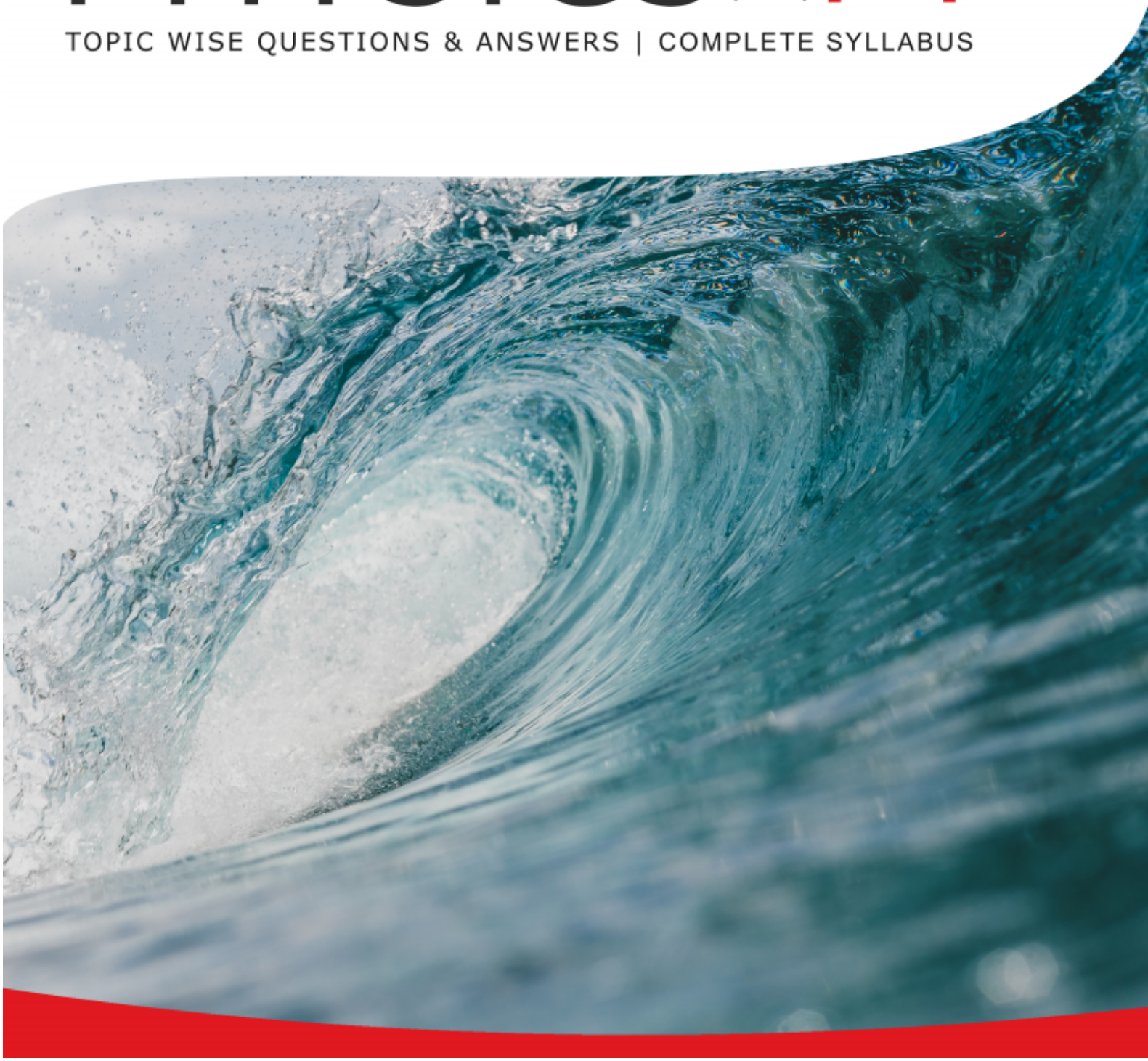
Cambridge International AS & A Level

PHYSICS (9702) P1

TOPIC WISE QUESTIONS & ANSWERS | COMPLETE SYLLABUS



PapaCambridge

Chapter 8

Waves

8.1 Progressive waves

721. 9702_m20_qp_12 Q: 21

A wave of frequency 15 Hz travels at 24 m s^{-1} through a medium.

What is the phase difference between two points 2.0 m apart?

A There is no phase difference.

B They are out of phase by a quarter of a cycle.

C They are out of phase by half a cycle.

D They are out of phase by 0.80 of a cycle.

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722. 9702_s20_qp_11 Q: 22

A sound wave reduces in intensity but maintains a constant frequency as it travels through air.

Which statement is correct?

A The maximum displacement of the particles changes between one particle and the next particle.

B The phase difference between adjacent particles is zero.

C The wavelength is the distance between two particles that have a phase difference of 180°.

D Two particles that have a phase difference of 360° have the same maximum displacement.

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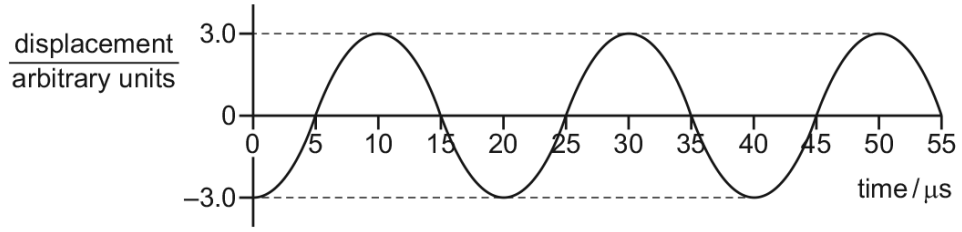
723. 9702_s20_qp_11 Q: 23

The graph shows the variation with time of the displacement of an electromagnetic wave at a point.



The wave is travelling in a vacuum.

What is the amplitude and what is the wavelength of the wave?

	amplitude / arbitrary units	wavelength / m
A	3.0	6000
B	6.0	6000
C	3.0	7500
D	6.0	7500

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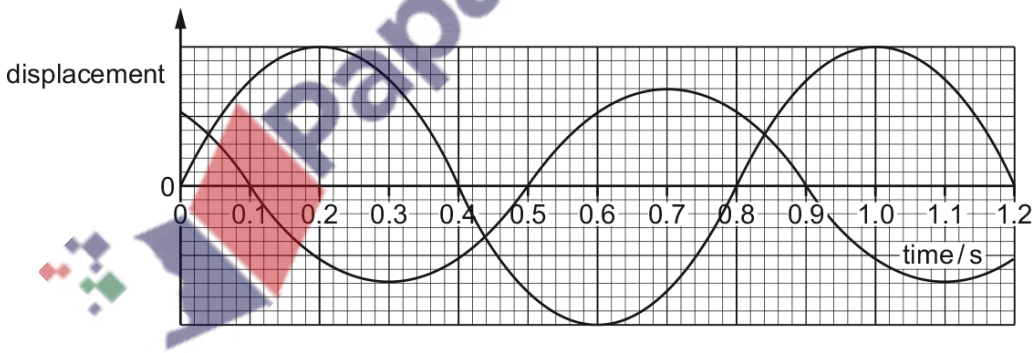
724. 9702_s20_qp_12 Q: 22

Two progressive waves meet at a fixed point P. The variation with time of the displacement of each wave at point P is shown in the graph.



What is the phase difference between the two waves at point P?

A 45° **B** 90° **C** 135° **D** 180°

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725. 9702_s20_qp_13 Q: 22

A wave of amplitude A has an intensity I.

After passing through a certain medium, the wave has a new intensity of $\frac{I}{4}$.

What is the new amplitude of the wave?

A $2A$ **B** $\frac{A}{2}$ **C** $\frac{A}{4}$ **D** $\frac{A}{16}$

---

726. 9702_m19_qp_12 Q: 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

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727. 9702_m19_qp_12 Q: 23

The top row of bars represents a set of particles inside the Earth and at rest.

The lower row represents the same particles at one instant as a longitudinal wave passes from left to right through the Earth.

What should be measured to determine the amplitude of the oscillations of the particles in the lower row as the wave passes?

A half the maximum displacement of the particles from their position at rest

B half the maximum distance apart of the particles

C the maximum displacement of the particles from their position at rest

D the maximum distance apart of the particles

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728. 9702_s19_qp_11 Q: 27

Two progressive waves of frequency 300 Hz superpose to produce a stationary wave in which adjacent nodes are 1.5 m apart.

What is the speed of the progressive waves?

A $100\,m\,s^{-1}$ **B** $200\,m\,s^{-1}$ **C** $450\,m\,s^{-1}$ **D** $900\,m\,s^{-1}$

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729. 9702_s19_qp_12 Q: 23

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

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 $\frac{v}{2L}$ **B** $\frac{v}{L}$ **C** $\frac{2v}{L}$ **D** $\frac{L}{v}$

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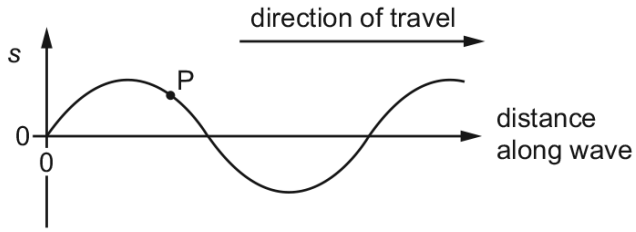
730. 9702_s19_qp_12 Q: 24

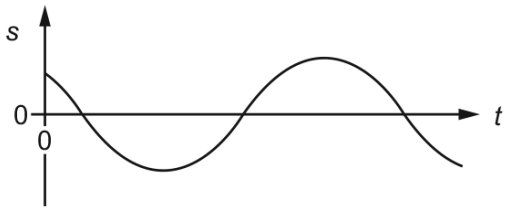
A wave moves along the surface of water.

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

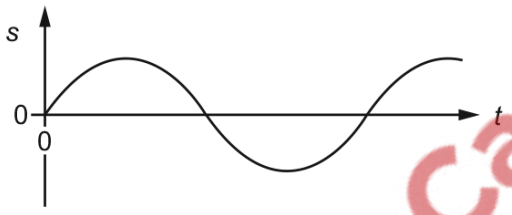


Which graph best shows the variation with time t of the displacement s of the point P on the wave?

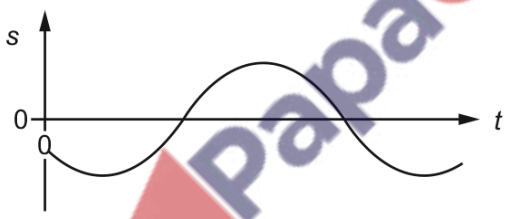
A



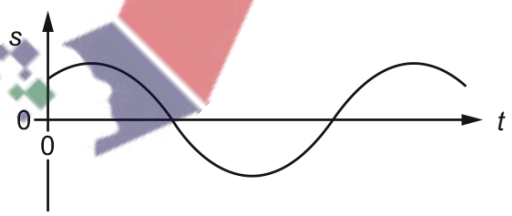
B



C

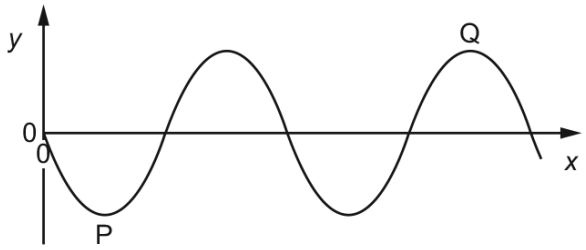


D



731. 9702_s19_qp_13 Q: 21

The graph shows the variation of displacement *y* with distance *x* along a progressive wave at one instant in time.



What is the phase difference between points P and Q on the wave?

A 90° **B** 270° **C** 540° **D** 630°

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732. 9702_s19_qp_13 Q: 22

Wave-power generators take advantage of the energy that is transferred by the motion of waves across the surface of the oceans. The energy of a wave depends on its amplitude.

What is the correct definition of amplitude?

A the average amount of energy possessed by a wave

B the difference in displacement between a peak and a trough

C the maximum displacement of a point on the wave from equilibrium

D the number of oscillations of a wave that occur per second

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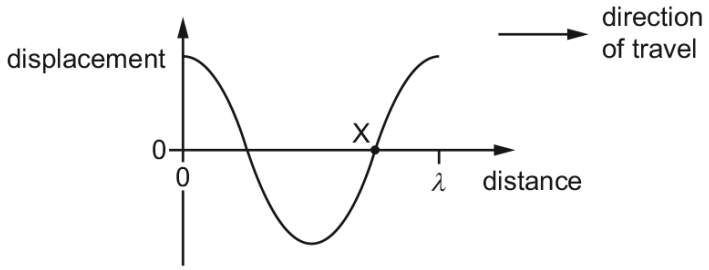
733. 9702_w19_qp_11 Q: 21

A transverse wave on a rope has wavelength λ and period T.

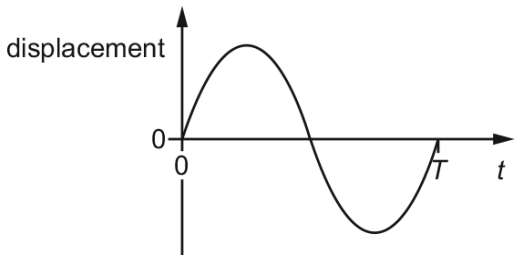
The graph shows the variation of the displacement of the particles of the rope with distance in the direction of travel of the wave at time $t = 0$.



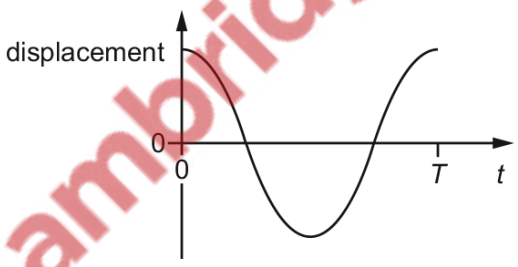
A particle X is labelled.

Which graph shows the variation of the displacement of particle X with time t?

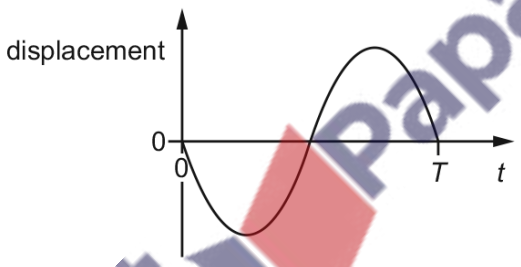
A



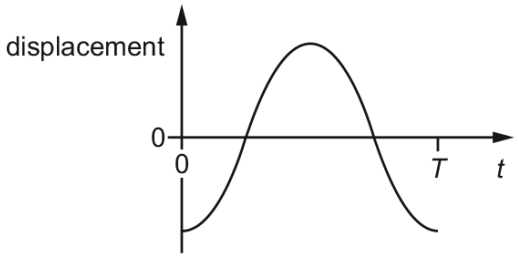
B



C

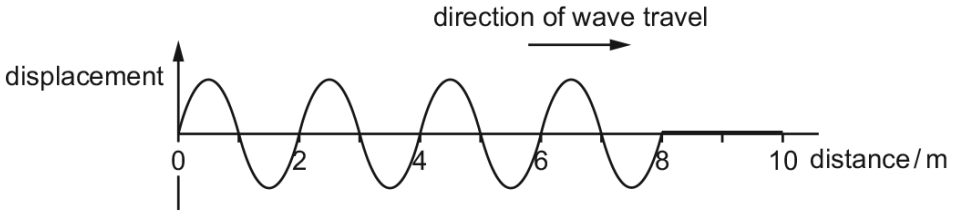


D



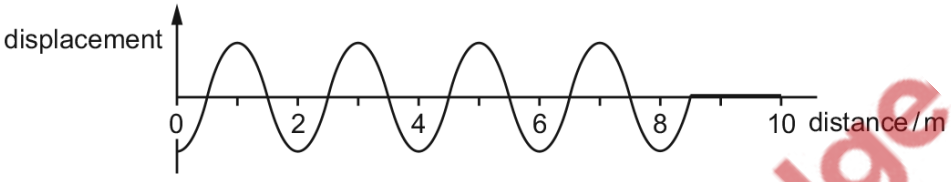
734. 9702_w19_qp_12 Q: 20

A transverse wave is travelling along a rope. The frequency of the wave is 2.0 Hz. The graph shows the variation with distance of the displacement of the wave at time $t = 0$.

