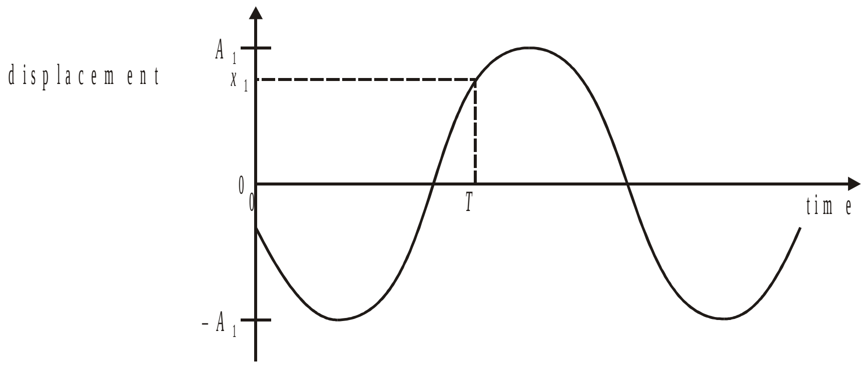
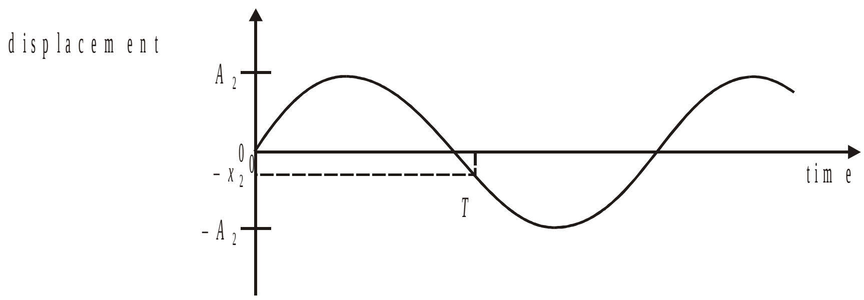
WAVE REVIEW

1. The two graphs show the variation with time of the individual displacements of two waves as they pass through the same point.





The displacement of the resultant wave at the point at time T is equal to

A. $x_1 + x_2$.

B. $x_1 - x_2$.

C. $A_1 + A_2$.

D. $A_1 - A_2$.

(1)

2. In a double-slit experiment using light of wavelength λ, 3 fringe spacings are observed per centimetre on the screen. When light of wavelength $\frac{\lambda}{2}$ is used, the number of fringe spacings observed per centimetre is

A. $\frac{2}{3}$.

B. $\frac{3}{2}$.

C. 3.

D. 6.

(1)

3. For a standing wave, all the particles between two successive nodes have the same

A. amplitude only.

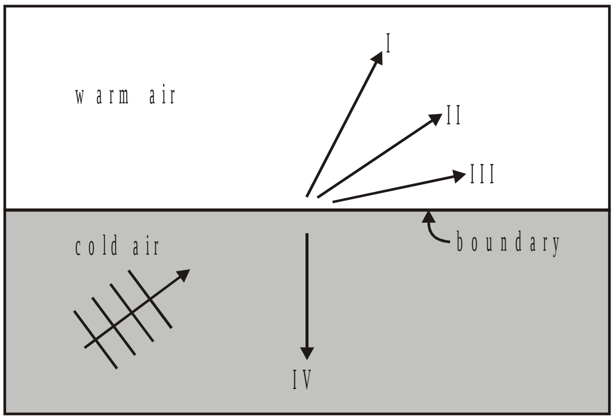
B. frequency only.

C. amplitude and frequency.

D. frequency and energy.

(1)

4. Sound waves move faster in warm air than in cold air. The diagram below shows plane waves in cold air moving towards a boundary with warm air.



Which of the arrows shows the possible direction of waves after reaching the boundary?

