OCR
RECOGNISING ACHIEVEMENT

Candidate Name	Centre Number	Candidate Number

General Certificate of Education Advanced Subsidiary (AS)

PHYSICS (B) (Advancing Physics) PILOT 7731

UNDERSTANDING PROCESSES

Monday **19 JUNE 2000** Morning 1 hour 30 minutes

Candidates answer on the question paper.
Additional materials:
Data, Formulae and Relationships Booklet

TIME 1 hour 30 minutes

INSTRUCTIONS TO CANDIDATES

Write your name, Centre number and candidate number in the spaces at the top of this page.

Answer **all** questions.

Write your answers, in ink, in the spaces provided on the question paper. Extra paper must **not** be used.

Read each question carefully and make sure you know what you have to do before starting your answer.

Show clearly the working in all calculations, and round answers to only a justifiable number of significant figures.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets [ ] at the end of each question or part question.

The values of standard physical constants are given in the Data, Formulae and Relationships Booklet. Any additional data required are given in the appropriate question.

You are advised to spend about 20 minutes on Section A, 40 minutes on Section B and 30 minutes on Section C.

You are reminded of the need for good English and clear presentation in your answers.

FOR EXAMINER'S USE		
Section	**Max.**	**Mark**
A	20	
B	40	
C	30	
TOTAL	90	

This question paper consists of 18 printed pages and 2 blank pages.

Section A

1 A bungee jumper leaps from a high bridge with an elastic cord fastened to her ankles. Fig. 1 shows how her height above the ground varies with time from the instant she jumps off the bridge.

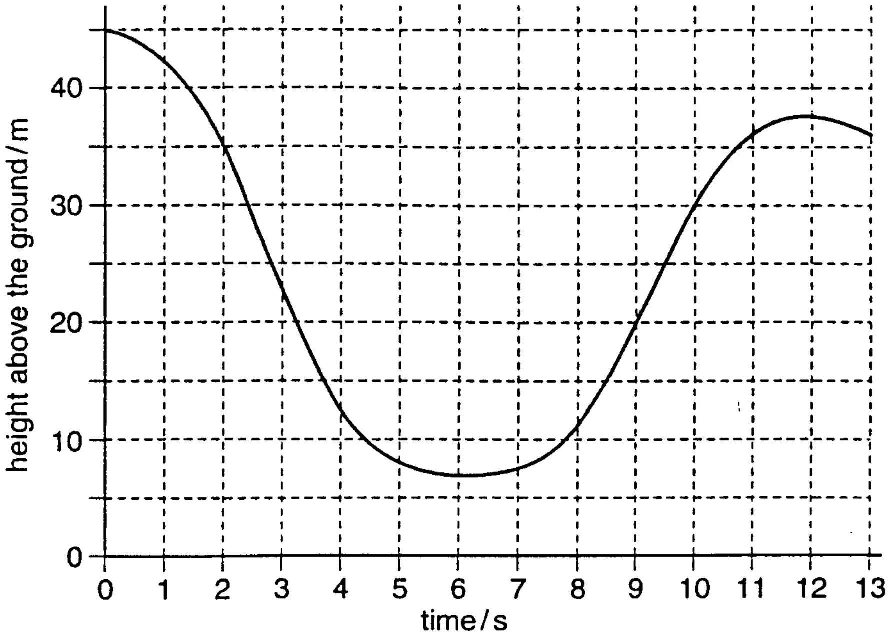

Fig. 1

(a) How long does it take for her to come to rest for the first time after jumping?

....[1]

(b) How can you tell that her average speed on the way down is greater than her average speed on the way back up again?

[2]

For Examiner's Use

2 A car manufacturer advertises that his car can be brought to rest from an initial speed of $30\,m\,s^{-1}$ (approximately 60 m.p.h.) in 3.3 s, when braking.

(a) Calculate the average deceleration of the car.

[1]

(b) Making an estimate for the mass of the driver, estimate the average force on the driver during braking, assuming he is held in his seat.