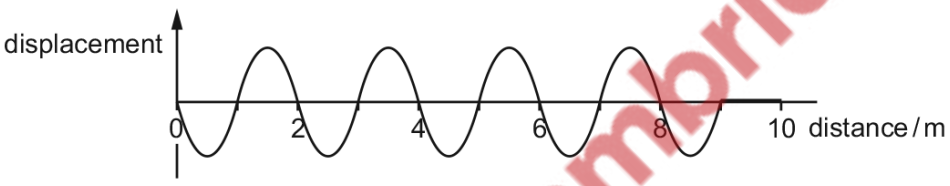


Which diagram shows the position of the wave at time $t = 0.5$ s?

A

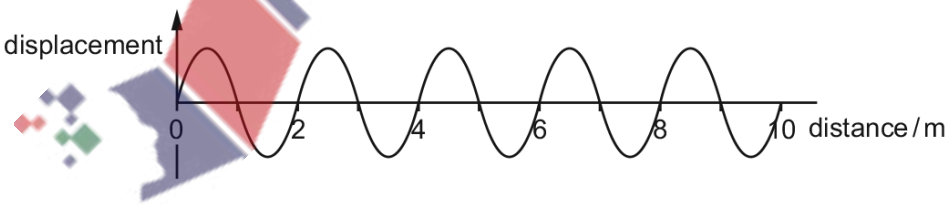


B



C

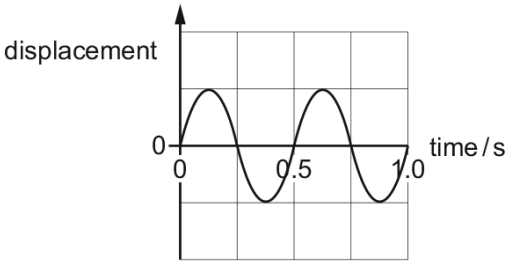
D



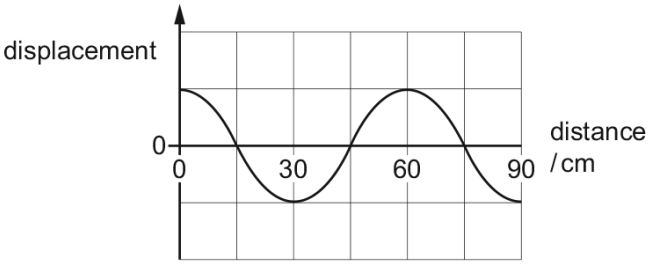
735. 9702_w19_qp_12 Q: 21

The two graphs represent the same wave.

Graph 1 shows the variation with time of the displacement at a particular distance. Graph 2 shows the variation with distance of the displacement at one instant.



graph 1



graph 2

What is the speed of the wave?

A $22.5\,\text{cm s}^{-1}$ **B** $30.0\,\text{cm s}^{-1}$ **C** $90.0\,\text{cm s}^{-1}$ **D** $120\,\text{cm s}^{-1}$

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736. 9702_w19_qp_13 Q: 25

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 $a \propto \frac{1}{r}$ **B** $a \propto \frac{1}{r^2}$ **C** $a \propto r$ **D** $a \propto r^2$

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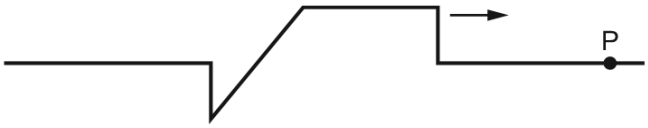
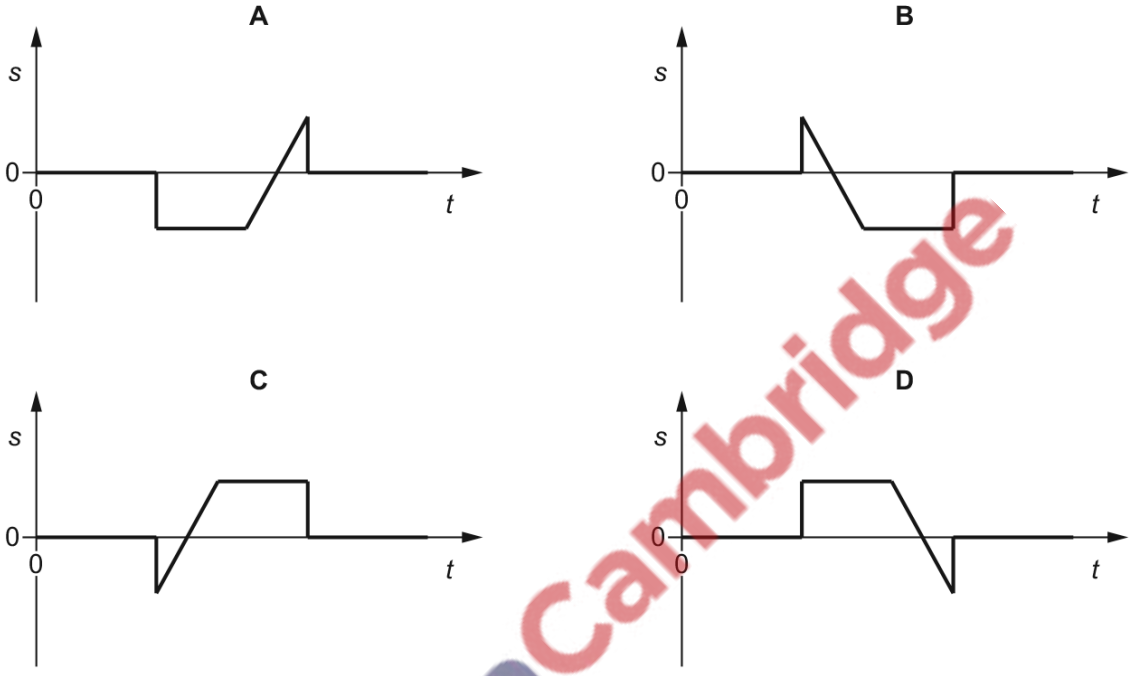
737. 9702_m18_qp_12 Q: 21

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



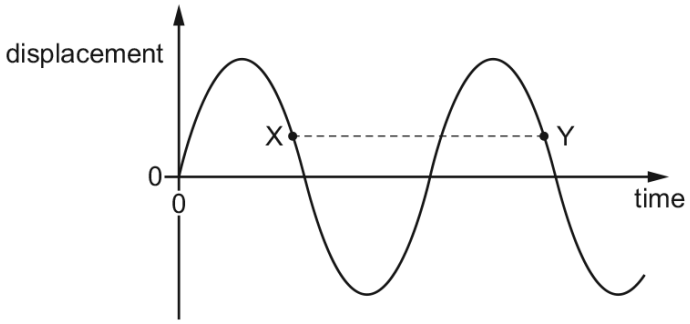
Which diagram shows the variation with time *t* of the displacement *s* of the particle P in the rope?



738. 9702_s18_qp_11 Q: 20

A transverse progressive wave is set up on a string.

The graph shows the variation with time of displacement for a point on this string.



The separation XY on the graph represents the ……1…… of the wave.

X and Y have equal ……2…… .

Which words correctly complete gaps 1 and 2?

	1	2
A	time period	amplitudes
B	time period	displacements
C	wavelength	amplitudes
D	wavelength	displacements

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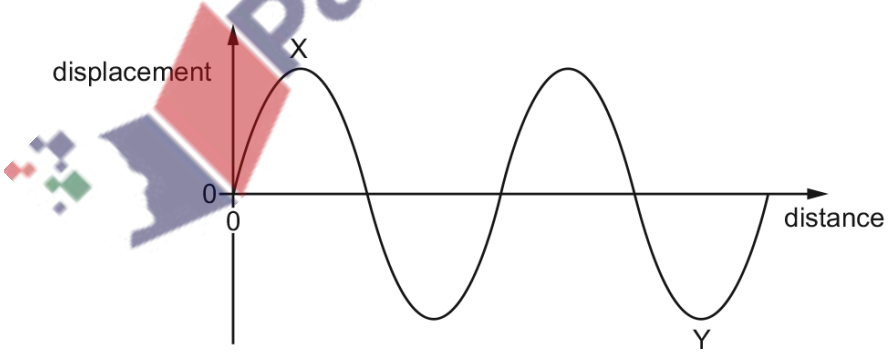
739. 9702_s18_qp_13 Q: 20

The displacement-distance graph for a transverse progressive wave is shown.



The phase difference between points X and Y can be expressed as $(180n)^\circ$.

What is the value of n?

A 1.5 **B** 2.5 **C** 3.0 **D** 6.0

---

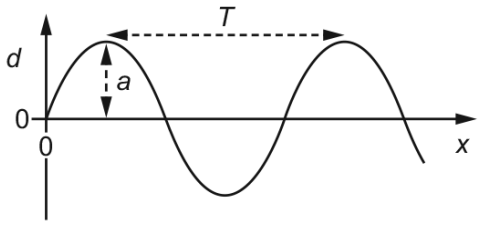
740. 9702_s18_qp_13 Q: 21

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*.

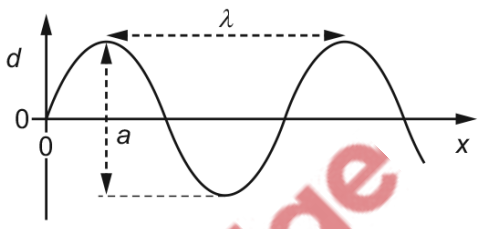
The labels on the graphs are intended to show the wavelength λ, the period *T* and the amplitude *a* of the wave, but only one graph is correctly labelled.

Which graph is correctly labelled?

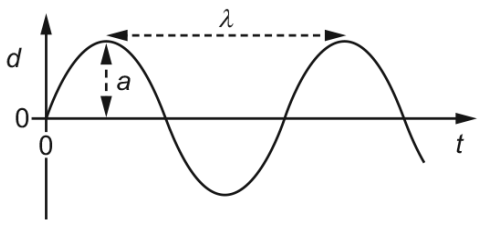
A



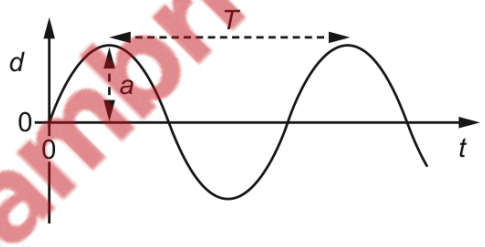
B



C

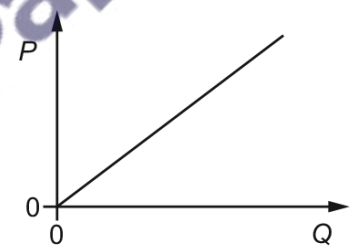


D



741. 9702_w18_qp_11 Q: 21

The graph shows the variation of a quantity *P* with a quantity *Q* for a sound wave travelling in air.



What could *P* and *Q* be?

	P	*Q*
A	amplitude	intensity
B	frequency	wavelength
C	speed	frequency
D	wavelength	period

742. 9702_w18_qp_12 Q: 22

A progressive wave on a wire has a frequency of 10 Hz. Two points on the wire, separated by a distance of 0.25 m, have a phase difference of 22.5°.

What is the maximum speed of the wave?

A $2.5\,\text{m s}^{-1}$ **B** $10\,\text{m s}^{-1}$ **C** $20\,\text{m s}^{-1}$ **D** $40\,\text{m s}^{-1}$

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743. 9702_w18_qp_13 Q: 21

A progressive sound wave in air has amplitude x_0 and intensity I.

The amplitude of the wave increases to $3x_0$.

What is the new intensity of the wave?

A $\frac{I}{9}$ **B** $\frac{I}{3}$ **C** $3I$ **D** $9I$

---

744. 9702_m17_qp_12 Q: 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)$^2 \propto \sqrt{\text{intensity}}$

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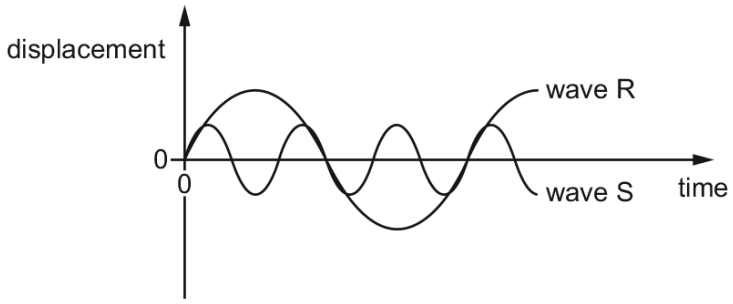
745. 9702_m17_qp_12 Q: 24

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

---

746. 9702_s17_qp_12 Q: 22

The period of an electromagnetic wave is 1.0 ns.

What are the frequency and wavelength of the wave?

	frequency / Hz	wavelength / m
A	1.0	3.0×10^{8}
B	1.0×10^{6}	300
C	1.0×10^{9}	0.30
D	1.0×10^{12}	3.0×10^{-4}

---

747. 9702_s17_qp_13 Q: 21

Which statement about electromagnetic waves in a vacuum is correct?

A Amplitude is inversely proportional to velocity.

B Frequency is inversely proportional to wavelength.

C Intensity is proportional to amplitude.

D Velocity is proportional to wavelength.

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748. 9702_s16_qp_11 Q: 22

Two sound waves have frequencies of 250 Hz and 300 Hz. The speed of sound is 340 m s^{-1}.

What is the difference between the wavelengths of the two waves?

A 0.23 m **B** 1.1 m **C** 1.4 m **D** 6.8 m

---

749. 9702_s16_qp_13 Q: 23

A beam of red laser light has length 1.0 m.

What is the order of magnitude of the number of wavelengths of the red light in 1.0 m?

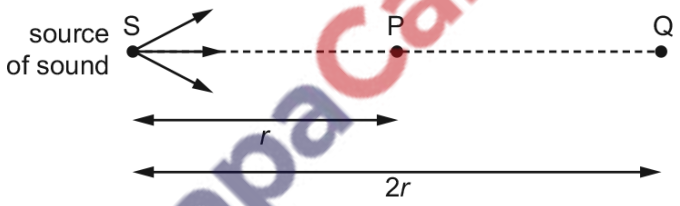
A 10^4 **B** 10^6 **C** 10^8 **D** 10^{10}

---

750. 9702_s16_qp_13 Q: 25

The intensity I of sound is inversely proportional to the square of the distance x from the source of the sound. This can be represented as

$$I \propto \frac{1}{x^2}.$$



Air molecules at point P, a distance r from the source S, oscillate with amplitude 8.0 μm.

Point Q is situated a distance $2r$ from S.

What is the amplitude of oscillation of air molecules at Q?

A 1.4 μm **B** 2.0 μm **C** 2.8 μm **D** 4.0 μm

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751. 9702_w16_qp_12 Q: 23

High-frequency sound waves with frequency 2.0 MHz travel with a speed of 2.0 km s^{-1} through a liquid.

What is the shortest distance between a compression and a rarefaction (expansion) in the liquid?

A 0.5 mm **B** 1.0 mm **C** 5.0 mm **D** 10.0 mm

---

752. 9702_s15_qp_11 Q: 25

A wave of frequency 15 Hz travels at 24 m s^{-1} through a medium.

What is the phase difference between two points 2 m apart?

A There is no phase difference.

B They are out of phase by a quarter of a cycle.

C They are out of phase by half a cycle.

D They are out of phase by 0.8 of a cycle.

---

753. 9702_s15_qp_11 Q: 26

A wave of amplitude *a* has an intensity of 3.0 W m^{-2}.

What is the intensity of a wave of the same frequency that has an amplitude 2*a*?

