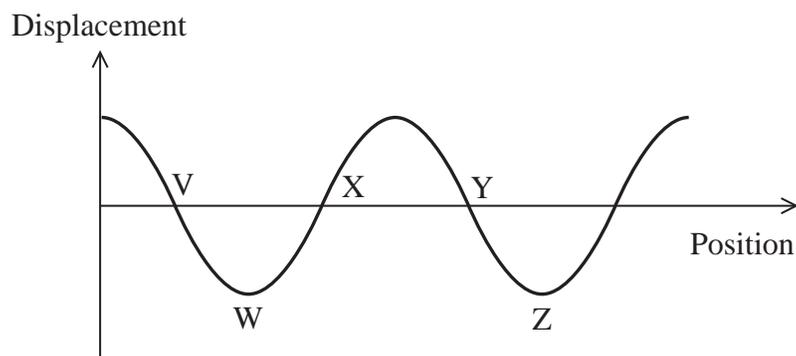


1 Which of the following is used for detecting security markings on property?

- A infrared
- B radio
- C ultrasound
- D ultraviolet

(Total for Question = 1 mark)

2 The graph shows displacement against position for the particles in a sound wave at a particular instant.



Which of the following could show the positions of a pair of particles moving in the same direction at that instant?

- A V and W
- B V and Y
- C W and Z
- D X and Y

(Total for Question = 1 mark)

3 Which of the following terms corresponds to the time taken for a complete wave to pass a point?

- A frequency
- B period
- C wavelength
- D wave speed

(Total for Question = 1 mark)

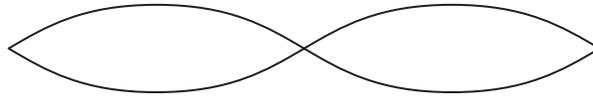
4 A source of sound of constant frequency is moving towards an observer. Compared to the frequency of the source, the frequency of sound heard by the observer is

- A higher, because the speed of sound increases.
- B lower, because the air is compressed.
- C higher, because the wavelength of the sound decreases.
- D lower, because the amplitude increases.

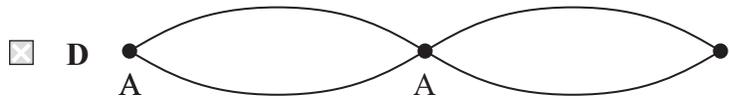
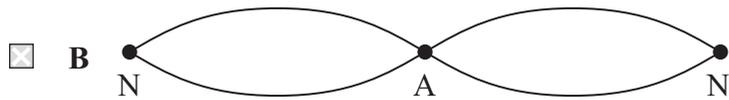
(Total for Question 1 mark)

Questions 5 and 6 refer to the diagram below.

The diagram represents a stationary wave on a string.



5 Which diagram correctly shows the position of nodes N and/or antinodes A?



(Total for Question 1 mark)

6 The length of the string is 4 m.
What is the wavelength of the stationary wave?

A 1 m

B 2 m

C 4 m

D 8 m

(Total for Question 1 mark)

- 7 A light illuminates a circular area of radius 30 cm. In a time of 20 s the total incident energy from the light is 70 J.

The radiation flux can be calculated from

A $\frac{70}{(\pi \times 0.30^2 \times 20)}$

B $\frac{70}{(\pi \times 0.15^2 \times 20)}$

C $\frac{70 \times \pi \times 0.30^2}{20}$

D $\frac{70 \times 20}{(\pi \times 0.15^2)}$

(Total for Question = 1 mark)

- 8 The distance travelled by a wave during one oscillation may be described as

- A frequency.
 B period.
 C wavelength.
 D wave speed.

