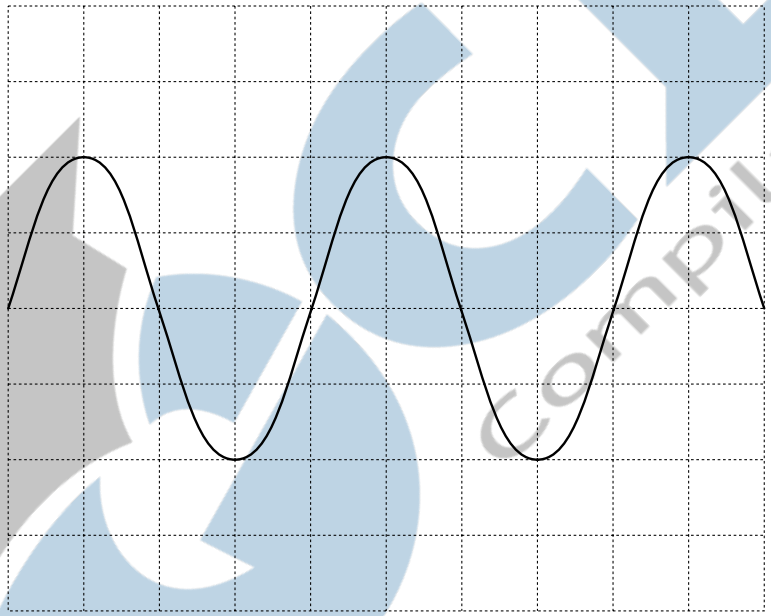
Waves

1 Which of the following summarises the change in wave characteristics on going from infra-red to ultraviolet in the electromagnetic spectrum?

	frequency	speed (in a vacuum)
A	decreases	decreases
B	decreases	remains constant
C	increases	remains constant
D	increases	increases

2 The diagram shows a cathode-ray oscilloscope trace of a sound wave. The time-base is calibrated at 2.0 ms cm^{-1}.



What is the frequency of the sound wave?

A 62.5 Hz **B** 125 Hz **C** 250 Hz **D** 500 Hz

3 Which statement correctly relates the intensity of a sound wave to the vibrations of the molecules?

A intensity α amplitude

B intensity α (amplitude)^2

C intensity α displacement

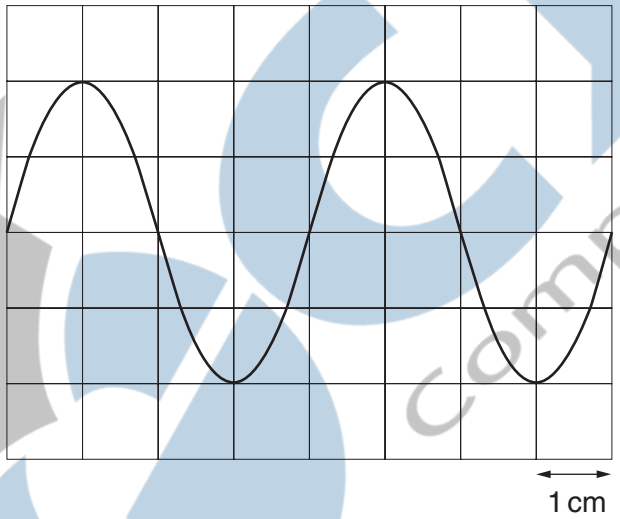
D intensity α (displacement)^2

4 Electromagnetic waves of wavelength λ and frequency f travel at speed c in a vacuum.

Which of the following describes the wavelength and speed of electromagnetic waves of frequency $f/2$?

	wavelength	speed in a vacuum
A	$\lambda/2$	$c/2$
B	$\lambda/2$	c
C	2λ	c
D	2λ	$2c$

5 A sound wave is displayed on the screen of a cathode-ray oscilloscope. The time base of the c.r.o. is set at 2.5 ms / cm.



What is the frequency of the sound wave?

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

6 When the light from two lamps falls on a screen, no interference pattern can be obtained.

Why is this?

A The lamps are not point sources.

B The lamps emit light of different amplitudes.

C The light from the lamps is not coherent.

D The light from the lamps is white.