Mass of driver = ... kg

average force on driver = ... N [2]

3 An aircraft is flying due south at a speed of $250\,m\,s^{-1}$ relative to the air. Calculate its speed relative to the ground when the wind is blowing due east at $45\,m\,s^{-1}$.

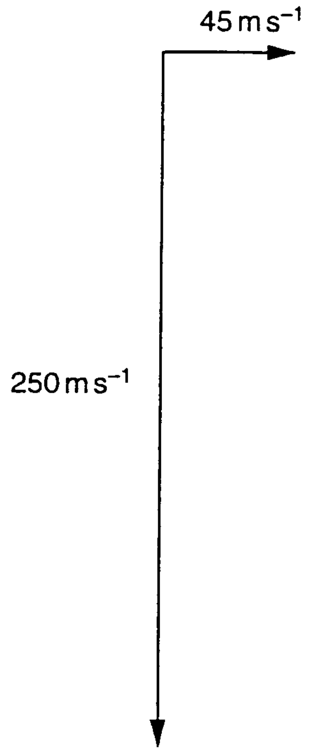

Fig. 3

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

4 Fig. 4 shows a diagram representing the electromagnetic spectrum.

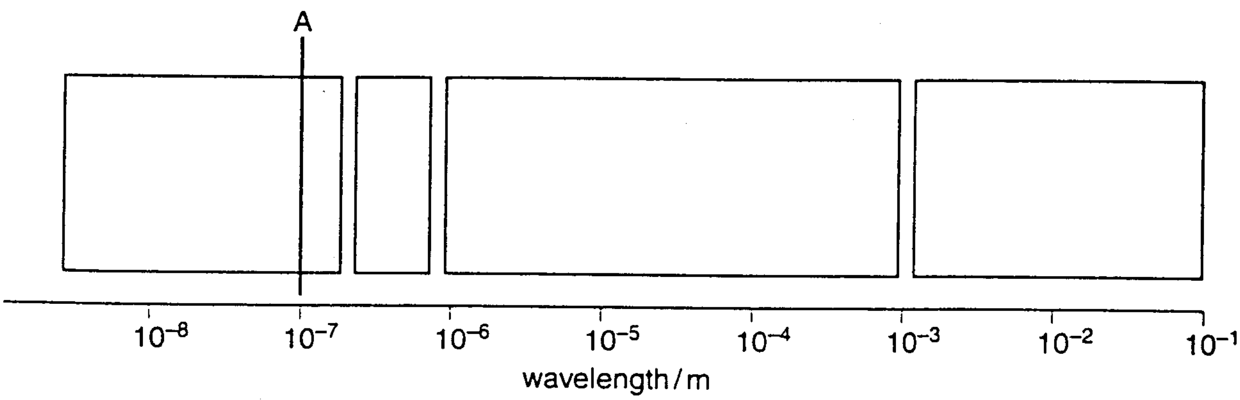

Fig. 4

(a) Write in the appropriate boxes on Fig. 4 the positions of the ultra-violet, infrared and microwave regions. [2]

(b) Write down the wavelength of the line A in nm.

Wavelength of A = ... nm [1]

For Examiner's Use

5 Fig. 5 shows two sine waves, A and B, plotted against time. The rotating phasors used to generate the waves are shown at $t = 0$.

