Centre Number	Candidate Number	Name

UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
General Certificate of Education Ordinary Level

PHYSICS **5054/02**

Paper 2 Theory

May/June 2005

1 hour 45 minutes

Candidates answer on the Question Paper.
Additional Materials: Answer Paper

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.

Section A
Answer **all** questions.
Write your answers in the spaces provided on the Question Paper.

Section B
Answer any **two** questions.
Write your answers on the separate answer paper provided.

At the end of the examination, fasten the separate answer paper securely to the Question Paper.
The number of marks is given in brackets [ ] at the end of each question or part question.

If you have been given a label, look at the details. If any details are incorrect or missing, please fill in your correct details in the space given at the top of this page.

Stick your personal label here, if provided.

For Examiner's Use	
Section A	
Q9	
Q10	
Q11	
Total	

This document consists of **12** printed pages.

Section A

Answer **all** the questions in this section.

1 Fig. 1.1 represents the motion of Earth and the planet Venus around the Sun. The orbits shown are circles.

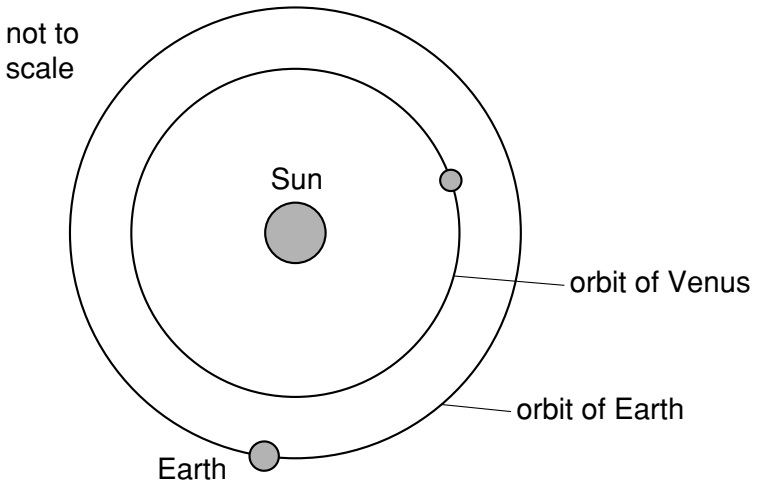

Fig. 1.1

(a) On Fig. 1.1, draw an arrow to show the direction of the force exerted by the Sun on the Earth. [1]

(b) Information about Earth and Venus is given in the table.

planet	time for one orbit in (Earth) years	radius of orbit / million km	circumference of orbit / million km
Venus	0.7	108	679
Earth	1.0	150	942

(i) Use the information in the table to show that Venus has a greater speed than Earth.

.....

.....

.....

..... [2]

(ii) As Earth and Venus move in their orbits, the distance between them changes. Calculate the largest possible distance between them.

distance = ... million km [1]

2 Fig. 2.1 shows the lens of a simple camera being used to photograph an object.

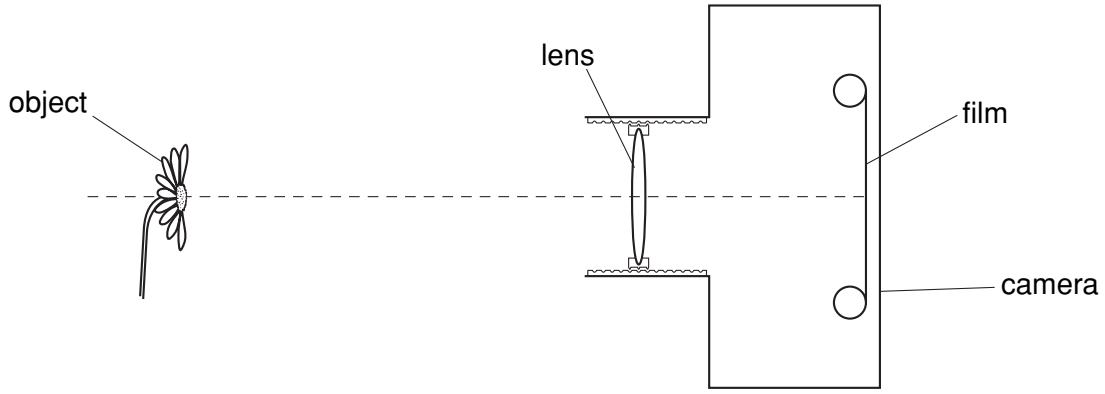

Fig. 2.1

The lens forms a focused image of the object on the film.

