Wave Basics

Question paper 1

Level	International A Level
Subject	Physics
Exam Board	CIE
Topic	Waves
Sub Topic	Wave Basics
Paper Type	Theory
Booklet	Question paper 1

Time Allowed: **80 minutes**

Score: **/66**

Percentage: **/100**

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

1 **(a)** State two differences between progressive waves and stationary waves.

1. .....

.....

2. .....

.....

[2]

(b) A source S of microwaves is placed in front of a metal reflector R, as shown in Fig. 6.1.

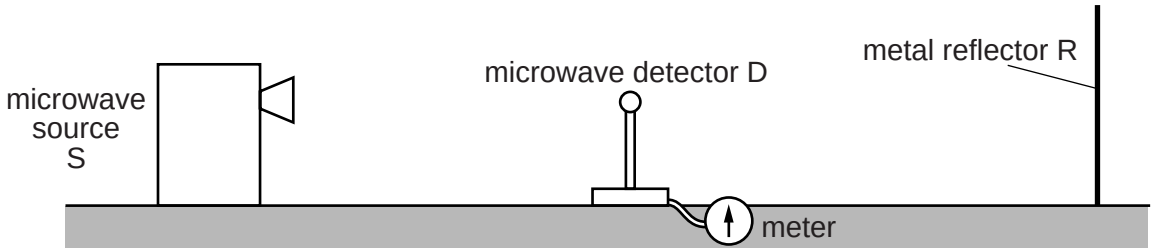

Fig. 6.1

A microwave detector D is placed between R and S.

Describe

(i) how stationary waves are formed between R and S,

.....

.....

.....

..... [3]

(ii) how D is used to show that stationary waves are formed between R and S,

.....

.....

..... [2]

(iii) how the wavelength of the microwaves may be determined using the apparatus in Fig. 6.1.

.....

.....

..... [2]

(c) The wavelength of the microwaves in **(b)** is 2.8 cm. Calculate the frequency, in GHz, of the microwaves.

frequency = ... GHz [3]

2 A microphone detects a musical note of frequency *f*. The microphone is connected to a cathode-ray oscilloscope (c.r.o.). The signal from the microphone is observed on the c.r.o. as illustrated in Fig. 2.1.

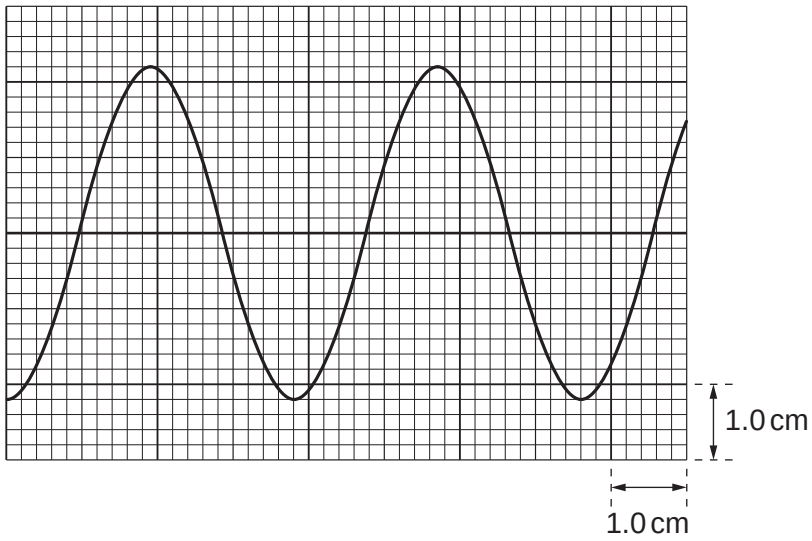

Fig. 2.1

The time-base setting of the c.r.o. is 0.50 ms cm^{-1}. The Y-plate setting is 2.5 mV cm^{-1}.

(a) Use Fig. 2.1 to determine

(i) the amplitude of the signal,

amplitude = ... mV [2]

(ii) the frequency *f*,

f = ... Hz [3]

(iii) the actual uncertainty in *f* caused by reading the scale on the c.r.o.

actual uncertainty = ... Hz [2]

(b) State *f* with its actual uncertainty.

f = ... ± ..... Hz [1]

3 **(a)** **(i)** Explain what is meant by a *progressive transverse* wave.

progressive: .....

