Waves

TOPIC QUESTIONS (1)

Level	AS Level
Subject	Physics
Exam Board	CIE
Paper Type	Multiple Choice

Time Allowed : 1Hour 10Min

1. What do not travel at the speed of light in a vacuum?

A electrons   B microwaves   C radio waves   D X-rays

2. 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}.

3. 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 2 I.
What is the corresponding sound wave amplitude?

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

4. 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

5. T is a microwave transmitter placed at a fixed distance from a flat reflecting surface S.

A small microwave receiver is moved steadily from T towards S and receives signals of alternate maxima and minima of intensity.
The distance between successive maxima is 15 mm. What is the frequency of the microwaves?

A 1.0 x 10^7 Hz   B 2.0 x 10^7 Hz
C 1.0 x 10^{10} Hz   D 2.0 x 10^{10} Hz

6. A wave of amplitude a has an intensity of 3.0 Wm^{-2}.

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

A   4.2 Wm^{-2} **B**   6.0 Wm^{-2} **C**   9.0 Wm^{-2} **D**   12 Wm^{-2}
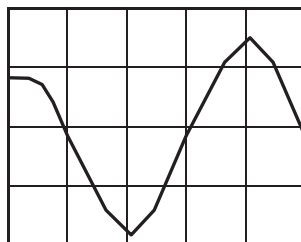
7. A cathode-ray oscilloscope (c.r.o.) is connected to an alternating voltage. The following trace is produced on the screen.

1 cm

1 cm
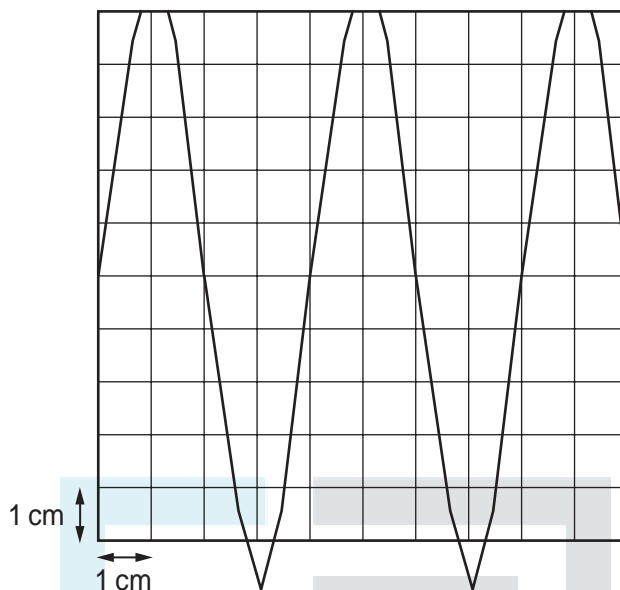
The oscilloscope time-base setting is $0.5\,ms\,cm^{-1}$ and the Y-plate sensitivity is $2\,V\,cm^{-1}$.

Which statement about the alternating voltage is correct?

A   The amplitude is 3.5 cm.

B   The frequency is 0.5 kHz.

C   The period is 1 ms.

D   The wavelength is 4 cm.

8. The display on a cathode-ray oscilloscope shows the signal produced by an electronic circuit. The time-base is set at 5.0 ns per division and the Y-gain at 10 V per division.

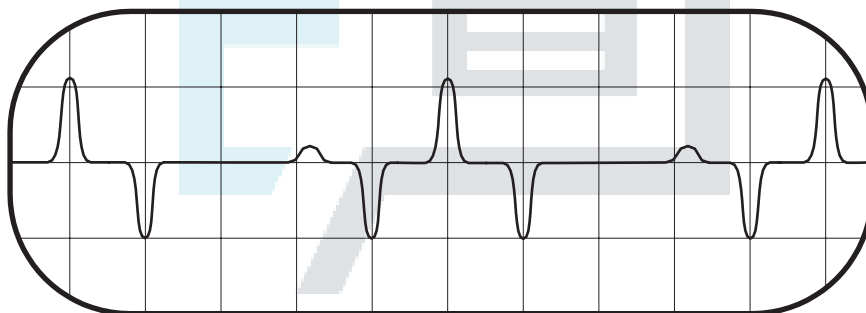What is the frequency of the signal?