(a) Draw two rays from the top of the object to show how the lens forms the image. [2]

(b) The object moves closer to the camera. State how the lens is adjusted to keep the image in focus.

.....

.....

..... [1]

(c) Complete Fig. 2.2 to show how white light is split into a spectrum when it passes through a glass prism. [3]

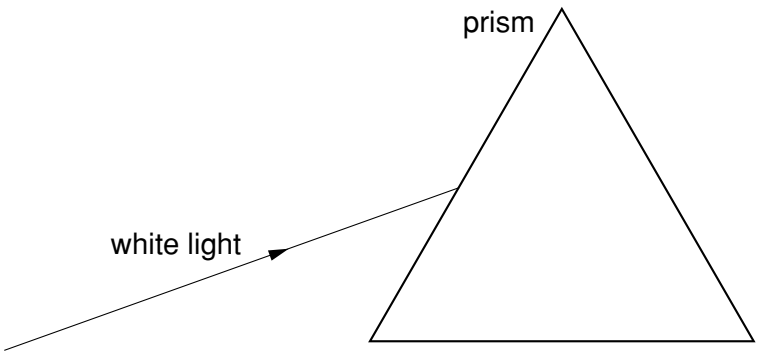

Fig. 2.2

3 Fig. 3.1 shows a weather balloon. The balloon is shown partly filled with gas from a cylinder.

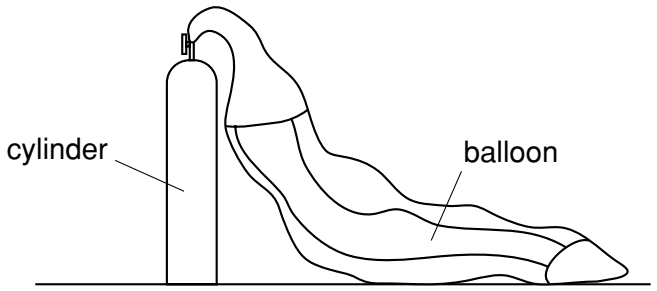

Fig. 3.1

The balloon contains no gas initially. When it is connected to the cylinder, gas enters the balloon. The pressure in the cylinder decreases.

(a) Explain why the molecules inside the cylinder

(i) exert a large pressure initially,

.....

.....

..... [2]

(ii) exert a smaller pressure in the cylinder when the balloon is filled.

.....

.....

..... [1]

(b) The volume of the cylinder is $0.0020\,m^3$. The pressure inside the cylinder is initially 200 atmospheres. When the cylinder is connected to the balloon, the final pressure in the cylinder and the balloon is 1.0 atmosphere.

The temperature of the gas remains constant.

Calculate the final volume of gas in the balloon. State the equation that you use.

volume = ... [3]