7 Which of the following is true for all transverse waves?

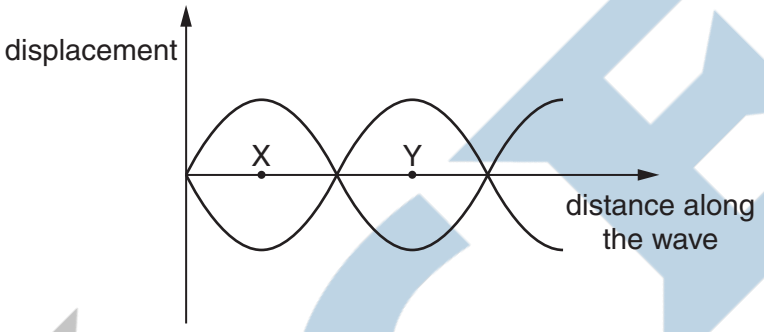
A They are all electromagnetic.

B They can all be polarised.

C They can all travel through a vacuum.

D They all involve the oscillation of atoms.

8 The graph represents a stationary wave at two different times.



What does the distance XY represent?

A half the amplitude

B half the frequency

C half the period

D half the wavelength

9 Which observation indicates that sound waves are longitudinal?

A Sound can be reflected from a solid surface.

B Sound cannot be polarised.

C Sound is diffracted around corners.

D Sound is refracted as it passes from hot air to cold air.

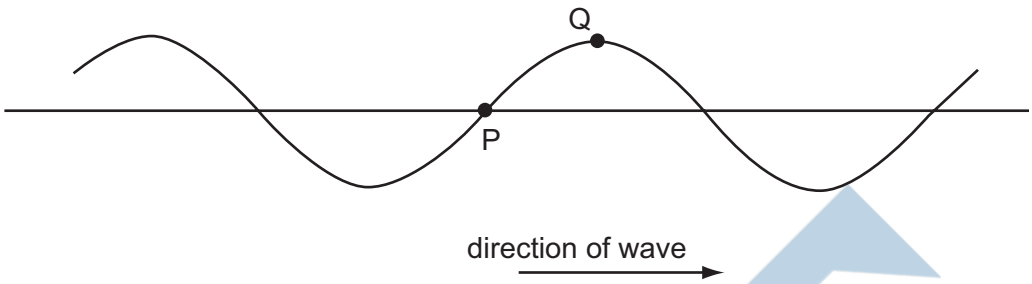
10 A health inspector is measuring the intensity of a sound. Near a loudspeaker his meter records an intensity I. This corresponds to an amplitude A of the sound wave. At another position the meter gives an intensity reading of $2I$.

What is the corresponding sound wave amplitude?

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

11 The diagram shows a transverse wave on a rope. The wave is travelling from left to right.

At the instant shown, the points P and Q on the rope have zero displacement and maximum displacement respectively.



Which of the following describes the direction of motion, if any, of the points P and Q at this instant?

	point P	point Q
A	downwards	stationary
B	stationary	downwards
C	stationary	upwards
D	upwards	stationary

12 A plane wave of amplitude A is incident on a surface of area S placed so that it is perpendicular to the direction of travel of the wave. The energy per unit time reaching the surface is E.

The amplitude of the wave is increased to $2A$ and the area of the surface is reduced to $\frac{1}{2}S$.

How much energy per unit time reaches this smaller surface?

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

13 What is the approximate range of frequencies of infra-red radiation?

A 1×10^3 Hz to 1×10^9 Hz

B 1×10^9 Hz to 1×10^{11} Hz

C 1×10^{11} Hz to 1×10^{14} Hz

D 1×10^{14} Hz to 1×10^{17} Hz

14 A sound wave is set up in a long tube, closed at one end. The length of the tube is adjusted until the sound from the tube is loudest.

What is the nature of the sound wave in the tube?

A longitudinal and progressive

B longitudinal and stationary

C transverse and progressive

D transverse and stationary

15 What do **not** travel at the speed of light in a vacuum?

A electrons

B microwaves

C radio waves

D X-rays

16 The number of wavelengths of visible light in one metre is of the order of

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

17 Where, in a standing wave, do the vibrations of the medium occur?

A only at the nodes

B only at the antinodes

C at all points between the nodes

D at all points between the antinodes

18 Sound waves, emitted by a small loudspeaker, are reflected by a wall.

The frequency f of the waves is adjusted until a stationary wave is formed with the antinode nearest the wall at a distance x from the wall.

Which expression gives f in terms of x and the speed of sound c?