A. I

B. II

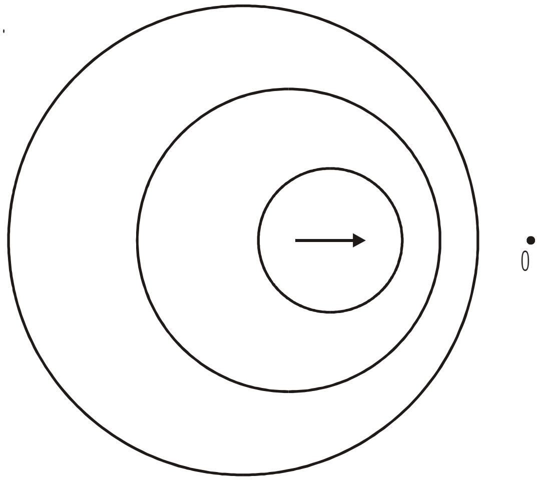
C. III

D. IV

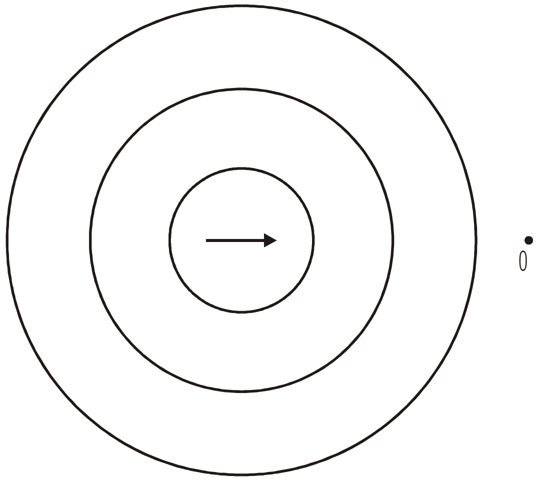
(1)

5. Which **one** of the following diagrams best represents wavefronts produced by a source of sound of constant frequency as it moves at constant speed towards a stationary observer at O?

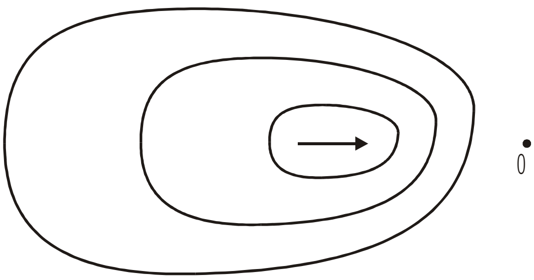
A.



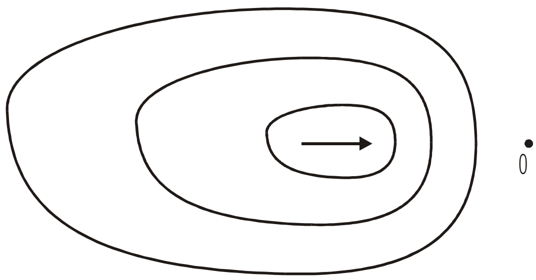
B.



C.

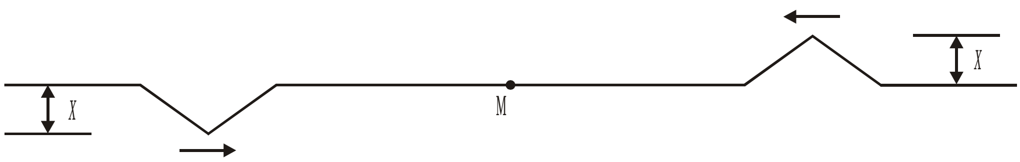


D.



(1)

7. Two identical triangular pulses of amplitude X travel toward each other along a string. At the instant shown on the diagram below, point M is midway between the two pulses.