4 Fig. 4.1 shows a hydroelectric power station. Water from the lake is used to produce electricity in the turbine house.

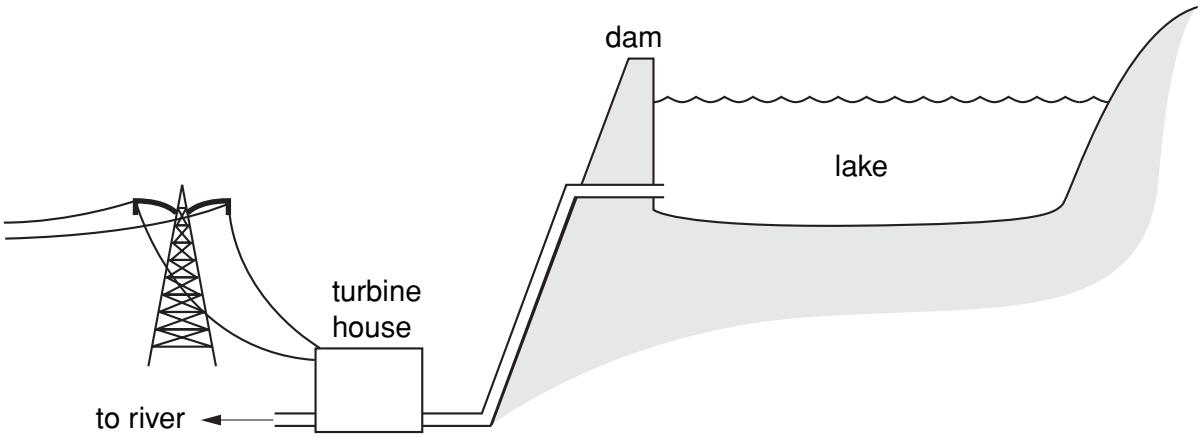

Fig. 4.1

(a) State where the water in Fig. 4.1 has the least potential energy.

..... [1]

(b) In 30 minutes, the water loses 5.0×10^9 J of energy and 4.5×10^9 J of electrical energy is produced in the turbine house.

(i) Calculate the efficiency of the energy conversion.

efficiency = ... [1]

(ii) Calculate, in watts, the electrical power output from the turbine house.

power = ... W [3]

(c) Some power stations burn coal to produce the same electrical power output. State one advantage of the hydroelectric power station.

.....

.....

..... [1]

(d) State one harmful effect that the hydroelectric power station may have on the environment.

.....

..... [1]

[Turn over

5 Fig. 5.1 shows a coil of wire wrapped around a plastic tube. Inside the tube are two pieces of soft iron. When the switch is closed, the compass needles point in the direction of the magnetic field produced at each position. You may ignore the magnetic field of the Earth in this question.

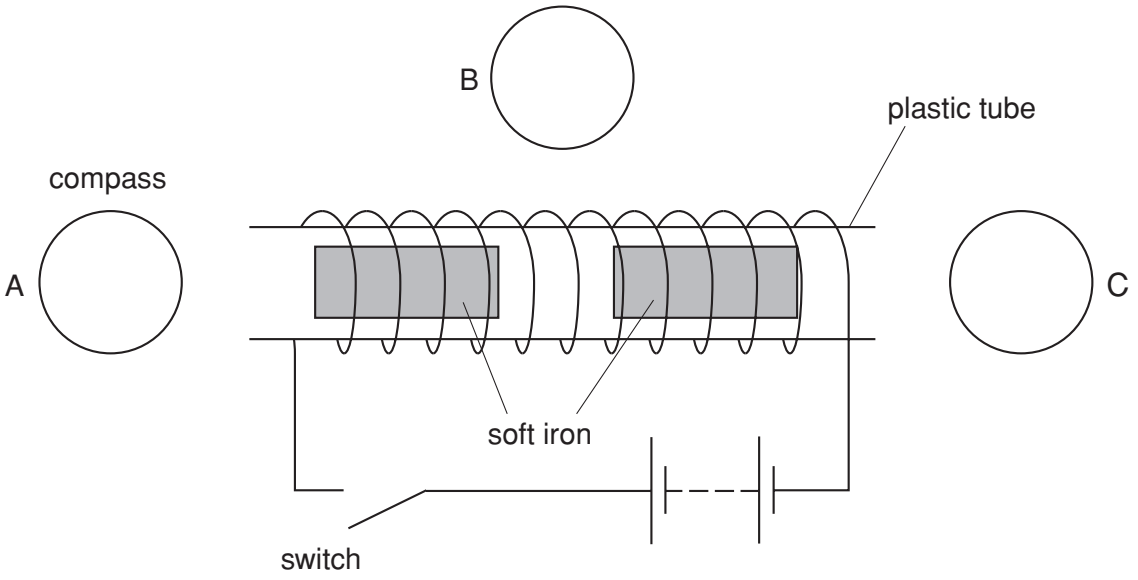

Fig. 5.1

(a) On Fig. 5.1 mark arrows, in compasses A, B and C, to show the direction of the magnetic field at each position after the switch has been closed. [2]

(b) When the switch is closed, the two pieces of soft iron in the tube become magnets and move.

(i) On Fig. 5.1, mark the poles formed on each piece of soft iron. [1]

(ii) State and explain how the pieces of iron move.

.....

.....

..... [2]

(c) State the effect on the magnetic field of

(i) reversing the direction of the current,

.....

..... [1]

(ii) reducing the size of the current.

.....

