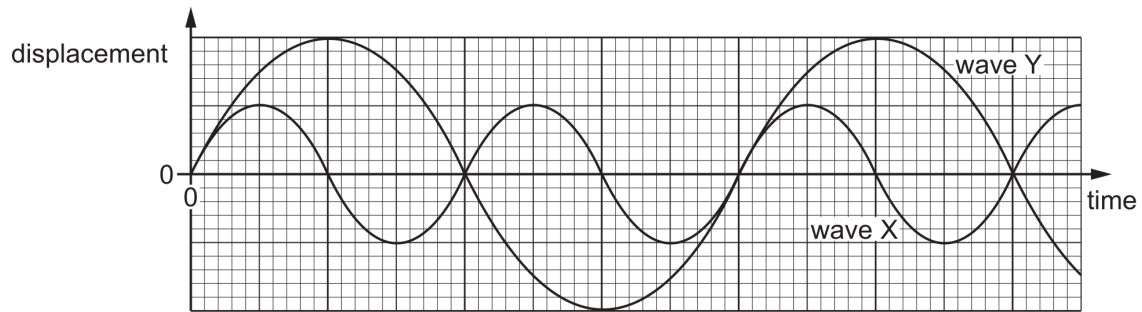# Unit 7: Waves:

Subunit 7.1: Progressive waves:

Topical Question No: 1

22 The graph shows the variation with time of the displacement of two separate waves X and Y.

Wave X has frequency f and amplitude A.

What is the frequency and what is the amplitude of wave Y?

	frequency	amplitude
A	$\frac{1}{2}f$	$\frac{1}{2}A$
B	$\frac{1}{2}f$	$2A$
C	$2f$	$\frac{1}{2}A$
D	$2f$	$2A$

Topical Question No: 2

2 What is an approximate value for the speed of sound in air?

A $30\,\text{m s}^{-1}$ **B** $300\,\text{m s}^{-1}$ **C** $30\,000\,\text{m s}^{-1}$ **D** $300\,000\,000\,\text{m s}^{-1}$
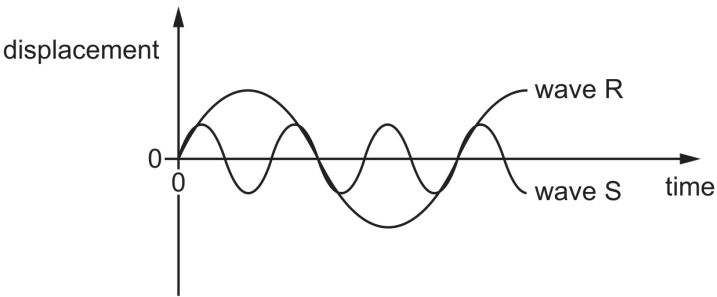
Topical Question No: 3

22 What is the relationship between the amplitude of a wave and its intensity?

A amplitude $\propto$ intensity

B amplitude $\propto$ (intensity)^2

C amplitude $\propto \sqrt{\text{intensity}}$

D (amplitude)$^2 \propto \sqrt{\text{intensity}}$

Topical Question No: 4

24 The diagram shows two waves R and S.

Wave R has an amplitude of 8 cm and a period of 30 ms.
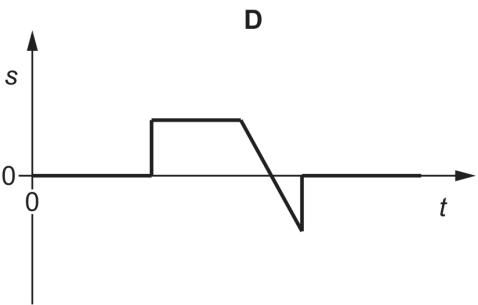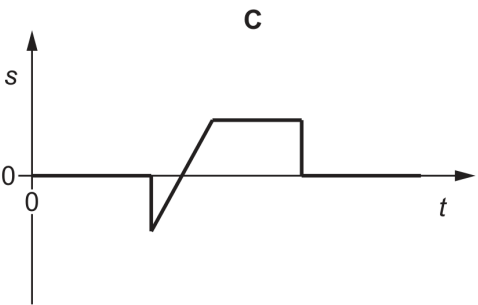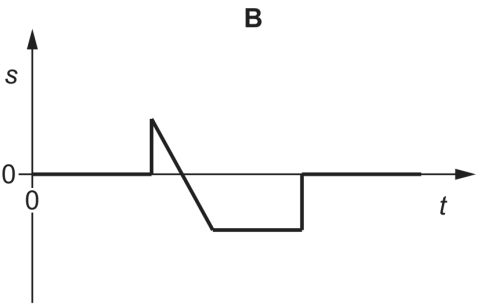
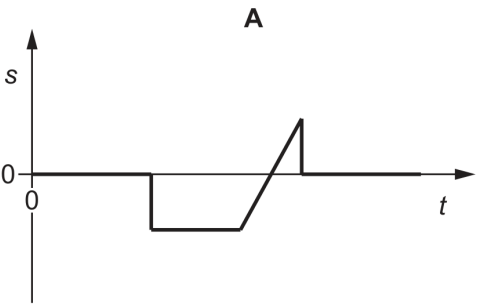What are the amplitude and the period of wave S?