The amplitude of the disturbance in the string as the pulses move through M is

A. $2X$.

B. X.

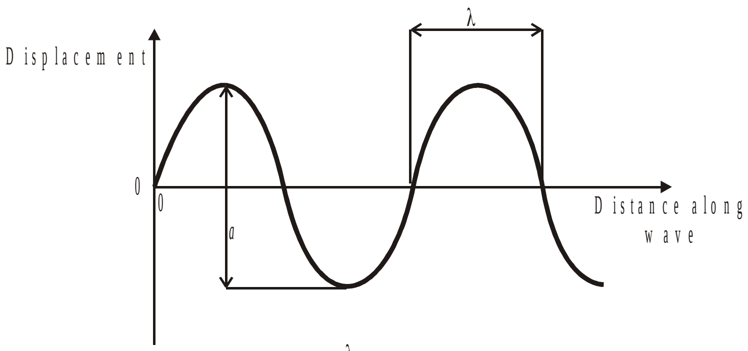
C. $\frac{X}{2}$

D. 0.

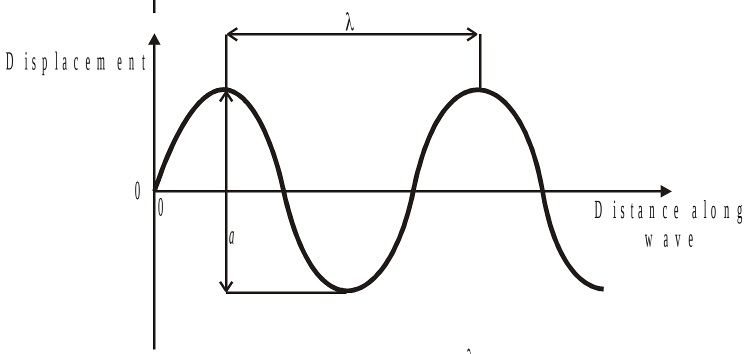
(1)

8. On which **one** of the following graphs is the wavelength λ and the amplitude a of a wave correctly represented?

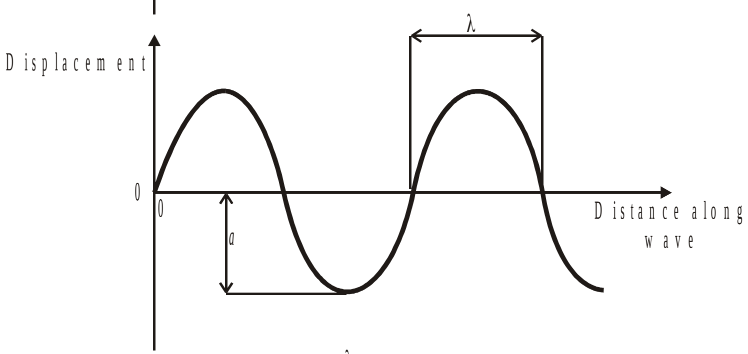
A.



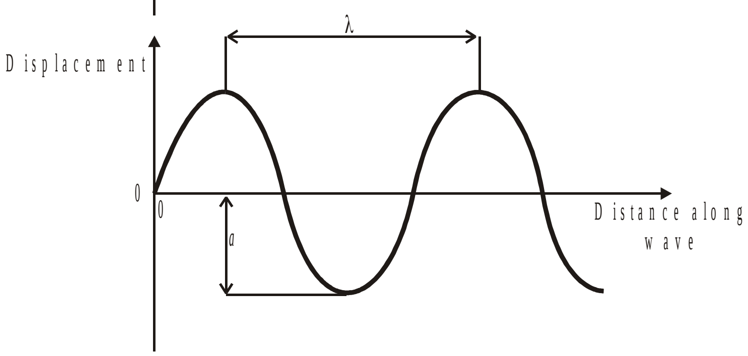
B.



C.

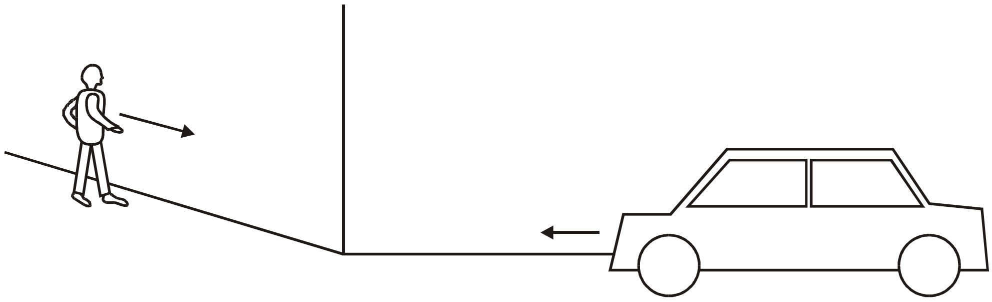


D.



