First Variant Question Paper

UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

CANDIDATE NAME

CENTRE NUMBER | | | | | |

CANDIDATE NUMBER | | | | |

5079794953

PHYSICS **0625/31**

Paper 3 Extended **May/June 2008**

1 hour 15 minutes

Candidates answer on the Question Paper.

No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name on all the work you hand in.
Write in dark blue or black pen.
You may use a soft pencil for any diagrams, graphs or rough working.
Do not use staples, paper clips, highlighters, glue or correction fluid.
DO **NOT** WRITE IN ANY BARCODES.

Answer **all** questions.
You may lose marks if you do not show your working or if you do not use appropriate units.
Take the weight of 1 kg to be 10 N (i.e. acceleration of free fall = 10 m/s^2).

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.

This document consists of **15** printed pages and **1** blank page.

1 Fig. 1.1 shows the speed-time graphs for two falling balls.

For Examiner's Use

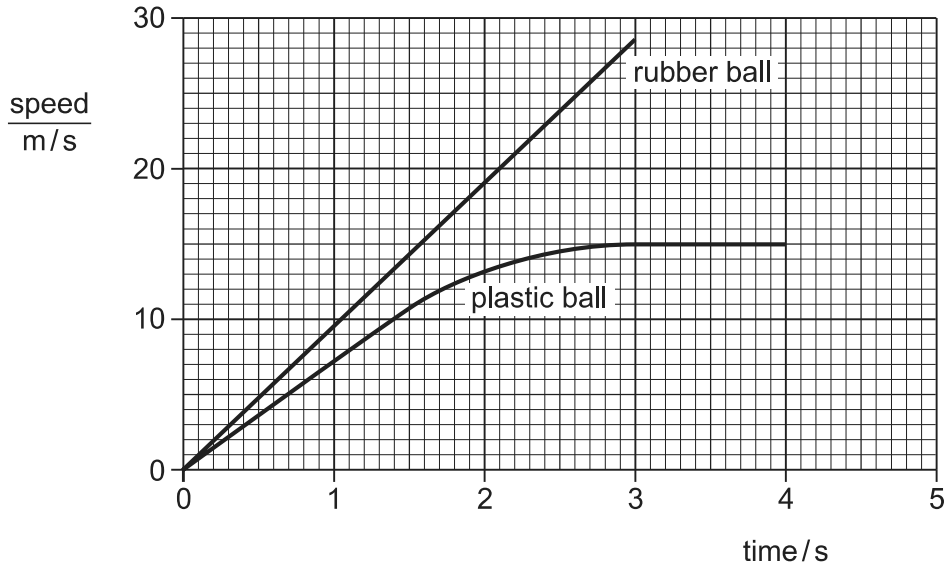

Fig. 1.1

Both balls fall from the same height above the ground.

(a) Use the graphs to find

(i) the average acceleration of the falling rubber ball during the first 3.0 s,

acceleration = ... [2]

(ii) the distance fallen by the rubber ball during the first 3.0 s,

distance = ... [2]

(iii) the terminal velocity of the plastic ball.

terminal velocity = ... [1]

(b) Both balls have the same mass but the volume of the plastic ball is much greater than that of the rubber ball. Explain, in terms of the forces acting on each ball, why the plastic ball reaches a terminal velocity but the rubber ball does not.

For Examiner's Use

.....

.....

.....

.....

.....

..... [3]

(c) The rubber ball has a mass of 50 g. Calculate the gravitational force acting on the rubber ball.

force = ... [2]

[Total: 10]

For Examiner's Use

2 **(a)** Name the process by which energy is released in the core of the Sun.

..... [1]

(b) Describe how energy from the Sun becomes stored energy in water behind a dam.

.....

.....

.....

..... [3]

(c) Data for two small power stations is given in Table 2.1.

	input to power station	**output of power station**
gas-fired	100 MW	25 MW
hydroelectric	90 MW	30 MW

Table 2.1

(i) State what is meant by the *efficiency* of a power station.

.....

.....

.....

..... [1]

(ii) Use the data in Table 2.1 to explain that the hydroelectric station is more efficient than the gas-fired power station.

.....

.....