	amplitude / cm	period / ms
A	2	10
B	2	90
C	4	10
D	4	90

Topical Question No: 5

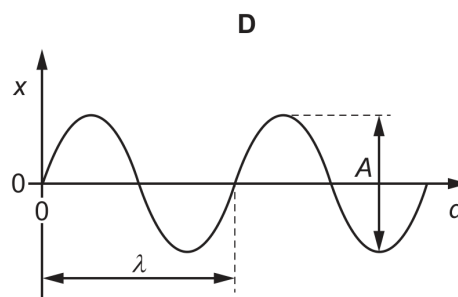**21** A wave pulse moves along a stretched rope in the direction shown.
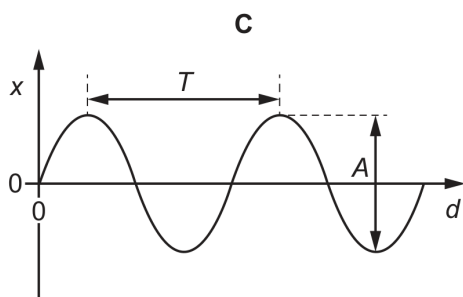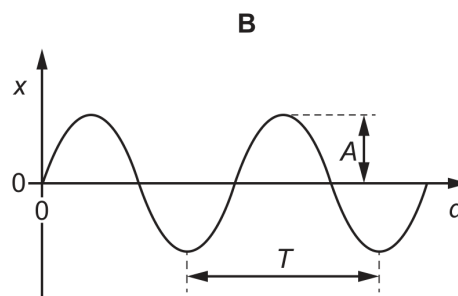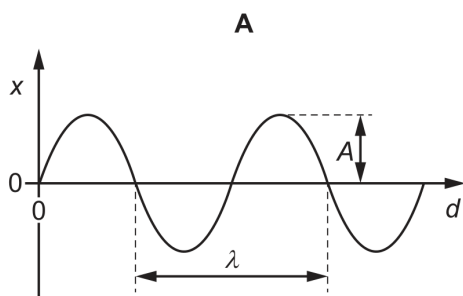

Which diagram shows the variation with time *t* of the displacement *s* of the particle P in the rope?

22 A wave has period T, wavelength λ and amplitude A. The wave is shown on a graph of displacement x against distance d.

Which graph is correctly labelled?

1 A wave has a frequency of 5 GHz.

What is the period of the wave?

A 200 ps

B 2 ns

C 20 ns

D 20 000 µs

21 A progressive radio wave in a vacuum has a frequency of 75 MHz.

What is the phase difference between two points on the wave that are 50 cm apart from each other?

A 23° **B** 45° **C** 90° **D** 180°

20 Which statement about progressive waves is correct?

    A They are always transverse waves.

    B They can exist in solids but not liquids.

    C They decrease in frequency as their speed increases.

    D They transfer energy away from their source.

Topical Question No: 10

21 A cathode-ray oscilloscope (CRO) is used to determine the frequency of a sound wave.

The diagram shows the waveform on the screen.
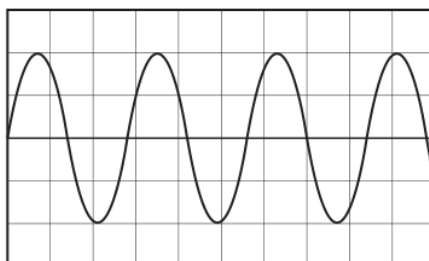
The time-base setting is $5.0\,\text{ms div}^{-1}$.

What is the best estimate of the frequency of the sound wave?