(1)

9. A person is walking along one side of a building and a car is driving along another side of the building.



The person can hear the car approach but cannot see it. This is explained by the fact that sound waves

A. travel more slowly than light waves.

B. are diffracted more at the corner of the building than light waves.

C. are refracted more at the corner of the building than light waves.

D. are longitudinal waves.

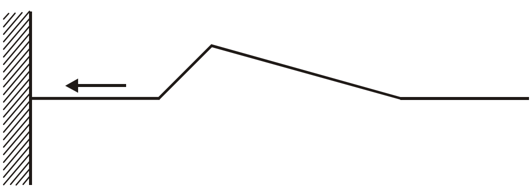
(1)

10. What change, if any, occurs in the wavelength and frequency of a light wave as it crosses a boundary from air into glass?

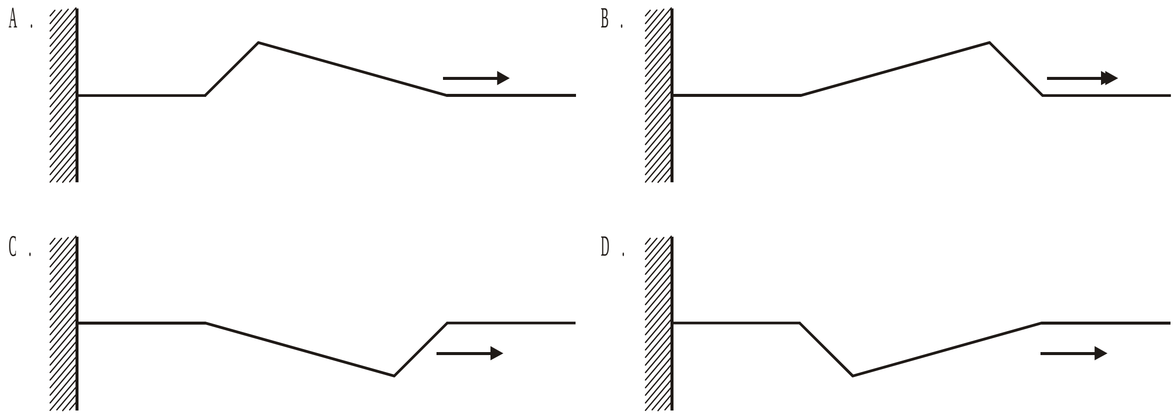
	Wavelength	**Frequency**
A.	Decreases	Decreases
B.	Decreases	Unchanged
C.	Increases	Increases
D.	Increases	Unchanged

(1)

11. A pulse is sent down a string fixed at one end.



Which **one** of the following diagrams best represents the reflected pulse?



(1)

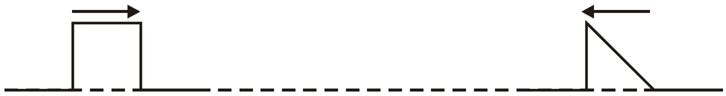
12. A piano tuner strikes and holds down the key on a piano that should produce a sound of frequency 440 Hz. At the same time he sounds a tuning fork that is known to have a frequency of 440 Hz. The resulting sound heard by the piano tuner fluctuates in loudness with a frequency of 2 Hz.

Which **one** of the following could be the frequency of the sound produced by the piano and the frequency of the sound heard by the piano tuner?