(Total for Question = 1 mark)

9 Which of the following phenomena does **not** occur with sound waves?

- A diffraction
- B interference
- C polarisation
- D refraction

(Total for Question = 1 mark)

10 A lamp illuminates a surface of area 0.80 m^2 with radiation flux of 0.50 W m^{-2} .

The rate, in watts, at which light energy strikes the illuminated surface is given by

- A 0.50×0.80^2
- B 0.50×0.80
- C $0.50 \div 0.80$
- D $0.80 \div 0.50$

(Total for Question = 1 mark)

11 Which of the following is a type of electromagnetic radiation with a wavelength longer than infrared?

- A microwave
- B ultrasound
- C ultraviolet
- D X-rays

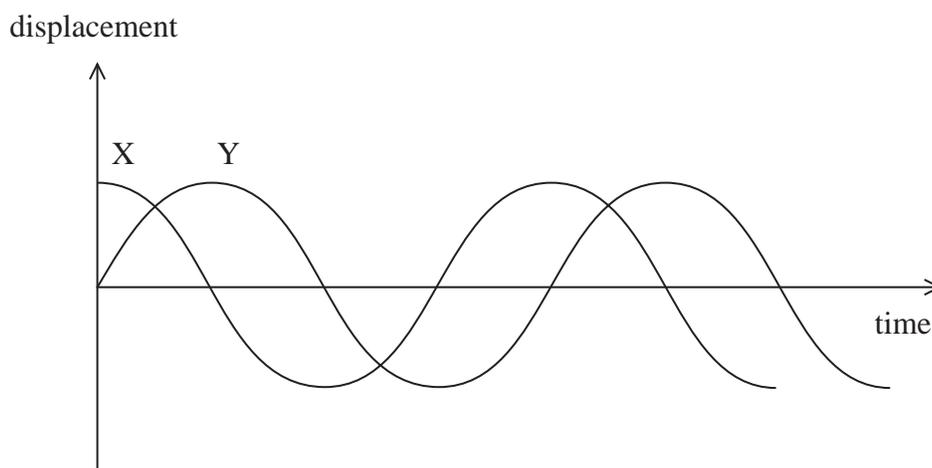
(Total for Question = 1 mark)

12 Which of the following is a standing wave?

- A light emitted as a line spectrum
- B ripples on water from a stone thrown into a pond
- C sound from an opera singer in a theatre
- D vibrations on a violin string as it is played

(Total for Question = 1 mark)

13 The diagram shows displacement-time graphs for two oscillations, X and Y.



Which of the following statements correctly describes their phase relationship?

- A X and Y are in antiphase
- B X and Y are in phase
- C X is $\pi/2$ radians ahead of Y
- D Y is $\pi/2$ radians ahead of X

(Total for Question = 1 mark)

14 The diagrams show the motions of a source of sound, S, and an observer, O.

Which line of the table correctly shows the effect this relative motion has on the frequency of the sound heard by the observer.

	Motions of S and O	Frequency
<input type="checkbox"/> A	<p>Diagram A shows a source S moving to the left (indicated by a left-pointing arrow) and an observer O who is stationary (indicated by the word 'stationary' below the dot).</p>	increased
<input type="checkbox"/> B	<p>Diagram B shows a source S moving to the right (indicated by a right-pointing arrow) and an observer O moving to the left (indicated by a left-pointing arrow).</p>	decreased
<input type="checkbox"/> C	<p>Diagram C shows a source S moving to the left (indicated by a left-pointing arrow) and an observer O moving to the right (indicated by a right-pointing arrow).</p>	decreased
<input type="checkbox"/> D	<p>Diagram D shows a source S who is stationary (indicated by the word 'stationary' below the dot) and an observer O moving to the right (indicated by a right-pointing arrow).</p>	increased

(Total for Question = 1 mark)

15 Light is shone perpendicularly onto a photovoltaic cell of area 0.01 m^2 . In 60 seconds, the total energy falling on the cell is 3 J.

The radiation flux is

- A $18\,000 \text{ W m}^{-2}$
- B 5 W m^{-2}
- C 1.8 W m^{-2}
- D 0.0005 W m^{-2}

(Total for Question = 1 mark)