A $f = \frac{4c}{x}$ **B** $f = \frac{2c}{x}$ **C** $f = \frac{c}{2x}$ **D** $f = \frac{c}{4x}$

19 Which phenomenon is associated with transverse waves but **not** longitudinal waves?

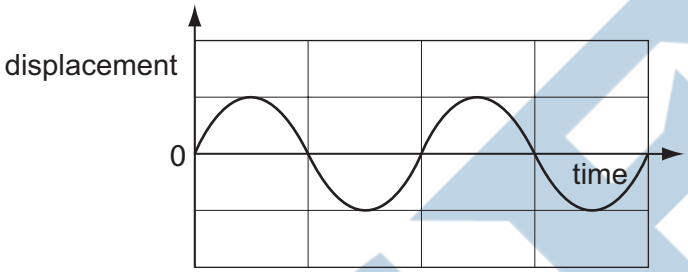
A polarisation

B reflection

C refraction

D superposition

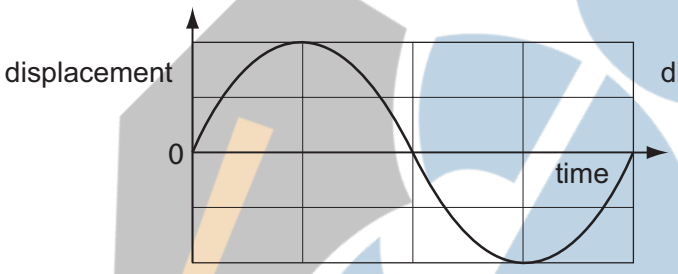
20 A displacement-time graph is shown for a particular wave.



A second wave of similar type has twice the intensity and half the frequency.

When drawn on the same axes, what would the second wave look like?

A



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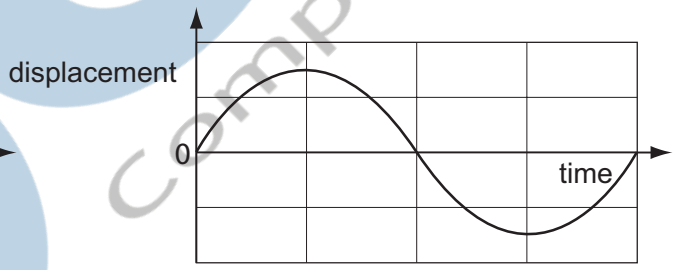

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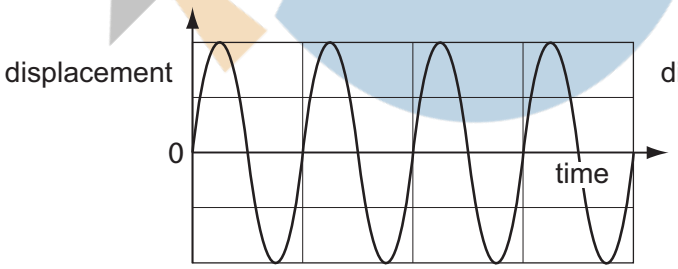
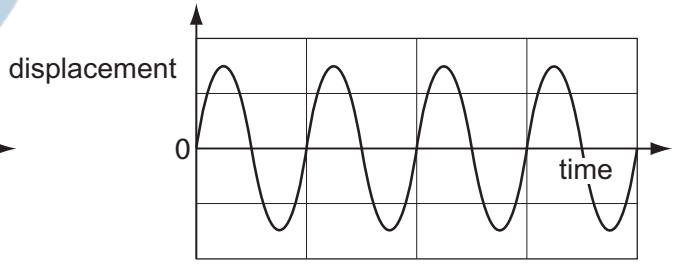


D



21 The frequency of a certain wave is 500 Hz and its speed is 340 $m\,s^{-1}$.

What is the phase difference between the motions of two points on the wave 0.17 m apart?

A $\frac{\pi}{4}$ rad **B** $\frac{\pi}{2}$ rad **C** $\frac{3\pi}{4}$ rad **D** π rad

22 Which of the following types of wave can be polarised?

A a longitudinal progressive wave

B a longitudinal stationary wave

C a transverse stationary wave

D a transverse sound wave

23 Sound wave X has intensity 10^{12} times greater than that of sound wave Y.

By how much is the amplitude of X greater than the amplitude of Y?

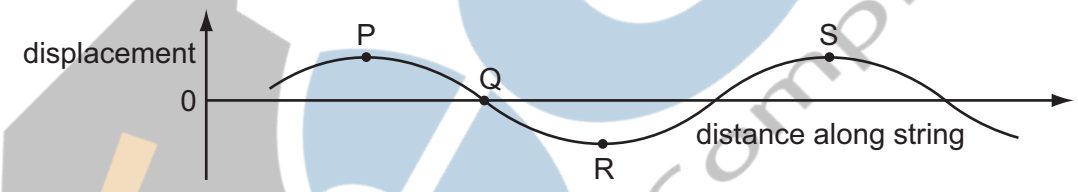
A 10^{6} times

B 3.16×10^{6} times

C 5×10^{11} times

D 10^{12} times

24 The graph shows the shape at a particular instant of part of a transverse wave travelling along a string.



Which statement about the motion of points in the string is correct?