A 4.2 W m^{-2} **B** 6.0 W m^{-2} **C** 9.0 W m^{-2} **D** 12 W m^{-2}

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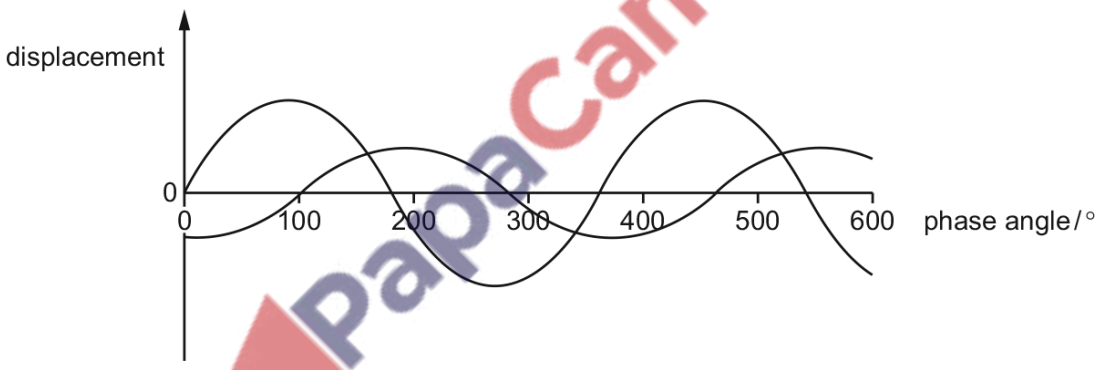
754. 9702_s15_qp_12 Q: 24

Two light waves of the same frequency are represented by the diagram.



What could be the phase difference between the two waves?

A 150° **B** 220° **C** 260° **D** 330°

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755. 9702_s15_qp_12 Q: 25

A sound wave has a speed of 330 m s^{-1} and a frequency of 50 Hz.

What is a possible distance between two points on the wave that have a phase difference of 60°?

A 0.03 m **B** 1.1 m **C** 2.2 m **D** 6.6 m

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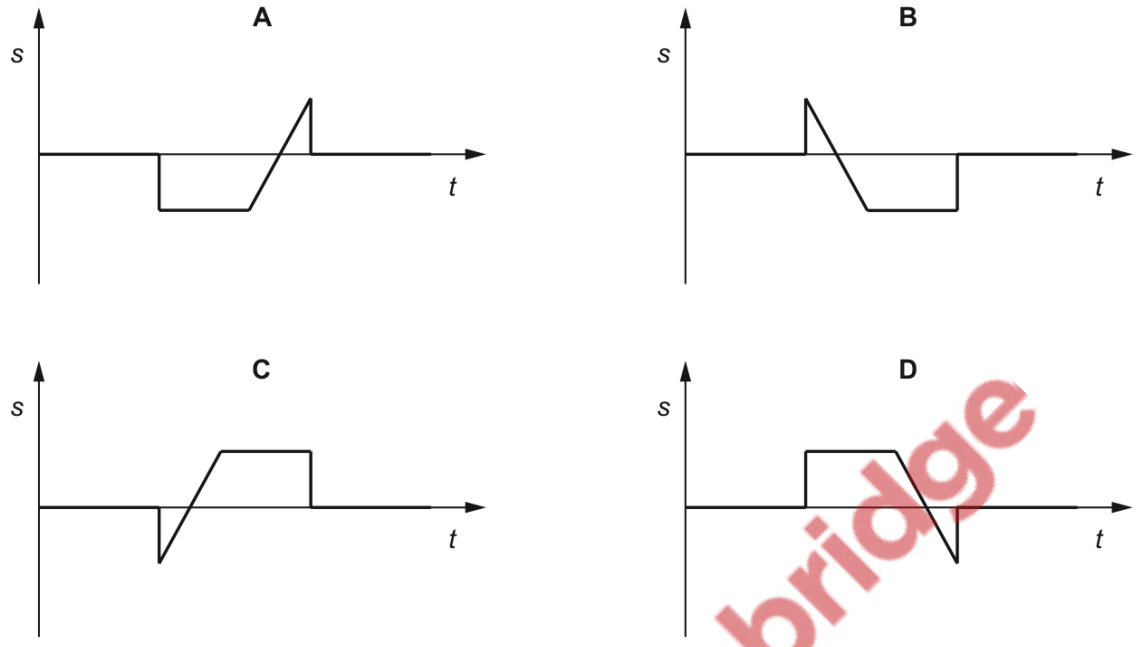
756. 9702_s15_qp_13 Q: 26

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



8.2 Transverse and longitudinal waves

757. 9702_m20_qp_12 Q: 22

Which row describes a longitudinal wave and a medium through which it can travel?

	direction of oscillation of the medium compared with the direction of propagation of wave energy	medium
A	parallel	air
B	parallel	vacuum
C	perpendicular	air
D	perpendicular	vacuum

758. 9702_s20_qp_12 Q: 21

A transverse wave is moving along a rope. Two points X and Y on the rope are a quarter of a wavelength apart from each other.

Which statement is **not** possible for the two points X and Y at any instant?

A They are both stationary.

B They are displaced in opposite directions from their equilibrium position.

C They are moving in opposite directions.

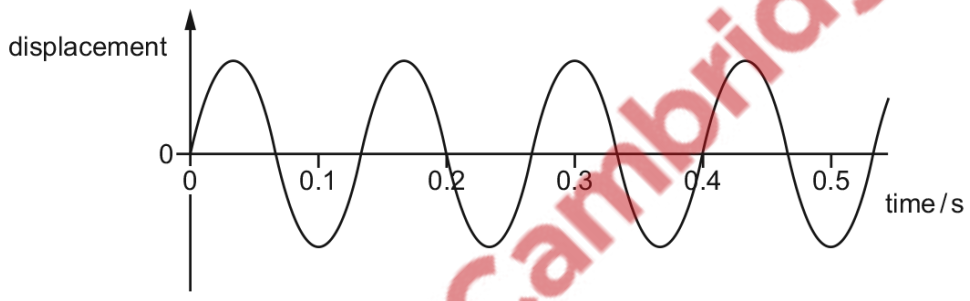
D They both have displacements of the same magnitude from their equilibrium positions.

---

759. 9702_s20_qp_13 Q: 23

A wave travels along a coiled spring.

The graph shows the variation with time of the displacement of a point on the spring.



What is the frequency of the wave?

A 0.13 Hz **B** 0.20 Hz **C** 5.0 Hz **D** 7.5 Hz

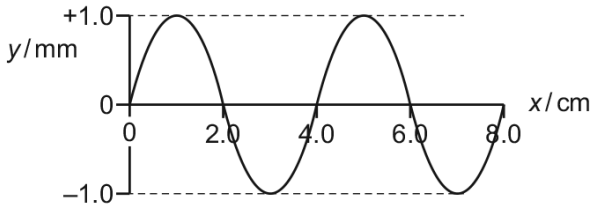
---

760. 9702_s19_qp_11 Q: 22

A transverse wave in a medium has the waveform shown, where

y = vertical displacement and x = horizontal distance.

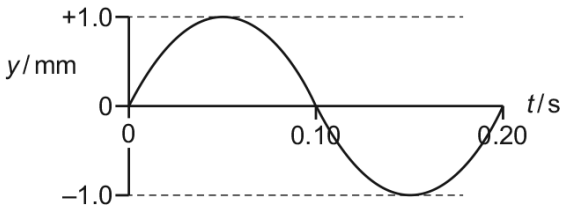
The speed of the wave is $20.0\,\text{cm}\,\text{s}^{-1}$.



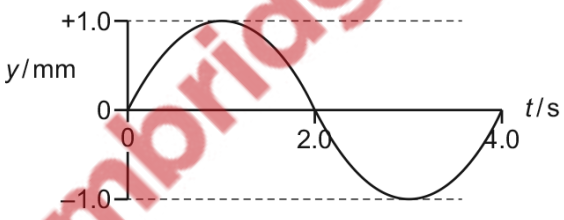
A particle of the medium oscillates vertically.

Which graph of vertical displacement y against time t best represents the motion of this particle?

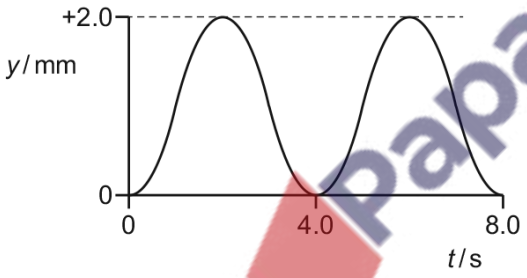
A



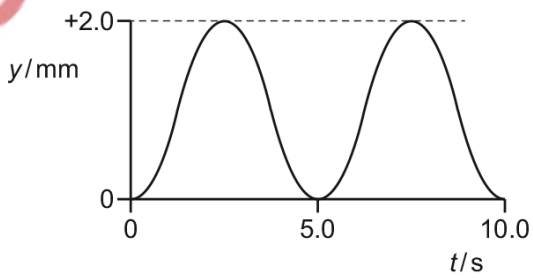
B



C



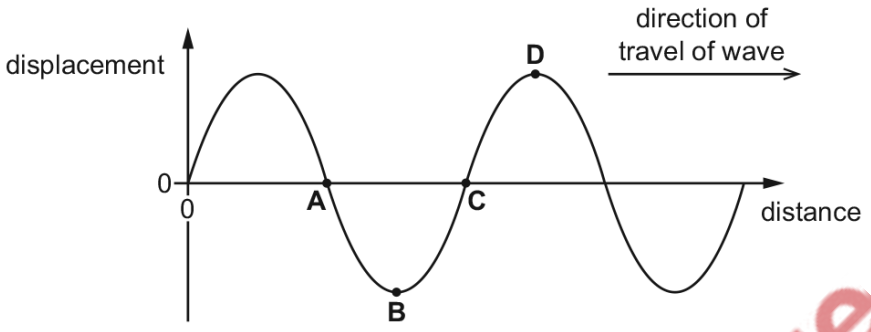
D



761. 9702_s19_qp_11 Q: 23

The graph shows the variation of the displacement of particles with distance along a transverse wave at an instant in time. The wave is moving to the right.

Which position along the wave corresponds to a point where particles in the wave are travelling the fastest upwards?



762. 9702_w19_qp_11 Q: 22

Which statement about all types of transverse waves is correct?

A They all have the same speed.

B They all have vibrations that are parallel to the direction of propagation of energy.

C They can all form stationary waves.

D They can all travel through a vacuum.

763. 9702_w19_qp_12 Q: 26

Which statement about a light wave and a sound wave is correct?

A Both can travel through free space.

B Both have a frequency inversely proportional to their wavelength.

C Both have an intensity proportional to their amplitude.

D Both have oscillations perpendicular to the direction of energy transfer.

764. 9702_w19_qp_13 Q: 21

Which statement about light waves and sound waves is **not** correct?

A Light waves and sound waves can both demonstrate the Doppler effect.

B Light waves are transverse waves and sound waves are longitudinal waves.

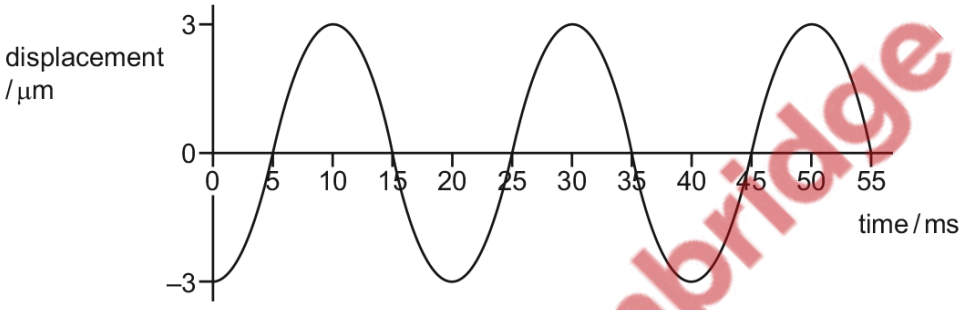
C Light waves can be diffracted but sound waves cannot.

D Light waves can travel in a vacuum but sound waves cannot.

---

765. 9702_w19_qp_13 Q: 22

The graph represents a sound wave.



Which statement is correct?

A The wave is longitudinal and has a period of 25 ms.

B The wave is longitudinal and has a frequency of 50 Hz.

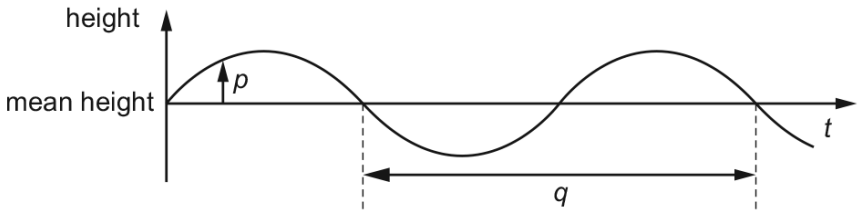
C The wave is transverse and has an amplitude of 3 μm.

D The wave is transverse and has a wavelength of 20 ms.

---

766. 9702_w19_qp_13 Q: 27

The graph shows how the height of the water surface at a point in a harbour varies with time t as waves pass the point.



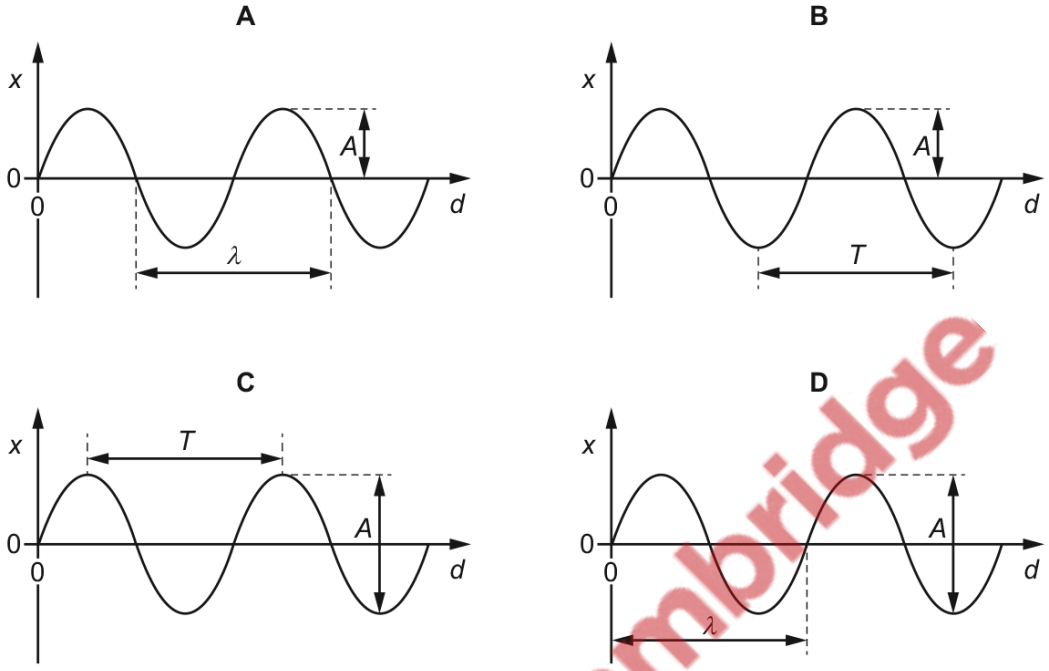
What are p and q?

	p	q
A	displacement	period
B	displacement	wavelength
C	amplitude	period
D	amplitude	wavelength

767. 9702_m18_qp_12 Q: 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?

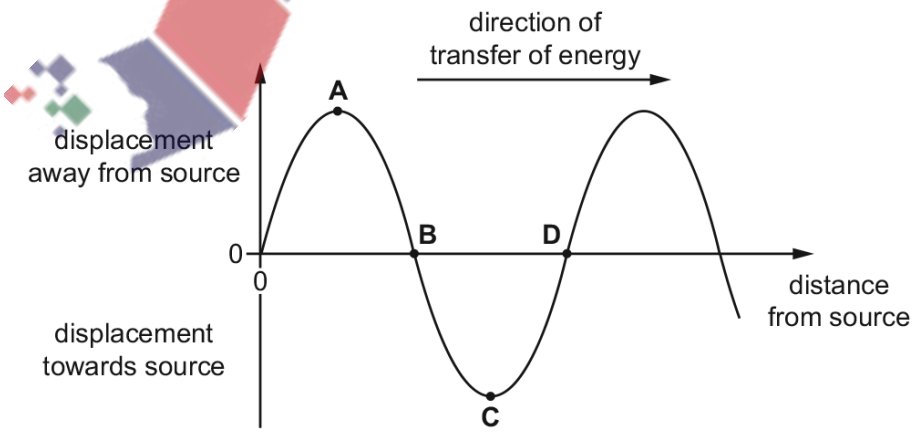


768. 9702_s18_qp_11 Q: 22

A longitudinal wave has vibrations parallel to the direction of transfer of energy by the wave.

