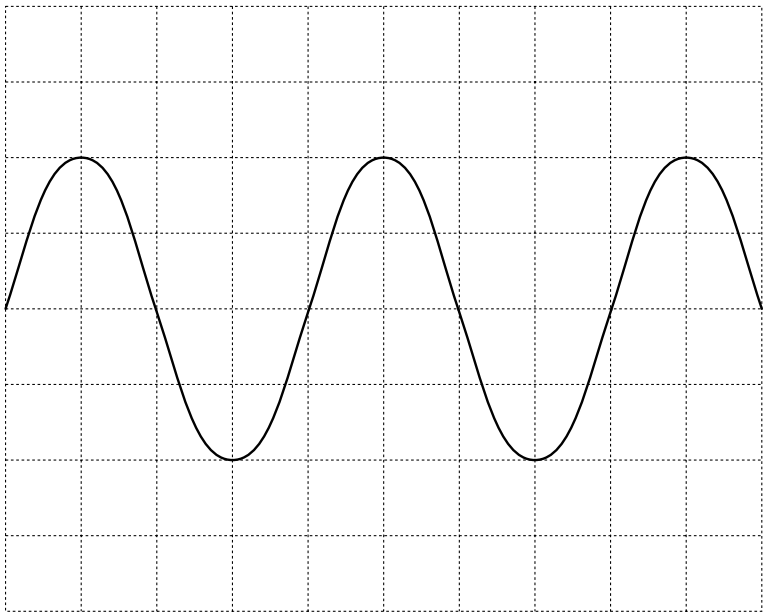
1 Which of the following summarises the change in wave characteristics on going from infra-red to ultraviolet in the electromagnetic spectrum?

9702/1/M/J/02

	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}.

9702/1/M/J/02



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?

9702/1/M/J/02

A intensity $\propto$ amplitude

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

C intensity $\propto$ displacement

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

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

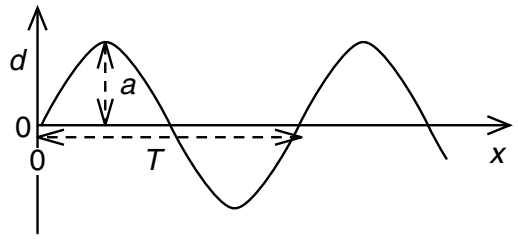
9702/1/O/N/02

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

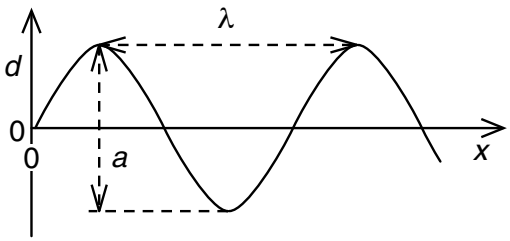
5 The four graphs represent a progressive wave on a stretched string. Graphs **A** and **B** show how the displacement *d* varies with distance *x* along the string at one instant. Graphs **C** and **D** show how the displacement *d* varies with time *t* at a particular value of *x*. 9702/1/O/N/02

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?

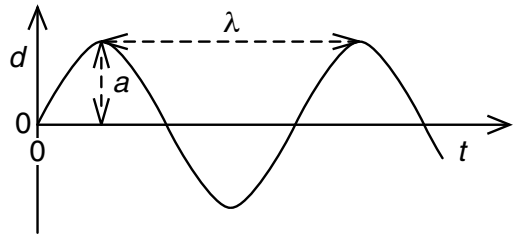
A



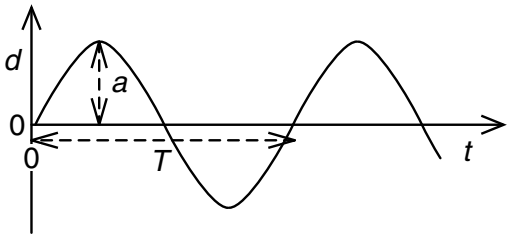
B



C



D



6 A wave of amplitude *a* has an intensity of $3.0\,\mathrm{W m^{-2}}$. 9702/1/O/N/02

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

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

7 Which of the following is true for all transverse waves? 9702/01/M/J/03

A They are all electromagnetic.

B They can all be polarised.

C They can all travel through a vacuum.

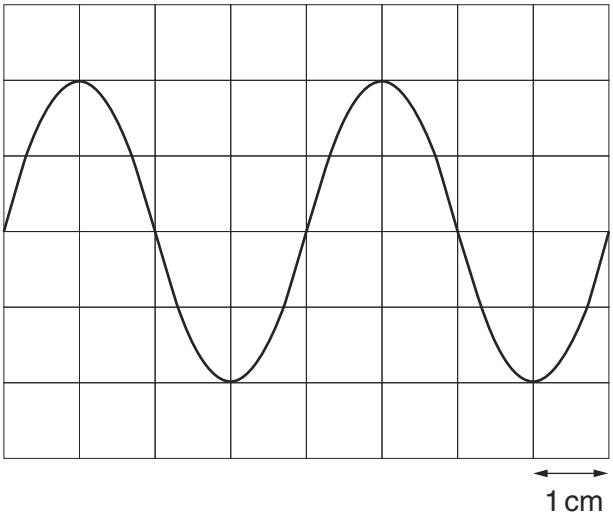
D They all involve the oscillation of atoms.

8 Electromagnetic waves of wavelength λ and frequency *f* travel at speed *c* in a vacuum. 9702/01/M/J/03

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	$2c$

9 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. 9702/01/M/J/03



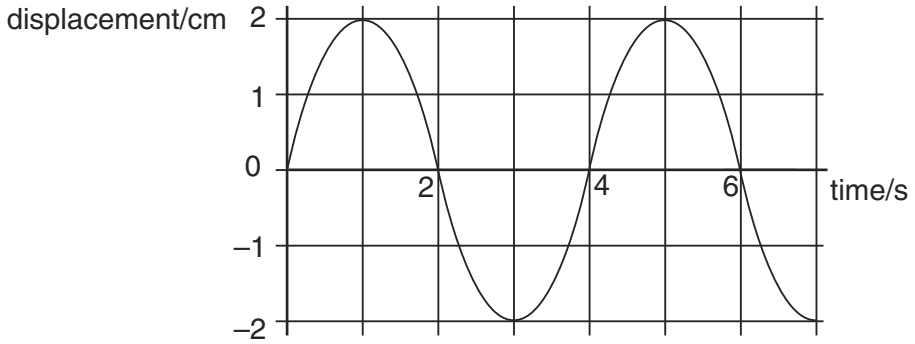
What is the frequency of the sound wave?

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

10 In which order of magnitude are the frequencies of electromagnetic waves in the visible spectrum? 9702/12/M/J/11

A 10^{12} Hz **B** 10^{13} Hz **C** 10^{14} Hz **D** 10^{15} Hz

11 The graph shows how the displacement of a particle in a wave varies with time. 9702/01/O/N/03



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.

12 Which of the following applies to a progressive transverse wave? 9702/01/O/N/03

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

13 Which observation indicates that sound waves are longitudinal? 9702/01/M/J/04

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.

14 Electromagnetic waves from an unknown source in space were found to be significantly diffracted when passing through gaps of the order of 10^{-5} m. 9702/12/M/J/10

Which type of wave are they most likely to be?