A The speed at point P is a maximum.

B The displacement at point Q is always zero.

C The energy at point R is entirely kinetic.

D The acceleration at point S is a maximum.

25 Polarisation is a phenomenon associated with a certain type of wave.

Which condition **must** be fulfilled if a wave is to be polarised?

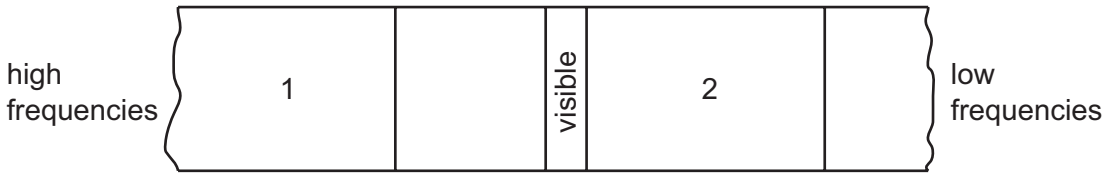
A It must be a light wave.

B It must be a longitudinal wave.

C It must be a radio wave.

D It must be a transverse wave.

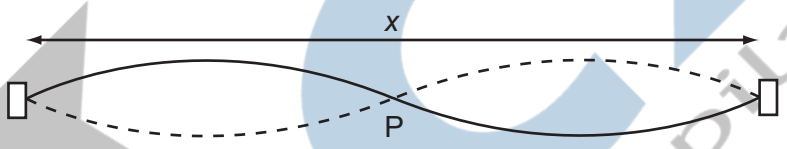
26 The diagram illustrates part of the electromagnetic spectrum.



Which labels are correct for the regions marked 1 and 2?

	1	2
A	infrared	X-rays
B	microwaves	X-rays
C	ultraviolet	microwaves
D	X-rays	infrared

27 The diagram represents a stationary wave on a stretched string.



What is represented by point P and by the length *x*?

	point P	length *x*
A	antinode	one wavelength
B	antinode	two wavelengths
C	node	one wavelength
D	node	two wavelengths

28 A wave motion is described by the oscillation of particles.

What is the name given to the number of complete oscillations of a particle in one second?

A amplitude

B frequency

C wavelength

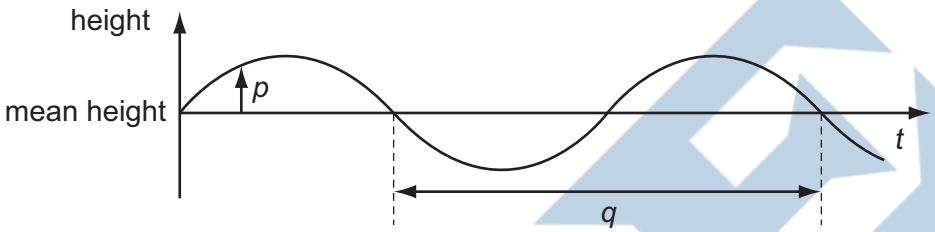
D wave speed

29 A wave of amplitude a has an intensity of $3.0\,\text{W m}^{-2}$.

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

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

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

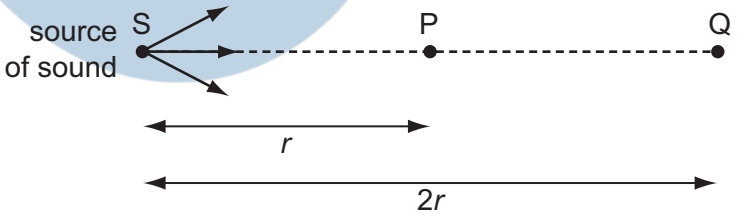


What are p and q?

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

31 The intensity I of a sound at a point P is inversely proportional to the square of the distance x of P from the source of the sound. That is

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



Air molecules at P, a distance r from S, oscillate with amplitude $8.0\,\mu\text{m}$.