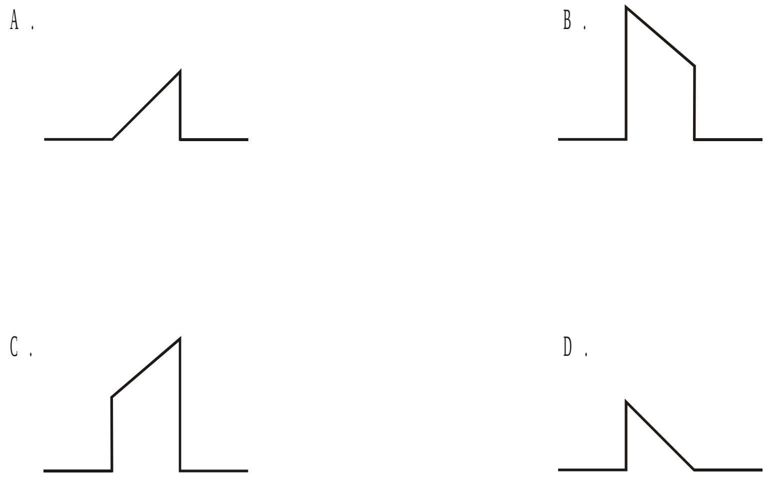
	Piano sound frequency / Hz	**Frequency of sound heard by piano tuner / Hz**
A.	438	441
B.	439	438
C.	441	442
D.	442	441

(1)

13. The diagram below shows two wave pulses moving towards one another.



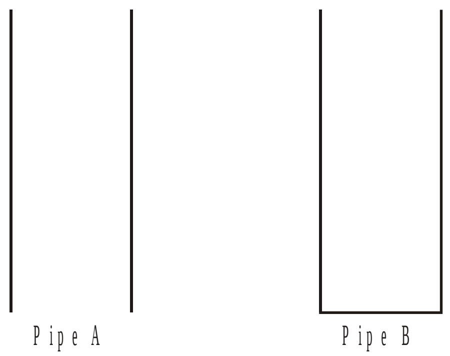
Which **one** of the following diagrams shows the resultant pulse when the two pulses are superposed?



(1)

14. This question is about standing waves in pipes.

The diagram below shows two pipes of the same length. Pipe A is open at both ends and pipe B is closed at one end.



(a) (i) On the diagrams above, draw lines to represent the waveforms of the fundamental (first harmonic) resonant note for each pipe.

(2)

(ii) On each diagram, label the position of the nodes with the letter N and the position of the antinodes with the letter A.

(2)

The frequency of the fundamental note for pipe A is 512 Hz.

(b) (i) Calculate the length of the pipe A. (Speed of sound in air = 325 m s^{-1})

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(3)

(ii) Suggest why organ pipes designed to emit low frequency fundamental notes (*e.g.* frequency ≈ 32 Hz) are often closed at one end.

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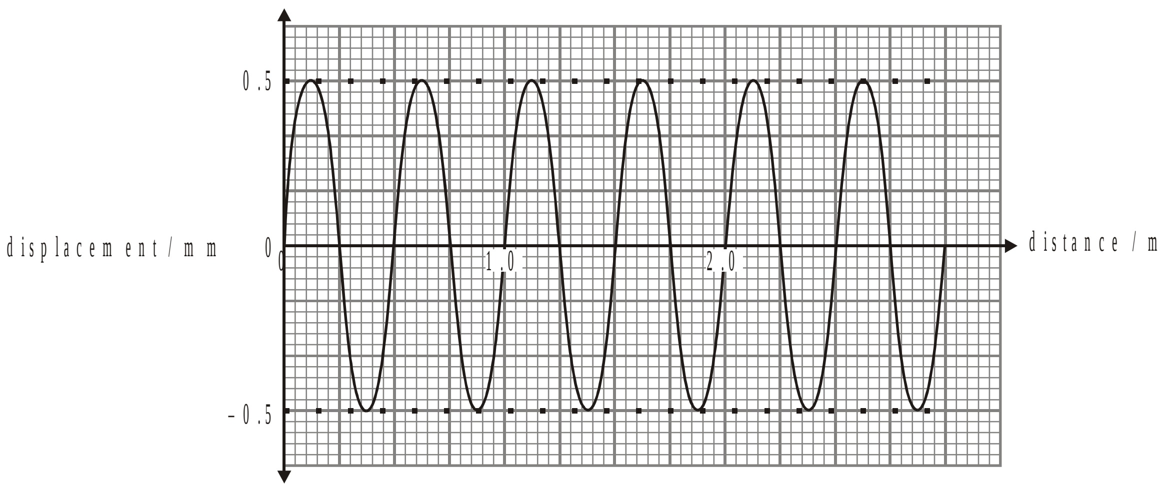
(2)
(Total 9 marks)

15. This question is about sound waves.

A sound wave of frequency 660 Hz passes through air. The variation of particle displacement with distance along the wave at one instant of time is shown below.