..... [1]

[Total: 6]

3 A cyclist rides up and then back down the hill shown in Fig. 3.1.

For Examiner's Use

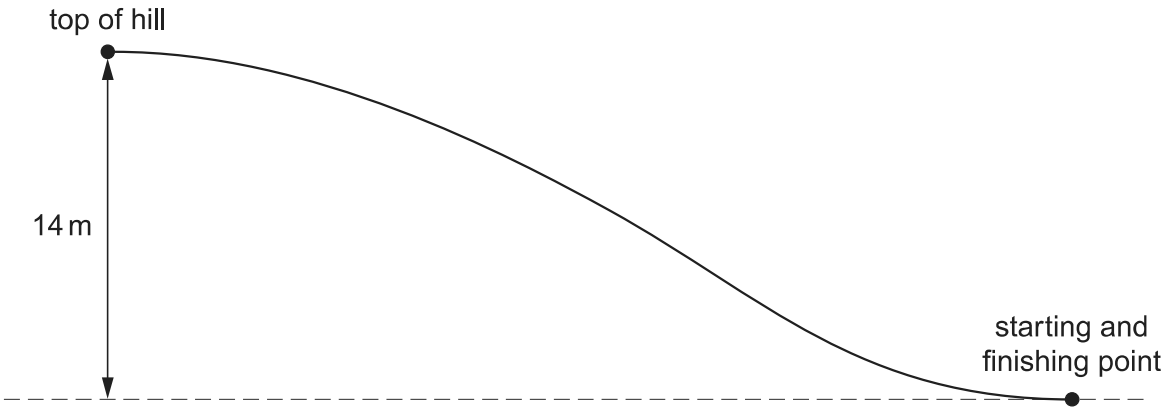

Fig. 3.1

The cyclist and her bicycle have a combined mass of 90 kg. She pedals up to the top and then stops. She turns around and rides back to the bottom without pedalling or using her brakes.

(a) Calculate the potential energy gained by the cyclist and her bicycle when she has reached the top of the hill.

potential energy = ... [2]

(b) Calculate the maximum speed she could have when she arrives back at the starting point.

speed = ... [3]

(c) Explain why her actual speed will be less than that calculated in **(b)**.

.....

.....

..... [1]

[Total: 6]

4 Fig. 4.1 is a design for remotely operating an electrical switch using air pressure.

For Examiner's Use

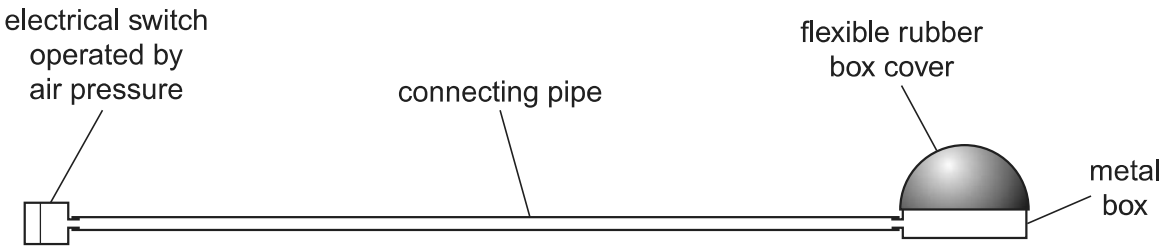

Fig. 4.1

The metal box and the pipe contain air at normal atmospheric pressure and the switch is off. When the pressure in the metal box and pipe is raised to 1.5 times atmospheric pressure by pressing down on the flexible rubber box cover, the switch comes on.

(a) Explain in terms of pressure and volume how the switch is made to come on.

.....

.....

.....

..... [2]

(b) Normal atmospheric pressure is 1.0×10^5 Pa. At this pressure, the volume of the box and pipe is 60 cm^3.

Calculate the **reduction** in volume that must occur for the switch to be on.

reduction in volume = ... [3]

(c) Explain, in terms of air particles, why the switch may operate, without the rubber cover being squashed, when there is a large rise in temperature.

.....

.....

.....

..... [2]

[Total: 7]

5 **(a)** Explain, in terms of molecules, how thermal expansion takes place in a solid and in a gas.

For Examiner's Use

solid .....

.....

.....

.....

.....

gas .....

.....

.....

.....

..... [4]

(b) Complete Table 5.1 to show the relative expansion of equal volumes of liquids, gases and solids.

Choose words from

much less, **slightly less**, **slightly more** and **much more**. [2]

state of matter	expansion compared to solids, for the same temperature rise
liquids	
gases	

Table 5.1

(c) Alcohol is often used in thermometers.

State one property of alcohol that makes it suitable for use in thermometers.

.....

..... [1]

[Total: 7]

6 Fig. 6.1 shows an object, the tip of which is labelled O, placed near a lens L.

The two principal foci of the lens are F_1 and F_2.