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

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

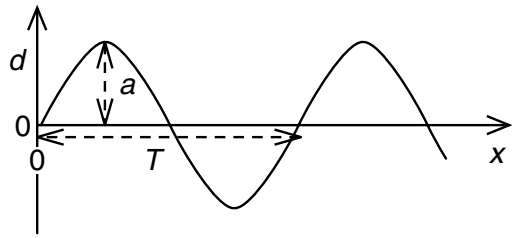
A $1.4\,\mu\text{m}$ **B** $2.0\,\mu\text{m}$ **C** $2.8\,\mu\text{m}$ **D** $4.0\,\mu\text{m}$

32 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*.

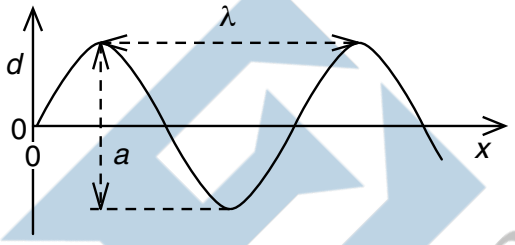
The labels on the graphs are intended to show the wavelength λ, the period *T*, and the amplitude *a* of the wave, but only one graph is correctly labelled.

Which graph is correctly labelled?

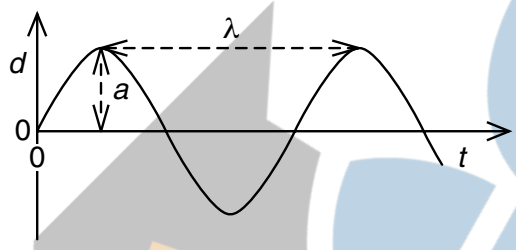
A



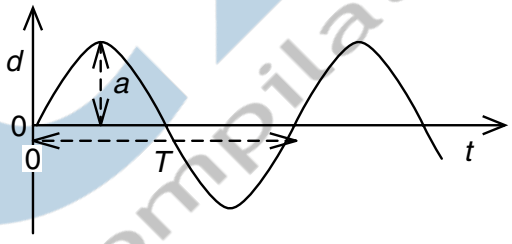
B



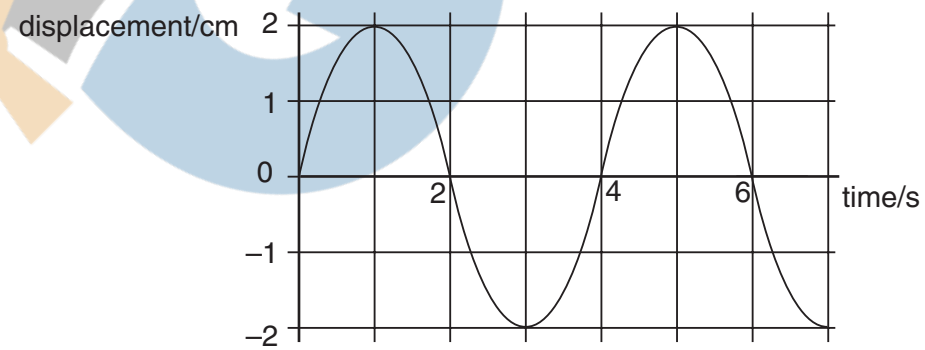
C



D



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



Which of the following is correct?

A The wave has an amplitude of 2 cm and could be either transverse or longitudinal.

B The wave has an amplitude of 2 cm and must be transverse.

C The wave has an amplitude of 4 cm and could be either transverse or longitudinal.

D The wave has an amplitude of 4 cm and must be transverse.

34 A stationary sound wave has a series of nodes. The distance between the first and the sixth node is 30.0 cm.

What is the wavelength of the sound wave?

A 5.0 cm **B** 6.0 cm **C** 10.0 cm **D** 12.0 cm

35 Which of the following applies to a progressive transverse wave?

	transfers energy	can be polarised
A	no	no
B	no	yes
C	yes	no
D	yes	yes

36 Which of the following may be used to produce stationary waves?

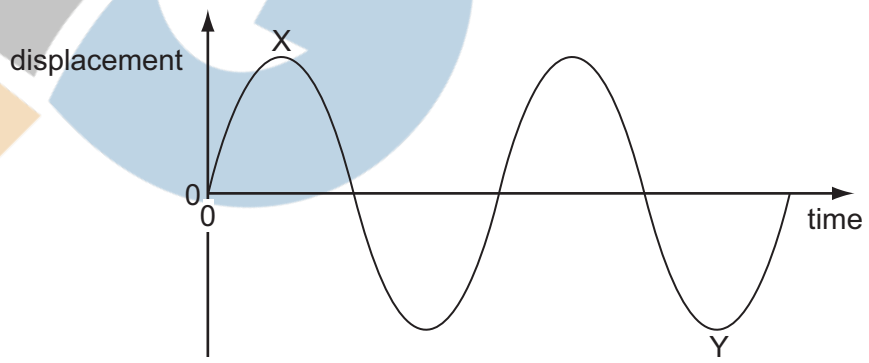
A blowing air over the top of an empty bottle