(a) State whether this wave is an example of a longitudinal **or** a transverse wave.

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(1)

(b) Using data from the above graph, deduce for this sound wave,

(i) the wavelength.

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(1)

(ii) the amplitude.

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(1)

(iii) the speed.

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(2)
(Total 5 marks)

16. This question is about waves and wave properties.

(a) (i) Describe what is meant by a *continuous travelling wave*.

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(2)

(ii) With reference to your answer in (a)(i), state what is meant by the speed of a travelling wave.

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(1)

(b) Define, for a wave,

(i) *frequency*.

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(1)

(ii) *wavelength*.

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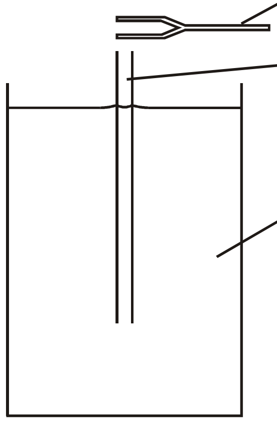
(1)

A tube that is open at both ends is placed in a deep tank of water, as shown below.



A tuning fork of frequency 256 Hz is sounded continuously above the tube. The tube is slowly raised out of the water and, at one position of the tube, a maximum loudness of sound is heard.

(c) (i) Explain the formation of a standing wave in the tube.

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(2)

(ii) The tube is raised a further small distance. Explain, by reference to resonance, why the loudness of the sound changes.

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(4)

(iii) The tube is gradually raised from a position of maximum loudness until the next position of maximum loudness is reached. The length of the tube above the water surface is increased by 65.0 cm. Calculate the speed of sound in the tube.

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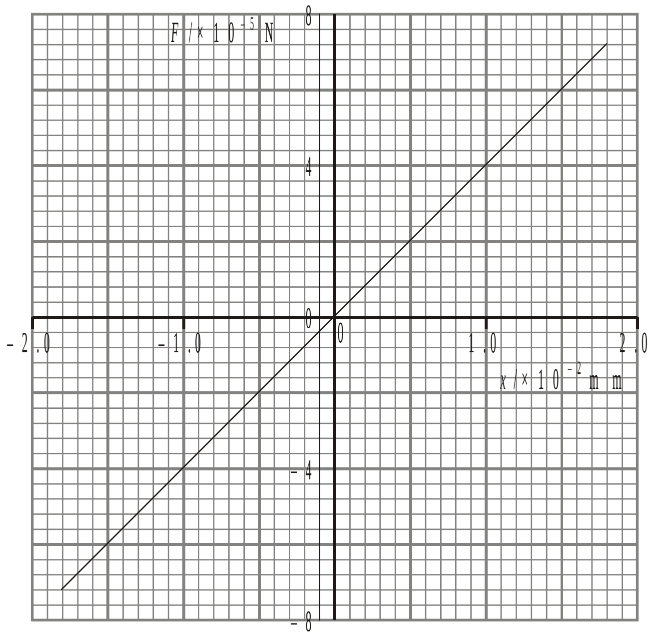
(2)

A sound wave is incident on the ear of a person. The pressure variation of the sound wave causes a force F to be exerted on a moveable part of the ear called the eardrum. The variation of the displacement x of the eardrum caused by the force F is shown below.



(d) The eardrum has an area of 30 mm^2. Calculate the pressure, in pascal, exerted on the eardrum for a displacement x of 1.0×10^{-2} mm.

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(2)

(e) (i) Calculate the energy required to cause the displacement to change from $x = 0$ to $x = +1.5 \times 10^{-2}$ mm.

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(3)

The sound wave causing a maximum displacement of the eardrum of 1.5×10^{-2} mm has frequency 1000 Hz.