   **A** 50 Hz   **B** 71 Hz   **C** 100 Hz   **D** 143 Hz

20 In a progressive water wave, two particles, P and Q, on the surface of the water, are a fixed horizontal distance apart. P and Q oscillate vertically.

At time $t = 0$, the wave is as shown.

Which graph best represents the variation with time t of the phase difference ϕ between the oscillation of the water particle P and the oscillation of the water particle Q?
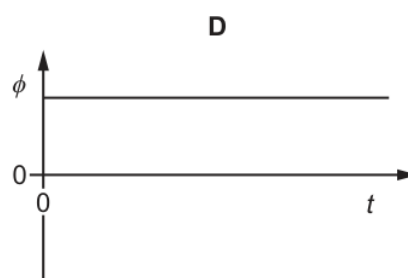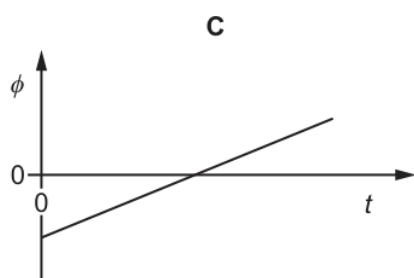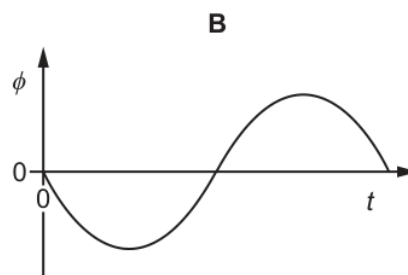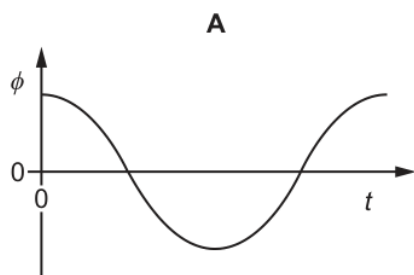
Topical Question No: 12

**24** The range of frequencies of sound waves emitted by blue whales is 10 Hz to 40 Hz.

The speed of sound in seawater is approximately $1.5\,\text{km}\,\text{s}^{-1}$.

What is the approximate range of wavelengths of the sound waves emitted by blue whales?

A   6.7 mm to 27 mm

B   3.8 cm to 15 cm

C   6.7 m to 27 m

D   38 m to 150 m

25 A sound wave is detected by a microphone and displayed on the screen of a cathode-ray oscilloscope (CRO).

1 cm

1 cm
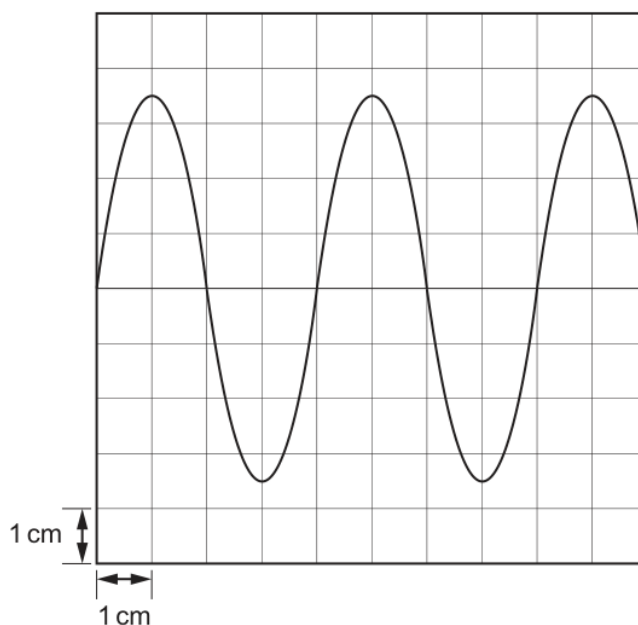
The frequency of the wave is 2.5 kHz.

What is the setting on the time-base of the CRO?

A 0.1 ms cm^{-1} **B** 0.4 ms cm^{-1} **C** 0.1 s cm^{-1} **D** 0.4 s cm^{-1}

Topical Question No: 14

28 A beam of light with power P has an area of cross-section A.

The amplitude of the light waves in the beam is X.

The beam of light is then changed to one with the same frequency but with an increased amplitude of $4X$ and an area of cross-section reduced to $\dfrac{A}{3}$.

What is the power of the new beam?