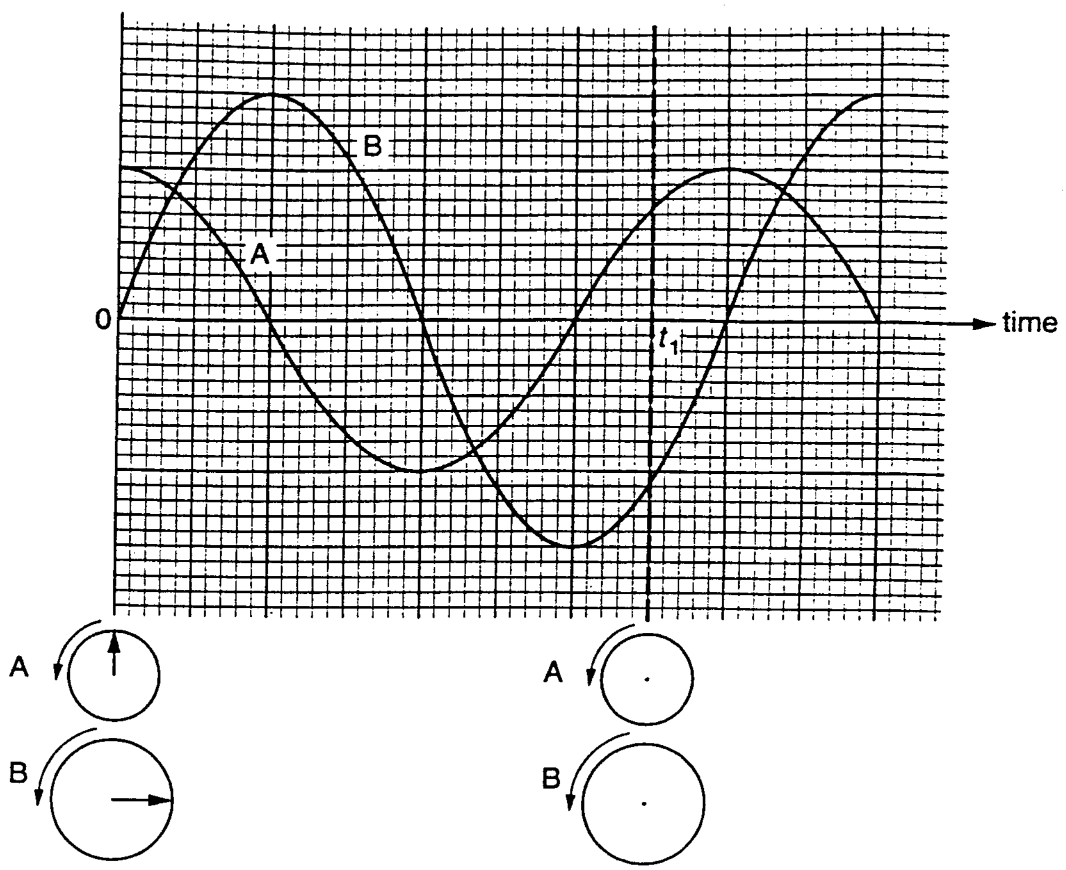

Fig. 5

(a) State the phase difference between A and B.

.... [1]

(b) Draw on Fig. 5 the positions of the rotating phasors for A and B at time t_1. [2]

6 The energy carried by light from an LED is radiated at a rate of 15 mW. The light emitted has a wavelength of 6.0×10^{-7} m. Calculate the number of photons emitted per second.

number of photons per second = ... [3]

For Examiner's Use

7 When seen in white light, a soap bubble appears coloured because light can be partially reflected from both surfaces of the bubble.

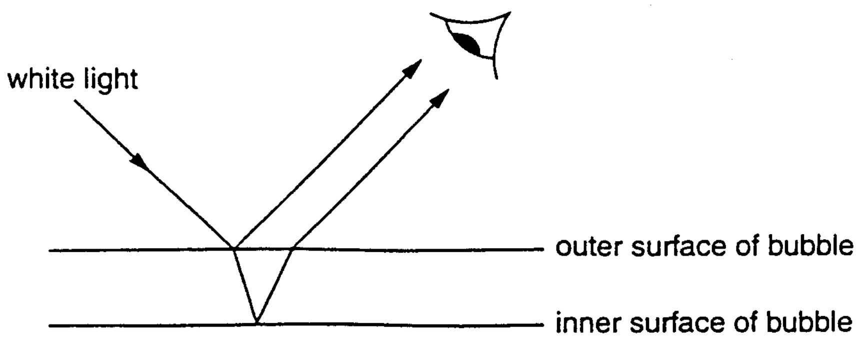

Fig. 7

Fig. 7 shows the paths of two rays of light partially reflected from a soap bubble. Looking in the direction shown, a part of the bubble appears green to the observer. Explain why the bubble appears coloured and what criteria determine the observed colour.

....

....

....

....