A $2.0 \times 10^{-8}\,Hz$

B $2.5 \times 10^{-2}\,Hz$

C $5.0 \times 10^{7}\,Hz$

D $3.1 \times 10^{8}\,Hz$

9. 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 waveformmust be measured and which c.r.o. setting must be known?

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

10. A signal that repeats periodically is displayed on the screen of a cathode-ray oscilloscope.

The screen has 1 cm squares and the time base is set at $2.00\,\text{ms}\,\text{cm}^{-1}$.

What is the frequency of this periodic signal?

A   50 Hz   B   100 Hz   C   125 Hz   D   200 Hz

11. 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

12. 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

13. The graph shows the shape at a particular instant of part of a transverse wave travelling along astring.
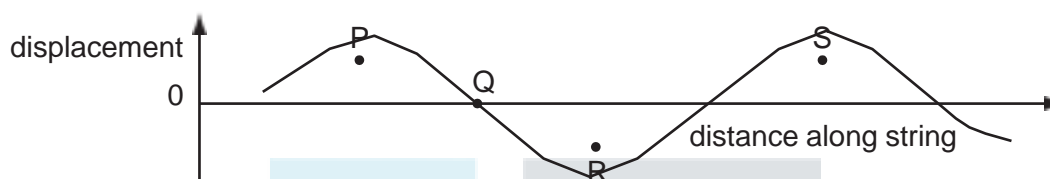
Which statement about the motion of points in the string is correct?

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.

14. The diagram illustrates part of the electromagnetic spectrum.

high
frequencies } | 1 | | | 2 | { low
frequencies
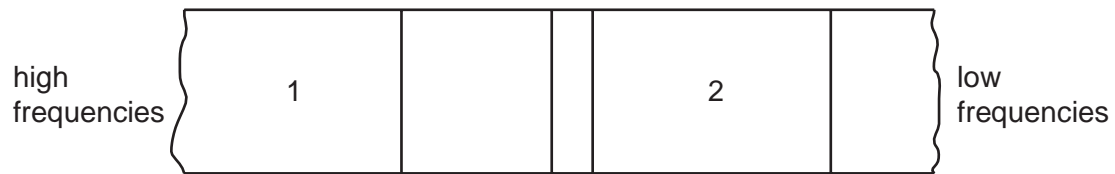
Which labels are correct for the regions marked 1 and 2?

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

15. 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

16. What is correct 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.

17. Which statement about different types of electromagnetic wave is correct?

   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.

18. Orange light has a wavelength of 600 nm.

   What is the frequency of this light?

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

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

What describes the wavelength and speed of electromagnetic waves of frequency *f*/2?

	wavelength	speed in a vacuum
A	λ/2	*c*/2
B	λ/2	*c*
C	2λ	*c*
D	2λ	2*c*

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

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

21. Microwaves of wavelength 3.00 cm are incident normally on a row of parallel metal rods. The separation of the rods is 8.00 cm. The first order diffraction maximum is observed at an angle of 22.0° to the direction of the incident waves.

What is the angle between the first and second order diffraction maxima?

A 22.0° **B** 26.6° **C** 44.0° **D** 48.6°

22. 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.
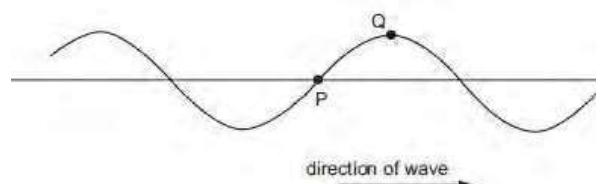
direction of wave

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

23 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 2 A and the area of the surface is reduced to ½ S.
How much energy per unit time reaches this smaller surface?

A 4E   B 2E   C E   D ½ E

24. 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

25. The lines of a diffraction grating have a spacing of 1.6×10^{-6} m. A beam of light is incident normally on the grating. The first order maximum makes an angle of 20° with the undeviated beam.
What is the wavelength of the incident light?
A 210 nm   B 270 nm   C 420 nm   D 550 nm

26. The Y-input terminals of a cathode-ray oscilloscope (c.r.o.) are connected to a supply of amplitude 5.0 V and frequency 50 Hz. The time-base is set at 10 ms per division and the Y-gain at
5.0 V per division.