For Examiner's Use

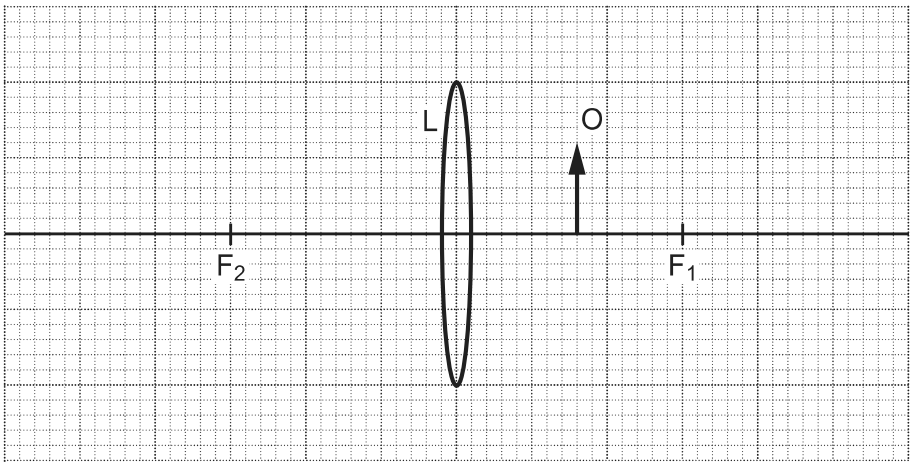

Fig. 6.1

(a) On Fig. 6.1, draw the paths of two rays from the tip of the object so that they pass through the lens and continue beyond.

Complete the diagram to locate the image of the tip of the object. Draw in the whole image and label it I. [3]

(b) Describe image I.

.....

.....

.....

..... [3]

[Total: 6]

7 Fig. 7.1 and Fig. 7.2 show wavefronts of light approaching a plane mirror and a rectangular glass block, respectively.

For Examiner's Use

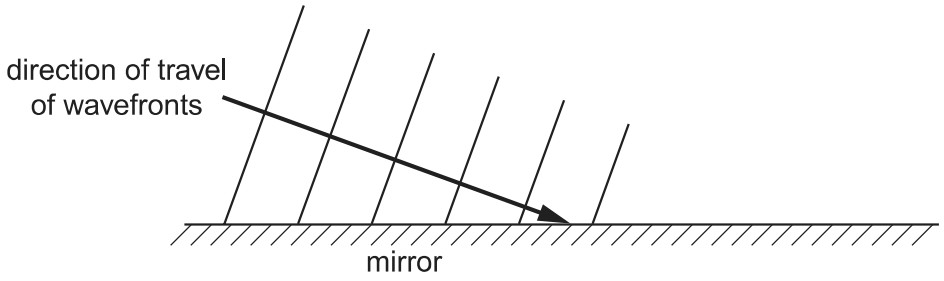

Fig. 7.1

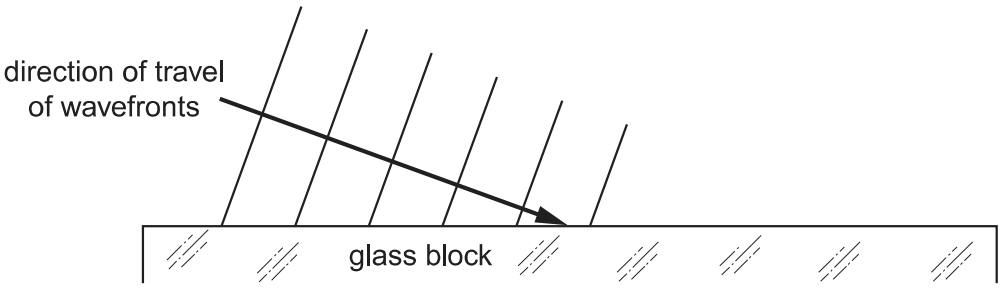

Fig. 7.2

(a) On Fig. 7.1 and on Fig. 7.2 draw wavefronts to show what happens after the waves strike the surface. [4]

(b) In Fig. 7.2, the waves approaching the block have a speed of 3.0×10^8 m/s and an angle of incidence of 70°. The refractive index of the glass of the block is 1.5.

(i) Calculate the speed of light waves in the block.

speed = ... [2]

(ii) Calculate the angle of refraction in the block.

angle = ... [2]

[Total: 8]

8 Fig. 8.1 is the plan of a small apartment that has four lamps as shown.

For Examiner's Use

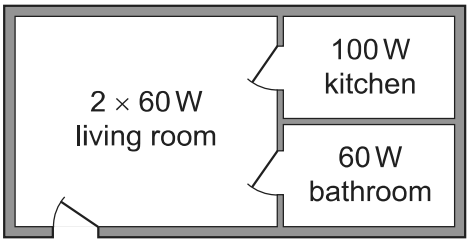

Fig. 8.1

Power for the lamps is supplied at 200 V a.c. and the lamps are all in parallel.

(a) In the space below, draw a lighting circuit diagram so that there is one switch for each room and one master switch that will turn off all the lamps. Label the lamps as 60 W or 100 W.

[3]

(b) The 100 W lamp is switched on. Calculate

(i) the current in the lamp,

current = ... [2]

(ii) the charge passing through the lamp in one minute.

charge = ... [2]

(c) The three 60W lamps are replaced by three energy-saving ones, that give the same light output but are rated at only 15W each.