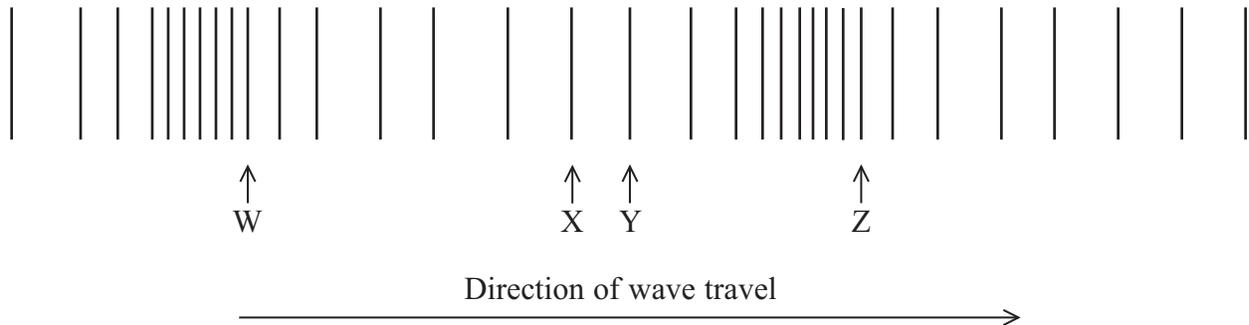
16 Compared to ultraviolet radiation, gamma radiation has

- A** a higher frequency and a longer wavelength.
- B** a higher frequency and a shorter wavelength.
- C** a lower frequency and a longer wavelength.
- D** a lower frequency and a shorter wavelength.

(Total for Question 1 mark)

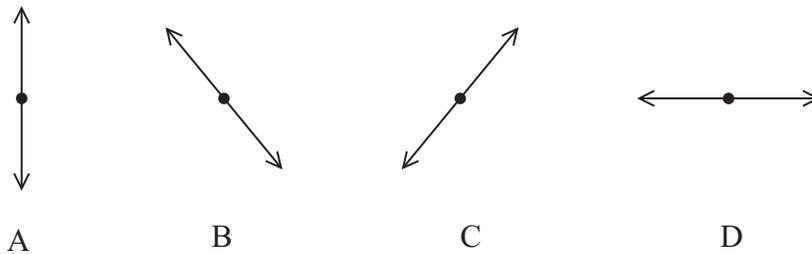
Use the following diagram to answer Questions 17 and 18

The diagram represents a longitudinal wave moving to the right through a uniform medium.



Points W, X, Y and Z represent the positions of particles of the medium.

17 The motion of the particle at W is represented by



- A
- B
- C
- D

(Total for Question 17 1 mark)

18 The wavelength of the wave shown is the distance between points

- A W and Y.
- B W and Z.
- C X and Y.
- D Y and Z.

(Total for Question 18 1 mark)

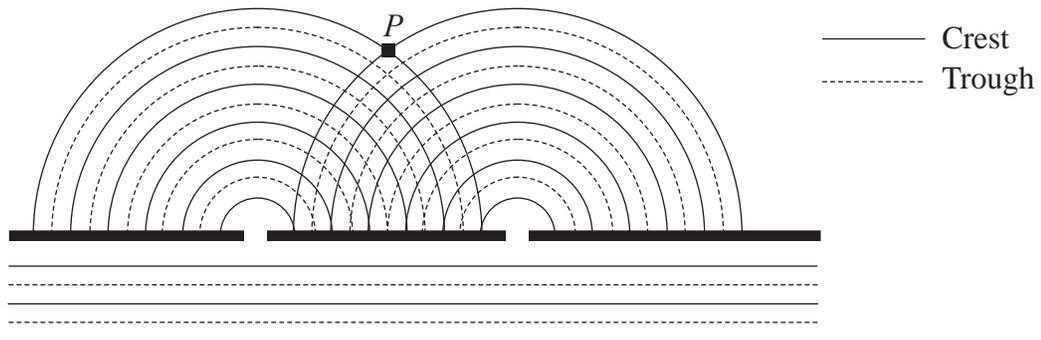
- 19 A longitudinal wave is moving along a spring. Two points on the spring are separated by half a wavelength. The displacements at these points on the spring are always
- A constant.
 - B in the same direction as each other.
 - C in opposite directions to each other.
 - D in a direction at right angles to the direction of travel of the wave.

(Total for Question = 1 mark)

- 20 Which of the following statements about infrared radiation and ultraviolet radiation is true?
- A An ultraviolet photon has more energy than an infrared photon.
 - B Energy can be transferred by infrared radiation but not by ultraviolet radiation.
 - C In a vacuum, infrared radiation travels faster than ultraviolet radiation.
 - D Ultraviolet radiation has a longer wavelength than infrared radiation.