Which trace is obtained?

A   **B**

C   **D**
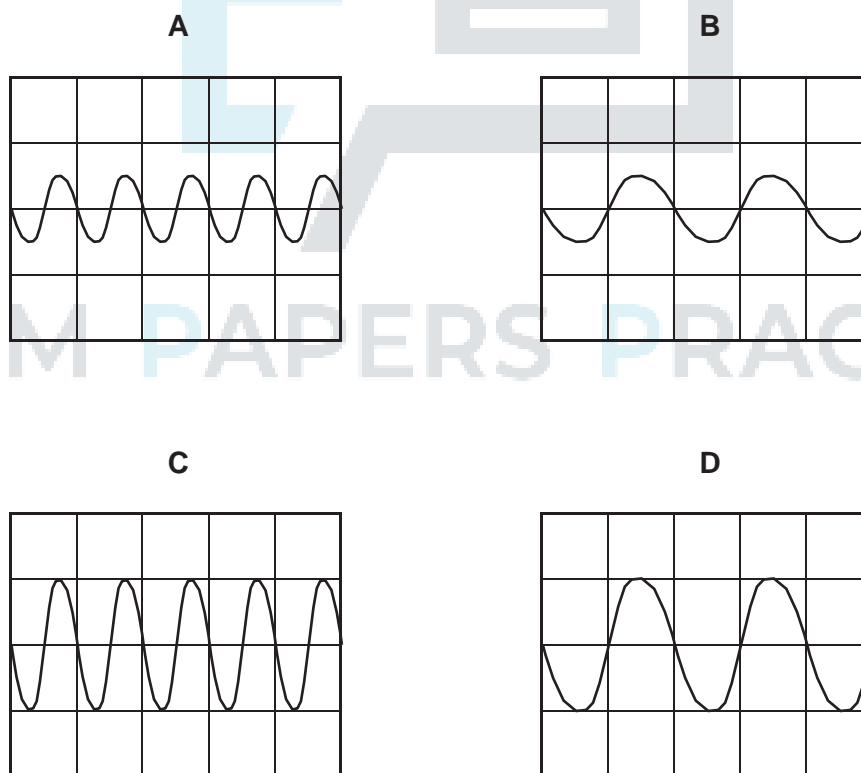
27. A cathode-ray oscilloscope displays a square wave, as shown in the diagram.
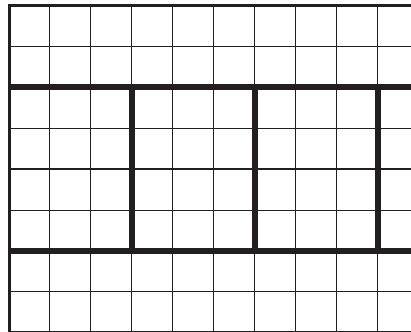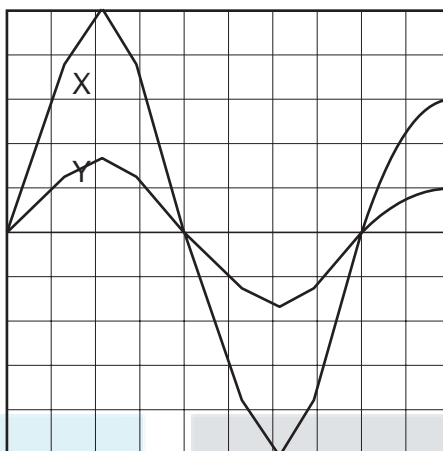
The time-base setting is 0.20 ms per division.

What is the frequency of the square wave?

A   8.3 Hz   B   830 Hz   C   1300 Hz   D   1700 Hz

28. The diagram shows an oscilloscope screen displaying two signals.

Signal X has a frequency of 50 Hz and peak voltage of

12 V. What is the period and peak voltage of signal Y?

	period / ms	peak voltage / V
A	20	4
B	20	12
C	50	4
D	50	12

29. Which wave properties change when light passes from air into glass?

A   colour and speed

B   frequency and wavelength

C   speed and wavelength

D   wavelength and colour

30. A laser emits light of wavelength 600 nm.

What is the distance, expressed as a number of wavelengths, travelled by the light in one second?