(ii) Deduce that the energy causing the displacement in (e)(i) is delivered in a time of 0.25 ms. Also, determine the mean power of the sound wave to cause this displacement.

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(4)

(iii) Suggest the form of energy into which the energy of the sound wave has been transformed at the eardrum.

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(1)

In an experiment to measure the speed of sound, two coherent sources S_1 and S_2 produce sound waves of frequency 1700 Hz. A sound detector is moved along a line AB, parallel to S_1S_2 as shown below.

When the detector is at P, such that $S_1P = S_2P$, maximum loudness of sound is detected. As the detector is moved along AB, regions of minimum and maximum loudness are detected. Point X is the *third* position of minimum loudness from P. The distance ($S_2X - S_1X$) is 0.50 m.

(f) (i) Determine the speed of the sound.

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(3)

(ii) At X, no sound is detected. The loudness of the sound produced by S_1 alone is then reduced. State and explain the effect of this change on the loudness of sound heard at X and at P.

at X: ....

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....

at P: ....

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(4)
(Total 30 marks)

17. This question is about wave properties and interference.

The diagram below represents the direction of oscillation of a disturbance that gives rise to a wave.

(a) By redrawing the diagram in the spaces below, add arrows to show the direction of wave energy transfer to illustrate the difference between

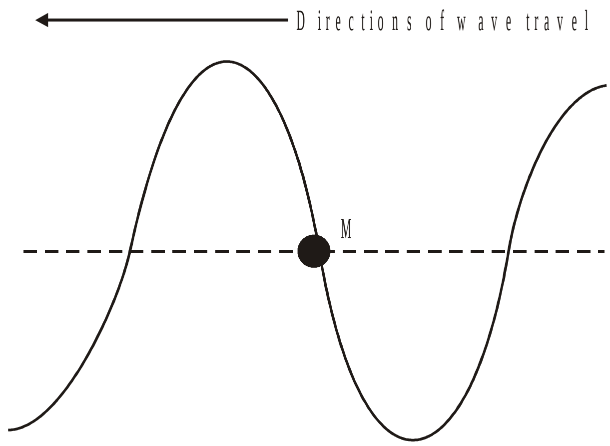
(i) a transverse wave and

(1)

(ii) a longitudinal wave.

(1)

A wave travels along a stretched string. The diagram below shows the variation with distance along the string of the displacement of the string at a particular instant in time. A small marker is attached to the string at the point labelled M. The undisturbed position of the string is shown as a dotted line.



(b) On the diagram above

(i) draw an arrow to indicate the direction in which the marker is moving.

(1)

(ii) indicate, with the letter A, the amplitude of the wave.

(1)

(iii) indicate, with the letter λ, the wavelength of the wave.

(1)

(iv) draw the displacement of the string a time $\frac{T}{4}$ later, where T is the period of oscillation of the wave. Indicate, with the letter N, the new position of the marker.

(2)

The wavelength of the wave is 5.0 cm and its speed is 10 cm s^{-1}.

(c) Determine

(i) the frequency of the wave.

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(1)

(ii) how far the wave has moved in $\frac{T}{4}$ s.

Interference of waves

(d) By reference to the principle of superposition, explain what is meant by constructive interference.

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(4)

18. This question is about waves and wave motion.

(a) Describe, by reference to the propagation of energy, what is meant by a transverse wave.

Transverse wave

(2)

(b) State **one** example, other than a wave on a string, of a transverse wave.