(Total for Question = 1 mark)

- 21 The diagram represents shallow water waves of constant wavelength passing through two small openings in a barrier.



The statement which best describes the interference at point P is:

- A It is constructive and causes a longer wavelength.
- B It is constructive and causes an increase in amplitude.
- C It is destructive and causes a shorter wavelength.
- D It is destructive and causes a decrease in amplitude.

(Total for Question = 1 mark)

- 22 A formula for the speed v of ocean waves, in terms of the acceleration of free fall g and the wavelength λ , is $v = \sqrt{g\lambda}$.

Which of the following is the correct expression for the SI base units on the right hand side of this formula?

- A $\sqrt{\text{m}^2\text{s}^{-2}}$
- B ms^{-2}
- C m^2s^{-2}
- D $\sqrt{\text{ms}^{-2}}$

(Total for Question = 1 mark)

- 23 Which line of the table correctly summarises the changes in wave characteristics when moving from ultraviolet to infrared in the visible spectrum?

		Wavelength	Speed in a vacuum
<input type="checkbox"/>	A	Decreases	Increases
<input type="checkbox"/>	B	Increases	Decreases
<input type="checkbox"/>	C	Decreases	Remains the same
<input type="checkbox"/>	D	Increases	Remains the same

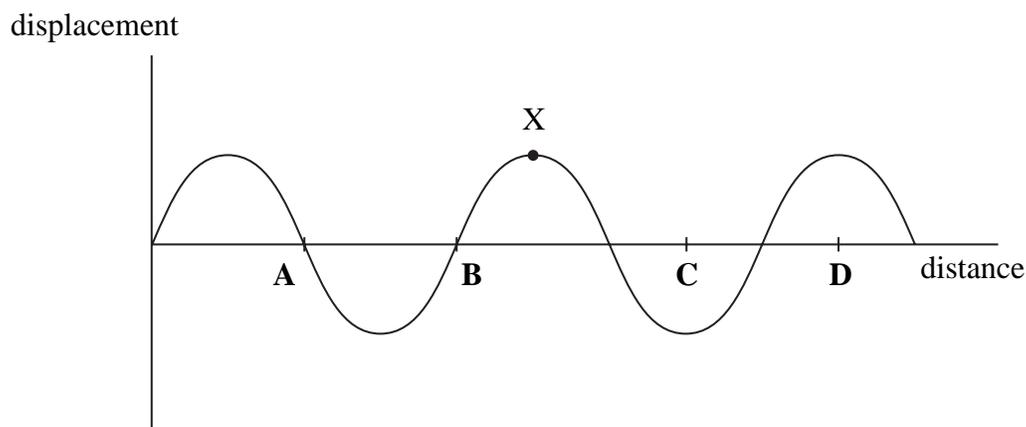
(Total for Question = 1 mark)

- 24 Ultrasound pulses are used to detect shoals of fish in the sea. A shoal of fish is at a depth of 300 m and the speed of ultrasound in water is 1500 m s^{-1} . The time interval between transmitting and receiving the pulse will be

- A** 0.20 s
- B** 0.40 s
- C** 2.5 s
- D** 5.0 s

(Total for Question = 1 mark)

- 25 The graph shows the displacement of molecules against their distance from a wave source. Which of the points A to D, marked on the graph, has a phase difference of 270° with point X?



- A
- B
- C
- D

(Total for Question = 1 mark)

- 26 Which of the following electromagnetic radiations has the highest frequency?

- A infrared
- B radio
- C ultraviolet
- D X-rays

(Total for Question = 1 mark)

27 Which of the following properties could **not** be demonstrated using sound waves?

- A diffraction
- B polarisation
- C reflection
- D refraction

(Total for Question = 1 mark)

28 A beam of light travels a distance X to arrive at a point. A second beam of light of the same frequency and initially in phase with the first beam, travels a distance Y to arrive at the same point. For destructive interference to occur between these two beams, the path difference $X-Y$ must equal

- A an odd number of wavelengths.
- B an even number of wavelengths.
- C an odd number of half wavelengths.
- D an even number of half wavelengths.