.....

transverse: .....

.....

[2]

(ii) Define frequency.

.....

.....[1]

(b) The variation with distance *x* of displacement *y* for a transverse wave is shown in Fig. 7.1.

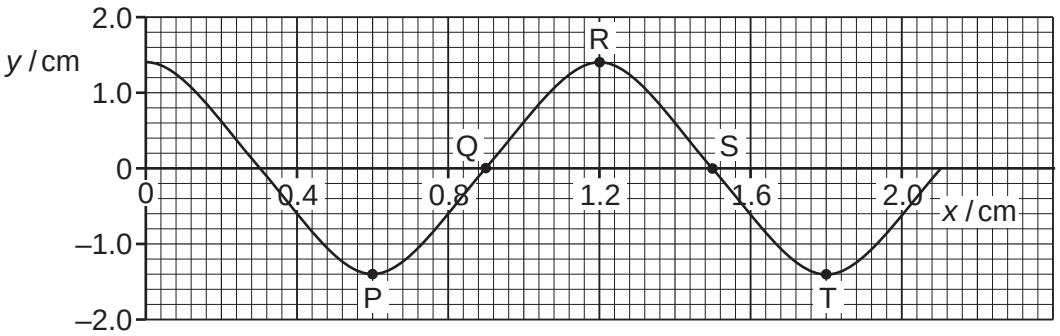

Fig. 7.1

On Fig. 7.1, five points are labelled.

Use Fig. 7.1 to state any two points having a phase difference of

(i) zero,

.....[1]

(ii) 270°.

.....[1]

(c) The frequency of the wave in **(b)** is 15 Hz.

Calculate the speed of the wave in **(b)**.

speed = ... $m\,s^{-1}$ [3]

(d) Two waves of the same frequency have amplitudes 1.4 cm and 2.1 cm.

Calculate the ratio

$$\frac{\text{intensity of wave of amplitude 1.4 cm}}{\text{intensity of wave of amplitude 2.1 cm}}.$$

ratio = ... [2]

4 **(a)** Explain what is meant by the following quantities for a wave on the surface of water:

(i) displacement and amplitude,

displacement .....

amplitude .....
[2]

(ii) frequency and time period.

frequency .....

time period .....
[2]

(b) Fig. 5.1 represents waves on the surface of water in a ripple tank at one particular instant of time.

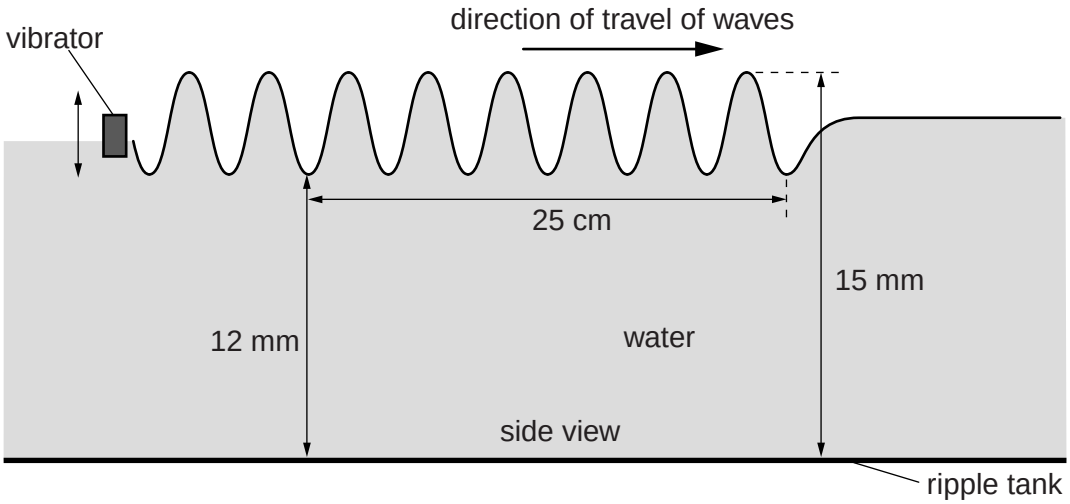

Fig. 5.1 (not to scale)

A vibrator moves the surface of the water to produce the waves of frequency *f*. The speed of the waves is 7.5 cm s^{-1}. Where the waves travel on the water surface, the maximum depth of the water is 15 mm and the minimum depth is 12 mm.