A 1.3P **B** 5.3P **C** 12P **D** 48P

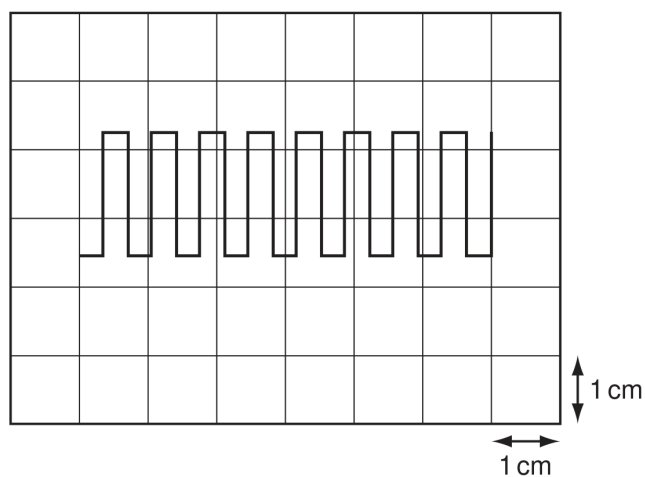*Topical Question No: 15*

30 Two wave sources emit coherent waves.

Which condition **must** be correct for the coherent waves?

A The waves are emitted in phase.

B The waves are emitted and move in opposite directions.

C The waves are emitted with a constant phase difference.

D The waves are emitted with the same amplitude.

Topical Question No: 16

4 The diagram shows a square-wave trace on the screen of a cathode-ray oscilloscope. A grid of 1 cm squares covers the screen. The time-base setting is 10 ms cm^{-1}.

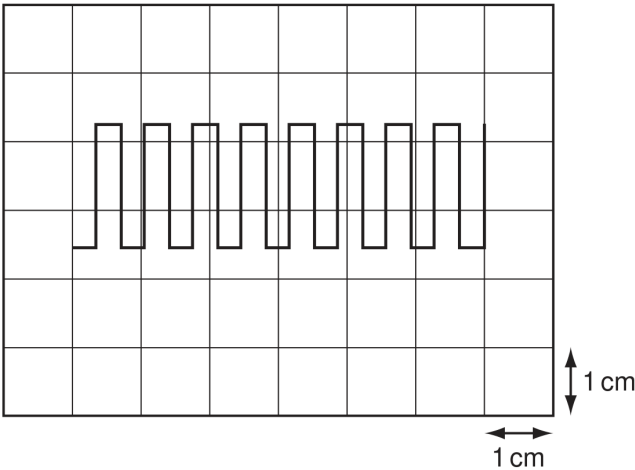What is the approximate frequency of the square wave?

A 70 Hz   **B** 140 Hz   **C** 280 Hz   **D** 1400 Hz

Space for working

3 The diagram shows a square-wave trace on the screen of a cathode-ray oscilloscope. A grid of 1 cm squares covers the screen. The time-base setting is $10\,\text{ms}\,\text{cm}^{-1}$.

What is the approximate frequency of the square wave?

A 70 Hz   **B** 140 Hz   **C** 280 Hz   **D** 1400 Hz

4 The diagram shows a trace of a wave on a cathode-ray oscilloscope.

The vertical and horizontal gridlines have a spacing of 1.0 cm. The voltage scaling is $4\,\text{V}\,\text{cm}^{-1}$ and the time scaling is $5\,\text{ms}\,\text{cm}^{-1}$.
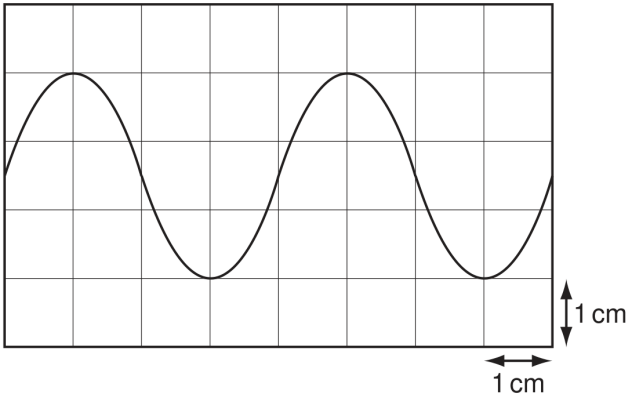
What are the amplitude and period of the wave?

	amplitude / V	period / ms
A	1.5	4
B	5.0	10
C	6.0	20
D	12.0	20

Space for working

**22** The four graphs represent a progressive wave on a stretched string. Graphs **A** and **B** show how the displacement *d* varies with distance *x* along the string at one instant. Graphs **C** and **D** show how the displacement *d* varies with time *t* at a particular value of *x*.