(Total for Question = 1 mark)

29 To be able to see smaller details in an ultrasound scan, you should

- A decrease the frequency of the ultrasound
- B decrease the wavelength of the ultrasound
- C increase the duration of the pulse of the ultrasound
- D increase the size of the screen to view the scan

(Total for Question = 1 mark)

30 An earthquake wave travels in an east-west direction in rocks.
The rocks are vibrating in a north-south direction.
The wave must be classified as a

- A** longitudinal wave
- B** standing wave
- C** stationary wave
- D** transverse wave

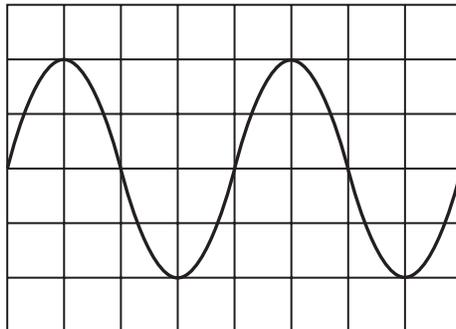
(Total for Question = 1 mark)

31 Which of the following summarises the change in wave characteristics when going from ultraviolet to infrared in the electromagnetic spectrum?

	Frequency	Speed (in a vacuum)
<input type="checkbox"/> A	decreases	decreases
<input type="checkbox"/> B	decreases	stays the same
<input type="checkbox"/> C	increases	decreases
<input type="checkbox"/> D	increases	stays the same

(Total for Question = 1 mark)

- 32 A particular sound is investigated by connecting a microphone to an oscilloscope. The diagram shows the trace of a sound wave on the oscilloscope. The screen of the oscilloscope has a grid on it. On the x-axis 1 division represents 5 ms.



The frequency of the sound wave is

- A 0.05 Hz
- B 0.1 Hz
- C 50 Hz
- D 100 Hz

(Total for Question 1 mark)

- 33 Two coherent sources emit waves of wavelength λ which are in phase. The two waves meet at a point, having travelled slightly different distances. The waves now have a phase difference of 180° (π radians).

Which of the following could be the path difference at this point?

- A $\frac{\lambda}{4}$
- B $\frac{\lambda}{2}$
- C $\frac{3\lambda}{4}$
- D λ

(Total for Question 1 mark)

34 Ultrasound is used to investigate the blood in an artery in a human body by detecting a Doppler shift. This Doppler shift is used to measure the

- A diameter of the artery.
- B size of the particles in the blood.
- C temperature of the blood.
- D velocity of the blood.

(Total for Question 1 mark)

35 Which of the following electromagnetic radiations has the lowest frequency?

- A gamma
- B infrared
- C ultraviolet
- D X-rays

(Total for Question 1 mark)

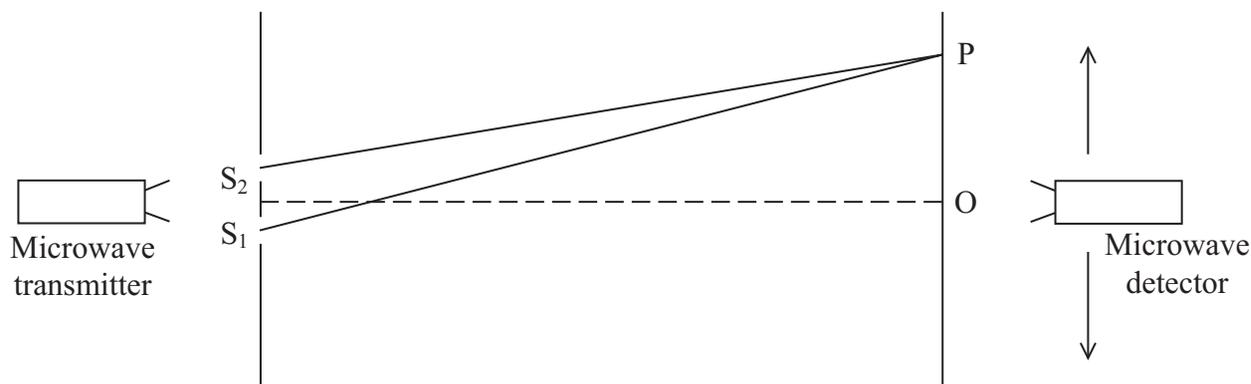
36 Two loudspeakers produce identical sounds of frequency 440 Hz which superpose to produce a standing wave. Adjacent nodes are formed 0.75 m apart.