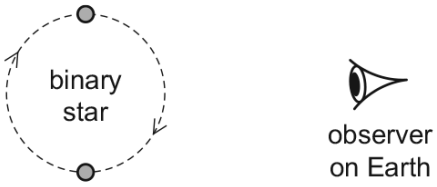
The wave can be represented on a graph showing the variation of the displacement of the particles with distance from the source.

Which point on the graph is the centre of a compression?

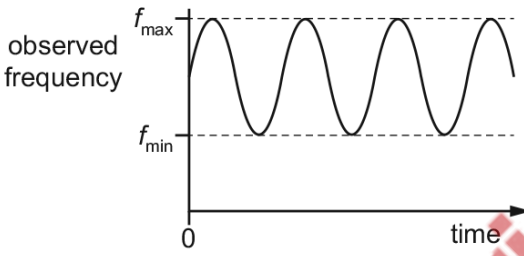


769. 9702_s18_qp_11 Q: 24

A binary star consists of two stars rotating around a common centre. Light from one of the stars is observed on the Earth.



The observed frequency of the light varies between a minimum frequency f_{min} and a maximum frequency f_{max}, as shown.



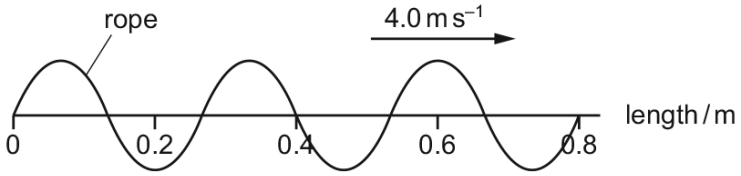
The rate of rotation of the binary star increases.

What is the change to f_{max} and the change to f_{min}?

	f_{max}	f_{min}
A	decreases	decreases
B	decreases	increases
C	increases	decreases
D	increases	increases

770. 9702_w18_qp_11 Q: 22

A vibration generator produces a progressive wave on a rope. The diagram shows the rope at one instant. The wave travels at a speed of $4.0\,m\,s^{-1}$.

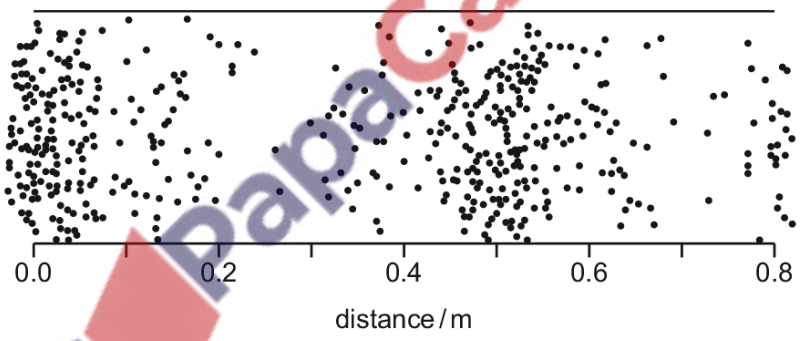


What are the wavelength and the frequency of the wave?

	wavelength / m	frequency / Hz
A	0.13	15
B	0.13	30
C	0.27	15
D	0.27	30

771. 9702_w18_qp_12 Q: 23

When a guitar string is plucked, it causes a longitudinal sound wave in the air, as shown.



The speed of sound in the air is $340\,m\,s^{-1}$.

What is the approximate frequency of the sound wave shown?

A 430 Hz **B** 680 Hz **C** 1100 Hz **D** 1400 Hz

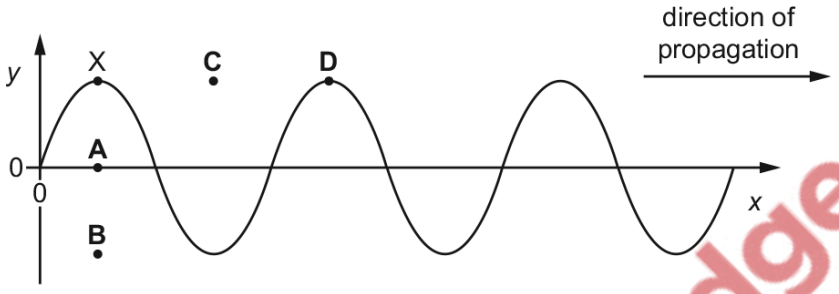
772. 9702_w18_qp_13 Q: 22

The variation with distance x of the displacement y of a transverse wave on a rope is shown at time $t = 0$.

The wave has a frequency of 0.5 Hz.

A point X on the rope is marked. The diagram shows the original position of X and four new positions.

What is the position of X at time $t = 1$ s?



---

773. 9702_m17_qp_12 Q: 23

Which statement about light waves and sound waves is correct?

A Both light waves and sound waves show the Doppler effect.

B Light waves can be diffracted but sound waves cannot be diffracted.

C Sound waves are transverse waves and light waves are longitudinal waves.

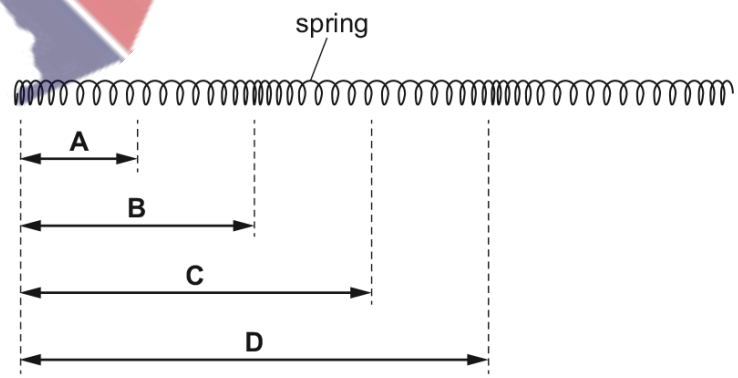
D Sound waves can travel in a vacuum but light waves cannot travel in a vacuum.

---

774. 9702_s17_qp_11 Q: 22

A longitudinal wave travels through a long spring. The spring is shown at one instant.

What is the wavelength of the wave?



---

775. 9702_s17_qp_11 Q: 23

A sound wave has a frequency of 2500 Hz and a speed of 1500 $m\,s^{-1}$.

What is the shortest distance from a point of maximum pressure in the wave to a point of minimum pressure?

A 0.15 m **B** 0.30 m **C** 0.60 m **D** 1.20 m

---

776. 9702_s17_qp_12 Q: 23

Which statement about progressive longitudinal waves is **not** correct?

A The oscillations of the particles are parallel to the direction of travel of the wave energy.

B They have a series of nodes and antinodes.

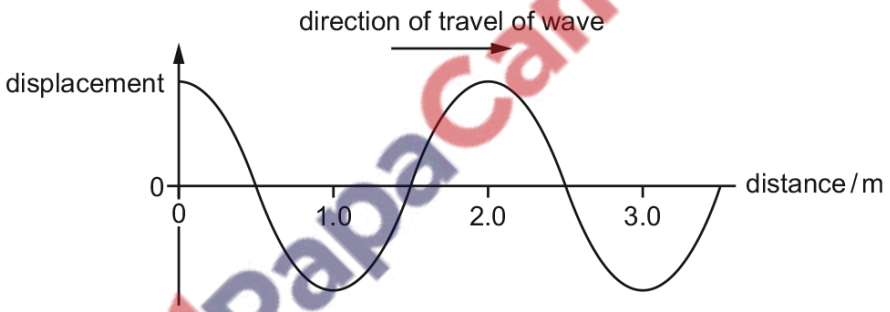
C They need a medium through which to travel.

D They transfer energy.

---

777. 9702_s17_qp_13 Q: 22

A transverse wave travels along a rope. The graph shows the variation of the displacement of the particles in the rope with distance along it at a particular instant.



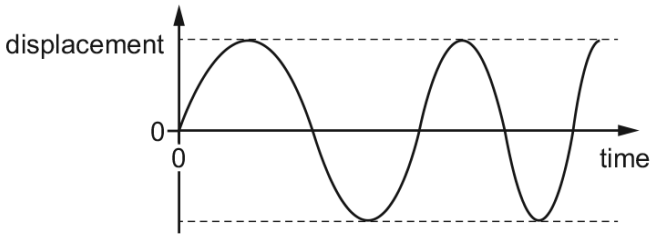
At which distance along the rope do the particles have maximum upwards velocity?

A 0.5 m **B** 1.0 m **C** 1.5 m **D** 2.0 m

---

778. 9702_w17_qp_11 Q: 22

The displacement-time graph for a layer of air in the path of a sound wave is shown.



Which wave quantity is increasing?

A amplitude

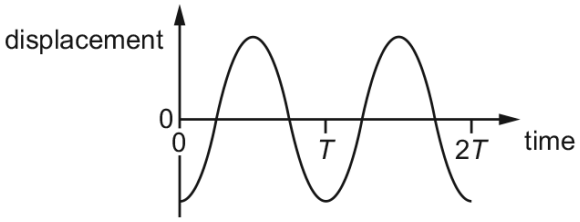
B frequency

C period

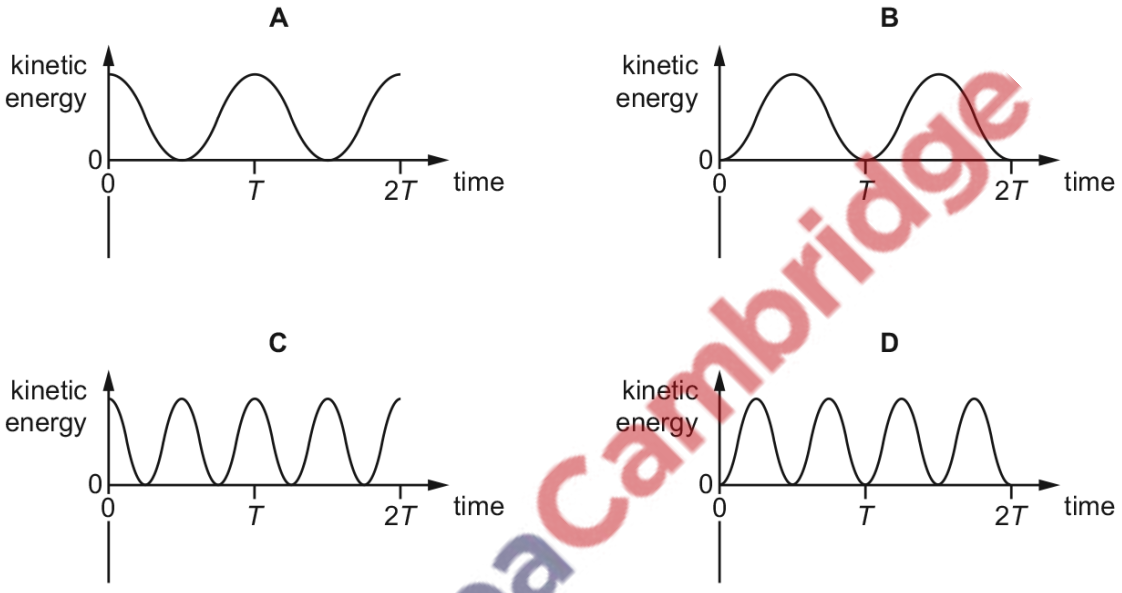
D wavelength

779. 9702_w17_qp_12 Q: 22

When sound travels through air, the air particles vibrate. A graph of displacement against time for a single air particle is shown.



Which graph best shows how the kinetic energy of the air particle varies with time?



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780. 9702_w17_qp_12 Q: 23

Which wave is a longitudinal wave?

A a light wave travelling through air

B a radio wave from a broadcasting station

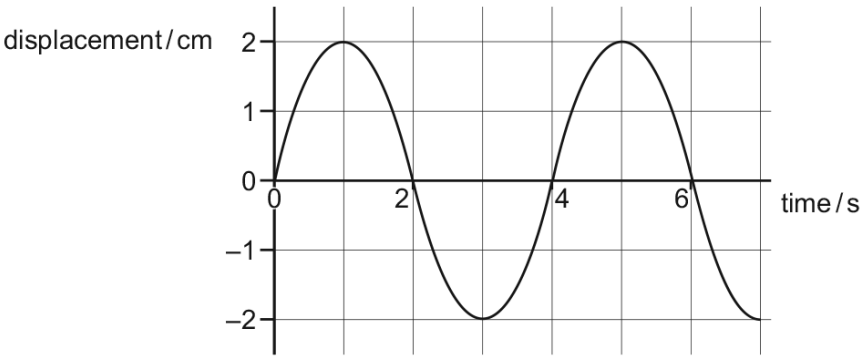
C a ripple on the surface of water

D a sound wave travelling through air

---

781. 9702_w17_qp_13 Q: 22

The graph shows how the displacement of a particle in a wave varies with time.



Which statement is correct?

A The wave has a period of 2 s and could be either transverse or longitudinal.

B The wave has a period of 2 s and must be transverse.

C The wave has a period of 4 s and could be either transverse or longitudinal.

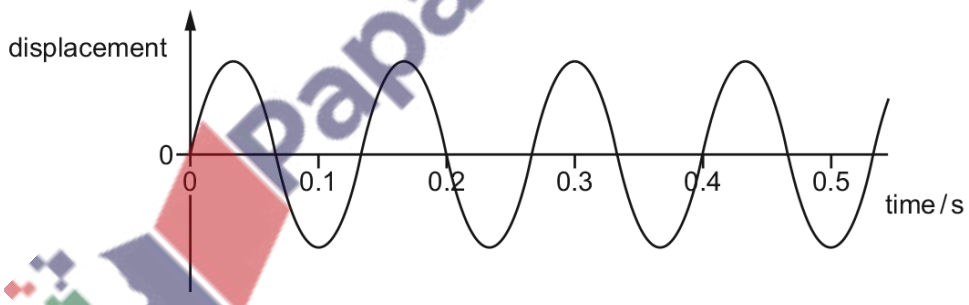
D The wave has a period of 4 s and must be transverse.

---

782. 9702_w17_qp_13 Q: 23

A wave travels along a coiled spring.

The graph shows the variation with time of the displacement of a point on the spring.



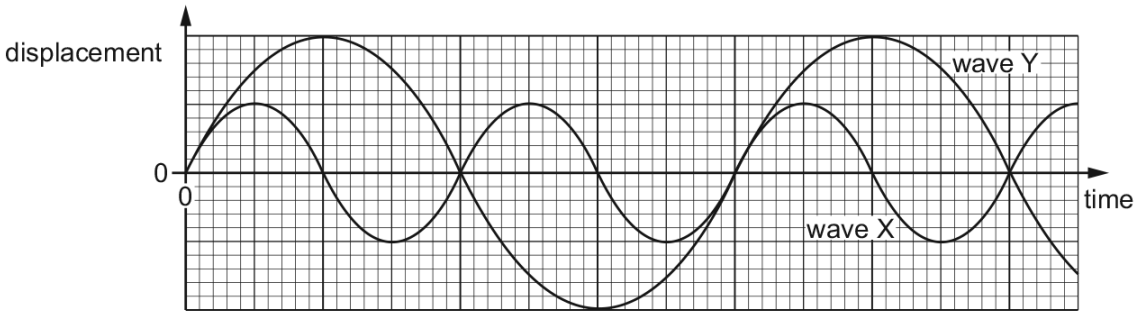
What is the frequency of the wave?

A 0.13 Hz **B** 0.20 Hz **C** 5.0 Hz **D** 7.5 Hz

---

783. 9702_m16_qp_12 Q: 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	$2f$	$2A$

---

784. 9702_s16_qp_12 Q: 25

A stationary wave is set up on a stretched string.

The diagram shows the string at two instants of time when it has maximum displacement.

The oscillations of point P on the string have amplitude A.

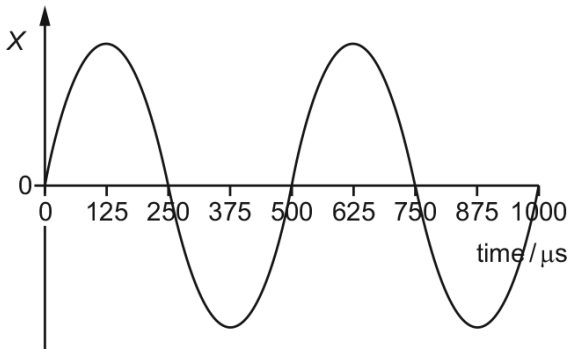
What is the distance moved by P from the position shown in the diagram after half a time period of the wave?

