Wave Basics

Question paper 2

Level	International A Level
Subject	Physics
Exam Board	CIE
Topic	Waves
Sub Topic	Wave Basics
Paper Type	Theory
Booklet	Question paper 2

Time Allowed: **76 minutes**

Score: **/63**

Percentage: **/100**

A*	A	B	C	D	E	U
>85%	'77.5%	70%	62.5%	57.5%	45%	<45%

1 **(a)** Explain the principle of superposition.

.....

.....

.....[2]

(b) Sound waves travel from a source S to a point X along two paths SX and SPX, as shown in Fig. 5.1.

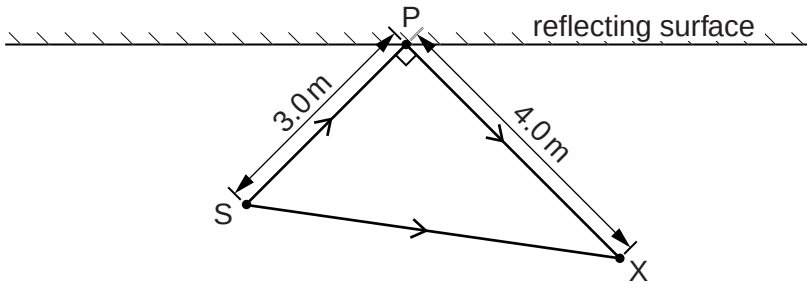

Fig. 5.1

(i) State the phase difference between these waves at X for this to be the position of

1. a minimum,

phase difference = ... unit .....[1]

2. a maximum.

phase difference = ... unit .....[1]

(ii) The frequency of the sound from S is 400 Hz and the speed of sound is 320 m s^{-1}. Calculate the wavelength of the sound waves.

wavelength = ... m [2]

(iii) The distance SP is 3.0 m and the distance PX is 4.0 m. The angle SPX is 90°. Suggest whether a maximum or a minimum is detected at point X. Explain your answer.

.....

.....[2]

2 **(a)** State one property of electromagnetic waves that is **not** common to other transverse waves.

..... [1]

(b) The seven regions of the electromagnetic spectrum are represented by blocks labelled A to G in Fig. 5.1.

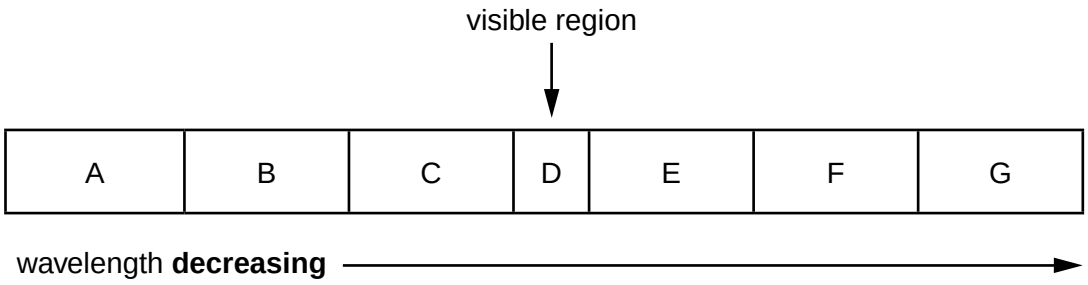

Fig. 5.1

A typical wavelength for the visible region D is 500 nm.

(i) Name the principal radiations and give a typical wavelength for each of the regions B, E and F.

B: name: ..... wavelength: ..... m

E: name: ..... wavelength: ..... m

F: name: ..... wavelength: ..... m
[3]

(ii) Calculate the frequency corresponding to a wavelength of 500 nm.

frequency = ... Hz [2]

(c) All the waves in the spectrum shown in Fig. 5.1 can be polarised. Explain the meaning of the term *polarised*.

.....

.....

.....

..... [2]

3 **(a)** By reference to vibrations of the points on a wave and to its direction of energy transfer, distinguish between transverse waves and longitudinal waves.

.....

.....

.....

..... [2]

(b) Describe what is meant by a *polarised* wave.

.....

.....