A 5×10^{8} B 5×10^{11} C 5×10^{14} D 5×10^{17}

31. The diagram shows two waves X and Y.
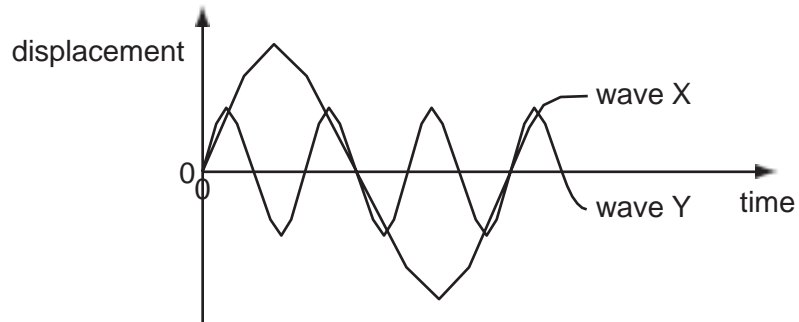
Wave X has amplitude 8 cm and frequency 100 Hz.

What are the amplitude and frequency of wave Y?

	amplitude / cm	frequen / Hz
A	2	3
B	2	30
C	4	3
D	4	30

32. Light can exhibit all of the properties listed.
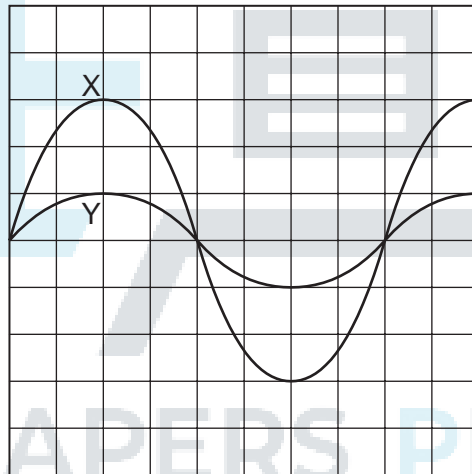
Which property can sound not exhibit?

A interferenceB

polarisation   C

refraction

D   total internal reflection

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

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

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

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

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.

35. When plane-polarised light of amplitude A is passed through a polarising filter as shown, the amplitude of the light emerging is $A\cos\theta$.

amplitude A
intensity I

plane-polarised
light

θ

amplitude $A\cos\theta$

polarising filter
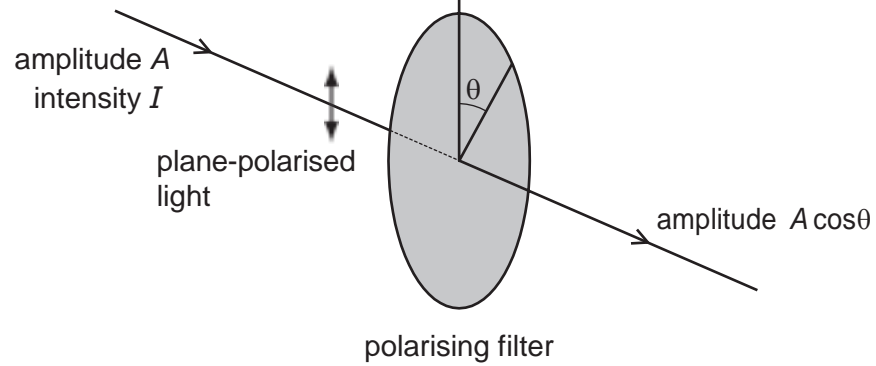
The intensity of the initial beam is I.

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

A   0.250I B   0.500I C   0.750I D   0.866I

36. 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.

    Which type of wave are they most likely to be?