A 0 **B** A **C** $2A$ **D** $4A$

---

785. 9702_w16_qp_11 Q: 25

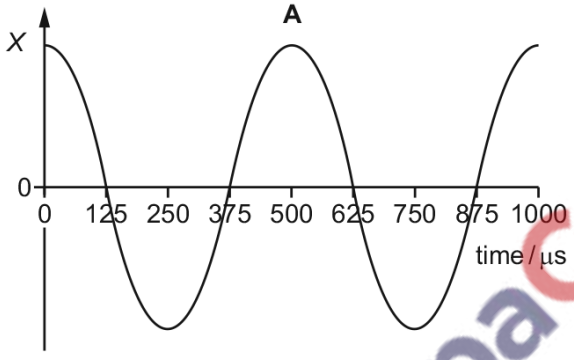
The graph shows the variation with time of the displacement X of a gas molecule as a continuous sound wave passes through a gas.



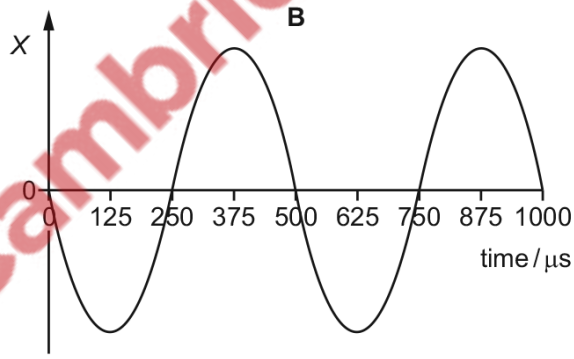
The velocity of sound in the gas is 330 m s^{-1}. All the graphs below have the same zero time as the graph above.

What is the displacement-time graph for a molecule that is a distance of 0.165 m further away from the source of the sound?

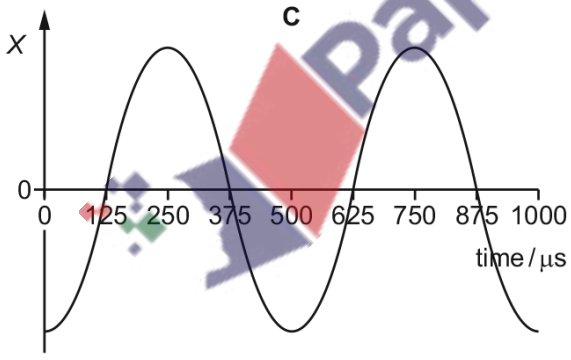
A



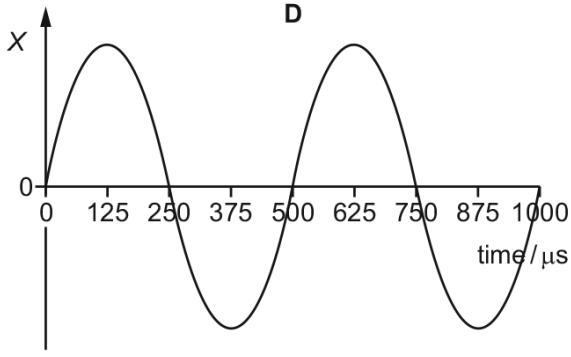
B



C

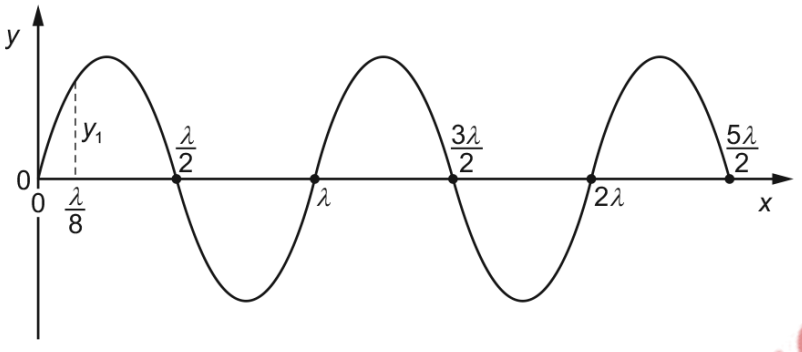


D



786. 9702_w16_qp_12 Q: 24

A transverse progressive wave of wavelength λ is set up on a stretched string. The graph shows the variation of displacement y with distance x at a particular instant of time. The displacement where distance $x = \frac{\lambda}{8}$ is y_1.



What are the next two values of x where the displacement y is again equal to y_1?

A $\frac{3\lambda}{8}$ and $\frac{5\lambda}{8}$

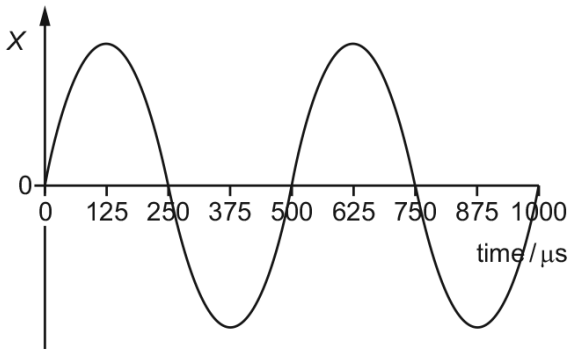
B $\frac{3\lambda}{8}$ and $\frac{9\lambda}{8}$

C $\frac{5\lambda}{8}$ and $\frac{9\lambda}{8}$

D $\frac{9\lambda}{8}$ and $\frac{17\lambda}{8}$

787. 9702_w16_qp_13 Q: 25

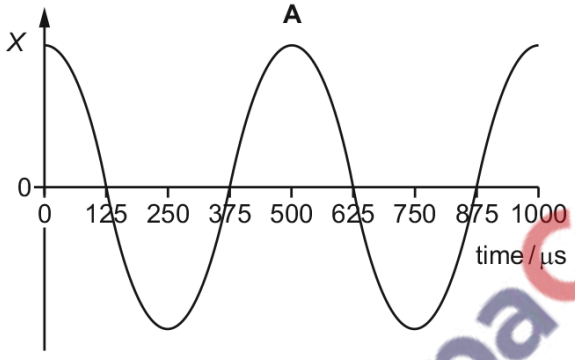
The graph shows the variation with time of the displacement X of a gas molecule as a continuous sound wave passes through a gas.



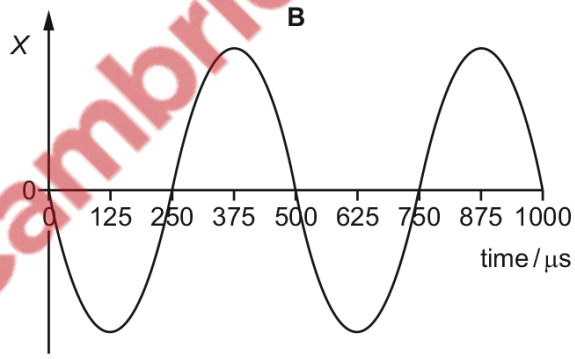
The velocity of sound in the gas is 330 m s^{-1}. All the graphs below have the same zero time as the graph above.

What is the displacement-time graph for a molecule that is a distance of 0.165 m further away from the source of the sound?

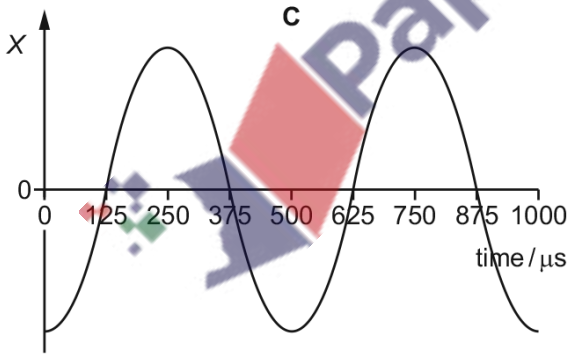
A



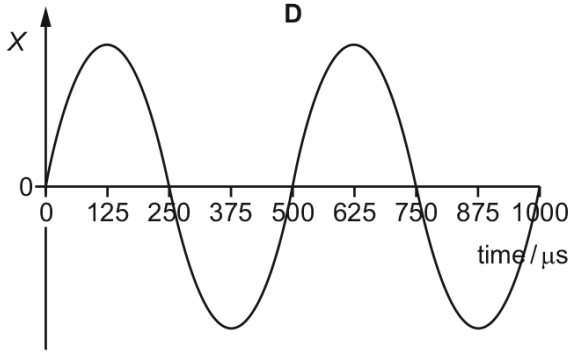
B



C

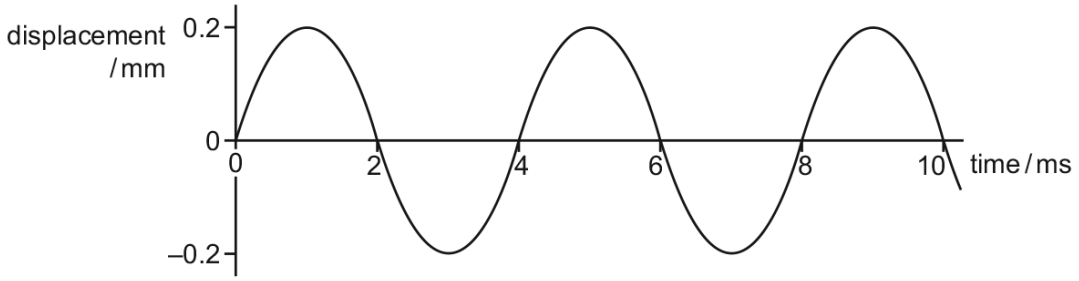


D



788. 9702_s15_qp_11 Q: 24

A sound wave moves with a speed of $320\,m\,s^{-1}$ through air. The variation with time of the displacement of an air particle due to this wave is shown in the graph.



Which statement about the sound wave is correct?

A The frequency of the wave is 500 Hz.

B The graph shows that sound is a transverse wave.

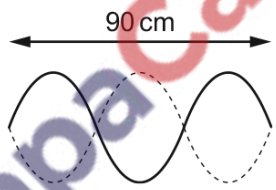
C The intensity of the wave will be doubled if its amplitude is increased to 0.4 mm.

D The wavelength of the sound wave is 1.28 m.

---

789. 9702_s15_qp_11 Q: 28

The diagram shows a stationary wave on a string at two instants of maximum vertical displacement.



The frequency of the wave is 12 Hz.

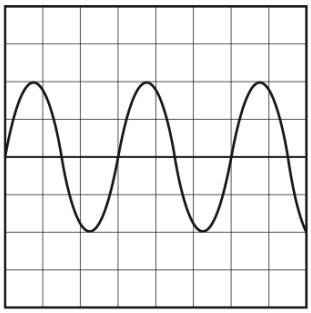
What is the speed of the wave?

A $3.6\,m\,s^{-1}$ **B** $7.2\,m\,s^{-1}$ **C** $360\,m\,s^{-1}$ **D** $720\,m\,s^{-1}$

8.3 Determination of frequency and wavelength of sound waves

790. 9702_m20_qp_12 Q: 23

A sound wave is displayed on the screen of a cathode-ray oscilloscope, as shown.



The time-base setting is 0.50 ms per division.

What is the frequency of the sound wave?

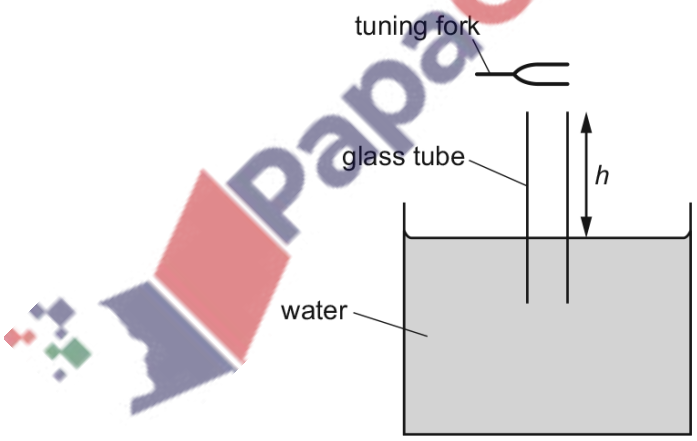
A 500 Hz **B** 670 Hz **C** 1000 Hz **D** 1300 Hz

---

791. 9702_s20_qp_11 Q: 24

A long glass tube is almost completely immersed in a large tank of water. A tuning fork is struck and held just above the open end of the tube as it is slowly raised.

A louder sound is first heard when the height h of the end of the tube above the water is 18.8 cm. A louder sound is next heard when h is 56.4 cm. The speed of sound in air is 330 m s^{-1}.



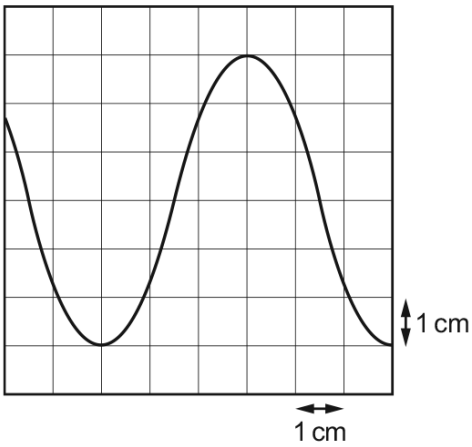
What is the frequency of the sound produced by the tuning fork?

A 220 Hz **B** 440 Hz **C** 660 Hz **D** 880 Hz

---

792. 9702_s20_qp_12 Q: 23

A microphone connected to the Y-plates of a cathode-ray oscilloscope (CRO) is placed in front of a loudspeaker. The trace on the screen of the CRO is shown.



The time-base setting is 0.5 ms cm^{-1} and the Y-plate sensitivity is 0.2 mV cm^{-1}.

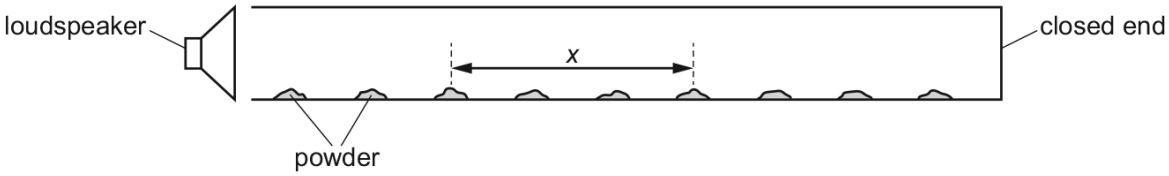
What is the frequency of the sound from the loudspeaker and what is the amplitude of the trace on the CRO?

	frequency / Hz	amplitude / mV
A	330	0.6
B	330	1.2
C	670	0.6
D	670	1.2

793. 9702_s20_qp_13 Q: 24

A loudspeaker is set up at the open end of a closed tube containing powder.

When the loudspeaker produces sound of frequency 1200 Hz, a stationary wave is produced in the tube. The powder gathers at the nodes of the stationary wave as shown.



The speed of sound in the air is 336 m s^{-1}.

What is the value of distance x?

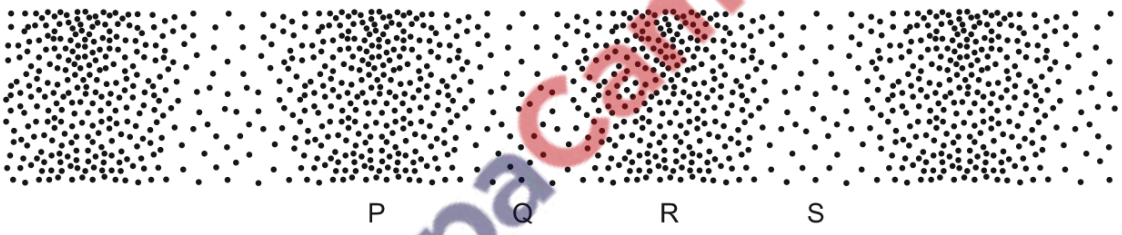
A 28 cm **B** 42 cm **C** 84 cm **D** 112 cm

---

794. 9702_m19_qp_12 Q: 22

A sound wave passes through air.