..... [2]

(c) The variation with distance x of the displacement y of a transverse wave is shown in Fig. 5.1.

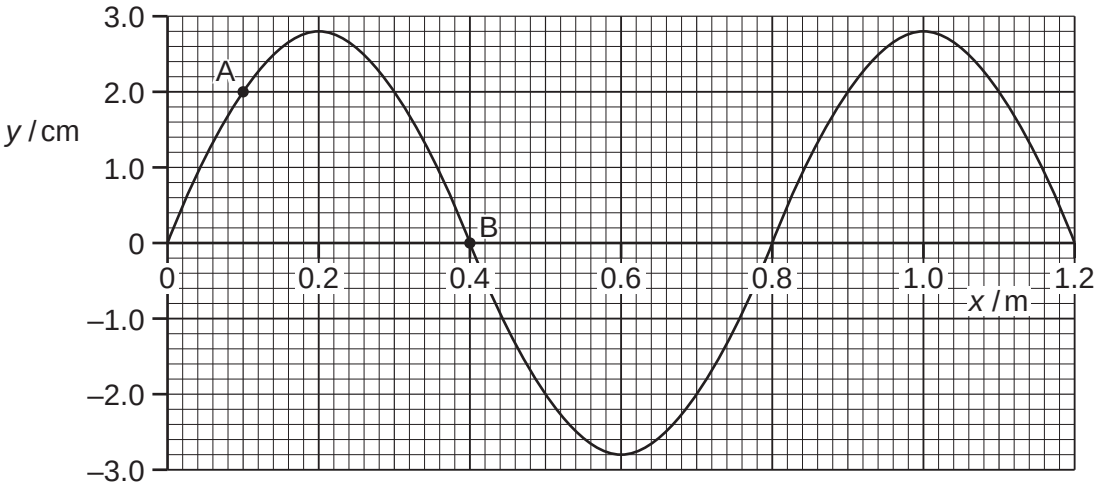

Fig. 5.1

(i) Use Fig. 5.1 to determine

1. the amplitude of the wave,

amplitude = ... cm [1]

2. the phase difference between the points labelled A and B.

phase difference = ... [2]

(ii) Determine the amplitude of a wave with twice the intensity of that shown in Fig. 5.1.

amplitude = ... cm [1]

4 **(a)** A transverse progressive wave travels along a stretched string from left to right. The shape of part of the string at a particular instant is shown in Fig. 6.1.