A radio waves

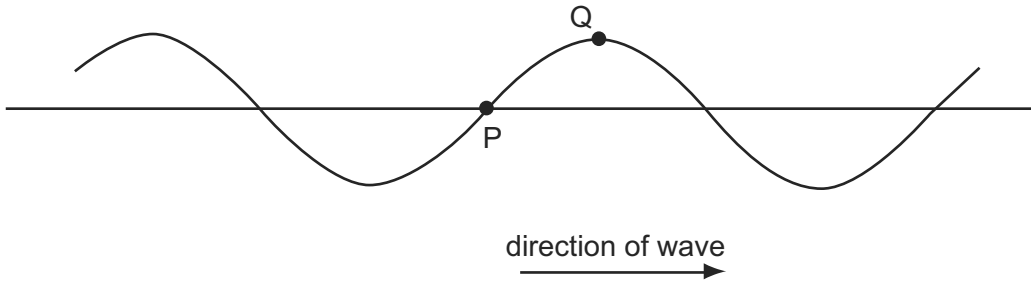
B microwaves

C infra-red waves

D ultraviolet waves

15 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. 9702/01/M/J/04



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

16 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? 9702/01/M/J/04

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

17 What is the approximate range of frequencies of infra-red radiation? 9702/01/M/J/04

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

18 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. 9702/01/O/N/04

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

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

19 Which of the following is a longitudinal wave? 9702/01/O/N/04

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

20 What do **not** travel at the speed of light in a vacuum? 9702/01/M/J/05

A electrons

B microwaves

C radio waves

D X-rays

21 The number of wavelengths of visible light in one metre is of the order of 9702/01/M/J/05

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

22 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 $2I$. 9702/01/M/J/0

What is the corresponding sound wave amplitude?

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

23 The frequency of a certain wave is 500 Hz and its speed is 340 m s^{-1}. 9702/01/M/J/06

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

24 Polarisation is a phenomenon associated with a certain type of wave. 9702/01/O/N/0

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.

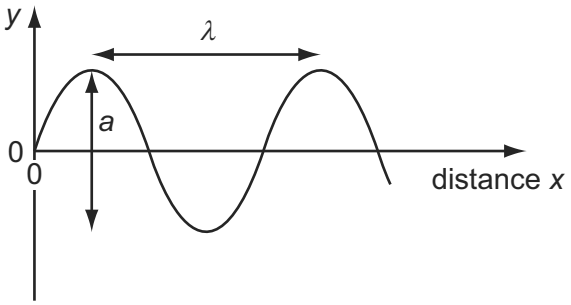
C It must be a radio wave.

D It must be a transverse wave.

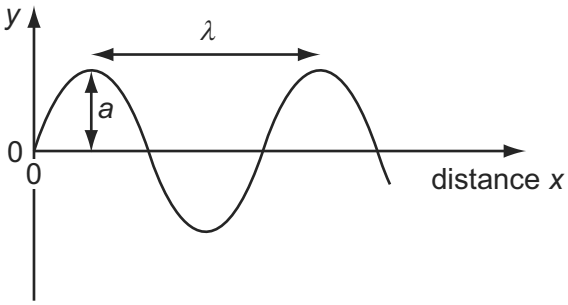
25 A sound wave has displacement *y* at distance *x* from its source at time *t*. 9702/13/M/J/13

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

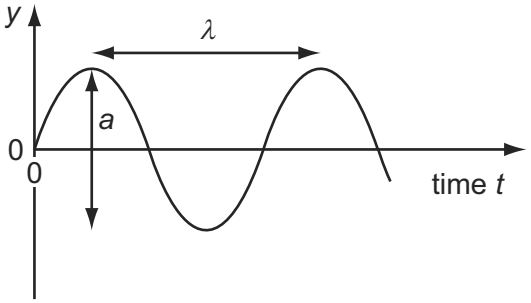
A



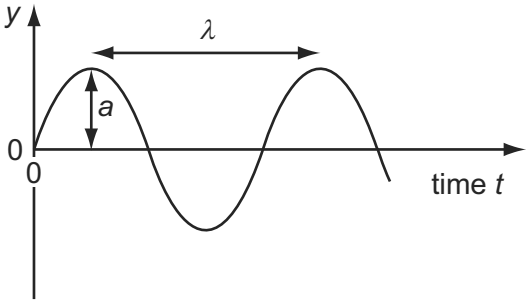
B



C



D



26 Which phenomenon is associated with transverse waves but **not** longitudinal waves? 9702/01/M/J/06

A polarisation

B reflection

C refraction

D superposition

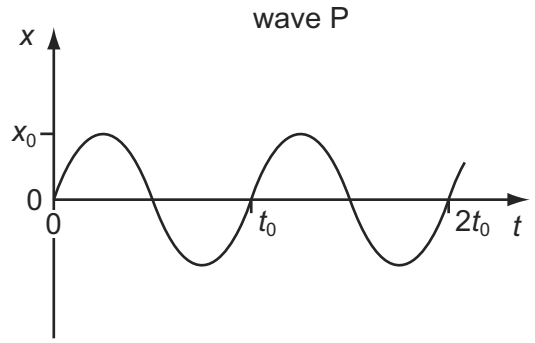
27 The order of magnitude of the frequency of the longest-wavelength ultraviolet waves can be expressed as 10^x Hz. 9702/11/O/N/09

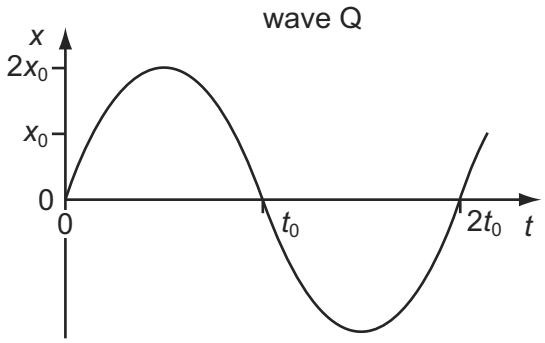
What is the value of *x*?

A 13 **B** 15 **C** 17 **D** 19

28 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. 9702/01/O/N/05

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** $16I_0$

29 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}. 9702/01/O/N/05

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

30 A wave motion is described by the oscillation of particles. 9702/01/O/N/06

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

A amplitude

B frequency

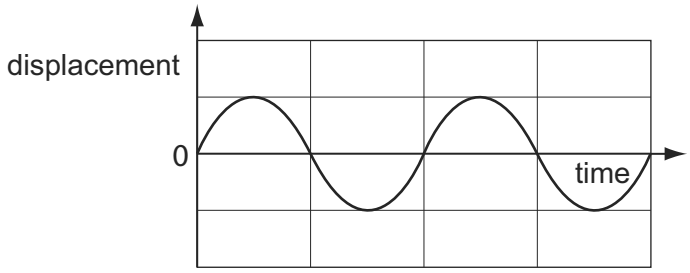
C wavelength

D wave speed

31 Orange light has a wavelength of 600 nm. What is the frequency of this light? 9702/13/M/J/13

A 180 GHz **B** 180 Hz **C** 500 THz **D** 500 kHz

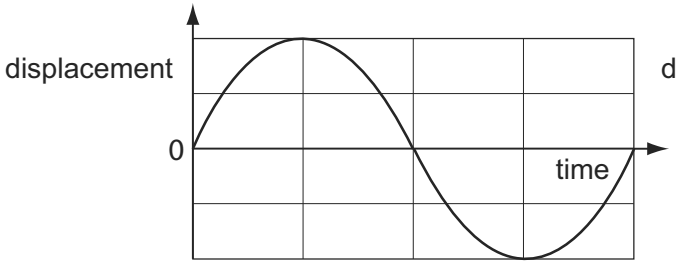
32 A displacement-time graph is shown for a particular wave. 9702/01/M/J/06



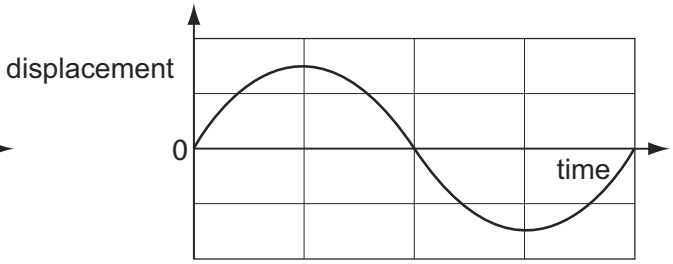
A second wave of similar type has twice the intensity and half the frequency.