The diagram shows the positions of the molecules of the air at one instant.



Which distance is equal to the wavelength of the wave?

A PQ **B** PS **C** QR **D** QS

---

795. 9702_m19_qp_12 Q: 24

A straight tube is closed at one end and has a loudspeaker positioned at the open end. The frequency of the loudspeaker is initially very low and is increased slowly. A series of loudness maxima are heard. The stationary wave which gives the first maximum has a node at the closed end and an antinode at the open end. The frequency of the loudspeaker is f_1 when the first maximum is heard.

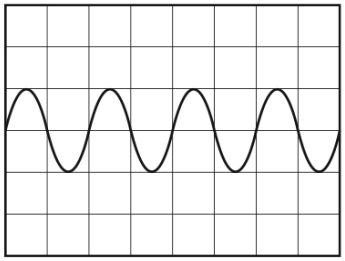
What is the frequency of the loudspeaker when the fourth maximum is heard?

A $\frac{7f_1}{4}$ **B** $2f_1$ **C** $4f_1$ **D** $7f_1$

---

796. 9702_s19_qp_11 Q: 4

A whale produces sound waves of frequency 5 Hz. The waves are detected by a microphone and displayed on an oscilloscope.



What is the time-base setting on the oscilloscope?

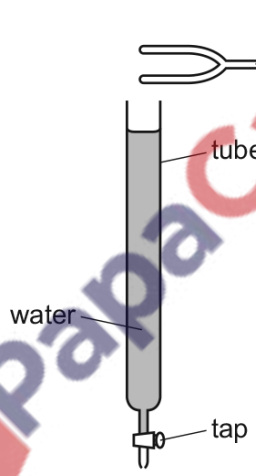
A 0.1 ms div^{-1} **B** 1 ms div^{-1} **C** 10 ms div^{-1} **D** 100 ms div^{-1}

---

797. 9702_s19_qp_11 Q: 24

A long tube, filled with water, has a tap fitted at its base, as shown.

A tuning fork is sounded above the tube and the water is allowed to run gradually out of the tube.



A louder sound is heard at intervals as the water runs out of the tube. The change in water level between louder sounds is 32 cm.

What is the wavelength of the sound in the tube?

A 16 cm **B** 32 cm **C** 64 cm **D** 128 cm

---

798. 9702_s19_qp_12 Q: 25

In an experiment to determine the wavelength of sound in air, a stationary wave is set up in an air column.

The distance between a node and an adjacent antinode is L.

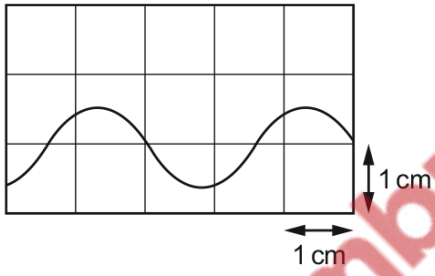
What is the wavelength of the sound?

A $\frac{1}{2}L$ **B** L **C** $2L$ **D** $4L$

---

799. 9702_s19_qp_12 Q: 28

A cathode-ray oscilloscope (CRO) is used to display the trace from a sound wave. The time-base is set at $5\,\mu s\,mm^{-1}$.



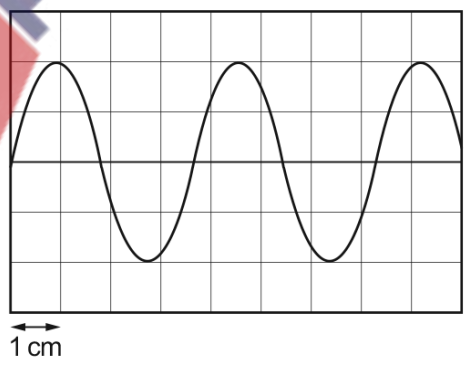
What is the frequency of the sound wave?

A 6.7 Hz **B** 67 Hz **C** 6.7 kHz **D** 67 kHz

---

800. 9702_s19_qp_13 Q: 23

A sound wave of frequency 270 Hz is recorded by a cathode-ray oscilloscope (CRO). The waveform on the CRO is shown.



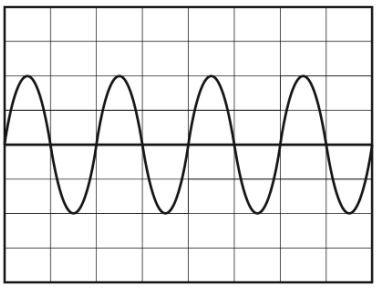
What is the time-base setting on the CRO?

A $0.1\,ms\,cm^{-1}$ **B** $1\,ms\,cm^{-1}$ **C** $10\,ms\,cm^{-1}$ **D** $100\,ms\,cm^{-1}$

---

801. 9702_w19_qp_12 Q: 22

A microphone is connected to a cathode-ray oscilloscope (CRO). When a tuning fork is struck and then held next to the microphone, the following waveform is shown on the display of the CRO.



The time-base setting on the CRO is 2.00 ms per division.

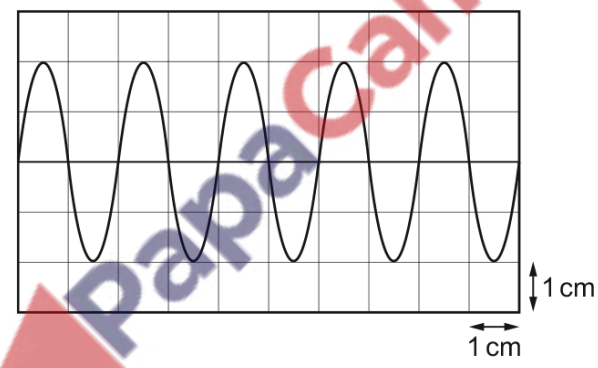
What is the best estimate of the frequency of the sound produced by the tuning fork?

A 63 Hz **B** 170 Hz **C** 250 Hz **D** 500 Hz

---

802. 9702_w19_qp_13 Q: 23

A cathode-ray oscilloscope (CRO) is used to display a wave of frequency 5.0 kHz. The display is shown.



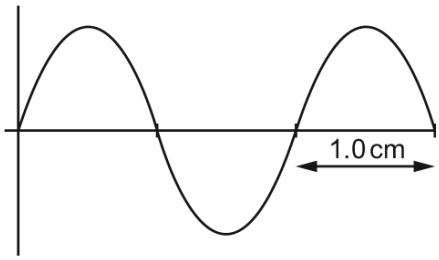
What is the time-base setting of the CRO?

A 10 μs cm^{-1} **B** 100 μs cm^{-1} **C** 10 ms cm^{-1} **D** 100 ms cm^{-1}

---

803. 9702_m18_qp_12 Q: 25

The diagram shows a cathode-ray oscilloscope display of an electromagnetic wave.



The time base setting is $0.20\,\mu s\,cm^{-1}$.

Which statement is correct?

A The frequency of the wave is 2.5 MHz and it lies in the microwave region of the electromagnetic spectrum.

B The frequency of the wave is 2.5 MHz and it lies in the radio-wave region of the electromagnetic spectrum.

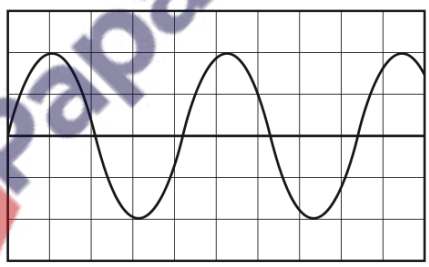
C The frequency of the wave is 5.0 MHz and it lies in the microwave region of the electromagnetic spectrum.

D The frequency of the wave is 5.0 MHz and it lies in the radio-wave region of the electromagnetic spectrum.

---

804. 9702_s18_qp_12 Q: 23

The diagram shows the screen of a cathode-ray oscilloscope (c.r.o.) displaying a wave.



The time-base of the c.r.o. is set at 10 ms / division.

What is the frequency of the wave?

A 0.24 Hz **B** 4.2 Hz **C** 12 Hz **D** 24 Hz

---

805. 9702_s18_qp_12 Q: 26

The diagram shows apparatus for the measurement of the frequency of a sound wave.

Sound of the unknown frequency is reflected back from a metal plate. A microphone placed at a distance D from the metal plate detects the sound intensity. A minimum intensity is detected with $D = 12.0\,\text{cm}$. The plate is moved further away from the microphone until the next minimum is detected with $D = 15.0\,\text{cm}$.

The speed of sound in air is $336\,\text{m s}^{-1}$.

What is the frequency of the sound?

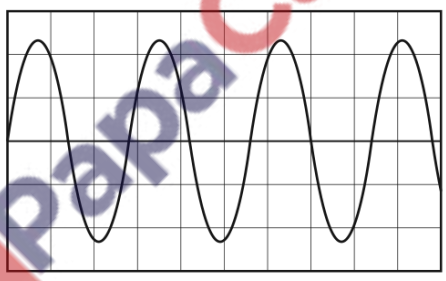
A 56 Hz **B** 112 Hz **C** 5600 Hz **D** 11 200 Hz

---

806. 9702_s18_qp_13 Q: 22

A cathode-ray oscilloscope (c.r.o.) 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 ms / div.

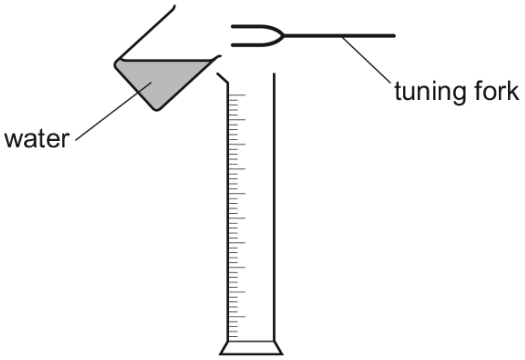
What is the frequency of the sound wave?

A 57 Hz **B** 71 Hz **C** 114 Hz **D** 143 Hz

---

807. 9702_s18_qp_13 Q: 24

A vibrating tuning fork is held over a measuring cylinder, as shown.



Water is then gradually poured into the measuring cylinder. A much louder sound is first heard when the water level is 2.9 cm above the base of the measuring cylinder. A second much louder sound is heard when the water level reaches a height of 67.3 cm above the base.

The speed of sound in air is 330 $m\,s^{-1}$.

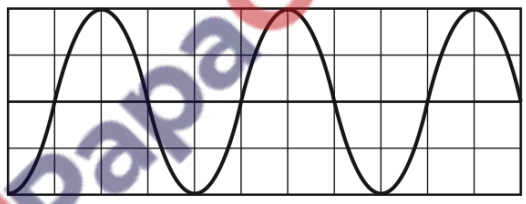
What is the frequency of the tuning fork?

A 128 Hz **B** 256 Hz **C** 512 Hz **D** 1024 Hz

---

808. 9702_w18_qp_11 Q: 23

The diagram shows the waveform of a signal displayed on a cathode-ray oscilloscope.



The time-base is set at 5.0 ms per division.

The Y-gain is set at 5.0 mV per division.

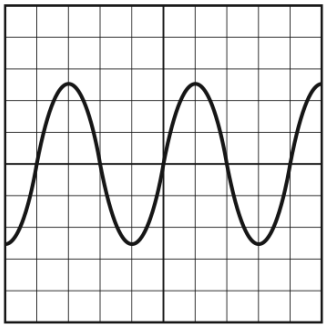
What are the amplitude and the frequency of the signal?

	amplitude / mV	frequency / Hz
A	10	50
B	10	100
C	20	50
D	20	100

---

809. 9702_w18_qp_13 Q: 23

A sound wave is detected by a microphone. The output from the microphone is connected to the Y-input of a cathode-ray oscilloscope (c.r.o.). The trace on the c.r.o. is shown.



The time-base is set at 0.20 ms per division.

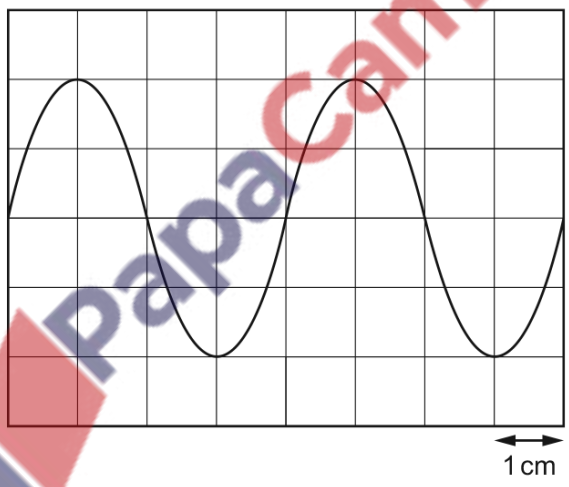
What is the frequency of the sound wave?

A 1000 Hz **B** 1250 Hz **C** 2000 Hz **D** 2500 Hz

---

810. 9702_s17_qp_11 Q: 24

A sound wave is displayed on the screen of a cathode-ray oscilloscope (c.r.o.) as shown.



The time-base of the c.r.o. is set at 2.5 ms cm^{-1}.

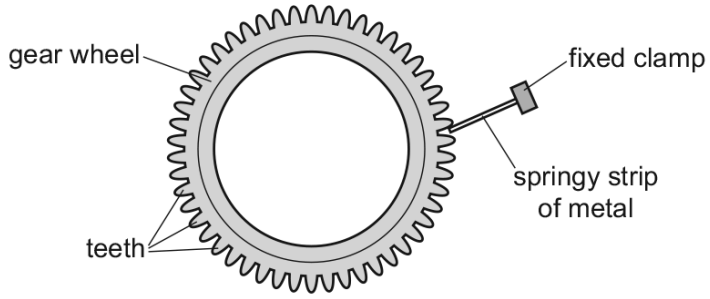
What is the frequency of the sound wave?

A 50 Hz **B** 100 Hz **C** 200 Hz **D** 400 Hz

---

811. 9702_s17_qp_12 Q: 24

A bicycle gear wheel is a disc with 50 'teeth' equally spaced around its edge, as shown. The gear wheel is rotated 10 times each second. A springy strip of metal is vibrated by the rotating 'teeth'. The metal strip produces a sound of frequency that is equal to the frequency of vibration of the strip.



The speed of sound in air is $330\,m\,s^{-1}$.

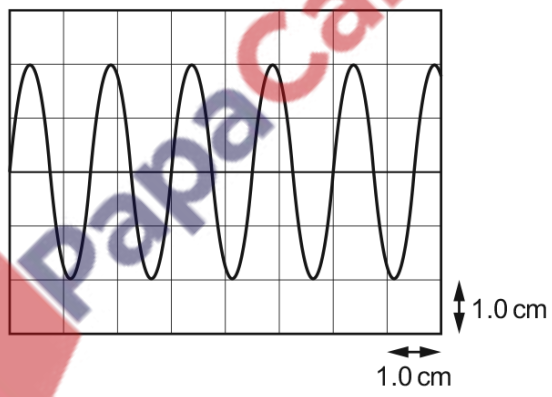
What is the wavelength of the emitted sound?

A 0.66 m **B** 1.5 m **C** 6.6 m **D** 500 m

---

812. 9702_s17_qp_13 Q: 23

A trace is shown on the screen of a cathode-ray oscilloscope (c.r.o.).



The time-base setting is $2.5\,ms\,cm^{-1}$ and the Y-gain is $2.0\,V\,cm^{-1}$.

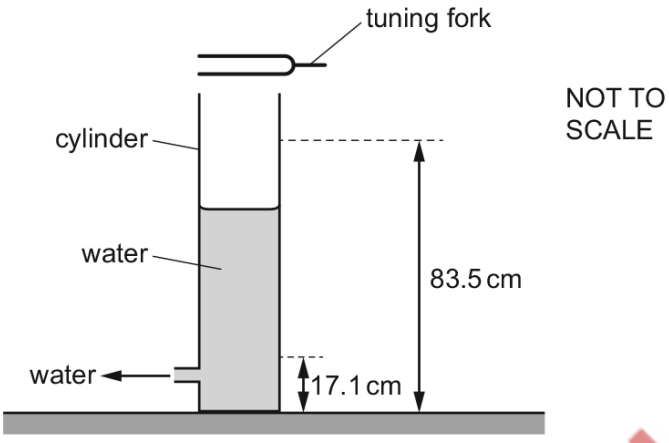
What is the frequency and the amplitude of the waveform displayed by the c.r.o.?

	frequency / Hz	amplitude / V
A	0.00375	4.0
B	0.00375	8.0
C	267	4.0
D	267	8.0

---

813. 9702_w17_qp_12 Q: 24

A vibrating tuning fork is held above a glass cylinder filled to the top with water. The water level is steadily lowered. A loud sound is first heard when the water level is 83.5 cm above the bench. The next loud sound is heard when the water level is 17.1 cm above the bench.