For Examiner's Use

Calculate

(i) the total reduction in power,

reduction in power = ... [1]

(ii) the energy saved when the lamps are lit for one hour.

energy saved = ... [2]

[Total: 10]

9 Fig. 9.1 shows apparatus used to investigate electromagnetic effects around straight wires.

For Examiner's Use

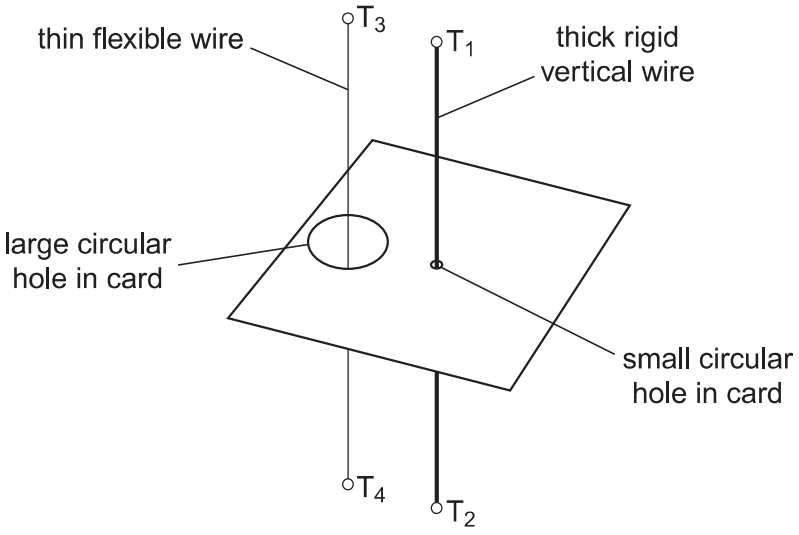

Fig. 9.1

Fig. 9.2 is a view looking down on the apparatus shown in Fig. 9.1.

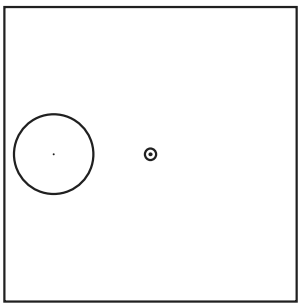

Fig. 9.2

(a) A battery is connected to T_1 and T_2 so that there is a current vertically down the thick wire.

On Fig. 9.2, draw three magnetic field lines and indicate, with arrows, the direction of all three. [2]

(b) Using a variable resistor, the p.d. between terminals T_1 and T_2 is gradually reduced.

State the effect, if any, that this will have on

(i) the strength of the magnetic field, ... [1]

(ii) the direction of the magnetic field. ..... [1]

(c) The battery is now connected to terminals T_3 and T_4, as well as to terminals T_1 and T_2, so that there is a current down both wires. This causes the flexible wire to move.

For Examiner's Use

(i) Explain why the flexible wire moves.

.....

.....

.....

..... [2]

(ii) State the direction of the movement of the flexible wire.

..... [1]

(iii) The battery is replaced by one that delivers a smaller current.

State the effect that this will have on the force acting on the flexible wire.

.....

..... [1]

[Total: 8]

[Turn over

10 **(a)** In the space below, draw the symbol for a NOR gate.

For Examiner's Use

[1]

(b) Describe the action of a NOR gate in terms of its inputs and output.

.....

.....

.....

.....

..... [2]

(c) A chemical process requires heating at low pressure to work correctly.

When the heater is working, the output of a temperature sensor is high.

When the pressure is low enough, a pressure sensor has a low output.

Both outputs are fed into a NOR gate. A high output from the gate switches on an indicator lamp.

(i) Explain why the indicator lamp is off when the process is working correctly.

.....

.....

..... [1]

(ii) State whether the lamp is on or off in the following situations.

1. The pressure is low enough, but the heater stops working. .....

2. The heater is working, but the pressure rises too high. ..... [2]

[Total: 6]

For Examiner's Use

11 **(a)** Chlorine has two isotopes, one of nucleon number 35 and one of nucleon number 37. The proton number of chlorine is 17.

Table 11.1 refers to neutral atoms of chlorine.

Complete Table 11.1.

	nucleon number 35	**nucleon number 37**
number of protons		
number of neutrons		
number of electrons		

[3]

Table 11.1

(b) Some isotopes are radioactive.

State the three types of radiation that may be emitted from radioactive isotopes.

1. .....

2. .....

3. ..... [1]

(c) **(i)** State one practical use of a radioactive isotope.

.....

..... [1]

(ii) Outline how it is used.

.....

.....

.....

.....

..... [1]

[Total: 6]

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