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

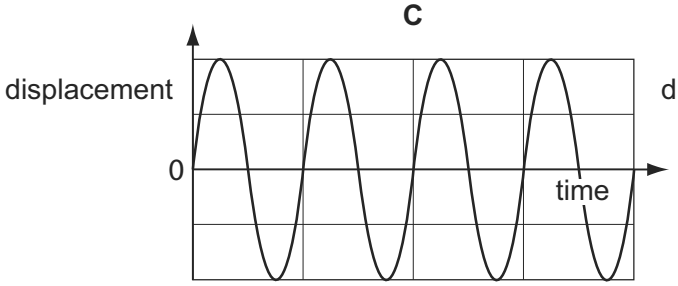
A



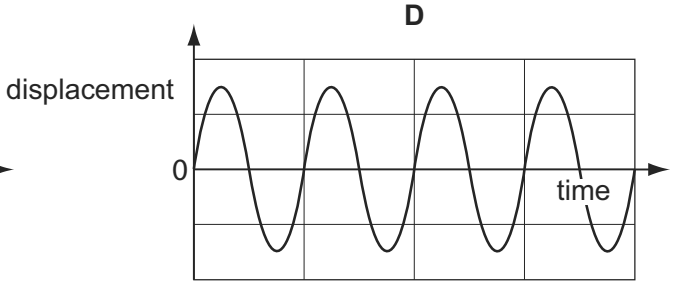
B



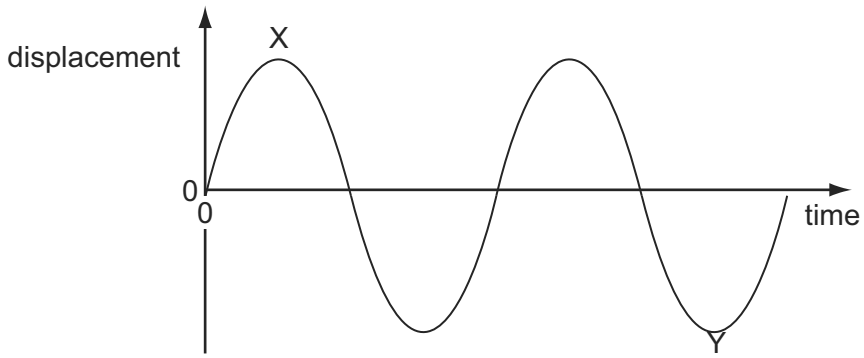
C



D



33 A displacement-time graph for a transverse wave is shown in the diagram. 9702/01/O/N/06



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

34 Sound wave X has intensity 10^{12} times greater than that of sound wave Y. 9702/01/M/J/07

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

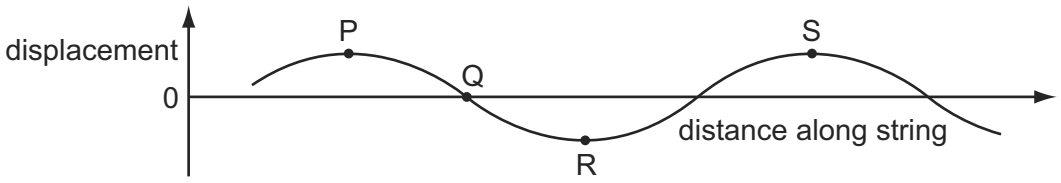
A 10^6 times

B 3.16×10^6 times

C 5×10^{11} times

D 10^{12} times

35 The graph shows the shape at a particular instant of part of a transverse wave travelling along a string. 9702/01/M/J/07



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.

36 The diagram illustrates part of the electromagnetic spectrum. 9702/01/M/J/07

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

37 What is the relationship between the intensity I and the amplitude a of a wave? 9702/01/O/N/07

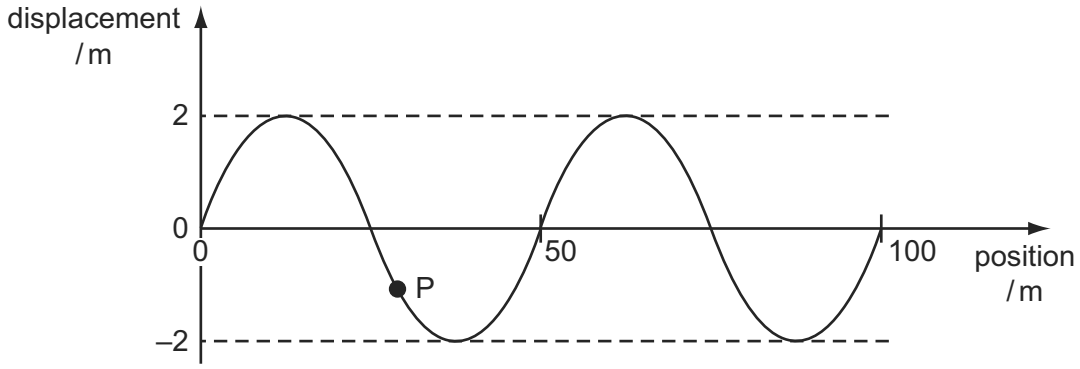
A $\frac{I}{a}$ = constant

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

C Ia = constant

D Ia^2 = constant

38 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. 9702/01/O/N/07



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

39 An electromagnetic wave has a frequency of 10^8 Hz. 9702/01/O/N/07

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

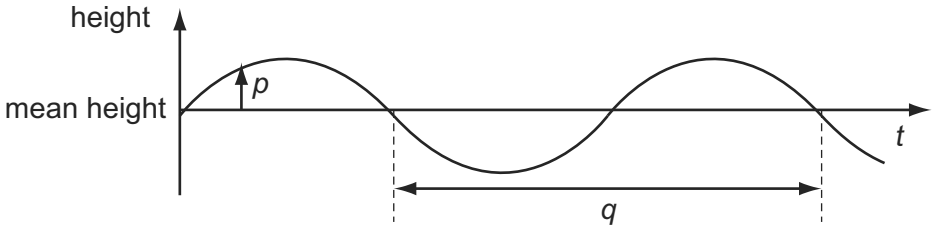
A infra-red

B radio

C ultraviolet

D visible

40 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. 9702/01/M/J/08

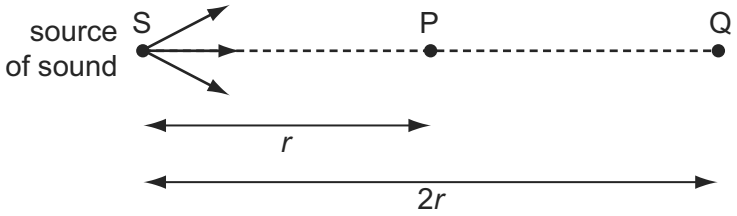


What are p and q?

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

41 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 9702/01/M/J/08

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



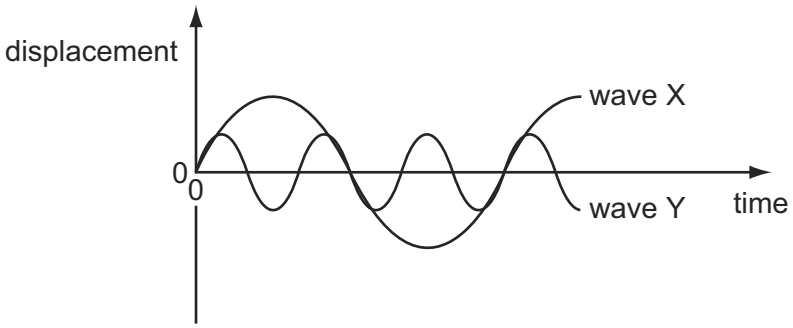
Air molecules at P, a distance r from S, oscillate with amplitude 8.0 μm.