    A   radio waves

    B   microwaves

    C   infra-red waves

    D   ultraviolet waves

37. 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.
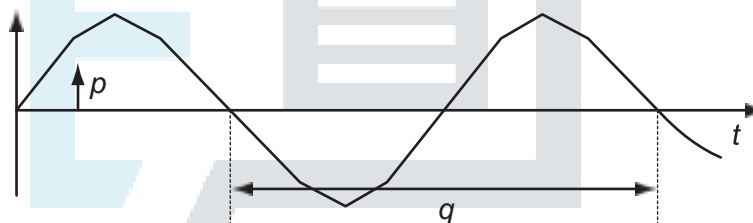
    What are p and q?

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

38. A wave has a frequency of 5 GHz.
    What is the period of the wave?

   A   20 000 µs

    B   20 ns

    C   2 ns

    D   200 ps

39. 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

40. Which statement correctly relates the intensity of a soundwave to the vibrations of the molecules?

A intensity α amplitude
B intensity α (amplitude)^2
C intensity α displacement
D intensity α (displacement)^2

41. The diagram shows an experiment which has been set up to demonstrate two-source interference, using microwaves of wavelength λ.
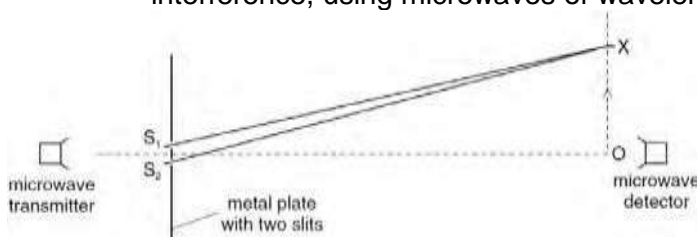
The detector is moved from O in the direction of the arrow. The signal detected decreases until the detector reaches the point X, and then starts to increase again as the detector moves beyond X.
Which equation correctly determines the position of X?

A OX = λ/2   **B** OX = λ
C S2X - S1X = λ/2   **D** S2X - S1X = λ

42. Two progressive waves of frequency 300 Hz are superimposed to produce a stationary wave in which adjacent nodes are 1.5m apart.
What is the speed of the progressive waves?

A 100ms^{-1} **B** 200ms^{-1} **C** 450ms^{-1} **D** 900ms^{-1}

43. 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

44. 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?
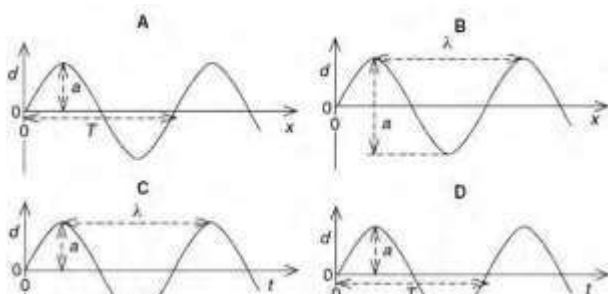
45. A wave of amplitude *a* has an intensity of 3.0Wm^{-2}. What is the intensity of a wave of the same frequency that has an amplitude 2*a*?

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

46. 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.

47. 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	λ/2	*c*/2
B	λ/2	*c*
C	2λ	*c*
D	2λ	2*c*

48. 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.


1 cm
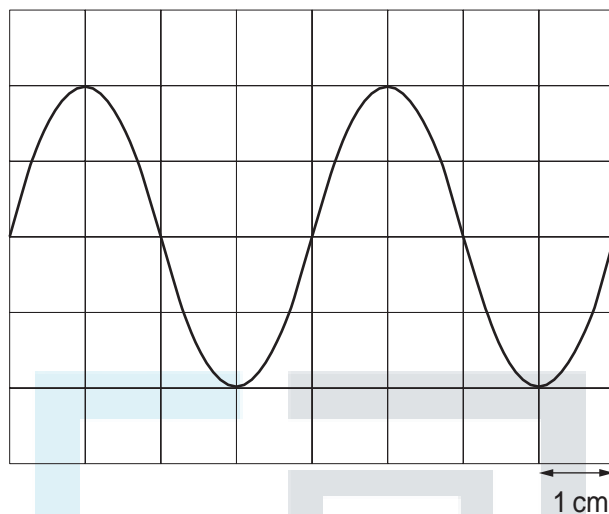
What is the frequency of the sound wave?