The speed of sound in air is 340 m s^{-1}.

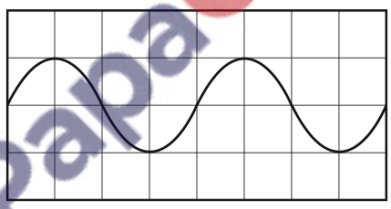
What is the frequency of the tuning fork?

A 128 Hz **B** 256 Hz **C** 384 Hz **D** 512 Hz

---

814. 9702_w17_qp_13 Q: 24

An electrical signal is displayed on a cathode-ray oscilloscope (c.r.o.).



The time-base setting is 50 ms div^{-1}.

The Y-gain setting is 2 V div^{-1}.

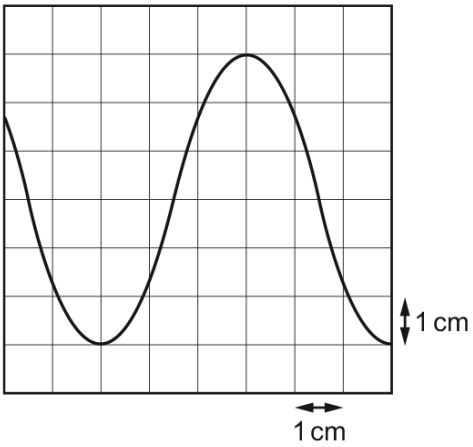
What is the amplitude of the signal?

A 2 V **B** 4 V **C** 5 V **D** 10 V

---

815. 9702_s16_qp_12 Q: 22

A microphone connected to the Y-plates of a cathode-ray oscilloscope (c.r.o.) is placed in front of a loudspeaker. The trace on the screen of the c.r.o. is shown.



The time-base setting is 0.5 ms cm^{-1} and the Y-plate sensitivity is 0.2 mV cm^{-1}.

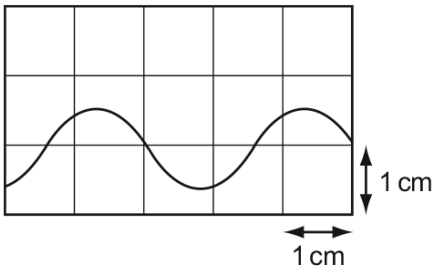
What is the frequency of the sound from the loudspeaker and what is the amplitude of the trace on the c.r.o.?

	frequency / Hz	amplitude / mV
A	330	0.6
B	330	1.2
C	670	0.6
D	670	1.2

---

816. 9702_s15_qp_13 Q: 25

A cathode-ray oscilloscope (c.r.o.) is used to display the trace from a sound wave. The time-base is set at 5 μs mm^{-1}.



What is the frequency of the sound wave?

A 6.7 Hz **B** 67 Hz **C** 6.7 kHz **D** 67 kHz

8.4 Doppler effect

817. 9702_m20_qp_12 Q: 24

An observer is situated at the top of a tall tower. An aeroplane emitting sound at a frequency of 1000 Hz approaches the observer at a speed of 165 m s^{-1}.

The speed of sound is 330 m s^{-1}.

What is the frequency of the sound received by the observer?

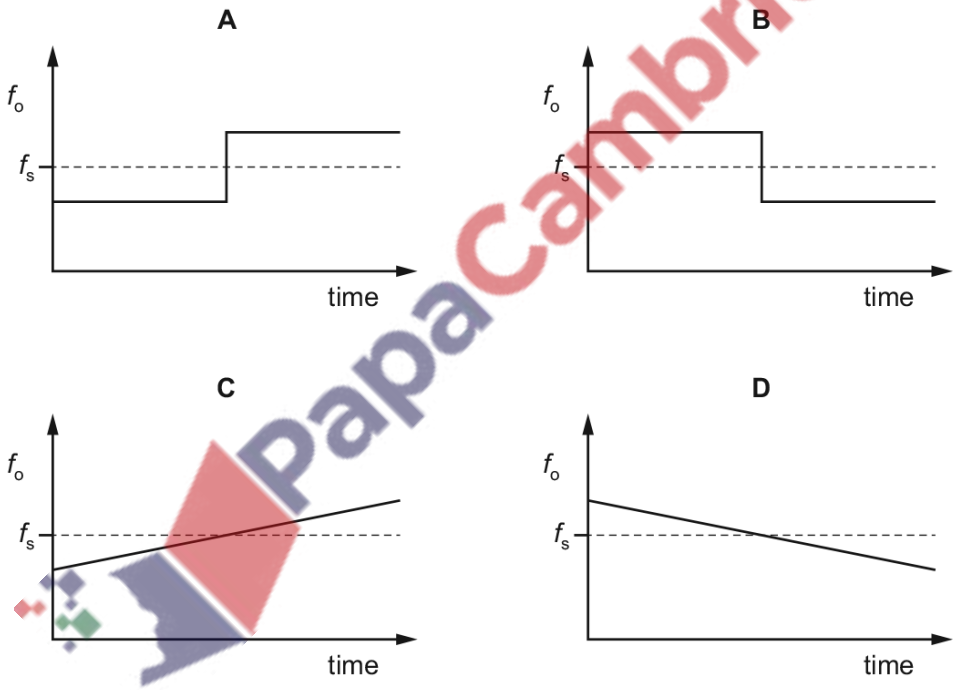
A 330 Hz **B** 667 Hz **C** 1000 Hz **D** 2000 Hz

---

818. 9702_s20_qp_11 Q: 25

A source emitting sound of a single frequency f_s travels at constant speed directly towards an observer. The source then passes the observer and continues to move directly away from the observer. The velocity of the source remains constant.

Which graph represents the variation with time of the frequency f_o of the sound heard by the observer?



---

819. 9702_s20_qp_12 Q: 25

A stationary person measures the speed and wavelength of the sound from a horn on a stationary vehicle. The person then repeats the measurements when the vehicle is approaching at a constant speed.

Which row describes the measured wavelength and the measured speed of the sound wave from the moving vehicle when compared with the sound wave from the stationary vehicle?

	wavelength of the sound wave	speed of the sound wave
A	longer	greater
B	shorter	greater
C	longer	same
D	shorter	same

---

820. 9702_s20_qp_13 Q: 25

A stationary source S emits a sound wave of frequency *f*.

The source now moves away from a stationary observer.

Which statement is correct?

A The frequency of the source S and the observed frequency are now both higher than *f*.

B The frequency of the source S and the observed frequency are now both lower than *f*.

C The frequency of the source S is now lower than *f*.

D The observed frequency is now lower than *f*.

---

821. 9702_m19_qp_12 Q: 25

A buzzer emitting sound of frequency 846 Hz is attached to a string and rotated in a horizontal circle. The linear speed of the buzzer is 25.0 $m\,s^{-1}$.

The speed of sound is 340 $m\,s^{-1}$.

What is the maximum frequency heard by the observer?

A 783 Hz **B** 788 Hz **C** 908 Hz **D** 913 Hz

---

822. 9702_s19_qp_11 Q: 25

A stationary insect on the surface of water creates circular waves with its legs, as shown in diagram 1. The insect begins to travel to the right as shown in diagram 2.

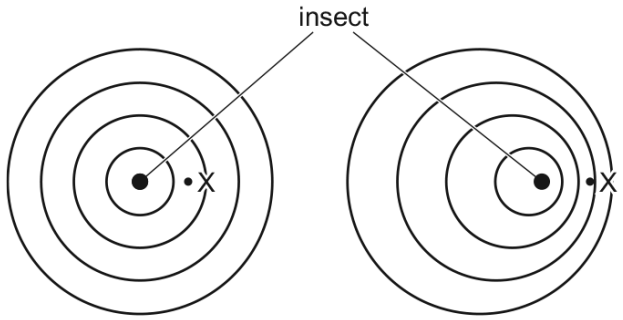


diagram 1 diagram 2

Which row describes the change to the waves at X caused by the movement of the insect?

	frequency	wave speed
A	decreases	increases
B	decreases	stays the same
C	increases	increases
D	increases	stays the same

---

823. 9702_s19_qp_11 Q: 26

A toy motorboat moving with constant velocity v vibrates up and down on the surface of a pond. This causes the boat to act as a source of circular water waves of frequency 2.0 Hz. The speed of the waves is 1.5 m s^{-1}.

A man, standing at the edge of the pond, observes that the waves from the boat approach him with a frequency of 3.0 Hz.

The formula for Doppler effect calculations with sound waves may also be used for water waves.

What is a possible value of v?

	speed / m s^{-1}	direction
A	0.50	directly away from the man
B	0.50	directly towards the man
C	0.75	directly away from the man
D	0.75	directly towards the man

---

824. 9702_s19_qp_12 Q: 26

In one of the first experiments to demonstrate the Doppler effect, a train was filled with trumpeters all playing a note of frequency 440 Hz. The difference in observed frequency of the note as the train directly approached a stationary observer was 22 Hz. The speed of sound was 340 $m s^{-1}$.

At which speed was the train moving?

A 15.4 $m s^{-1}$ **B** 16.2 $m s^{-1}$ **C** 17.0 $m s^{-1}$ **D** 17.9 $m s^{-1}$

---

825. 9702_s19_qp_13 Q: 24

A motor boat vibrates in the water so that it produces water waves of frequency 0.20 Hz. The speed of these waves in the water is 20 $m s^{-1}$. The motor boat moves with a speed of 5.0 $m s^{-1}$ directly towards a stationary sailing boat.

The Doppler effect equation for sound waves also applies to water waves.

What is the frequency with which the waves hit the stationary sailing boat?

A 0.15 Hz **B** 0.16 Hz **C** 0.25 Hz **D** 0.27 Hz

---

826. 9702_w19_qp_11 Q: 24

The siren of a moving police car emits a sound wave with a frequency of 440 Hz. A stationary observer hears sound of frequency 494 Hz. The speed of sound in the air is 340 $m s^{-1}$.

What could be the speed and the direction of movement of the car?

A 37 $m s^{-1}$ directly towards the observer

B 37 $m s^{-1}$ directly away from the observer

C 42 $m s^{-1}$ directly towards the observer

D 42 $m s^{-1}$ directly away from the observer

---

827. 9702_w19_qp_12 Q: 23

A loudspeaker emitting a constant frequency of 2000 Hz is swung in a horizontal circle with a speed of 15.0 $m s^{-1}$.

A stationary observer is level with the loudspeaker and situated a long distance from the loudspeaker. The observer hears a sound of varying frequency. The maximum frequency heard is 2097 Hz.

What is the speed of the sound in the air?

A 294 $m s^{-1}$ **B** 309 $m s^{-1}$ **C** 324 $m s^{-1}$ **D** 330 $m s^{-1}$

---

828. 9702_w19_qp_13 Q: 24

A siren emits sound of frequency 1000 Hz. The siren moves at 20 m s^{-1} towards an observer who is standing still.

The speed of sound in the air is 330 m s^{-1}.

Which expression would correctly give the frequency heard by the observer?

A $\frac{1000 \times 330}{330 + 20}$

B $\frac{1000 \times 330}{330 - 20}$

C $\frac{1000\,(330 + 20)}{330}$

D $\frac{1000\,(330 - 20)}{330}$

---

829. 9702_m18_qp_12 Q: 24

A vehicle carries a microwave transmitter that emits microwaves of a constant frequency. A stationary observer has a microwave receiver.

The vehicle moves directly towards the observer at constant speed. The observer detects microwaves of frequency F_o.

The vehicle then accelerates, still moving towards the observer, travels at higher steady speed for a time and then decelerates until it stops.

What is the variation in the frequency of the microwaves that are detected by the observer?

A The observed frequency will fall, then remain steady then return to the frequency F_o.

B The observed frequency will fall, then remain steady then rise to a higher frequency than F_o.

C The observed frequency will rise, then remain steady then fall to a lower frequency than F_o.

D The observed frequency will rise, then remain steady then return to the frequency F_o.

---

830. 9702_s18_qp_12 Q: 27

An astronomer observes the light from a star that is moving away from the Earth.

For the observed light, what has been increased due to the star's motion?

A amplitude

B frequency

C speed

D wavelength

---

831. 9702_s18_qp_13 Q: 23

A police car travels at a velocity of 30.0 m s^{-1} directly towards a stationary observer. The horn of the car emits sound of frequency 2000 Hz. The speed of sound is 340 m s^{-1}.

What is the frequency of the sound heard by the observer?

A 1840 Hz **B** 2000 Hz **C** 2180 Hz **D** 2190 Hz

---

832. 9702_w18_qp_11 Q: 24

A jet aircraft travels at a speed of 0.8v where v is the speed of sound. The aircraft approaches a stationary observer. The frequency of sound emitted by the aircraft is 100 Hz.

Which frequency does the observer hear?

A 56 Hz **B** 180 Hz **C** 400 Hz **D** 500 Hz

---

833. 9702_w18_qp_12 Q: 25

A police car has a two-tone siren emitting sound of frequencies of 700 Hz and 1000 Hz.

The police car is travelling at a speed of 40.0 m s^{-1} towards a stationary observer. The speed of sound in the air is 340 m s^{-1}.

What is the difference between the two frequencies of the sound that is heard by the observer?

A 268 Hz **B** 300 Hz **C** 335 Hz **D** 340 Hz

---

834. 9702_w18_qp_13 Q: 24

A bat flies directly towards a fixed ultrasound detector at a speed of 25.0 m s^{-1} emitting pulses of ultrasound of frequency 40.0 kHz.

The speed of sound in air is 330 m s^{-1}.

Which frequency does the ultrasound detector record?

A 37.0 kHz **B** 37.2 kHz **C** 43.0 kHz **D** 43.3 kHz

---

835. 9702_m17_qp_12 Q: 25

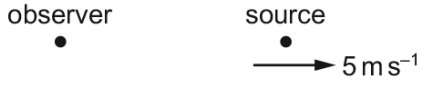
A source of sound waves is travelling as shown.

In which situation would the stationary observer detect the largest decrease in the observed frequency?

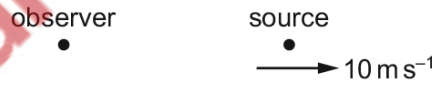
A

B

C



D



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836. 9702_s17_qp_11 Q: 25

A car travelling in a straight line at a speed of 30 m s^{-1} passes near a stationary observer while sounding its horn. The true frequency of sound from the horn is 400 Hz.

The speed of sound in air is 336 m s^{-1}.

What is the change in the frequency of the sound heard by the observer as the car passes?

A 39 Hz **B** 66 Hz **C** 72 Hz **D** 78 Hz

---

837. 9702_s17_qp_12 Q: 25

An ambulance travels along a straight road at a speed of $30.0\,m\,s^{-1}$. Its siren emits sound of frequency 2000 Hz. The speed of sound in the air is $340\,m\,s^{-1}$. The ambulance passes a man standing at the side of the road.

What is the frequency of the sound heard by the man as the ambulance moves towards him and as the ambulance moves away from him?

	frequency heard as ambulance moves towards man / Hz	frequency heard as ambulance moves away from man / Hz
A	1820	2180
B	1840	2190
C	2180	1820
D	2190	1840

---

838. 9702_s17_qp_13 Q: 24

A high-speed train approaches a stationary observer at a speed of $80\,m\,s^{-1}$. The train's horn emits a sound of frequency 250 Hz.

The speed of sound is $340\,m\,s^{-1}$.

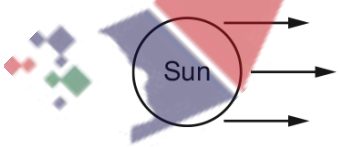
What is the observed frequency of the sound from the horn?

A 190 Hz **B** 200 Hz **C** 310 Hz **D** 330 Hz

---

839. 9702_w17_qp_11 Q: 25

Light of a particular wavelength λ_s is emitted from the Sun. At any instant, a band of wavelengths ranging from less than λ_s to more than λ_s is observed on the Earth. This is caused by the Doppler effect.