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

42 The diagram shows two waves X and Y. 9702/01/O/N/08



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

43 Light can exhibit all of the properties listed. 9702/01/O/N/08

Which property can sound **not** exhibit?

A interference

B polarisation

C refraction

D total internal reflection

44 Which statement about sound waves in air at constant temperature is correct? 9702/11/M/J/11

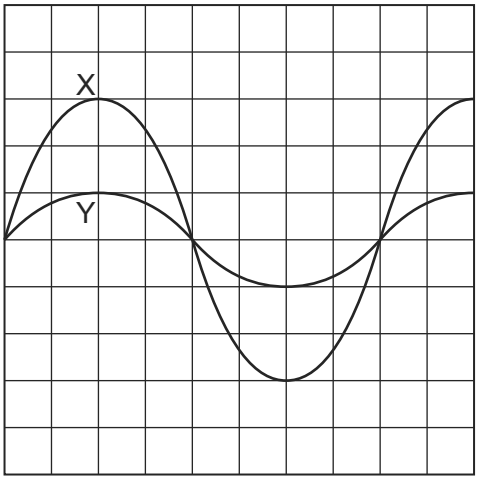
A Amplitude is inversely proportional to velocity.

B Frequency is inversely proportional to wavelength.

C Velocity is proportional to wavelength.

D Wavelength is proportional to amplitude.

45 The diagram represents the screen of a cathode-ray oscilloscope displaying two sound waves labelled X and Y. 9702/01/O/N/08



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** $\frac{1}{1}$

46 Which wave properties change when light passes from air into glass? 9702/01/M/J/09

A colour and speed

B frequency and wavelength

C speed and wavelength

D wavelength and colour

47 The light from two lasers passes through a vacuum. One laser emits red light and the other emits green light. 9702/11/O/N/09

Which property of the two laser beams must be different?

A amplitude

B frequency

C plane of polarisation

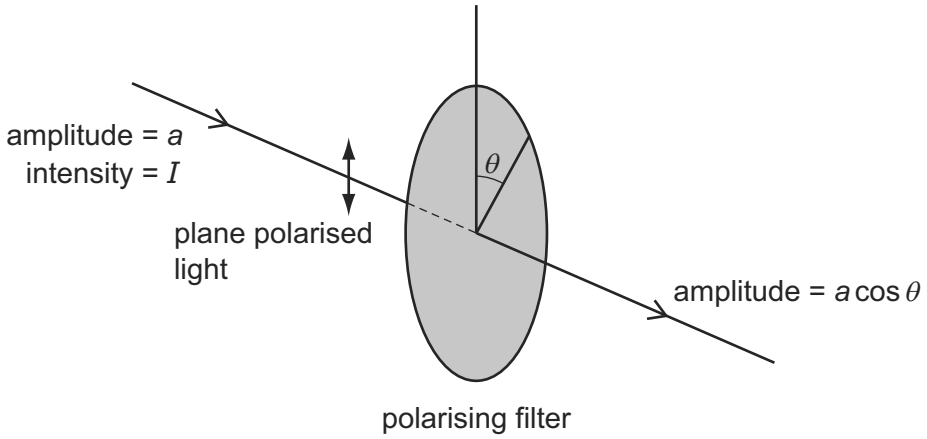
D speed

48 The amplitude of a wave is A and its intensity is I. 9702/12/O/N/10

Which amplitude is necessary for the intensity to be doubled to $2I$?

A A^2 **B** $\sqrt{A}$ **C** $\sqrt{2}\,A$ **D** $2A$

49 When plane-polarised light of amplitude a is passed through a polarising filter as shown, the amplitude of the light emerging is $a\cos\theta$. 9702/11/O/N/10



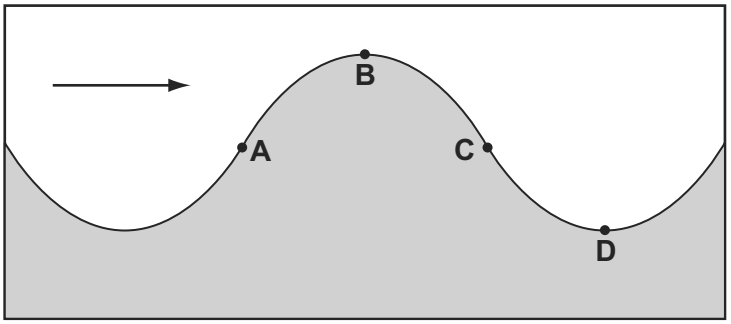
The intensity of the initial beam is I.

What is the intensity of the emerging light when θ is 60.0°?

A $0.250\,I$ **B** $0.500\,I$ **C** $0.750\,I$ **D** $0.866\,I$

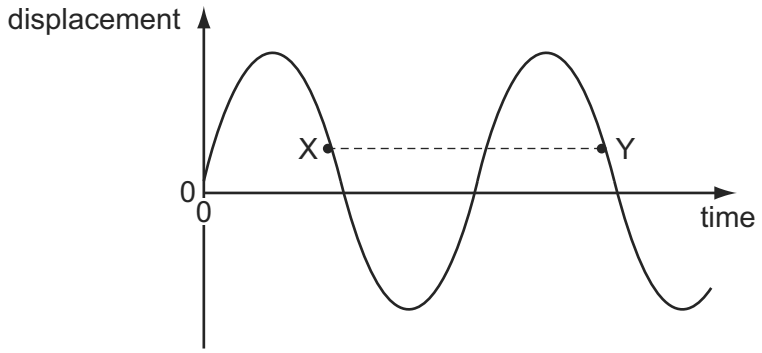
50 The diagram shows a vertical cross-section through a water wave moving from left to right. 9702/11/O/N/10

At which point is the water moving upwards with maximum speed?



51 A transverse progressive wave is set up on a string. 9702/12/M/J/11

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

52 Which electromagnetic wave would cause the most significant diffraction effect for an atomic lattice of spacing around 10^{-10} m? 9702/13/O/N/10