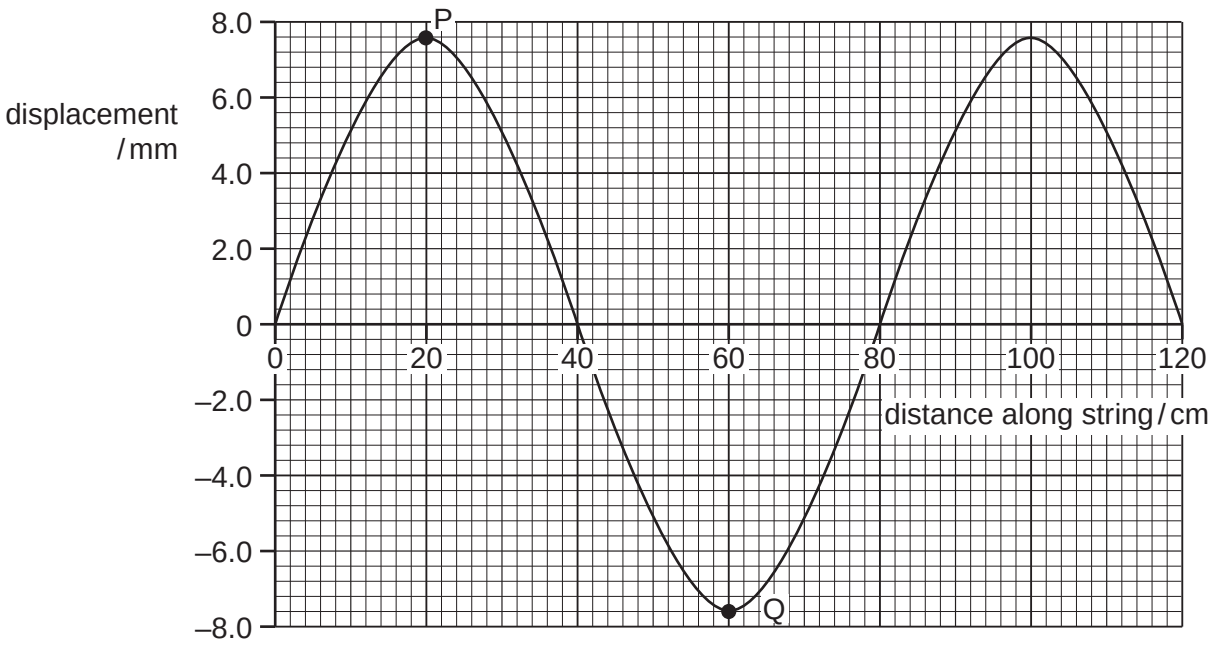

Fig. 6.1

The frequency of the wave is 15 Hz.
For this wave, use Fig. 6.1 to determine

(i) the amplitude,

amplitude = ... mm [1]

(ii) the phase difference between the points P and Q on the string,

phase difference = ... [1]

(iii) the speed of the wave.

speed = ... $m\,s^{-1}$ [2]

(b) The period of vibration of the wave is *T*. The wave moves forward from the position shown in Fig 6.1 for a time 0.25 *T*. On Fig. 6.1, sketch the new position of the wave. [2]

(c) Another stretched string is used to form a stationary wave. Part of this wave, at a particular instant, is shown in Fig. 6.2.

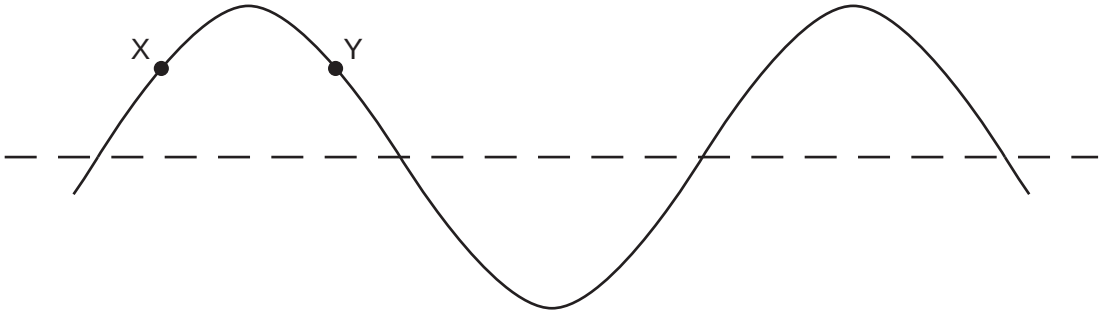

Fig. 6.2

The points on the string are at their maximum displacement.

(i) State the phase difference between the particles labelled X and Y.

phase difference = ... [1]

(ii) Explain the following terms used to describe stationary waves on a string:

antinode: .....

node: .....
[1]

(iii) State the number of antinodes shown on Fig. 6.2 for this wave.

number of antinodes = ... [1]

(iv) The period of vibration of this wave is τ. On Fig. 6.2, sketch the stationary wave $0.25\,\tau$ after the instant shown in Fig. 6.2. [1]

5 A student is studying a water wave in which all the wavefronts are parallel to one another. The variation with time t of the displacement x of a particular particle in the wave is shown in Fig. 5.1.