....[3]

For Examiner's Use

Section B

8 This question is about a ski jumper who skis down a ramp to start his jump (Fig. 8). Assume that the only force acting during his jump is gravity.

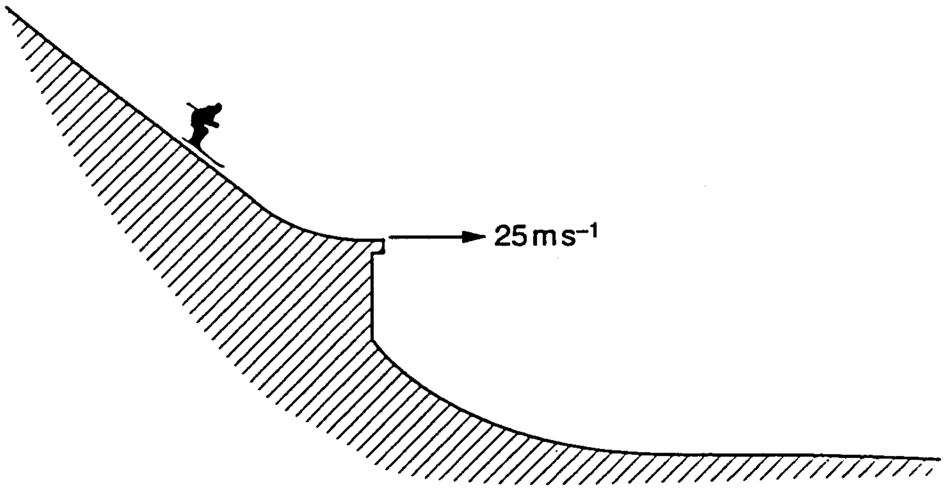

Fig. 8

(a) Describe the energy changes which take place as he skis down the ramp.

[3]

(b) He leaves the ramp horizontally with a speed of 25 m s^{-1}.

(i) Calculate how far he travels in the first 0.50 s in

1. the horizontal direction,

....

2. the vertical direction.

....

For Examiner's Use

(ii) He lands 3.5 s after leaving the ramp. At the instant before he touches down, calculate

1. the vertical component of his velocity,

vertical component of velocity = ... $m\,s^{-1}$

2. the angle to the horizontal at which he is moving.

angle to horizontal = ... °

[7]

(c) Your calculation has assumed that the only force acting is gravity. The situation is more complicated than this. There may be lift forces on the skis and drag forces due to air resistance. Discuss the effect of each of these on the length of the jump.

1. Effect of lift forces:

2. Effect of drag forces:

[2]

9 This question is about a journey made by train. Fig. 9 shows a speed against time graph for the journey.

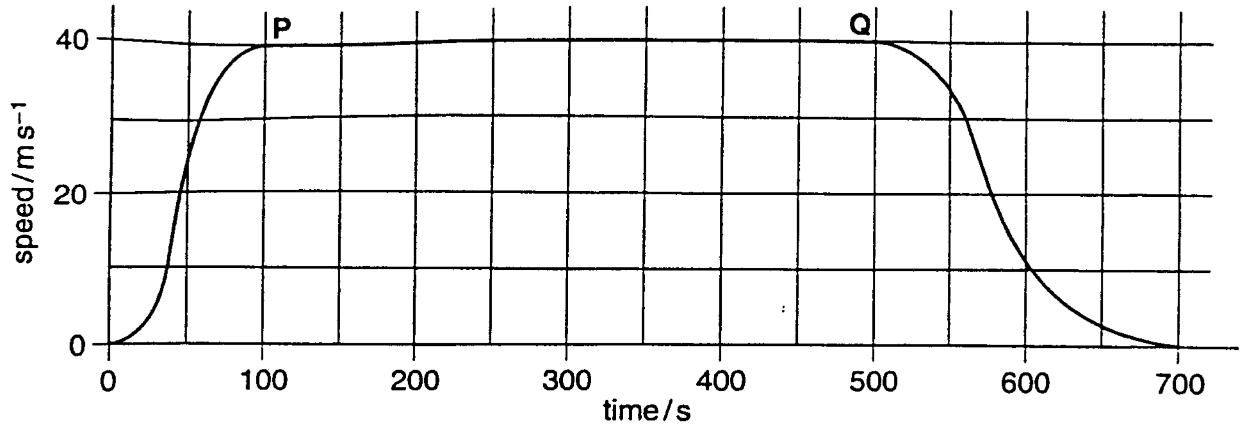

Fig. 9

(a) Show that the average acceleration of the train in the first 50 s is 0.5 m s^{-2}.