A infra-red

B microwave

C ultraviolet

D X-ray

53 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 9702/13/M/J/11

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

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** $a \propto r^2$

54 Which statement about electromagnetic radiation is correct? 9702/12/O/N/11

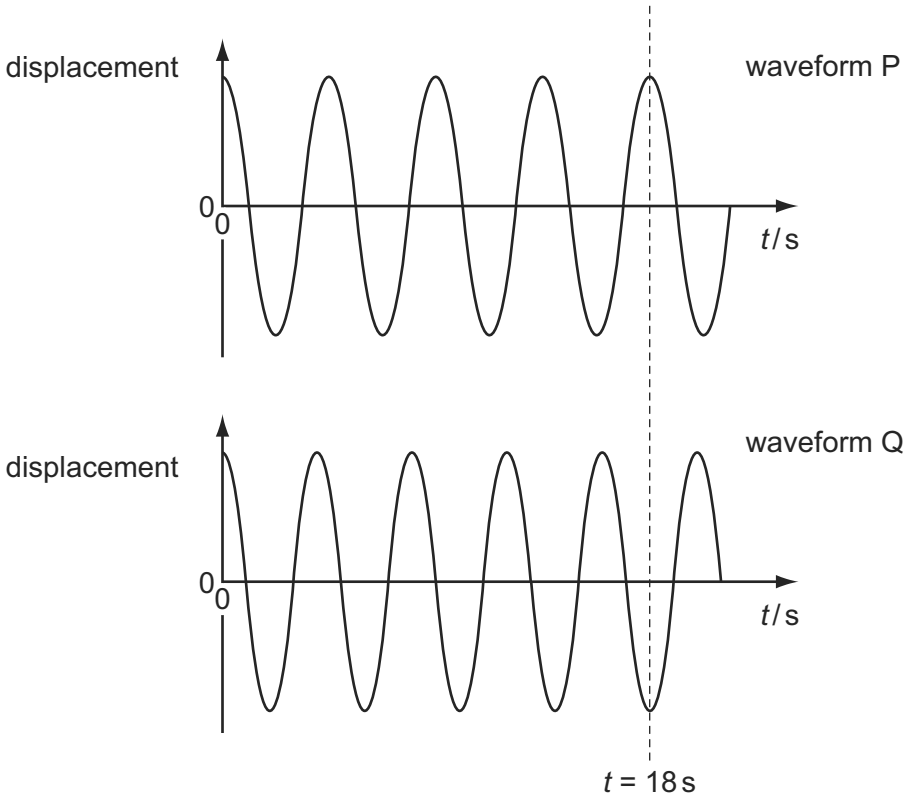
A Waves of wavelength 5×10^{-9} m are high-energy gamma rays.

B Waves of wavelength 3×10^{-8} m are ultra-violet waves.

C Waves of wavelength 5×10^{-7} m are infra-red waves.

D Waves of wavelength 9×10^{-7} m are light waves.

55 The diagram shows two sinusoidal waveforms. 9702/12/O/N/11

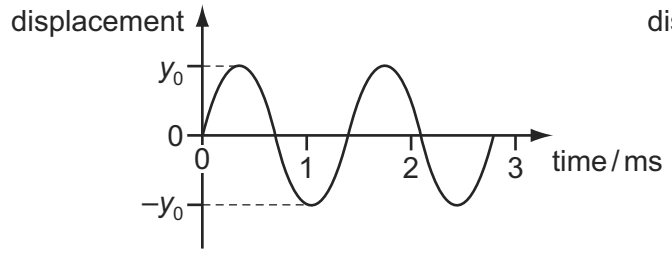


At time $t = 0$ the waves are in phase. At the dotted line, $t = 18$ s.

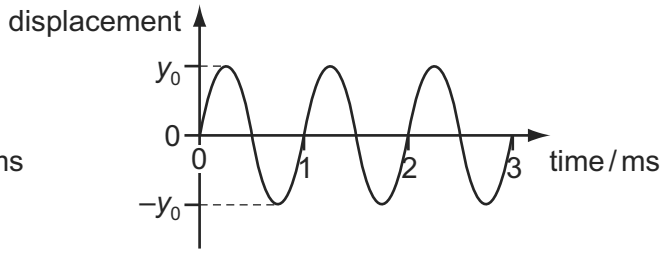
At which time is the phase difference between the two oscillations ⅛ of a cycle?

A 4.0 s **B** 4.5 s **C** 8.0 s **D** 9.0 s

5**6** Two waves E and G are shown. The waves have the same speed. 9702/11/M/J/12



E



G

Which statement is correct?

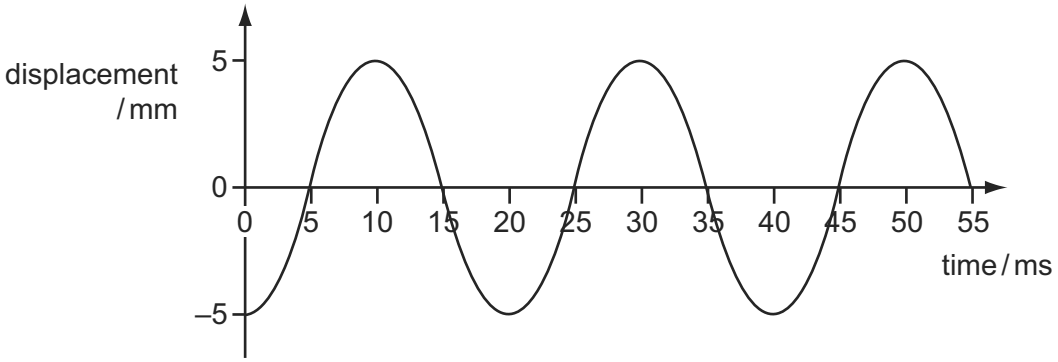
A Wave E has a greater amplitude than wave G.

B Wave E has a greater intensity than wave G.

C Wave E has a smaller frequency than wave G.

D Wave E has a smaller wavelength than wave G.

5**7** The diagram shows a displacement-time graph for a progressive wave. 9702/11/M/J/12



What are the amplitude and frequency of the wave?

	amplitude / mm	frequency / Hz
A	5	40
B	5	50
C	10	40
D	10	50

58 A surveyor's device emits a laser pulse. 9702/12/M/J/12

What is the time taken for the pulse to travel from the device to a wall 150 m away, where it is reflected, and then return to the device?

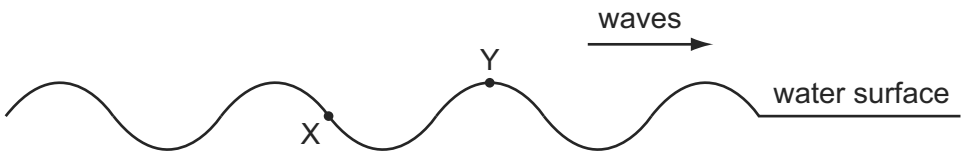
A 0.05 ns **B** 0.10 ns **C** 0.50 μs **D** 1.0 μs

59 The period of an electromagnetic wave is 1.0 ns. 9702/12/M/J/12

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}

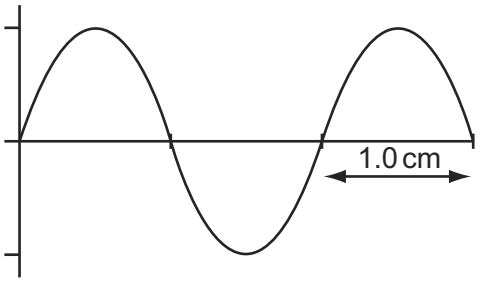
60 X and Y are two points on the surface of water in a ripple tank. A source of waves of constant frequency begins to generate waves which then travel past X and Y, causing them to oscillate. 9702/12/M/J/12



What is the phase difference between X and Y?

A 45° **B** 135° **C** 180° **D** 270°

61 The diagram shows a cathode-ray oscilloscope display of an electromagnetic wave. 9702/12/O/N/12



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 radio wave region of the electromagnetic spectrum.

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

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

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

62 A wave has a speed of $340\,m\,s^{-1}$ and a period of 0.28 ms. 9702/11/M/J/13

What is its wavelength?

A 0.095 m **B** 95 m **C** 1.2×10^{3} m **D** 1.2×10^{6} m

63 A light wave of amplitude A is incident normally on a surface of area S. The power per unit area reaching the surface is P. 9702/11/M/J/13

The amplitude of the light wave is increased to $2A$. The light is then focussed on to a smaller area $\frac{1}{3}S$.

What is the power per unit area on this smaller area?