The labels on the graphs are intended to show the wavelength λ, the period *T* and the amplitude *a* of the wave, but only one graph is correctly labelled.

Which graph is correctly labelled?

A

B

C

D
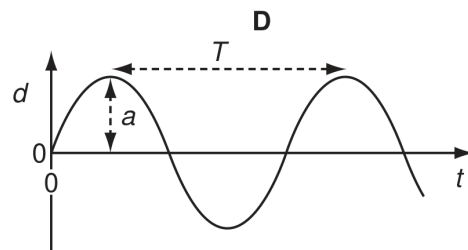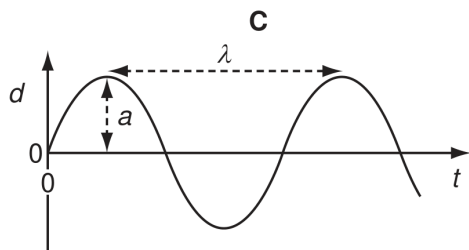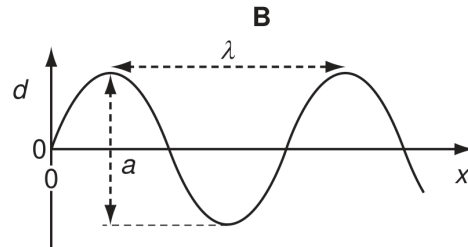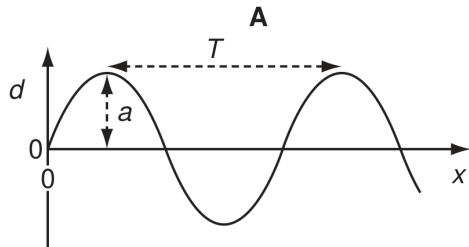
Space for working

23 Which statement about sound waves in air at constant temperature is correct?

    A Amplitude is inversely proportional to velocity.

    B Frequency is inversely proportional to wavelength.

    C Velocity is proportional to wavelength.

    D Wavelength is proportional to amplitude.

24 A source of sound of constant power *P* is situated in an open space. The intensity *I* of sound at distance *r* from this source is given by

$$I = \frac{P}{4\pi r^2}.$$

How does the amplitude *a* of the vibrating air molecules vary with the distance *r* from the source?
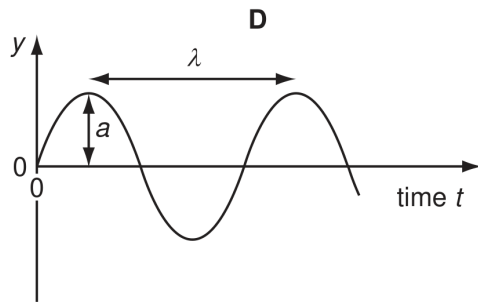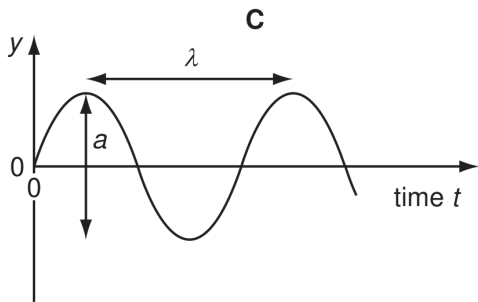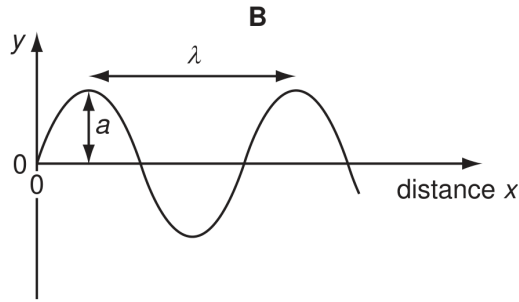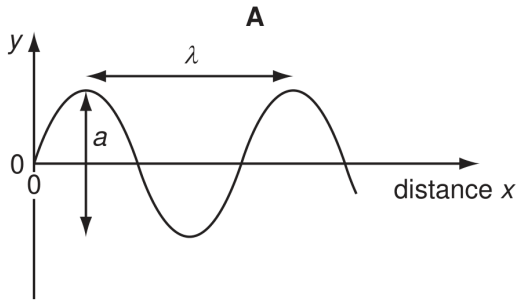
    A $a \propto \dfrac{1}{r}$ **B** $a \propto \dfrac{1}{r^2}$ **C** $a \propto r$ **D** $a \propto r^2$
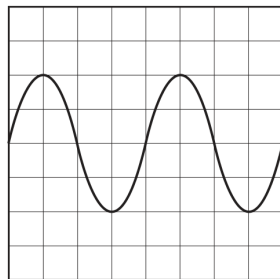
Space for working