[2]

(b) In the section **PQ** of the graph the train travels at constant speed on level track. The engine produces power at a rate of 2.50 MW.

(i) Calculate the tractive force exerted by the engine.

tractive force = ... N

For Examiner's Use

(ii) Explain why the engine needs to produce a large power output even though the train is travelling at constant speed on level track.

[4]

(c) Use the graph to estimate the total distance travelled in the train journey.

total distance = ... m [3]

For Examiner's Use

10 This question is about the diffraction of light by a reflection grating formed by a CD (compact disc).

(a) Fig. 10 shows a beam of light illuminating a reflection grating. A_1, A_2, A_3 and A_4 are four reflecting strips. Light reflected from the grating in the direction shown produces a bright image on a distant screen. The diagram also shows the wave crests drawn for light leaving A_1.

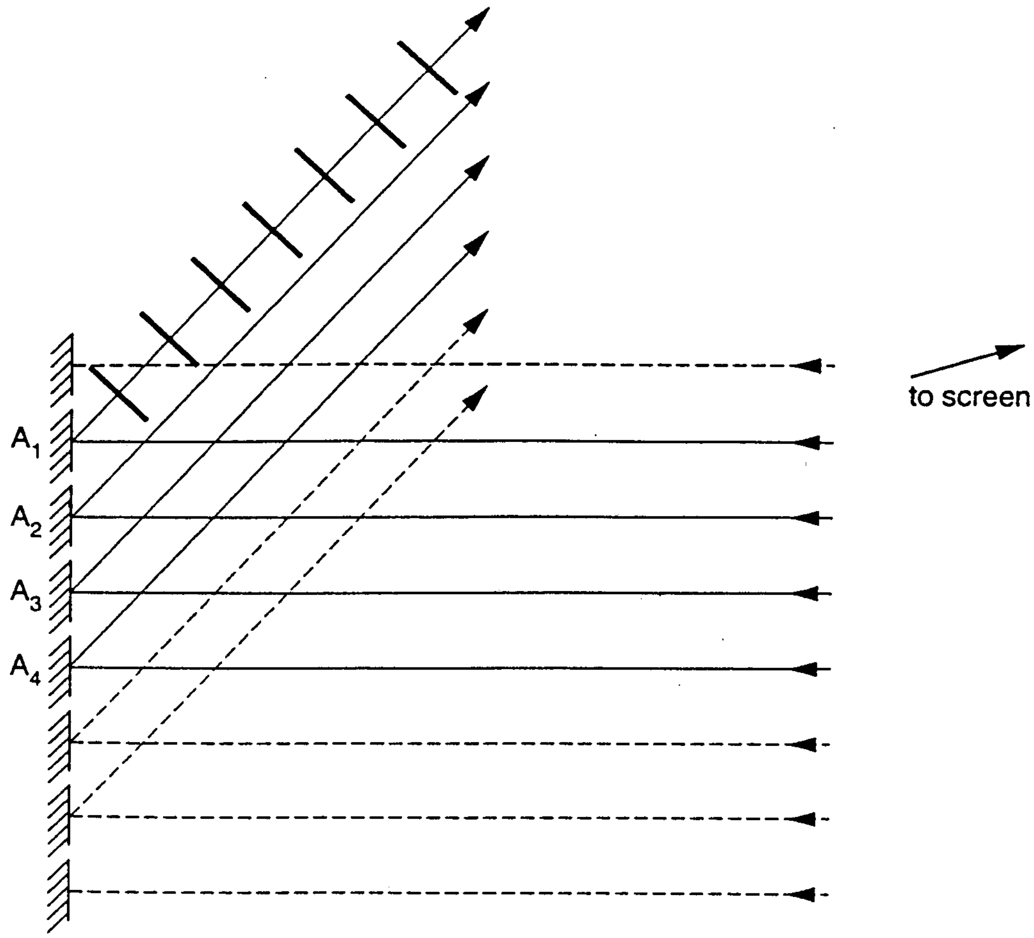

Fig. 10

(i) On Fig. 10:

1. draw in the corresponding wave crests for the light leaving A_2 and A_4, which give rise to the bright image.