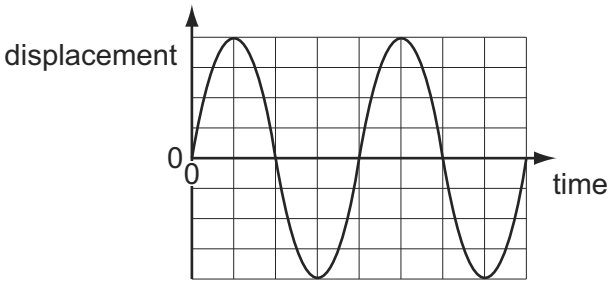
A $36P$

B $18P$

C $12P$

D $6P$

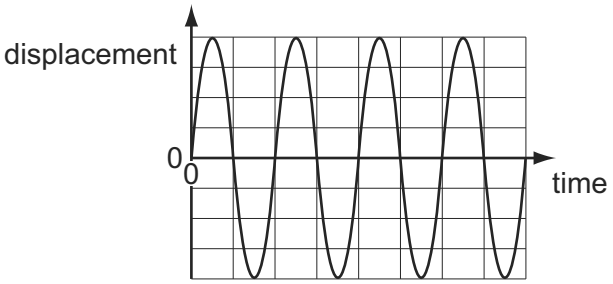
64 The diagram shows a graph of displacement against time for a sound wave. 9702/11/O/N/12



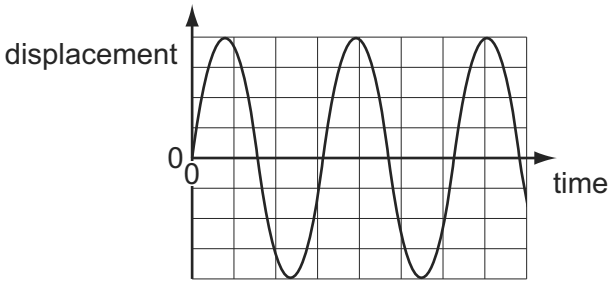
The intensity of the sound is halved.

Which graph shows the displacement of this sound wave?

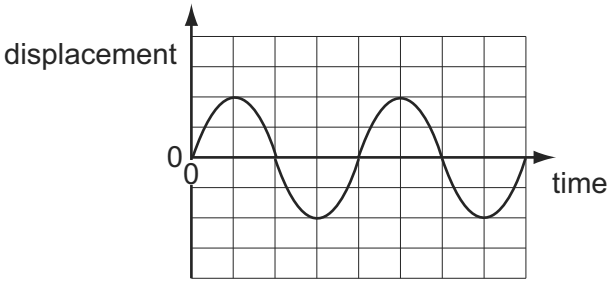
A



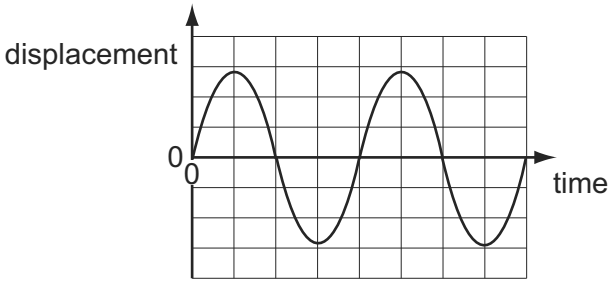
B



C

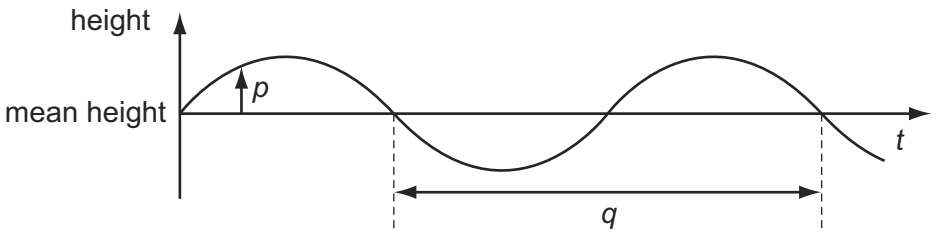


D



65 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.

9702/13/O/N/13



What are p and q?

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

66 When the liquid crystal display of a calculator is observed through a polarising film, the display changes as the film is rotated.

9702/13/M/J/13

Which property describes the radiation from the calculator display?

A unpolarised

B a longitudinal wave

C a transverse wave

D a wave with a 3 cm wavelength

67 A wave has a frequency of 5 GHz.

9702/11/M/J/13

What is the period of the wave?

A 20 000 μs

B 20 ns

C 2 ns

D 200 ps

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

9702/11/O/N/13

A Both can be polarised.

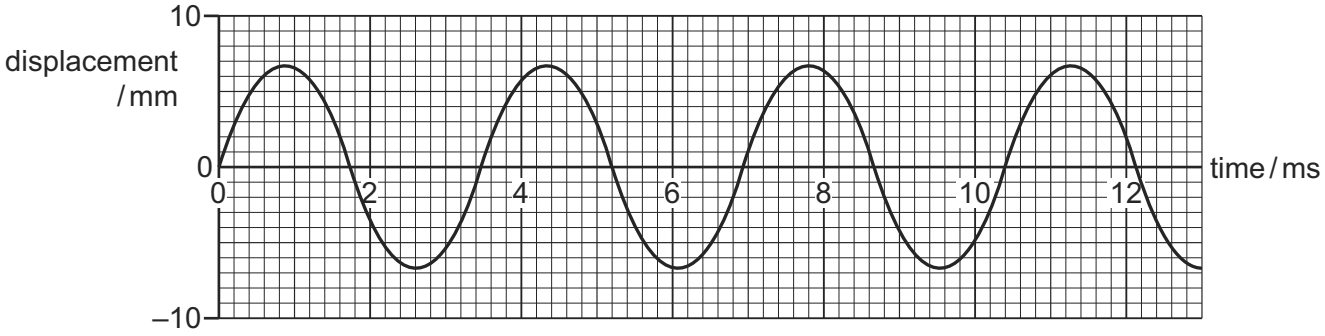
B Both can travel through free space.

C Both have a frequency inversely proportional to their wavelength.

D Both have an intensity proportional to their amplitude.

69 What, to two significant figures, are the period, the frequency and the amplitude of the wave represented by the graph?

9702/12/M/J/14



	period / s	frequency / Hz	amplitude / m
A	0.0027	370	0.0067
B	0.0031	320	0.013
C	0.0035	290	0.0067
D	0.0042	240	0.013

70 Which statement about waves is correct?

9702/13/O/N/14

A All electromagnetic waves travel at the same speed in a vacuum.

B Longitudinal waves can be polarised.

C The amplitude of a wave is directly proportional to the energy transferred by the wave.

D The frequency of infra-red light is greater than the frequency of ultra-violet light.

71 Which statement describes a situation when polarisation could **not** occur?

9702/11/O/N/14

A Light waves are reflected.

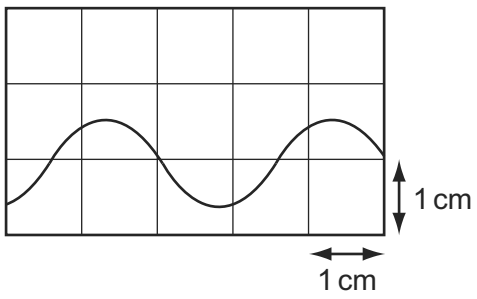
B Light waves are scattered.

C Microwaves pass through a metal grid.

D Sound waves pass through a metal grid.