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

49. 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

50. 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** showhow 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
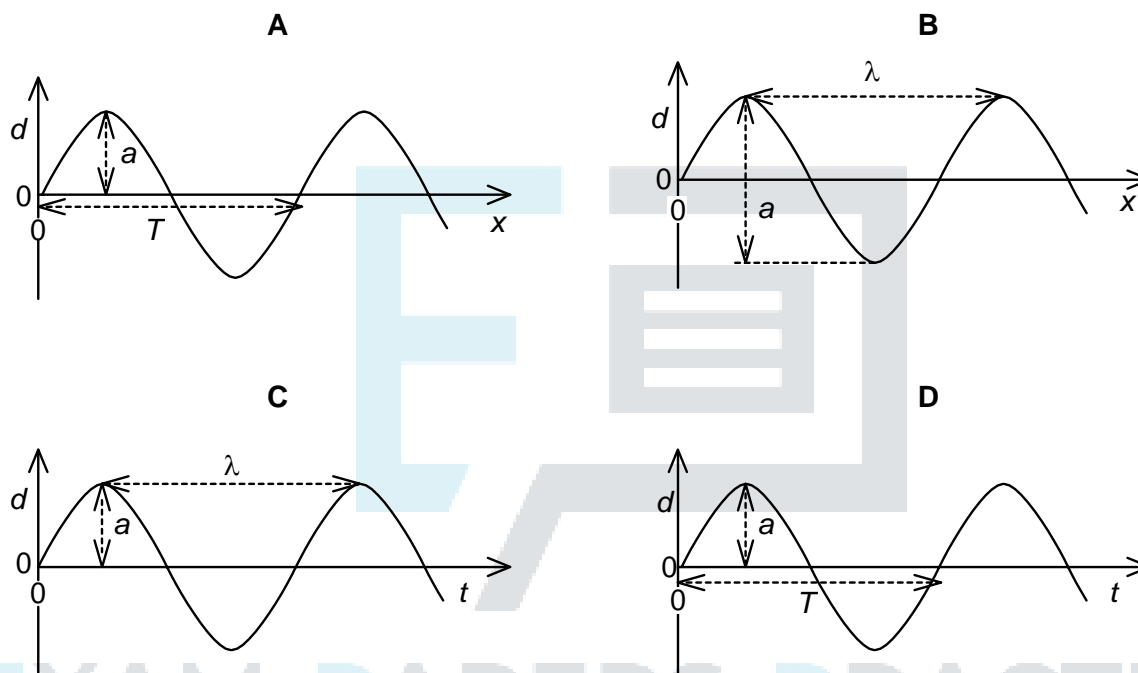
51. P is a source emitting infra-red radiation and Q is a source emitting ultra-violet radiation. Thefigures in the table are suggested values for the wavelengths emitted by P and Q.