Select the correct statement about the waves.

- A The frequency heard is 880 Hz.
- B The speed of the waves is 165 m s^{-1} .
- C The wavelength of the waves is 1.5 m.
- D The waves are travelling in the same direction.

(Total for Question 1 mark)

- 37 The diagram shows an experiment set up to demonstrate two-source interference, using microwaves of wavelength λ .



The detector is moved from O in the direction of the upwards arrow. The first position where the signal is a minimum is P.

The equation that correctly determines the position of P is

- A $OP = \lambda$
- B $OP = \lambda/2$
- C $S_1P - S_2P = \lambda$
- D $S_1P - S_2P = \lambda/2$

(Total for Question 1 mark)

- 38 Early experiments to measure the speed of light involved timing pulses of light being reflected back from distant mirrors. If a pulse of light was emitted and then 0.24 ms later, the distance to the mirror was _____ detected

- A 7.2×10^7 m
- B 3.6×10^7 m
- C 7.2×10^4 m
- D 3.6×10^4 m

(Total for Question 1 mark)

39 The magnitude of the fractional change in frequency, $\Delta f/f$, produced in the Doppler effect depends upon

- A the relative velocity of the source and the observer.
- B the wavelength of the radiation being emitted by the source.
- C whether it is the source or the observer that is moving.
- D whether the source and observer are approaching or receding.

(Total for Question 1 mark)

40 A stationary observer hears a sound emitted by a moving source.

This produces a Doppler effect which is a

- A change in frequency of the sound emitted by the source.
- B change in frequency of the sound heard by the observer.
- C change in velocity of the sound emitted by the source.
- D change in velocity of the sound heard by the observer.

(Total for Question 1 mark)

41 Two waves have the same frequency and are travelling in the same medium. The two waves can produce a standing wave if they

- A have different amplitudes and travel in opposite directions.
- B have different amplitudes and travel in the same direction.
- C have the same amplitude and travel in opposite directions.
- D have the same amplitude and travel in the same direction.

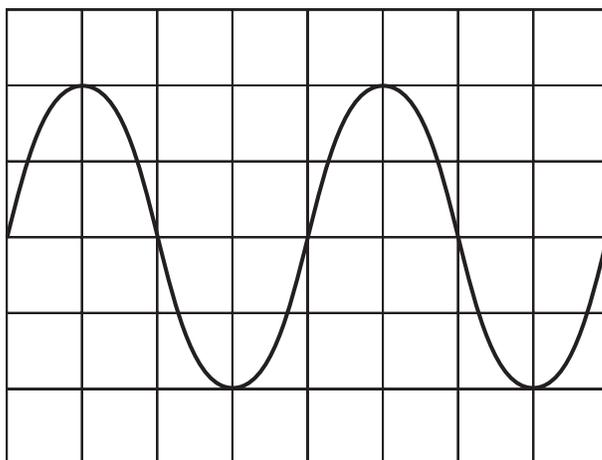
(Total for Question 1 mark)

42 Which of the following statements about standing waves is **not** true?

- A particles between adjacent nodes oscillate with varying amplitudes
- B particles between adjacent nodes are moving in phase with each other
- C particles immediately either side of a node are moving in opposite directions
- D particles undergo no disturbance at an antinode

(Total for Question = 1 mark)

43 A cathode ray oscilloscope can be used to show how the displacement of a wave varies with time. Each square in the horizontal direction represents 5.00 ms.



The frequency of the wave is

- A 25 Hz
- B 50 Hz
- C 250 Hz
- D 500 Hz

(Total for Question = 1 mark)

44 A source of sound moves away from an observer at a steadily increasing speed. Compared with the original sound, the wavelength reaching the observer will be

- A greater and decreasing.
- B greater and increasing.
- C smaller and decreasing.
- D smaller and increasing.

(Total for Question = 1 mark)

45 Which one of the following does **not** apply to sound waves?

- A They transmit energy.
- B They travel faster in a vacuum.
- C They result from vibrations.
- D They are longitudinal waves.