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

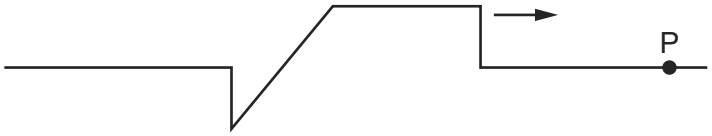
9702/13/M/J/15



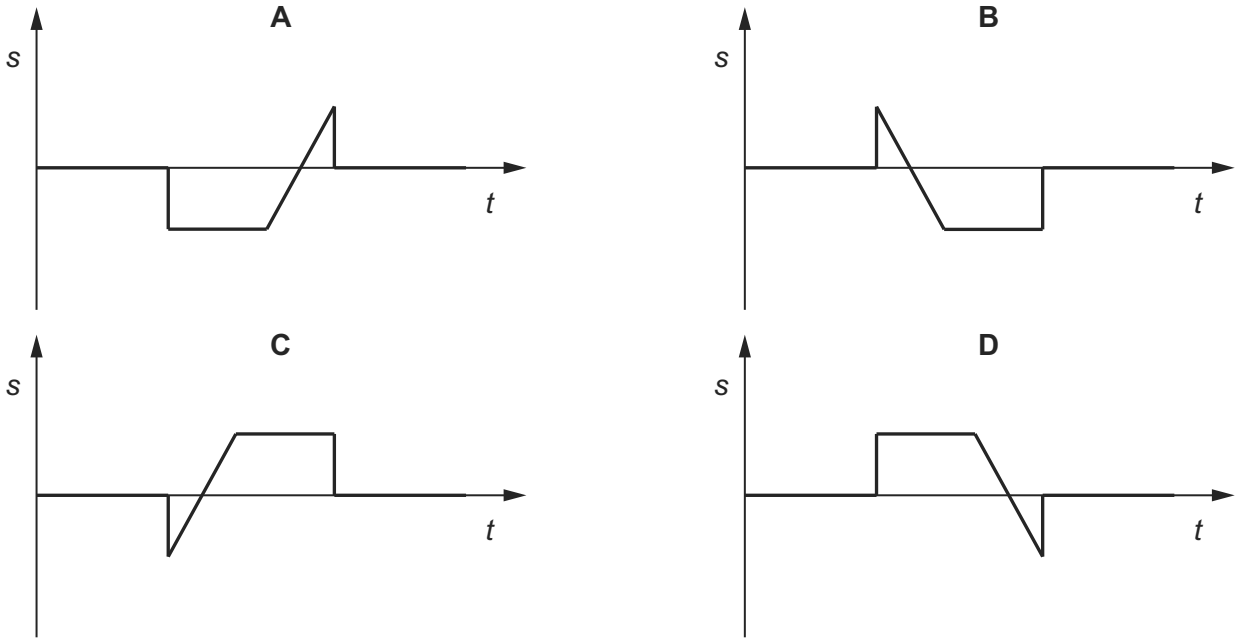
What is the frequency of the sound wave?

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

73 A wave pulse moves along a stretched rope in the direction shown. 9702/13/M/J/15



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

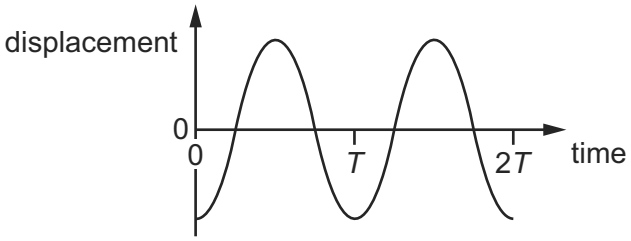


74 A sound wave has a speed of 330 m s^{-1} and a frequency of 50 Hz. 9702/12/M/J/15

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

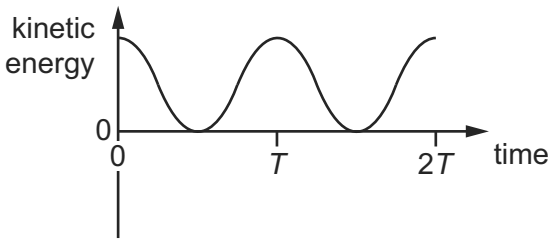
A 0.03 m **B** 1.1 m **C** 2.2 m **D** 6.6 m

75 When sound travels through air, the air particles vibrate. A graph of displacement against time for a single air particle is shown. 9702/11/O/N/14

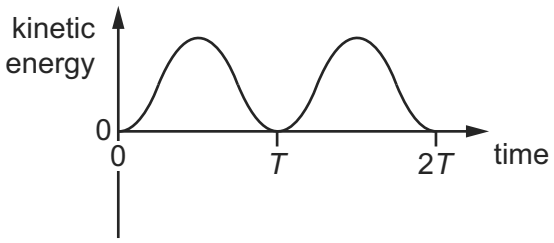


Which graph best shows how the kinetic energy of the air particle varies with time?