B making a loud sound near a mountain

C passing monochromatic light through a double slit

D passing water waves through a narrow slit

37 A displacement-time graph for a transverse wave is shown in the diagram.

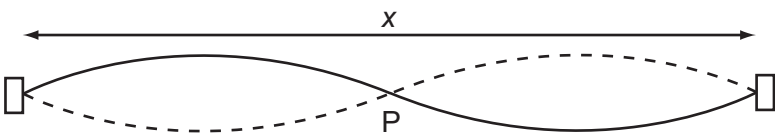


The phase difference between X and Y can be expressed as $n\pi$.

What is the value of n?

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

38 The diagram represents a stationary wave on a stretched string.



What is represented by point P and by the length *x*?

	point P	length *x*
A	antinode	one wavelength
B	antinode	two wavelengths
C	node	one wavelength
D	node	two wavelengths

39 Which of the following 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

40 A stationary sound wave is set up along the line joining two loudspeakers.

Which measurement is sufficient on its own to enable you to deduce the wavelength of the wave?

A the amplitude of the sound wave

B the distance between the two loudspeakers

C the distance between two adjacent antinodes

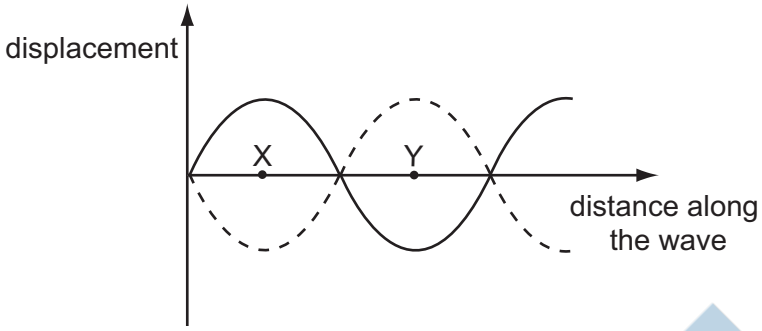
D the frequency of the sound wave

41 A wave of amplitude 20 mm has intensity I_X. Another wave of the same frequency but of amplitude 5 mm has intensity I_Y.

What is $\frac{I_X}{I_Y}$?

A 2 **B** 4 **C** 16 **D** 256

42 The graph represents a standing wave at two different times.



What does the distance XY represent?

A half the amplitude

B half the frequency

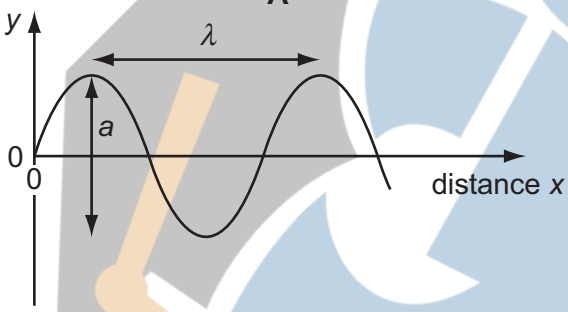
C half the period

D half the wavelength

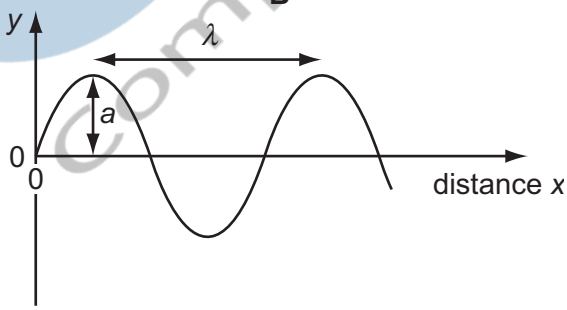
43 A sound wave has displacement *y* at distance *x* from its source at time *t*.

