Question 23, 1 mark

What is the distance l (in cm) moved by the source between any two successive instants at which it dips into the water?

Example 61   1966 Question 24, 1 mark

Consider a particular wavefront. What is the distance m (in cm) which it travels between any two successive instants at which the source dips into the water?

Example 62   1966 Question 25, 1 mark

In terms of l and m only, what is the wavelength, λ (in cm) of the waves?

Extension questions (beyond the course outline, the study design specifies qualitative only)
An eye dropper is used to release six drops into a still pool of water at a constant frequency, f s^{-1}, whilst the dropper is moving in a straight line at constant speed, v cm s^{-1}. Successive drops hit the water at distance a cm apart.
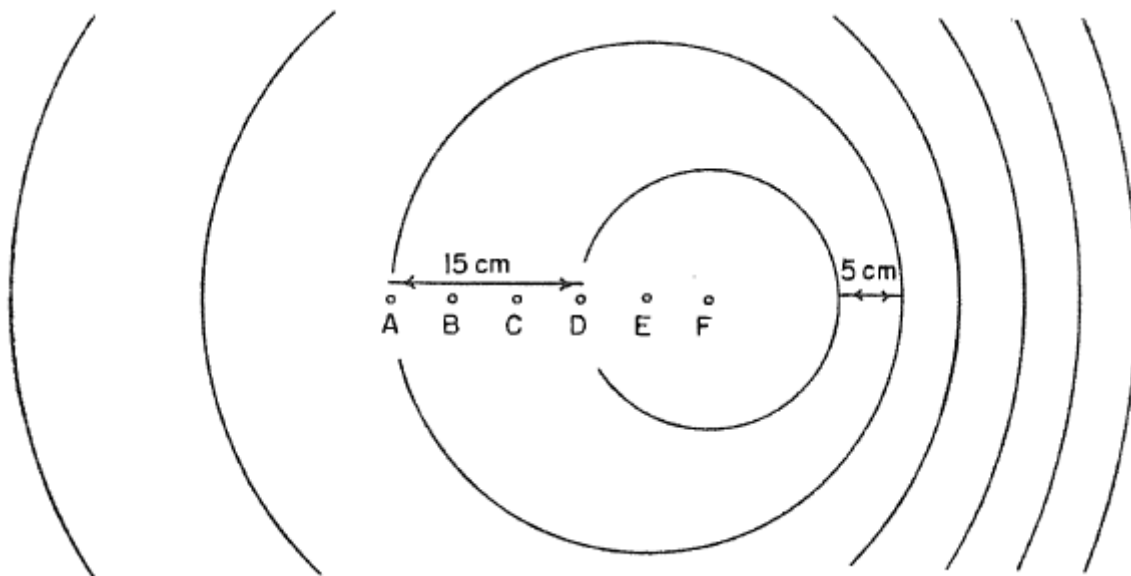
Frequency of dropper, $f = 2.0$ s^{-1}.
Distance between successive drops, $a = 5.0$ cm.

Example 63   1975 Question 48, 1 mark

What is the speed, v, of the dropper?

Example 64   1975 Question 49, 1 mark

Which of the points, **A** - **F**, represents the point of impact of the *first* drop?

Example 65   1975 Question 50, 1 mark

Distances between successive waves to the left and right of point F are shown on the diagram. If the dropper had *not moved*, what would have been the wave length of the resulting wave pattern?

Example 66   1975 Question 51, 1 mark

What is the speed of the waves shown in the diagram above?