Earth
O

NOT TO SCALE

What could be the explanation for this Doppler effect?

A The Sun is moving at right-angles to a line joining the Sun and the Earth.

B The Sun is moving away from the Earth.

C The Sun is moving towards the Earth.

D The Sun is rotating.

---

840. 9702_w17_qp_12 Q: 25

A train that is moving in a straight line along a railway track has a whistle that continuously emits sound of frequency *f*.

A woman standing by the side of the track hears sound of frequency 0.85*f*.

The speed of sound in the air is 340 m s^{-1}.

What is the velocity of the train?

A 51 m s^{-1} away from the woman

B 51 m s^{-1} towards the woman

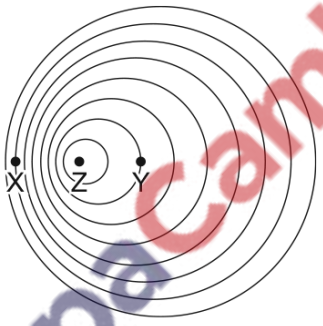
C 60 m s^{-1} away from the woman

D 60 m s^{-1} towards the woman

---

841. 9702_w17_qp_13 Q: 25

A source of sound of frequency *F* at point Z is moving at a steady speed. The pattern of the emitted wavefronts is shown.



Which row describes the frequencies of the sound heard by stationary observers at X and Y?

	frequency heard at X	frequency heard at Y
A	$<F$	$<F$
B	$<F$	$>F$
C	$>F$	$<F$
D	$>F$	$>F$

---

842. 9702_w17_qp_13 Q: 26

A car travelling at a steady speed in a straight line passes close to a stationary observer. The observer measures the frequency of the sound from the engine.

As the car approaches, the observed frequency is 220 Hz. When the car moves away, the observed frequency is 180 Hz.

The speed of sound in air is 340 $m s^{-1}$.

What is the speed of the car?

A 8.5 $m s^{-1}$ **B** 31 $m s^{-1}$ **C** 34 $m s^{-1}$ **D** 38 $m s^{-1}$

---

843. 9702_m16_qp_12 Q: 20

With which types of wave can the Doppler shift be observed?

A all types of wave

B light and sound waves only

C sound waves and water waves only

D sound waves only

---

844. 9702_m16_qp_12 Q: 21

A distant star is receding from the Earth with a speed of 1.40×10^7 $m s^{-1}$. It emits light of frequency 4.57×10^{14} Hz. The speed of light is 3.00×10^8 $m s^{-1}$.

The Doppler effect formula can be used with light waves.

What will be the frequency of this light when detected on Earth?

A 2.04×10^{13} Hz

B 4.37×10^{14} Hz

C 4.57×10^{14} Hz

D 4.79×10^{14} Hz

---

845. 9702_s16_qp_12 Q: 23

A source of sound of frequency 1000 Hz moves away from a stationary observer at a speed of 30.0 $m s^{-1}$. The speed of sound is 330 $m s^{-1}$.

What is the frequency of the sound heard by the observer?

A 909 Hz **B** 917 Hz **C** 1090 Hz **D** 1100 Hz

---

846. 9702_s16_qp_13 Q: 24

When a car travelling with constant velocity passes a stationary observer, the observer hears a change in the frequency of the sound emitted by the car.

Which statement is correct?

A The change in frequency is greater as the car moves away than as it approaches.

B The greater the speed of the car, the greater the change in observed frequency.

C The observed frequency is lower as the car moves towards the observer and higher as the car moves away from the observer.

D The volume of the sound heard by the observer does not change as the car approaches.

---

847. 9702_w16_qp_11 Q: 26

The warning signal on an ambulance has a frequency of 600 Hz. The speed of sound is 330 m s^{-1}. The ambulance is travelling with a constant velocity of 25 m s^{-1} towards an observer.

Which overall change in observed frequency takes place between the times at which the ambulance is a long way behind the observer and when it is a long way in front of the observer?

A 49 Hz **B** 84 Hz **C** 91 Hz **D** 98 Hz

---

848. 9702_w16_qp_12 Q: 25

A man standing next to a stationary train hears sound of frequency 400 Hz emitted from the train's horn. The train then moves directly away from the man and sounds its horn when it has a speed of 50 m s^{-1}. The speed of sound is 340 m s^{-1}.

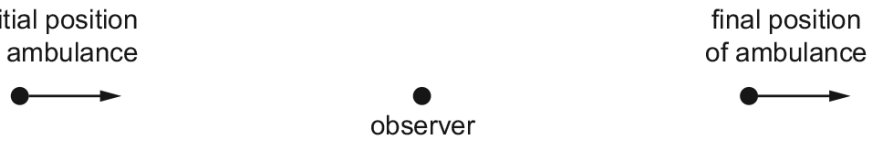
What is the difference in frequency of the sound heard by the man on the two occasions?

A 51 Hz **B** 69 Hz **C** 349 Hz **D** 469 Hz

---

849. 9702_w16_qp_13 Q: 26

The warning signal on an ambulance has a frequency of 600 Hz. The speed of sound is 330 m s^{-1}. The ambulance is travelling with a constant velocity of 25 m s^{-1} towards an observer.



Which overall change in observed frequency takes place between the times at which the ambulance is a long way behind the observer and when it is a long way in front of the observer?

A 49 Hz **B** 84 Hz **C** 91 Hz **D** 98 Hz

8.5 Electromagnetic spectrum

850. 9702_m20_qp_12 Q: 25

What is the order of magnitude of the wavelengths of microwaves and X-rays?

	wavelength of microwaves / m	wavelength of X-rays / m
A	10^{-6}	10^{3}
B	10^{-2}	10^{3}
C	10^{-6}	10^{-10}
D	10^{-2}	10^{-10}

851. 9702_s20_qp_11 Q: 26

What are the names of the electromagnetic waves that have wavelengths in a vacuum of 100 pm and of 100 μm?

	wavelength 100 pm	wavelength 100 μm
A	γ-rays	infrared
B	γ-rays	red light
C	X-rays	infrared
D	X-rays	red light

852. 9702_s20_qp_12 Q: 26

The table shows the wavelengths of five electromagnetic waves.

Which row correctly identifies the principal radiation for each of these wavelengths?

	10^{-14} m	10^{-10} m	10^{-6} m	10^{-2} m	10^{2} m
A	gamma-ray	X-ray	infrared	microwave	radio wave
B	radio wave	microwave	infrared	X-ray	gamma-ray
C	radio wave	microwave	ultraviolet	infrared	X-ray
D	X-ray	infrared	ultraviolet	microwave	radio wave

---

853. 9702_s20_qp_13 Q: 26

The table lists possible wavelengths of four different electromagnetic waves.

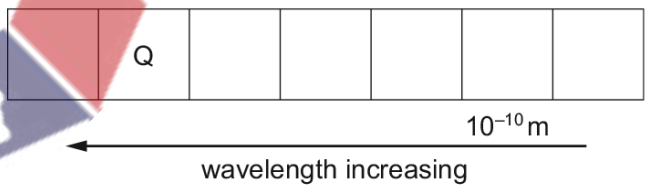
Which row is correct?

	type of wave	approximate wavelength / m
A	infrared	10^{-5}
B	radio	10^{-3}
C	ultraviolet	10^{-12}
D	X-rays	10^{-7}

---

854. 9702_m19_qp_12 Q: 26

The diagram shows the principal regions of the electromagnetic spectrum, with some details labelled. The diagram is not to scale.



What is a typical order of magnitude of the wavelength of the radiation in region Q?

A 10^{-7} m **B** 10^{-5} m **C** 10^{-2} m **D** 10^{0} m

---

855. 9702_s19_qp_12 Q: 27

The electromagnetic spectrum consists of waves with different wavelengths.

Which row correctly identifies regions of the electromagnetic spectrum?

	10^{-10} m	10^{-8} m	10^{-5} m	10^{-2} m
A	microwaves	X-rays	ultraviolet	infrared
B	infrared	microwaves	X-rays	ultraviolet
C	microwaves	infrared	ultraviolet	X-rays
D	X-rays	ultraviolet	infrared	microwaves

---

856. 9702_s19_qp_13 Q: 25

Infrared laser light is used for the transmission of data along optic fibres.

What is a typical wavelength of infrared radiation?

A 5×10^{-5} m **B** 5×10^{-7} m **C** 2×10^{-9} m **D** 2×10^{-11} m

---

857. 9702_w19_qp_11 Q: 25

An electromagnetic wave has a wavelength of 138 pm in a vacuum.

To which region of the electromagnetic spectrum does this wave belong?

A radio wave

B microwave

C visible light

D X-ray

---

858. 9702_w19_qp_12 Q: 24

Two electromagnetic waves have wavelengths of 5.0×10^{-7} m and 5.0×10^{-2} m.

Which row identifies the regions of the electromagnetic spectrum to which the waves belong?

	wavelength 5.0×10^{-7} m	wavelength 5.0×10^{-2} m
A	ultraviolet	infrared
B	visible	microwave
C	ultraviolet	microwave
D	visible	infrared

---

859. 9702_m18_qp_12 Q: 23

The table lists possible orders of magnitude of the wavelengths of some of the principal radiations of the electromagnetic spectrum.

Which row shows the correct orders of magnitude of the wavelengths?

	wavelength / m			
	microwaves	infra-red	ultraviolet	X-rays
A	10^{-6}	10^{-10}	10^{-12}	10^{-14}
B	10^{-4}	10^{-8}	10^{-10}	10^{-12}
C	10^{-2}	10^{-6}	10^{-8}	10^{-10}
D	10^{2}	10^{-4}	10^{-6}	10^{-8}

---

860. 9702_s18_qp_11 Q: 21

Which region of the electromagnetic spectrum includes waves with a frequency of 10^7 MHz?

A infra-red waves

B radio waves

C ultraviolet waves

D X-rays

---

861. 9702_s18_qp_11 Q: 23

What can be deduced from a table of wavelengths of the waves in the electromagnetic spectrum?

A Green light has a shorter wavelength than X-rays.

B Red light has a shorter wavelength than green light.

C The wavelength range for radio waves is less than that for infra-red waves.

D The wavelength range for X-rays is less than that for radio waves.

---

862. 9702_s18_qp_12 Q: 22

Two lasers emit light in a vacuum. One laser emits red light and the other emits green light.

Which property of the two laser beams **must** be different?

A amplitude

B frequency

C intensity

D speed

---

863. 9702_w18_qp_11 Q: 25

A telescope detects and analyses some electromagnetic radiation of wavelength 2 cm.

Which type of telescope is it?

A microwave telescope

B optical telescope

C radio telescope

D X-ray telescope

---

864. 9702_w18_qp_12 Q: 26

A surveyor's device emits a pulse of light. The light is reflected from a wall 150 m away.

What is the time taken for the pulse to travel from the device to the wall and then back to the device?

A 0.05 ns **B** 0.10 ns **C** 0.50 μs **D** 1.0 μs

---

865. 9702_w18_qp_13 Q: 25

An electromagnetic wave has a wavelength of 1.0×10^{-7} m.

To which region of the electromagnetic spectrum does this wave belong?

A infra-red

B ultraviolet

C visible

D X-ray

---

866. 9702_m17_qp_12 Q: 26

M and N are two electromagnetic waves.

The ratio

$$\frac{\text{wavelength of M}}{\text{wavelength of N}} = 10^5.$$

What could M and N be?

	M	N
A	microwaves	visible light
B	microwaves	γ-rays
C	γ-rays	microwaves
D	visible light	microwaves

---

867. 9702_s17_qp_11 Q: 26

Which list shows electromagnetic waves in order of increasing frequency?

A radio waves → gamma rays → ultraviolet → infra-red

B radio waves → infra-red → ultraviolet → gamma rays

C ultraviolet → gamma rays → radio waves → infra-red

D ultraviolet → infra-red → radio waves → gamma rays

---

868. 9702_s17_qp_12 Q: 26

Three different electromagnetic waves P, Q and R have the frequencies shown.

	frequency / Hz
P	3×10^{10}
Q	3×10^{13}
R	6×10^{14}

Which row identifies P, Q and R?

	P	Q	R
A	infra-red	visible	ultraviolet
B	microwave	infra-red	visible
C	ultraviolet	X-ray	gamma ray
D	visible	ultraviolet	X-ray

---

869. 9702_s17_qp_13 Q: 25

Which row shows a correct frequency in Hz for each of the four principal radiations?

	X-rays	ultraviolet	microwaves	infra-red
A	10^{10}	10^{14}	10^{18}	10^{15}
B	10^{14}	10^{18}	10^{15}	10^{10}
C	10^{15}	10^{10}	10^{14}	10^{18}
D	10^{18}	10^{15}	10^{10}	10^{14}

---

870. 9702_w17_qp_11 Q: 4

What is a typical value of the wavelength of a microwave travelling in a vacuum?

A 3 000 000 pm

B 30 nm

C 30 000 μm

D 3000 mm

---

871. 9702_w17_qp_11 Q: 26

What is the order of magnitude of the frequencies of electromagnetic waves in the visible spectrum?

A 10^{10} Hz **B** 10^{12} Hz **C** 10^{14} Hz **D** 10^{16} Hz

---

872. 9702_w17_qp_12 Q: 26

Orange light in a vacuum has a wavelength of 600 nm.

What is the frequency of this light?

A 180 Hz **B** 5.0×10^{5} Hz **C** 1.8×10^{11} Hz **D** 5.0×10^{14} Hz

---

873. 9702_w17_qp_13 Q: 27

Which frequency of electromagnetic radiation could be ultraviolet?

A 1.0×10^{6} Hz

B 1.0×10^{9} Hz

C 1.0×10^{12} Hz

D 1.0×10^{15} Hz

---

874. 9702_w17_qp_13 Q: 28

An electromagnetic wave travels in a straight line through a vacuum. The wave has a frequency of 6.0 THz.

What is the number of wavelengths in a distance of 1.0 m along the wave?

A 5.0×10^{-5} **B** 2.0×10^{1} **C** 2.0×10^{4} **D** 5.0×10^{7}

---

875. 9702_s16_qp_11 Q: 23

Which electromagnetic waves have the wavelengths of 10^{-2} m, 10^{-5} m, 10^{-10} m and 10^{-13} m?

	10^{-2} m	10^{-5} m	10^{-10} m	10^{-13} m
A	infra-red	microwaves	visible light	X-rays
B	microwaves	infra-red	X-rays	gamma rays
C	microwaves	visible light	ultraviolet	gamma rays
D	radio waves	microwaves	ultraviolet	X-rays

---

876. 9702_s16_qp_12 Q: 24

Each of the principal radiations of the electromagnetic spectrum has a range of wavelengths.

Which wavelength is correctly linked to its radiation?

	wavelength / m	radiation
A	10^{-9}	gamma ray
B	10^{-5}	microwave
C	10^{-8}	ultraviolet
D	10^{-14}	X-ray

---

877. 9702_w16_qp_11 Q: 23

The table shows the wavelengths of five electromagnetic waves.

Which row correctly identifies the principal radiation for each of these wavelengths?

	10^{-14} m	10^{-10} m	10^{-6} m	10^{-2} m	10^{2} m
A	gamma ray	X-ray	infra-red	microwave	radio wave
B	radio wave	microwave	infra-red	X-ray	gamma ray
C	radio wave	microwave	ultraviolet	infra-red	X-ray
D	X-ray	infra-red	ultraviolet	microwave	radio wave

---

878. 9702_w16_qp_13 Q: 23

The table shows the wavelengths of five electromagnetic waves.

Which row correctly identifies the principal radiation for each of these wavelengths?

	10^{-14} m	10^{-10} m	10^{-6} m	10^{-2} m	10^{2} m
A	gamma ray	X-ray	infra-red	microwave	radio wave
B	radio wave	microwave	infra-red	X-ray	gamma ray
C	radio wave	microwave	ultraviolet	infra-red	X-ray
D	X-ray	infra-red	ultraviolet	microwave	radio wave

---

879. 9702_s15_qp_11 Q: 27

An electromagnetic wave has a wavelength that is numerically of the same order of magnitude as the diameter of a nucleus.

In which region of the electromagnetic spectrum does the wave occur?

A gamma ray

B X-ray

C visible light

D infra-red