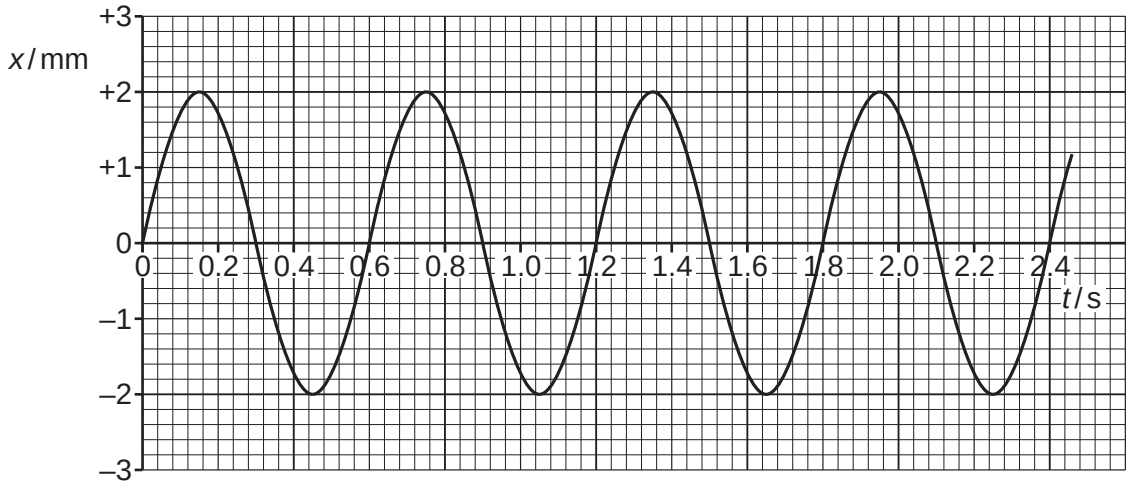

Fig. 5.1

The distance d of the oscillating particles from the source of the waves is measured. At a particular time, the variation of the displacement x with this distance d is shown in Fig. 5.2.

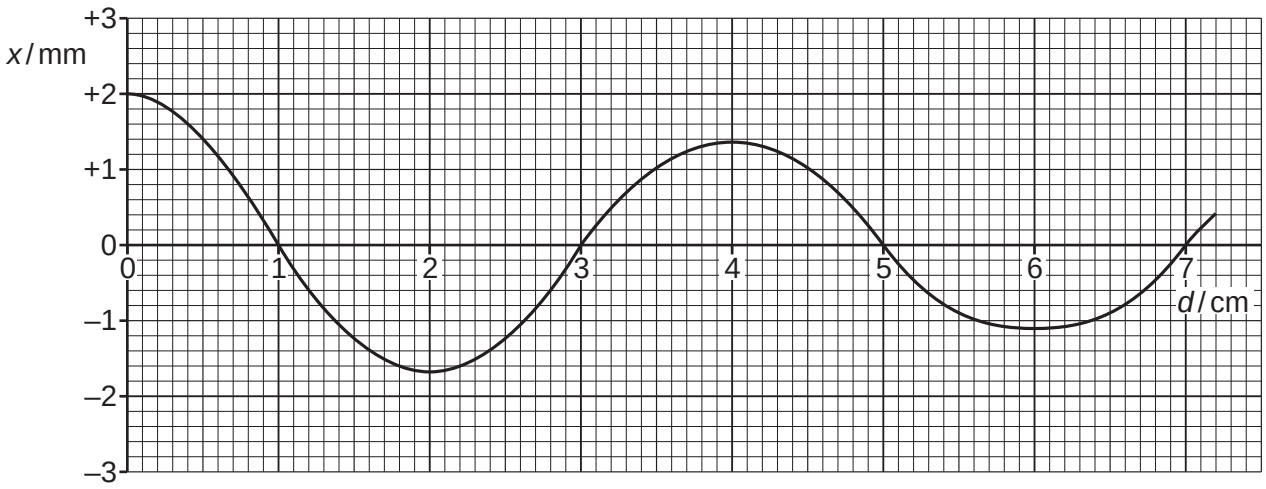

Fig. 5.2

(a) Define, for a wave, what is meant by

(i) *displacement*,

.....

.....[1]

(ii) *wavelength*.

.....

.....[1]

(b) Use Figs. 5.1 and 5.2 to determine, for the water wave,

(i) the period T of vibration,

T = ... s [1]

(ii) the wavelength λ,

λ = ... cm [1]

(iii) the speed v.

v = ... cm s^{-1} [2]

(c) **(i)** Use Figs. 5.1 and 5.2 to state and explain whether the wave is losing power as it moves away from the source.

.....

.....