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}

52. A wave that can be polarised must be

A. longitudinal.

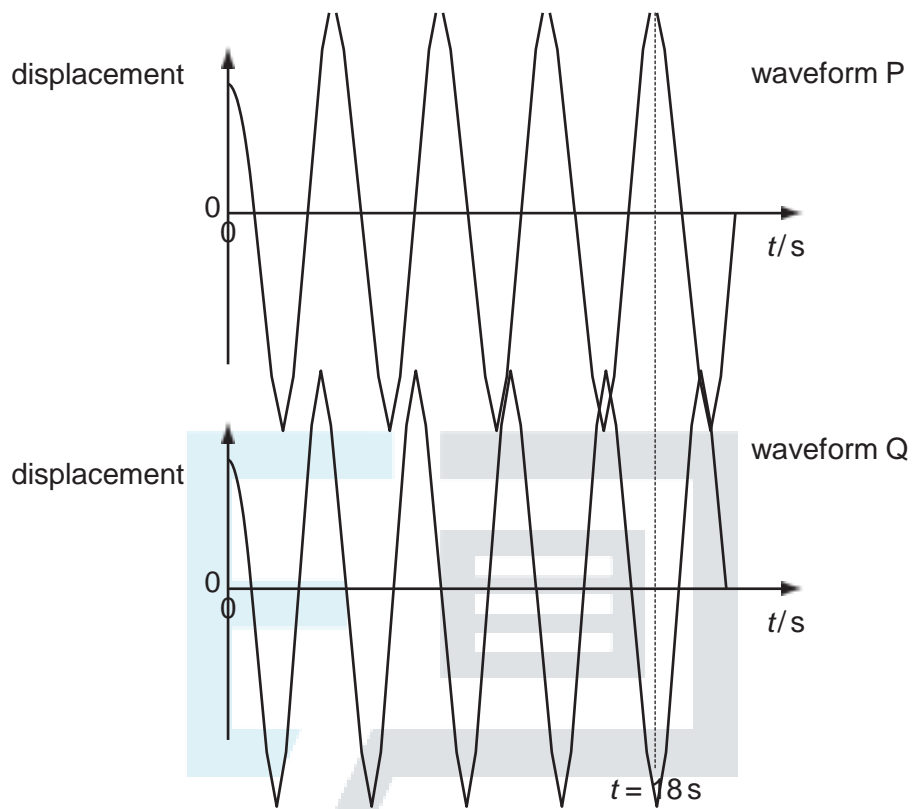B. progressive.

C. stationary.

D. transverse.

53. Which statement about electromagnetic radiation is correct?

    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.
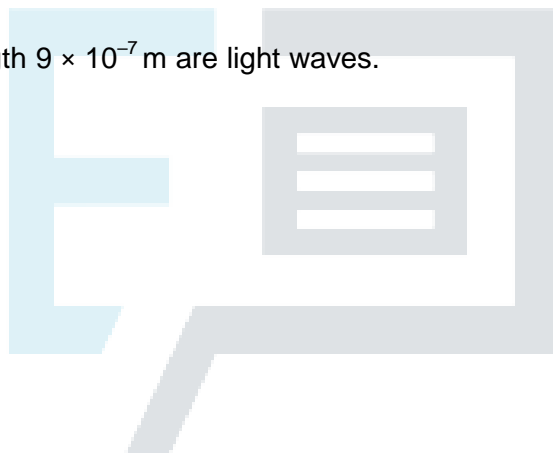
54. The diagram shows two sinusoidal waveforms.

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

55. 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*.
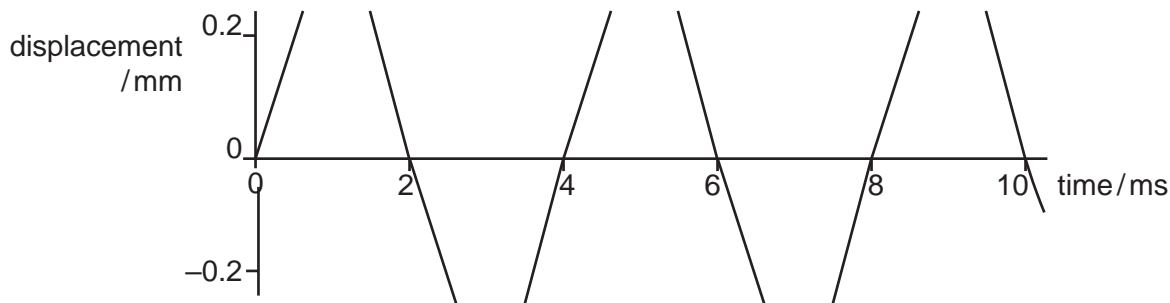
The labels on the graphs are intended to show the wavelength λ, the period *T* and the amplitude *a* of the wave, but only one graph is correctly labelled.