..... [1]

6 The table gives information about two household appliances.

appliance	mains supply voltage / V	current through appliance / A	power / W	power / kW	time used per day / h	energy used per day / kW h
television	240	1.20	288	0.288	2.50	0.720
water heater	240	12.6			0.50	

(a) Write the missing values in the empty spaces in the table. [3]

(b) Why is more power needed for the water heater than for the television?

.....

.....

..... [1]

(c) The water heater is connected to the mains supply. Explain why using a 3 A fuse would **not** be suitable.

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..... [2]

[Turn over

7 Fig. 7.1 shows an electrical circuit.

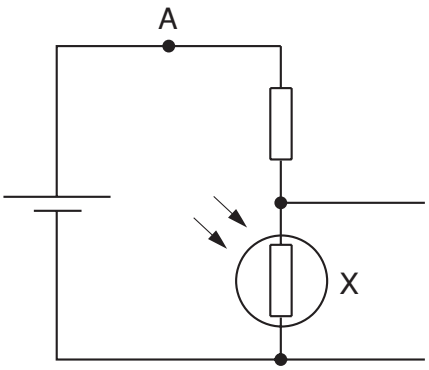

Fig. 7.1

(a) On Fig. 7.1, draw an arrow at A to show the direction of flow of the electrons in the wire. [1]

(b) What is the name of component X?

..... [1]

(c) State and explain how the potential difference across X varies as the light shining on it becomes brighter.

.....

.....

.....

.....

..... [2]

8 Three cells are connected in series making a battery, as shown in Fig. 8.1. The e.m.f. of each cell is 1.5 V. A resistance of 15 Ω is connected to the battery.

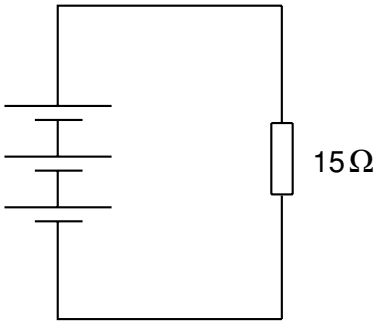

Fig. 8.1

(a) What is the total e.m.f. of the battery?

..... [1]

(b) Calculate the current in the circuit.

State the equation that you use.

current = ... [3]

(c) A battery can be made from cells connected in parallel, as shown in Fig. 8.2.

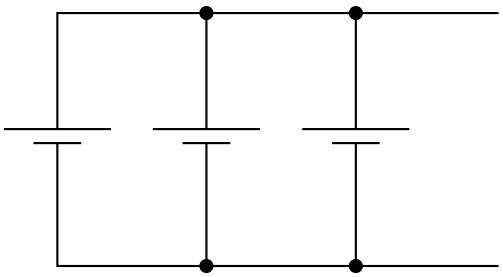

Fig. 8.2

State one advantage of connecting the cells in parallel.

.....

.....

.....

..... [1]

Section B

Answer **two** questions from this section.

Write your answers on the separate answer paper provided.

9 A train travels from one station to the next. It starts from rest at time $t = 0$ and accelerates uniformly for the first 20 s. At $t = 20$ s it reaches its top speed of 25 m/s. It then travels at this speed for a further 30 s before decelerating uniformly to rest. The total time for the journey is 60 s.

(a) **(i)** Sketch a speed-time graph for the motion of the train. Do **not** use graph paper. Put the speed of the train on the *y*-axis and time along the *x*-axis. [3]

(ii) Write down the equation, **in words**, that relates acceleration, time and change in velocity. [1]

(iii) Explain what is meant by a *uniform* acceleration. [1]

(iv) Use your graph to calculate the deceleration of the train as it comes to rest. [2]

(b) Several forces act on the train when it is moving.

(i) Name the horizontal and vertical forces that act on the train and give the direction of each force. [4]

(ii) Explain whether the horizontal forces are balanced or unbalanced,

1. when the train accelerates,

2. when the train travels at constant speed,

3. when the train decelerates.

You may draw diagrams to help your explanations. [3]

(c) A second train has a non-uniform acceleration. Sketch a speed-time graph showing a non-uniform acceleration. Do **not** use graph paper. [1]

10 When a house is heated, energy is lost to the outside.

Fig. 10.1 shows where the energy is lost from the house.