26 A sound wave has displacement *y* at distance *x* from its source at time *t*.

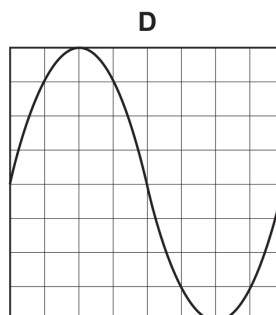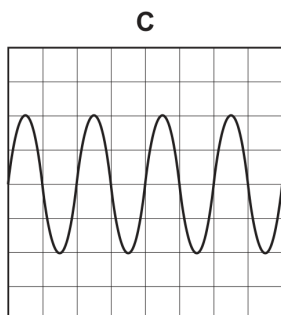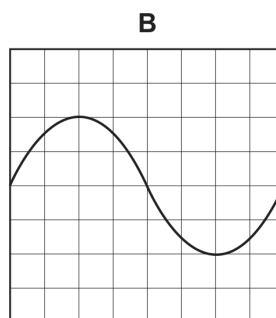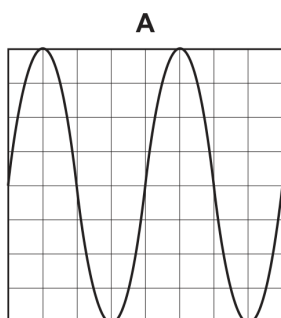Which graph correctly shows the amplitude *a* and the wavelength λ of the wave?

A

y ↑

λ

a

0

distance *x*

B

y ↑

λ

a

0

distance *x*

C

y ↑

λ

a

0

time *t*

D

y ↑

λ

a

0

time *t*

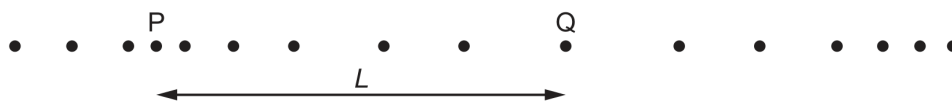**5**   The following trace is seen on the screen of a cathode-ray oscilloscope.

The setting of the time-base is then changed from $10\,\text{ms}\,\text{cm}^{-1}$ to $20\,\text{ms}\,\text{cm}^{-1}$ and the Y-plate sensitivity remains constant.

Which trace is now seen on the screen?

A

B

C

D

23   The diagram illustrates the position of particles in a progressive sound wave at one instant in time.

P

Q

L

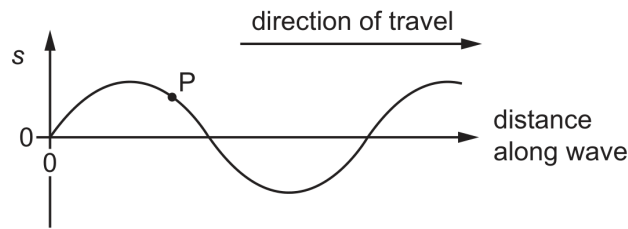The speed of the wave is *v*. P and Q are two points in the wave a distance *L* apart.

What is an expression for the frequency of the wave?