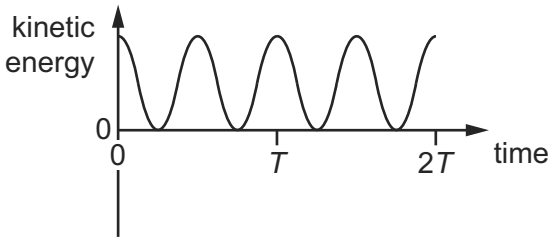
A



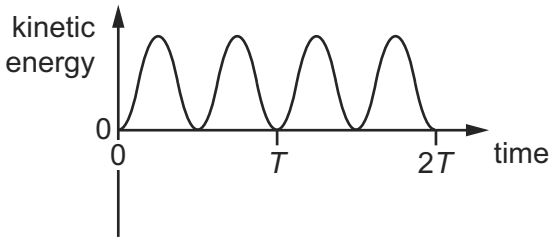
B



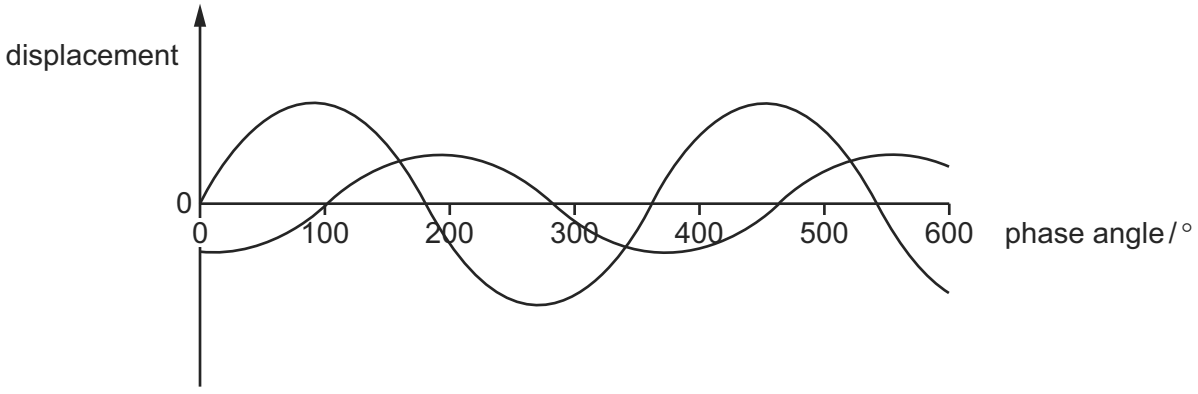
C



D



76 Two light waves of the same frequency are represented by the diagram. 9702/12/M/J/15



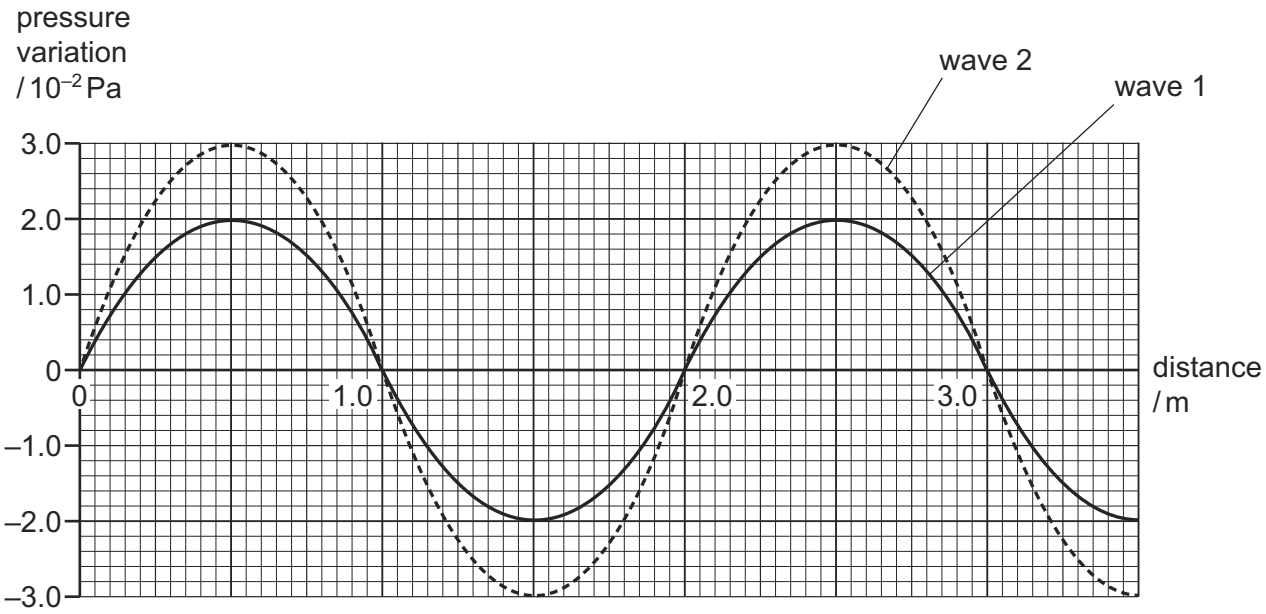
What could be the phase difference between the two waves?

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

77 A sound wave consists of a series of moving pressure variations from the normal, constant air pressure.

9702/12/M/J/14

The graph shows these pressure variations for two waves at one instant in time.



Wave 1 has an intensity of $1.6 \times 10^{-6}\,W\,m^{-2}$.

What is the intensity of wave 2?

A $2.4 \times 10^{-6}\,W\,m^{-2}$

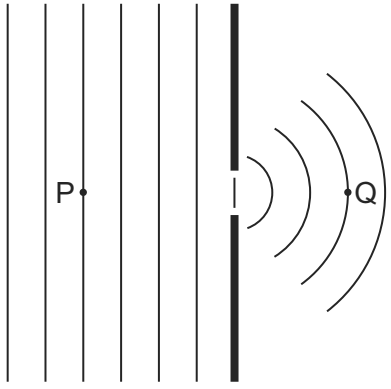
B $3.0 \times 10^{-6}\,W\,m^{-2}$

C $3.6 \times 10^{-6}\,W\,m^{-2}$

D $4.5 \times 10^{-6}\,W\,m^{-2}$

78 Plane wavefronts in a ripple tank pass through a gap as shown.

9702/13/O/N/14



Which property of the wave will be different at Q compared with P?

A velocity

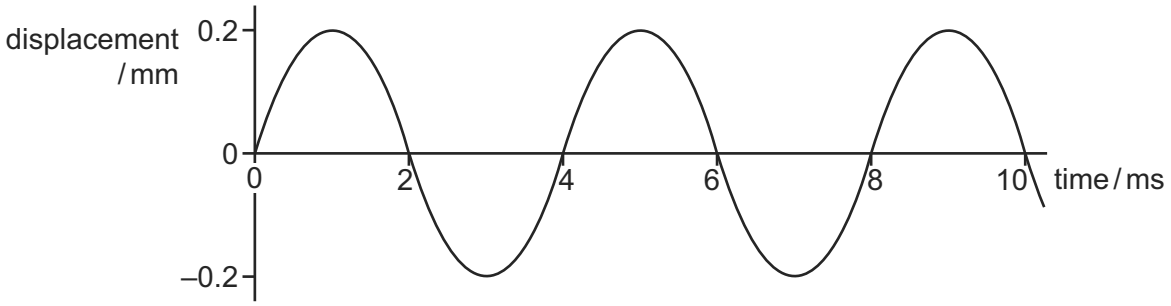
B frequency

C amplitude

D wavelength

79 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.

9702/11/M/J/15



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.

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

9702/11/M/J/15

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

A There is no phase difference.

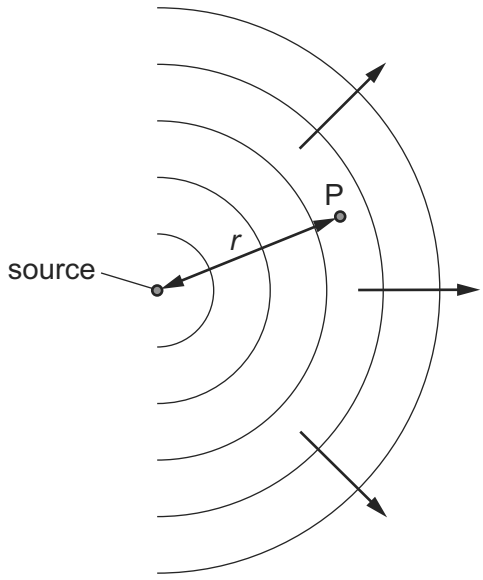
B They are out of phase by a quarter of a cycle.

C They are out of phase by half a cycle.

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

81 A small source emits spherical waves.

9702/13/M/J/14



The wave intensity I at any point P, a distance r from the source, is inversely proportional to r^2.

What is the relationship between the wave amplitude a and the distance r?

A $a^2 \propto \frac{1}{r}$ **B** $a \propto \frac{1}{r}$ **C** $a \propto \frac{1}{r^2}$ **D** $a \propto \frac{1}{r^4}$

82 The speed v of waves in deep water is given by the equation $v^2 = \frac{g\lambda}{2\pi}$ 9702/11/M/J/14

where λ is the wavelength of the waves and g is the acceleration of free fall.

A student measures the wavelength λ and the frequency f of a number of these waves.

Which graph should he plot to give a straight line through the origin?

A f^2 against λ

B f against λ^2

C f against $\frac{1}{\lambda}$

D f^2 against $\frac{1}{\lambda}$

83 Which statement about different types of electromagnetic wave is correct? 9702/13/M/J/13

A The frequency of infra-red waves is less than the frequency of blue light.

B The frequency of radio waves is greater than the frequency of gamma rays.

C The wavelength of red light is less than the wavelength of ultraviolet waves.

D The wavelength of X-rays is greater than the wavelength of microwaves.

84 What is correct for all transverse waves? 9702/12/M/J/13

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.

85 A cathode-ray oscilloscope (c.r.o.) displays a waveform corresponding to a sound wave.

In order to determine the frequency of the sound wave, which part of the displayed waveform must be measured and which c.r.o. setting must be known? 9702/13/M/J/14

	on-screen measurement	c.r.o. setting
A	amplitude	time-base
B	amplitude	Y-gain
C	wavelength	time-base
D	wavelength	Y-gain

86 P is a source emitting infra-red radiation and Q is a source emitting ultra-violet radiation. The figures in the table are suggested values for the wavelengths emitted by P and Q. 9702/11/O/N/11

Which row is correct?

	wavelength emitted by P / m	wavelength emitted by Q / m
A	5×10^{-5}	5×10^{-8}
B	5×10^{-5}	5×10^{-10}
C	5×10^{-7}	5×10^{-8}
D	5×10^{-7}	5×10^{-10}