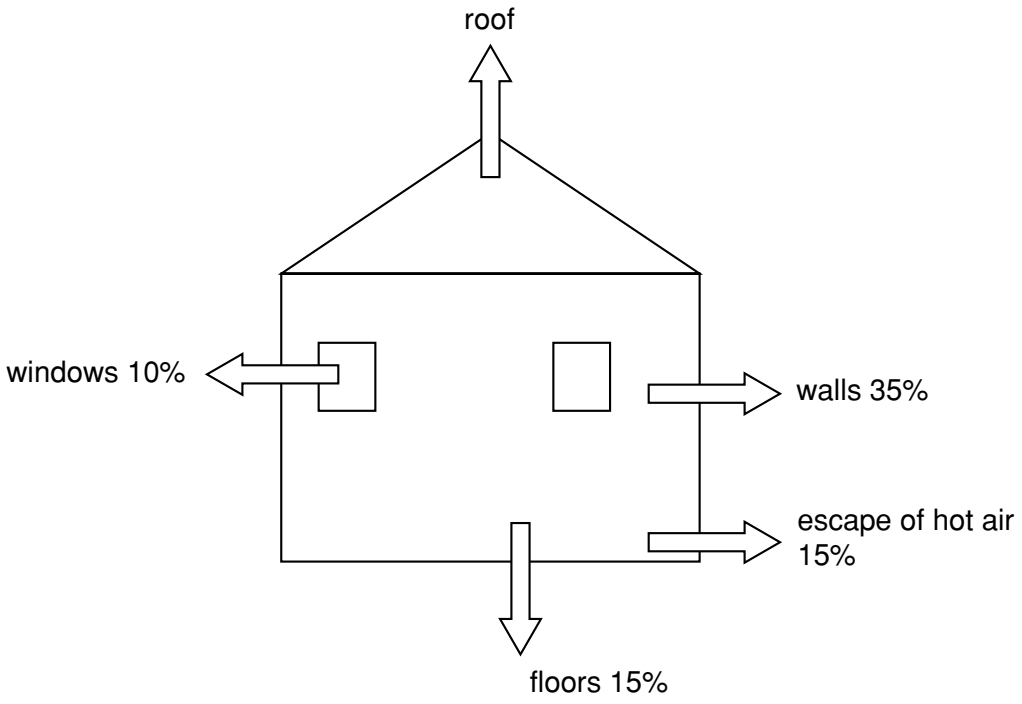

Fig. 10.1

(a) **(i)** Calculate the percentage of the energy lost through the roof. [1]

(ii) Energy is lost through the roof by conduction and from the roof by convection and by radiation. Explain in detail how this happens. [6]

(iii) Fitting carpets on the floor reduces energy loss. Explain how a carpet reduces energy loss. [2]

(b) The table gives information about three methods of reducing energy loss.

	method of reducing energy loss	installation cost	saving on energy costs in one year	number of years of saving needed to cover installation costs
A	fitting carpets on the floor	$600	$10	60
B	insulating the roof	$300	Y	3
C	fitting modern windows	X	$20	40

(i) Calculate the values of X and Y. [2]

(ii) Which one of these three methods should the house owner choose? Explain your answer. [2]

(iii) State **two** other ways, not already mentioned, of reducing energy loss from the house. [2]

[Turn over

11 (a) Some atoms that undergo radioactive decay have a half-life of 6 hours. The count rate near a sample of these atoms is initially 838 counts/minute. Background radiation near the sample is 18 counts/minute.

(i) Describe the structure of an atom. It may help to draw a diagram. [3]

(ii) Explain what is meant by *radioactive decay*. State clearly which part of the atom decays. [3]

(iii) State what is meant by *background radiation*. [1]

(iv) The equipment is left undisturbed for 12 hours. Calculate the count rate due to the sample of atoms alone after this time. [2]

(b) The table shows a radioactive series. Atom A emits a beta-particle and becomes atom B. Atom B then emits a particle to become atom C.

atom	proton number (atomic number)	nucleon number (mass number)	radiation emitted
A	83	214	beta-particle
B	X	214	Y
C	82	210	none

(i) Calculate the proton number X of atom B and explain how you calculated it. [2]

(ii) State the name of radiation Y and describe the changes that occur in the atom when this radiation is emitted. [3]

(iii) Using information from the table, explain why atoms A and C are **not** isotopes of the same element. [1]