A $\dfrac{v}{2L}$ **B** $\dfrac{v}{L}$ **C** $\dfrac{2v}{L}$ **D** $\dfrac{L}{v}$
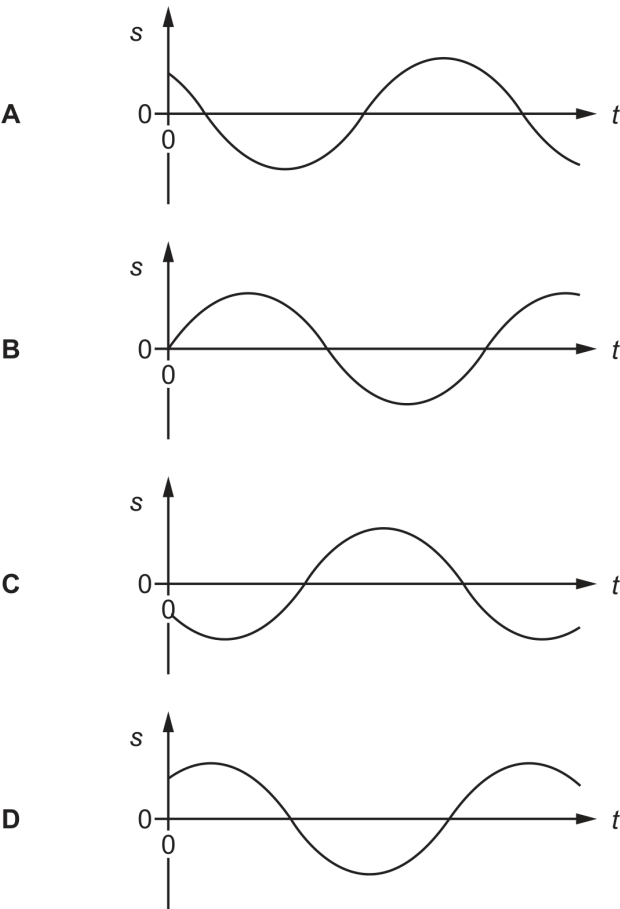
24 A wave moves along the surface of water.

The diagram shows the variation of displacement *s* with distance along the wave at time *t* = 0.

Which graph best shows the variation with time *t* of the displacement *s* of the point P on the wave?

22 A transverse water wave is moving along the surface of some water. This causes a ball to move vertically without moving horizontally as it floats upon the surface. At one instant, the ball is at the position shown.

ball

NOT TO
SCALE

0.70 m

direction of
wave travel

2.4 m
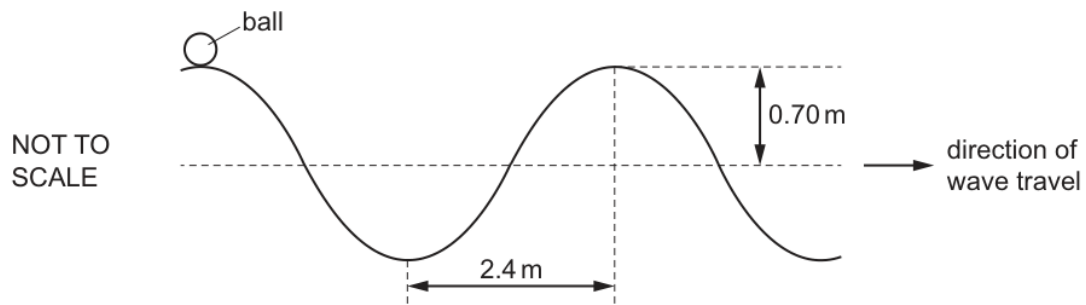
The wave has a frequency of 0.20 Hz and an amplitude of 0.70 m. The distance between a trough and an adjacent peak is 2.4 m.
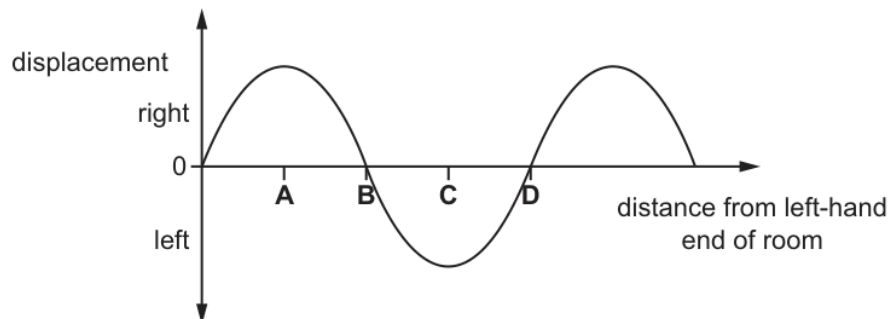
What is the distance travelled by the ball in a time of 20 s?

A 5.6 m **B** 9.6 m **C** 11.2 m **D** 19.2 m

23 A sound wave travels from left to right across a room. The variation with distance across the room of the displacement of the air molecules at one instant is shown.