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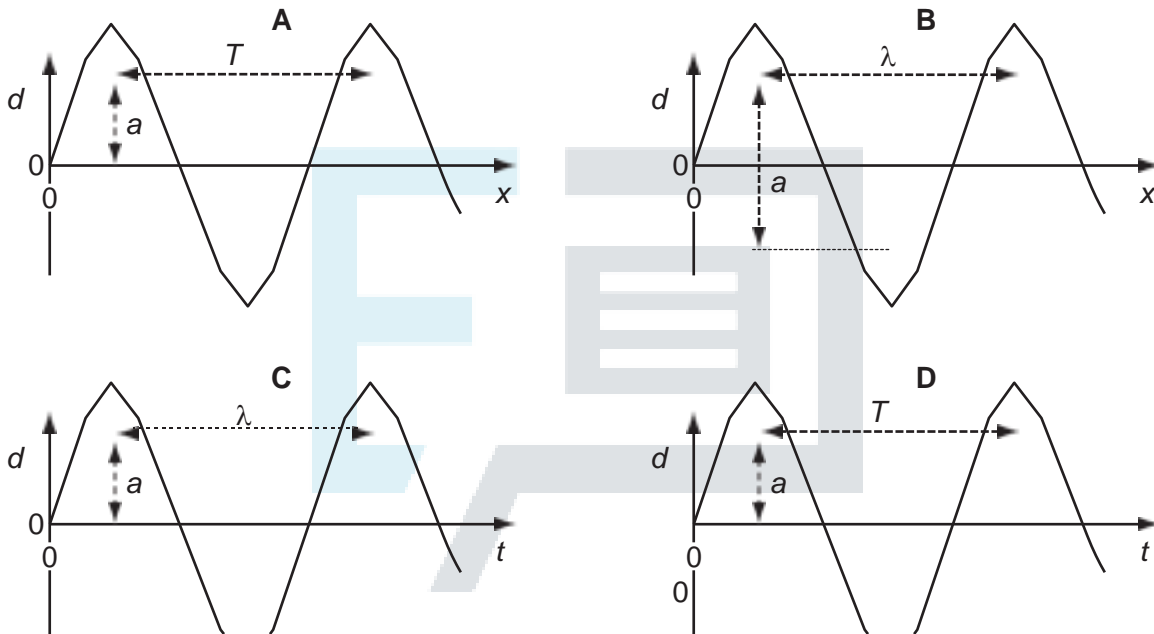
56. A sound wave moves with a speed of $320\,\text{m}\,\text{s}^{-1}$ through air. The variation with time of thedisplacement of an air particle due to this wave is shown in the graph.

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.

57. A wave of frequency 15 Hz travels at $24\,\text{m}\,\text{s}^{-1}$ 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.

58. A wave of amplitude a has an intensity of $3.0\,\text{Wm}^{-2}$.

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

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

59. An electromagnetic wave has a wavelength that is numerically of the same order of magnitude asthe 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

60. Two light waves of the same frequency are represented by the diagram.
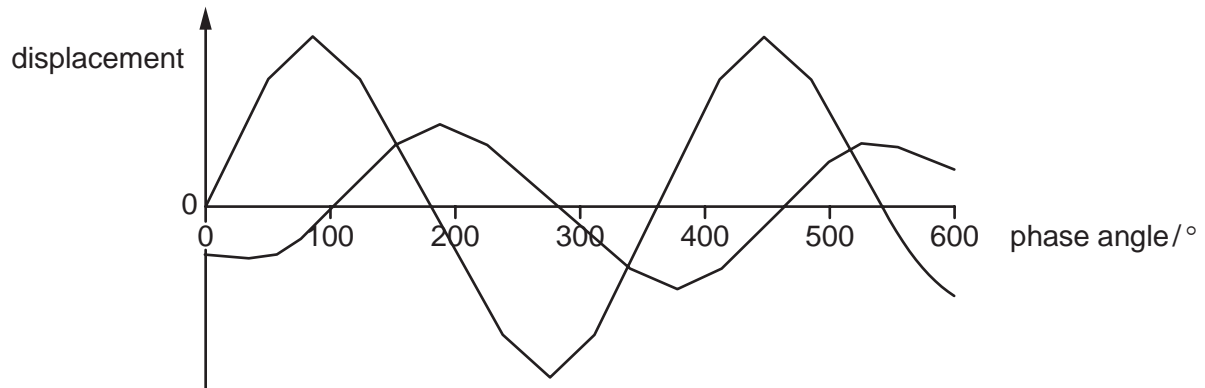
What could be the phase difference between the two waves?

A 150°   B 220°   C 260°   D 330°