.....[2]

(ii) Determine the ratio

$$\frac{\text{intensity of wave at source}}{\text{intensity of wave 6.0 cm from source}}.$$

ratio = ... [3]

6 **(a)** A source of sound has frequency *f*. Sound of wavelength λ is produced by the source.

(i) State

1. what is meant by the *frequency* of the source,

.....

.....[1]

2. the distance moved, in terms of λ, by a wavefront during *n* oscillations of the source.

distance = ...[1]

(ii) Use your answers in **(i)** to deduce an expression for the speed *v* of the wave in terms of *f* and λ.

[2]

(b) The waveform of a sound wave produced on the screen of a cathode-ray oscilloscope (c.r.o.) is shown in Fig. 5.1.

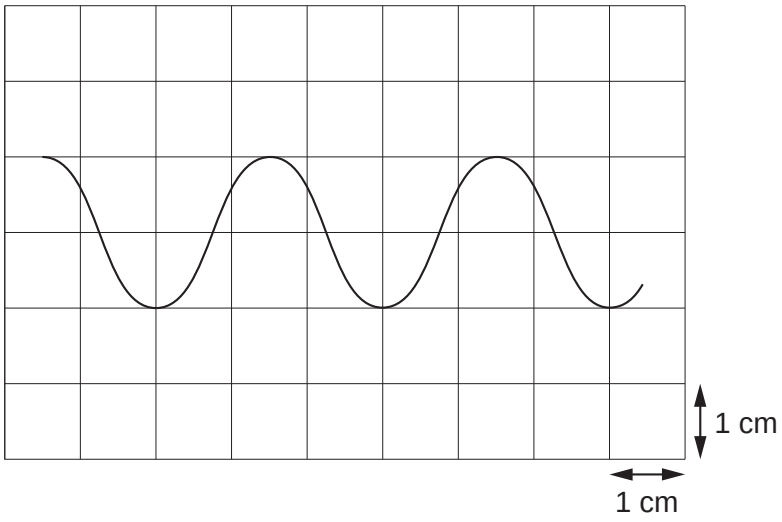

Fig. 5.1

The time-base setting of the c.r.o. is 2.0 ms cm^{-1}.

(i) Determine the frequency of the sound wave.

frequency = ...Hz [2]

(ii) A second sound wave has the same frequency as that calculated in **(i)**. The amplitude of the two waves is the same but the phase difference between them is 90°.

On Fig. 5.1, draw the waveform of this second wave. [1]

7 **(a)** State what is meant by a *progressive wave*.

.....

.....

..... [2]

(b) The variation with distance *x* along a progressive wave of a quantity *y*, at a particular time, is shown in Fig. 5.1.

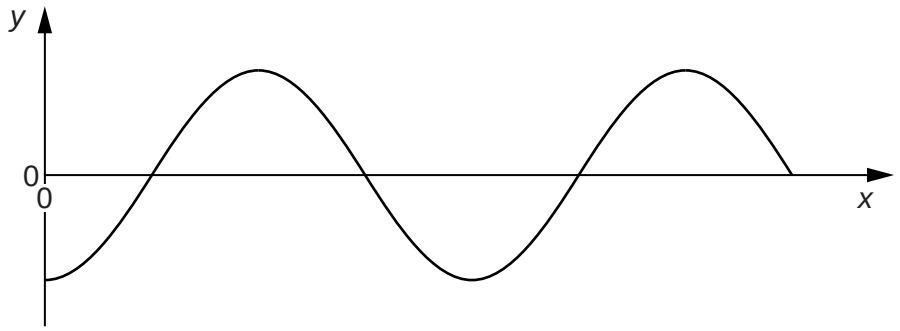

Fig. 5.1

(i) State what the quantity *y* could represent.

.....

..... [1]

(ii) Distinguish between the quantity *y* for

1. a transverse wave,

.....

..... [1]

2. a longitudinal wave.

.....

..... [1]

(c) The wave nature of light may be demonstrated using the phenomena of diffraction and interference.

Outline how diffraction and how interference may be demonstrated using light.
In each case, draw a fully labelled diagram of the apparatus that is used and describe what is observed.

diffraction

.....

.....

.....

interference

.....

.....

.....

[6]