2. mark and label the path difference between adjacent beams.

(ii) Explain:

1. why a bright image is seen on the screen at this angle;

2. why it is so bright.

[6]

For Examiner's Use

(b) (i) Explain why spectra are seen when a CD is viewed in white light.

(ii) The spacing of the reflecting strips on a CD is 1.6 μm. Calculate the angle at which a bright image will be seen for green light of wavelength 550 nm.

[4]

11 Two travelling waves of the same frequency, moving in opposite directions can make a standing wave.

(a) Fig. 11.1 shows the two waves, of the same amplitude and frequency, moving in opposite directions. The diagrams show the positions of the two waves at successive times t_1 t_2, t_3 and t_4. Use the diagrams in Fig. 11.1 to describe how the superposition of the waves produces a standing wave. Identify the positions of nodes and antinodes.

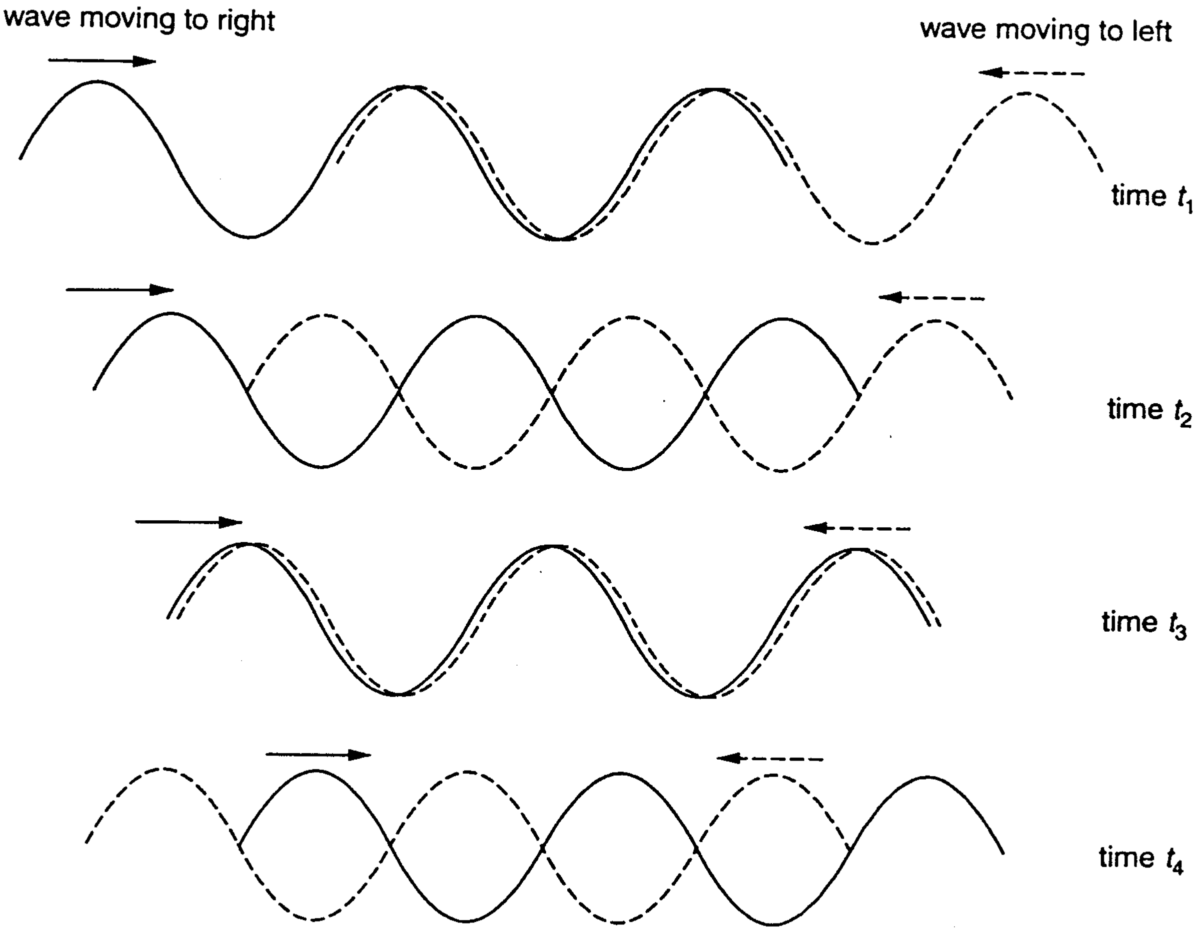

Fig. 11.1

....

....

....

....[4]

For Examiner's Use

(b) A loudspeaker is mounted near the end of a tube of length 1.2 m (Fig. 11.2). As the frequency of the sound emitted by the loudspeaker is varied, very loud sounds are heard in the tube at several frequencies.

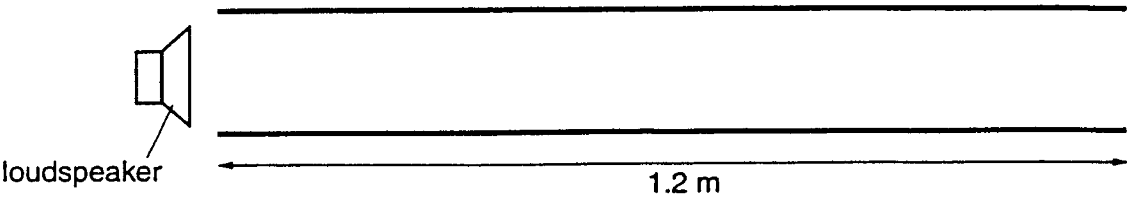

Fig. 11.2

(i) Explain this observation.

(ii) One such loud sound is heard when the frequency is 570 Hz.

1. Calculate the wavelength of this sound wave.
Take speed of sound in air to be 340 m s^{-1}.

2. Sketch on Fig. 11.2 the standing wave in the pipe.

[5]

For Examiner's Use

Section C

In this section of the paper you have the opportunity to write about some of the physics you have studied independently.

Use diagrams to help your explanations and take particular care with your written English. Up to four marks will be awarded in this section for the quality of communication.