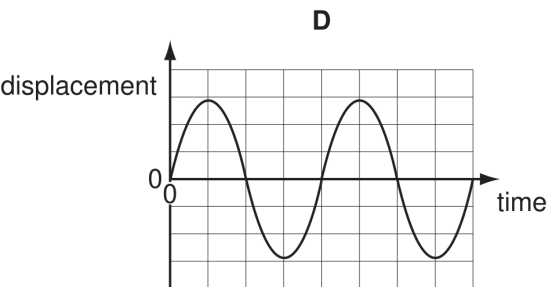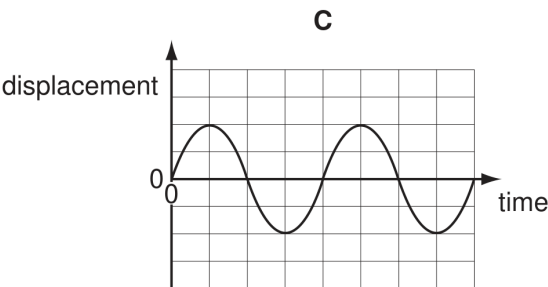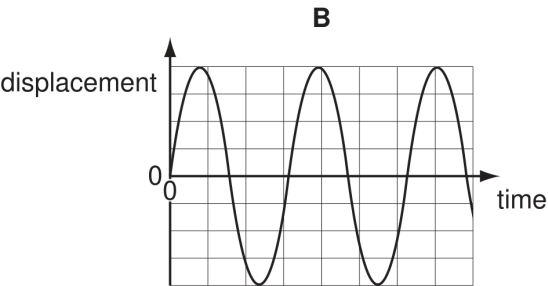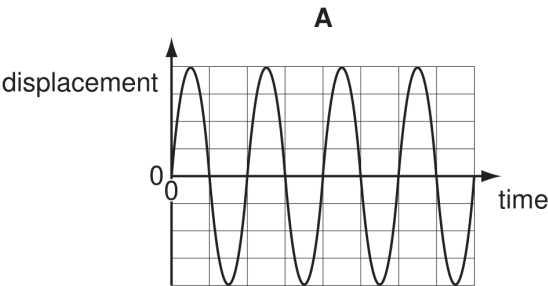At which distance will the air pressure be lowest?

displacement

right

0

A B C D

left

distance from left-hand
end of room

26 The diagram shows a graph of displacement against time for a sound wave.
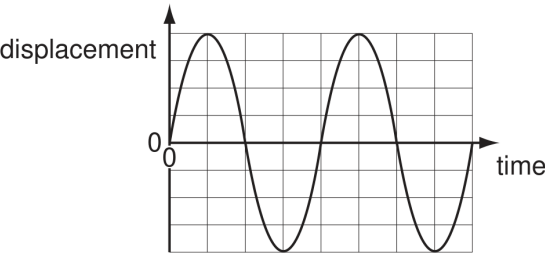
The intensity of the sound is halved.

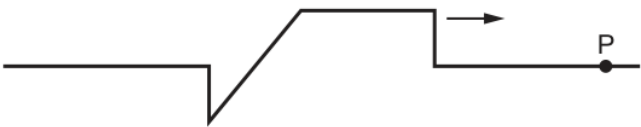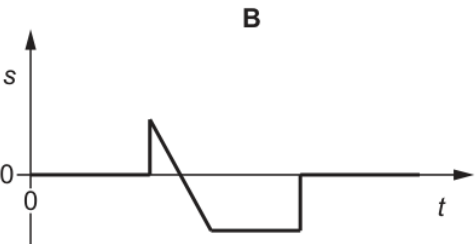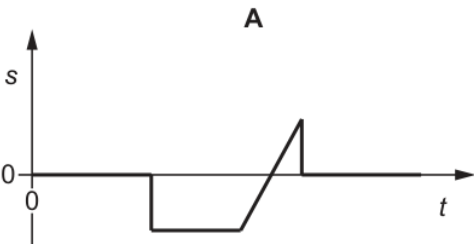Which graph shows the displacement of this sound wave?

A

B

C

D

Space for working

Topical Question No: 29

22 A wave pulse moves along a stretched rope in the direction shown.

Which diagram shows the variation with time *t* of the displacement *s* of the particle P in the rope?

A

B

Answer Key

1. N/A

2. N/A

3. N/A

4. N/A

5. N/A

6. N/A

7. N/A

8. B

9. D

10. B

11. D

12. D

13. A

14. B

15. C

16. N/A

17. N/A

18. N/A

19. N/A

20. N/A

21. N/A

22. N/A

23. N/A

24. N/A

25. N/A

26. C

27. D