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

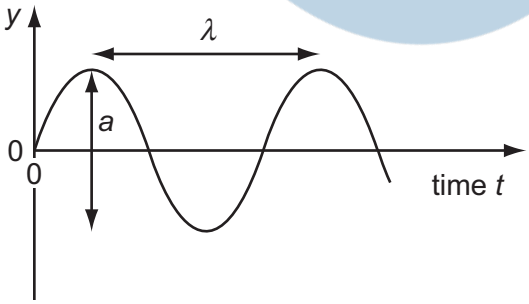
A



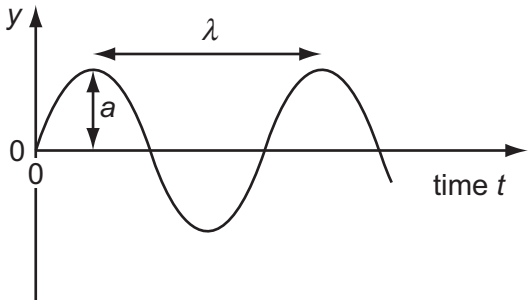
B



C

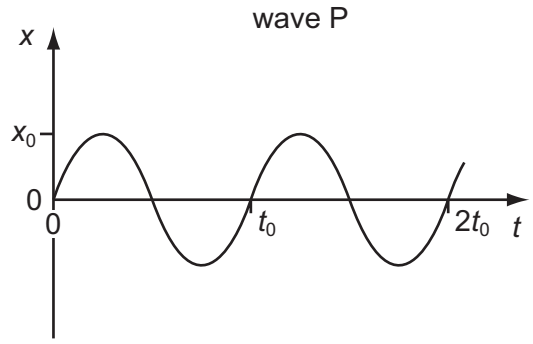


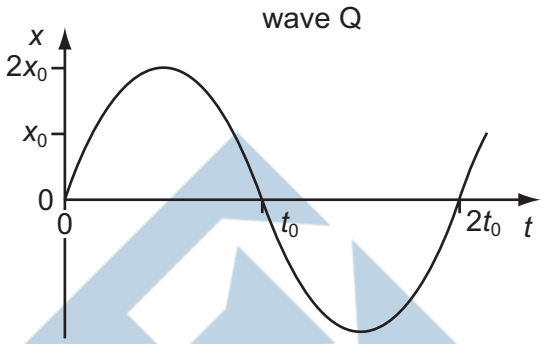
D



44 The intensity of a progressive wave is proportional to the square of the amplitude of the wave. It is also proportional to the square of the frequency.

The variation with time t of displacement x of particles in a medium, when two progressive waves P and Q pass separately through the medium, are shown on the graphs.





The intensity of wave P is I_0.

What is the intensity of wave Q?

A $\frac{1}{2}I_0$ **B** I_0 **C** $8I_0$ **D** $16I_0$

45 A sound wave of frequency 150 Hz travels in water at a speed of 1500 m s^{-1}. It then travels through the surface of the water and into air, where its speed is 300 m s^{-1}.

Which line in the table gives the correct values for the wavelengths of the sound in water and in air?

	wavelength in water / m	wavelength in air / m
A	0.10	0.10
B	0.10	0.50
C	10	2.0
D	10	50

46 An electromagnetic wave has a frequency of 10^8 Hz.

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

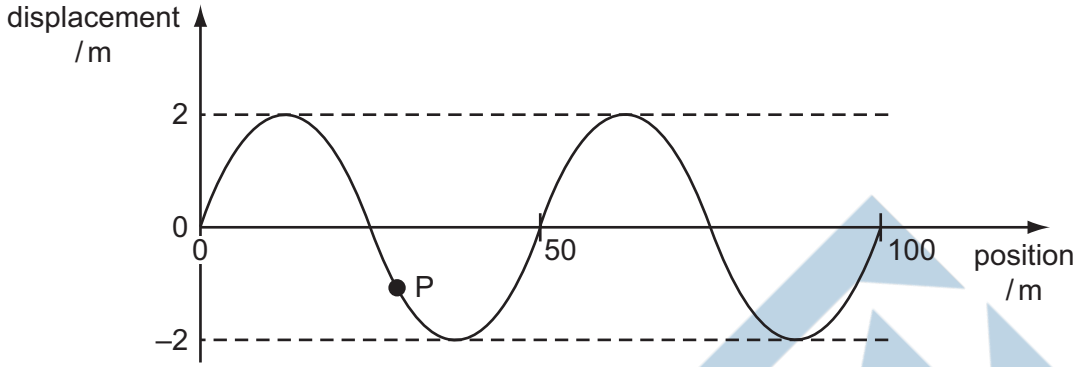
A infra-red

B radio

C ultraviolet

D visible

47 The graph represents a sinusoidal wave in the sea, travelling at a speed of 8.0 m s^{-1}, at one instant of time. The maximum speed of the oscillating particles in the wave is $2\pi af$, where a is the amplitude and f is the frequency.