12 By measuring the distance between you and an object moving relative to you at two different times it is possible to work out the velocity of the object.

(a) Explain how you can calculate a speed from two distance measurements made at different times. Under what conditions will your calculated speed equal the velocity of the moving object?

[4]

(b) Give a commercial application of velocity measurement from multiple measurements of position.

....[1]

For Examiner's Use

(c) For your application, describe

(i) how the distance measurements are made,

(ii) how often the distance measurements need to be made.

....

....

....

....

....

....

....

....[6]

(d) Outline one economic or social benefit of the application you have given.

....

....

....

....[2]

13 One hundred years ago in 1900, Max Planck put forward the idea that electromagnetic energy is emitted and absorbed in lumps or quanta.

(a) Describe one experimental observation which can be explained in terms of quanta.

....

....

....[3]

(b) Explain how the idea of quanta is used to explain the observation.

....

....

....[3]

(c) Describe one practical device which makes use of the observation you have used.

....

....

....[3]

For Examiner's Use

(d) Light is emitted from atoms when electrons change their energy state.

(i) Electron energies are often given in 'electron volts' (eV). Explain how the unit 'electron volt' is related to the joule and give its value in joule.

(ii) Red light has a frequency of 4.5 x 10^{14} Hz. What is the minimum change in energy, in eV, for an electron which can give rise to the emission of red light.

change in energy = ... eV [4]

Quality of Written Communication [4]