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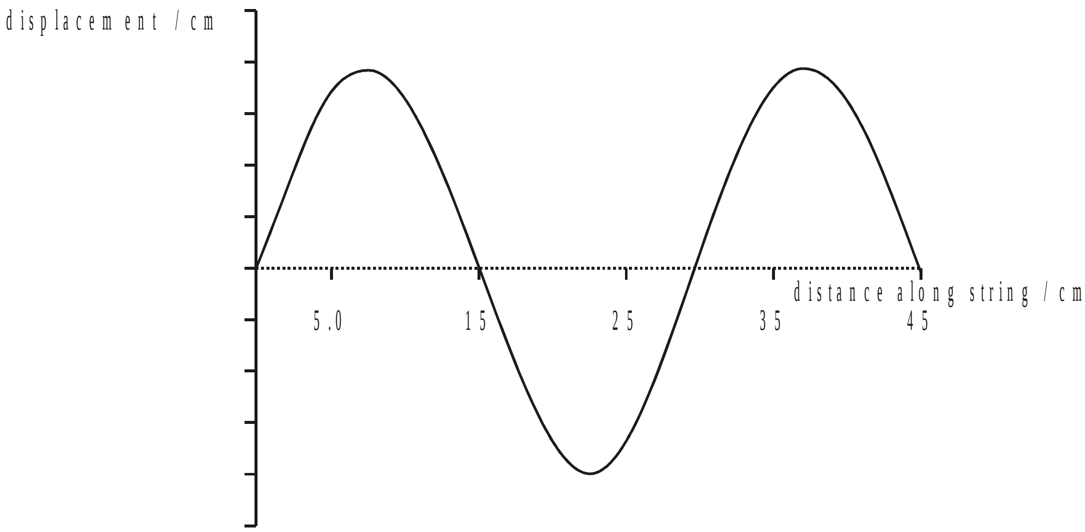
(1

A transverse wave is travelling along a string that is under tension. The diagram below shows the displacement of part of the string at time $t = 0$. The dotted line shows the position of the string when there is no wave travelling along it.



(c) On the diagram above, draw lines to identify for this wave

(i) the amplitude (label this A).

(1)

(ii) the wavelength (label this λ).

(1)

(d) The period of the wave is 1.2×10^{-3} s. Deduce that the speed of the wave is 250 m s^{-1}.

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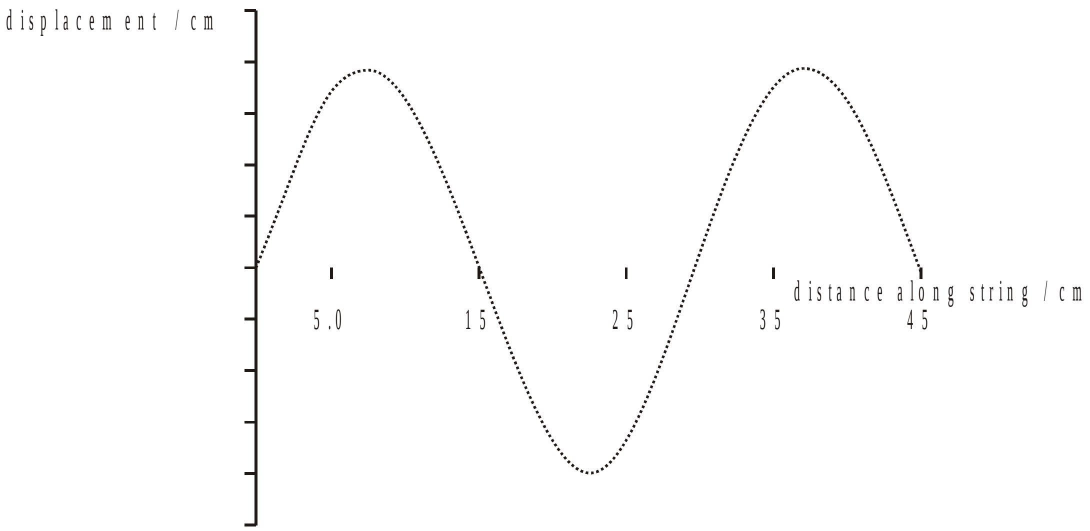
(2)

(e) Using the axes below, draw the displacement of the string when $t = 3.0 \times 10^{-4}$ s. (The displacement of the string at $t = 0$ is shown as a dotted line.)



(3)

The string is maintained at the same tension and is adjusted in length to 45 cm. It is made to resonate at its first harmonic (fundamental) frequency.

(f) Explain what is meant by resonance.

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(2)

(g) Describe how the string can be made to resonate at its first harmonic frequency only.

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(2)

(h) Determine the frequency of the first harmonic of the string.

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(2)
Total 16 marks