An object P of mass 2.0×10^{-3} kg floats on the surface.

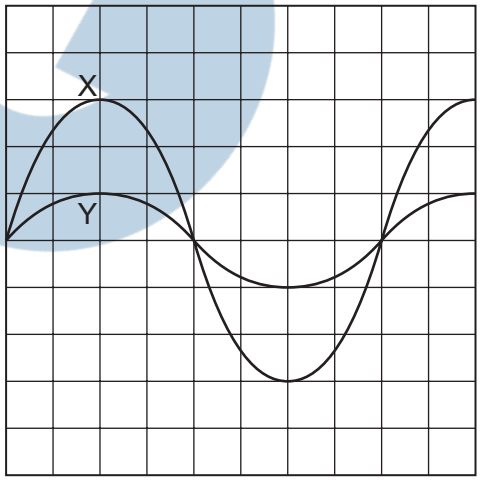
What is the maximum kinetic energy of P due to the wave? Assume that its motion is vertical.

A 0.026 mJ **B** 4.0 mJ **C** 39 mJ **D** 64 mJ

48 Which value is a possible wavelength for radiation in the microwave region of the electromagnetic spectrum?

A 3×10^{-2} m **B** 3×10^{-5} m **C** 3×10^{-8} m **D** 3×10^{-10} m

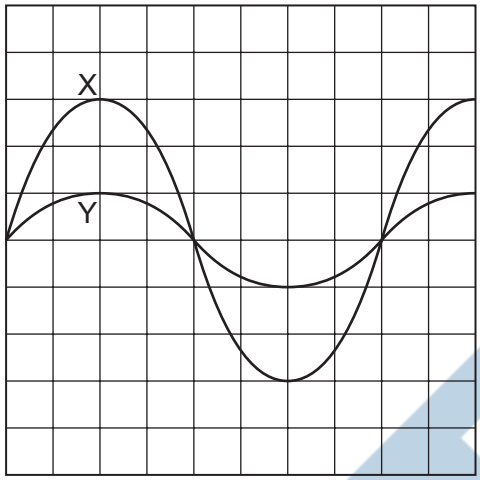
49 The diagram represents the screen of a cathode-ray oscilloscope displaying two sound waves labelled X and Y.



What is the ratio $\frac{\text{intensity of sound wave X}}{\text{intensity of sound wave Y}}$?

A $\frac{9}{1}$ **B** $\frac{3}{1}$ **C** $\frac{\sqrt{3}}{1}$ **D** $\frac{1}{1}$

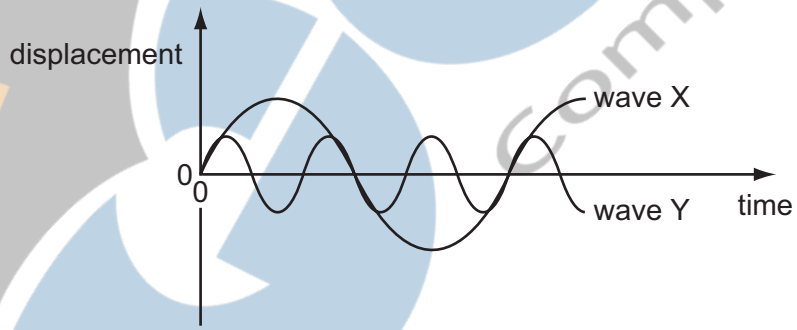
50 The diagram represents the screen of a cathode-ray oscilloscope displaying two sound waves labelled X and Y.



What is the ratio $\frac{\text{intensity of sound wave X}}{\text{intensity of sound wave Y}}$?

A $\frac{9}{1}$ **B** $\frac{3}{1}$ **C** $\frac{\sqrt{3}}{1}$ **D** $\frac{1}{1}$

51 The diagram shows two waves X and Y.



Wave X has amplitude 8 cm and frequency 100 Hz.

What are the amplitude and frequency of wave Y?

	amplitude / cm	frequency / Hz
A	2	33
B	2	300
C	4	33
D	4	300

47 Light can exhibit all of the properties listed.

Which property can sound **not** exhibit?

A interference

B polarisation

C refraction

D total internal reflection

48 What is the relationship between the intensity I and the amplitude a of a wave?

A $\frac{I}{a}$ = constant

B $\frac{I}{a^2}$ = constant

C Ia = constant

D Ia^2 = constant