(i) Calculate, for the waves,

1. the amplitude,

amplitude = ... mm [1]

2. the wavelength.

wavelength = ... m [2]

(ii) Calculate the time period of the oscillations of the vibrator.

time period = ... s [2]

(c) State and explain whether the waves on the surface of the water shown in Fig. 5.1 are

(i) progressive or stationary,

.....

..... [1]

(ii) transverse or longitudinal.

.....

..... [1]

5 A source of radio waves sends a pulse towards a reflector. The pulse returns from the reflector and is detected at the same point as the source. The emitted and reflected pulses are recorded on a cathode-ray oscilloscope (c.r.o.) as shown in Fig. 2.1.

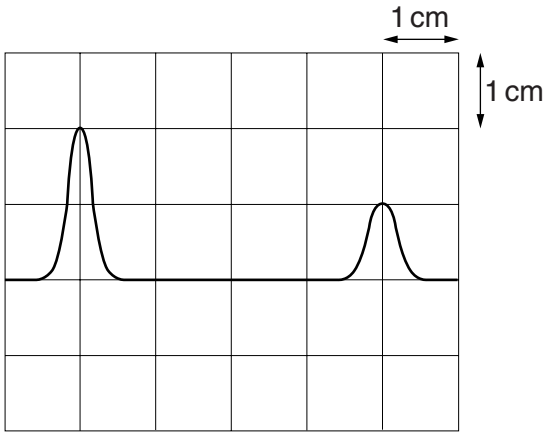

Fig. 2.1

The time-base setting is $0.20\,\mu s\,cm^{-1}$.

(a) Using Fig. 2.1, determine the distance between the source and the reflector.

distance = ... m [4]

(b) Determine the time-base setting required to produce the same separation of pulses on the c.r.o. when sound waves are used instead of radio waves.
The speed of sound is $300\,m\,s^{-1}$.

.....

.....

..... [3]

6 A long rope is held under tension between two points A and B. Point A is made to vibrate vertically and a wave is sent down the rope towards B as shown in Fig. 5.1.

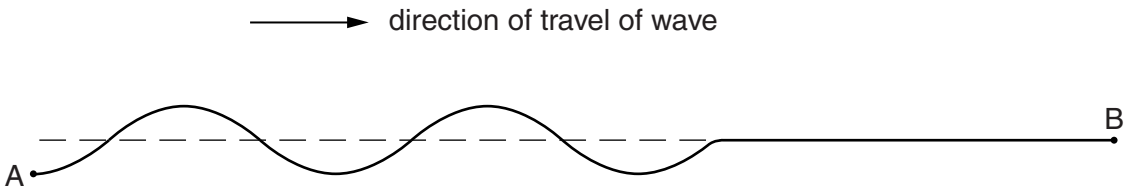

Fig. 5.1 (not to scale)

The time for one oscillation of point A on the rope is 0.20 s. The point A moves a distance of 80 mm during one oscillation. The wave on the rope has a wavelength of 1.5 m.

(a) **(i)** Explain the term *displacement* for the wave on the rope.

.....

..... [1]

(ii) Calculate, for the wave on the rope,

1. the amplitude,

amplitude = ... mm [1]

2. the speed.

speed = ... $m\,s^{-1}$ [3]

(b) On Fig. 5.1, draw the wave pattern on the rope at a time 0.050 s later than that shown. [2]

(c) State and explain whether the waves on the rope are

(i) progressive or stationary,

.....

..... [1]

(ii) longitudinal or transverse.

.....

..... [1]

7 **(a)** Distinguish between gravitational potential energy and elastic potential energy.

.....

.....

.....[2]

(b) A ball of mass 65 g is thrown vertically upwards from ground level with a speed of 16 m s^{-1}. Air resistance is negligible.

(i) Calculate, for the ball,

1. the initial kinetic energy,

kinetic energy = ... J [2]

2. the maximum height reached.

maximum height = ... m [2]

(ii) The ball takes time t to reach maximum height. For time $\frac{t}{2}$ after the ball has been thrown, calculate the ratio

$$\frac{\text{potential energy of ball}}{\text{kinetic energy of ball}}.$$

ratio = ... [3]

(iii) State and explain the effect of air resistance on the time taken for the ball to reach maximum height.

.....

.....

.....[1]