(Total for Question = 1 mark)

46 Two coherent sources emit waves of wavelength λ in phase. At a point where the two waves meet they have a phase difference of 90° ($\frac{\pi}{2}$ radians). Which of the following could be the path difference at this point?

- A 2λ
- B λ
- C $\frac{\lambda}{2}$
- D $\frac{\lambda}{4}$

(Total for Question = 1 mark)

47 The speed of sound in steel is 6000 m s^{-1} . The wavelength of an ultrasound wave of frequency 50 kHz travelling through a steel girder is

- A 0.0083 m
- B 0.12 m
- C 8.3 m
- D 120 m

(Total for Question = 1 mark)

48 When a fire engine moves away from an observer, the pitch of the siren heard by the observer decreases. This is because

- A the wavelength of the sound wave decreases
- B the speed of the fire engine increases
- C the frequency of the siren decreases
- D the distance travelled by each wavefront increases

(Total for Question = 1 mark)

49 A glass tube, closed at one end, has a loudspeaker placed at the other end. This is used to create a vibrating column of air, producing sound.

The wave in the tube is best described as

- A longitudinal and progressive.
- B longitudinal and standing.
- C transverse and progressive.
- D transverse and standing.

(Total for Question = 1 mark)

50 Which of the following does **not** apply to longitudinal waves?

- A coherence
- B polarisation
- C superposition
- D transmission

(Total for Question = 1 mark)

51 Waves from a point light source follow separate paths and recombine at a point after travelling different distances.

When the waves recombine the path difference is $\lambda/2$. The corresponding phase difference is

- A 360°
- B $\pi/2$ radians
- C 180°
- D 2π radians

(Total for Question = 1 mark)

52 Which type of electromagnetic radiation is used for communicating with satellites?

- A infrared
- B microwave
- C ultraviolet
- D visible light

(Total for Question = 1 mark)

53 A standing wave is created on a string stretched between two supports.

Which statement is always true?

- A** There is a node at each end.
- B** There is a node in the centre.
- C** There is an antinode at each end.
- D** There is an antinode in the centre.

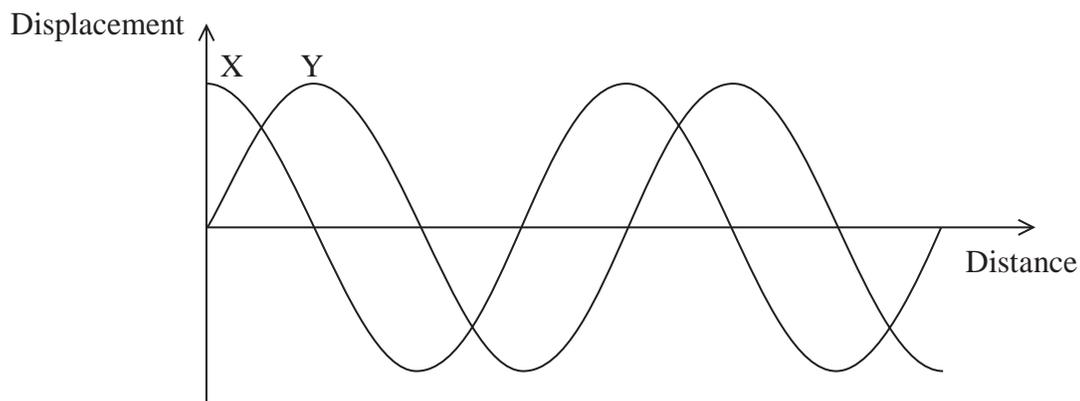
(Total for Question = 1 mark)

54 Which term may be defined as the number of waves passing a point in one second?

- A** wave speed
- B** wavelength
- C** period
- D** frequency

(Total for Question = 1 mark)

- 55 The diagram shows a displacement–distance graph at an instant for two waves, X and Y, travelling to the right.



Which of the following statements correctly describes the phase relationship between the two waves?

- A X and Y are in antiphase
- B X and Y are in phase
- C X is $\pi/2$ radians ahead of Y
- D Y is $\pi/2$ radians ahead of X

(Total for Question = 1 mark)