UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
General Certificate of Education Ordinary Level

PHYSICS **5054/02**

Paper 2 Theory

May/June 2004

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.

For Examiner's Use	
Section A	
Q9	
Q10	
Q11	
Total	

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

UNIVERSITY *of* CAMBRIDGE
International Examinations

[Turn over

Section A

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

1 Fig. 1.1 shows a free-fall parachutist falling vertically downwards. Fig. 1.2 shows how the speed of the parachutist varies with time.
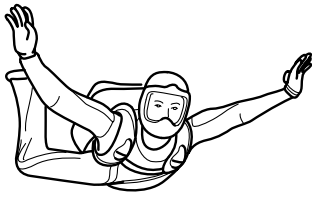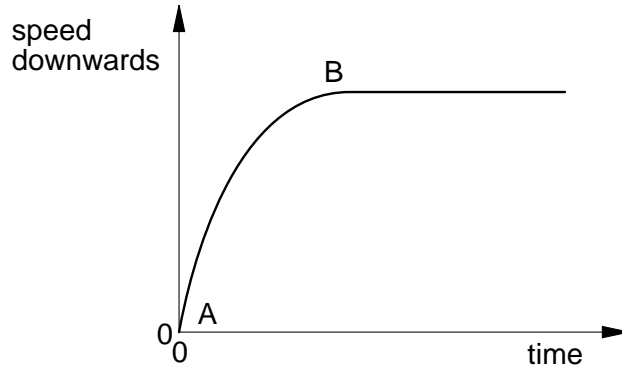
Fig. 1.1   **Fig. 1.2**

(a) (i) State the name of the downward force acting on the parachutist.

....

(ii) State the name of one upward force acting on the parachutist.

....
[2]

(b) (i) State the initial value of the acceleration of the parachutist. Give the unit of your answer.

....

(ii) Explain why the acceleration decreases from A to B.

....

....

....

(iii) Explain why the parachutist falls at a constant speed after B.

....

....

....
[4]

2 Heat is transferred by conduction, convection and radiation.

(a) (i) State which of the three methods is responsible for the transfer of heat from the Sun to the Earth.

....

(ii) Explain why the other two methods cannot be involved in this transfer.

....

....

....
[2]

(b) A hand feels hot when placed above a lighted match, as shown in Fig. 2.1.
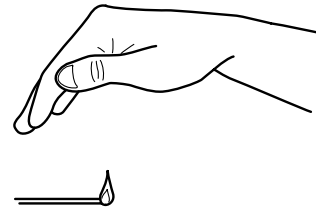Explain in detail how convection causes this to happen.

....

....

....

....

....

Fig. 2.1 [2]

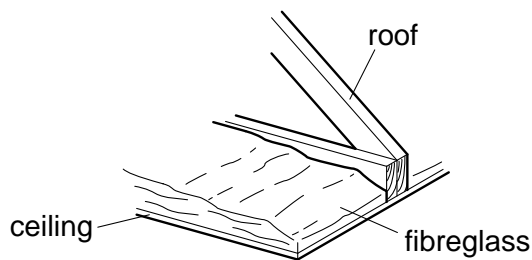**(c)** Fig. 2.2 shows a layer of fibreglass placed between the ceiling of a room and the roof of a house.

roof

ceiling

fibreglass

Fig. 2.2

Explain how the layer of fibreglass helps to keep the room warm when it is cold outside.

....

....

....

....[2]
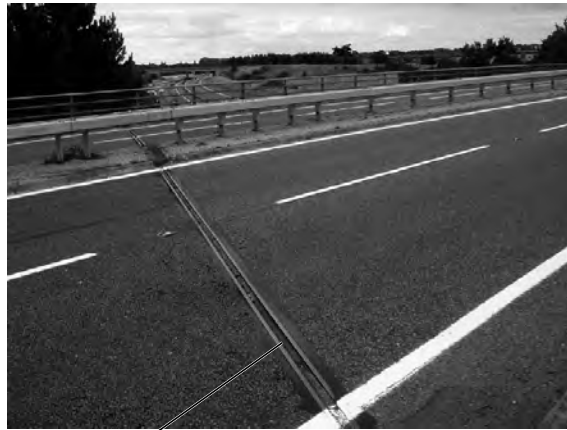
 [Turn over

3 Thermal expansion can be a problem.

gap in
bridge

Fig. 3.1

Small gaps are left in railway lines and in bridges, as shown in Fig. 3.1.

(a) Explain in detail why the gaps are needed.

....

....

....

....

....[3]

(b) State one other problem caused by thermal expansion and explain how it can be solved.

....

....

....[1]

4 Fig. 4.1 shows a student clapping in front of a vertical wall. The wall reflects the sound.

student makes
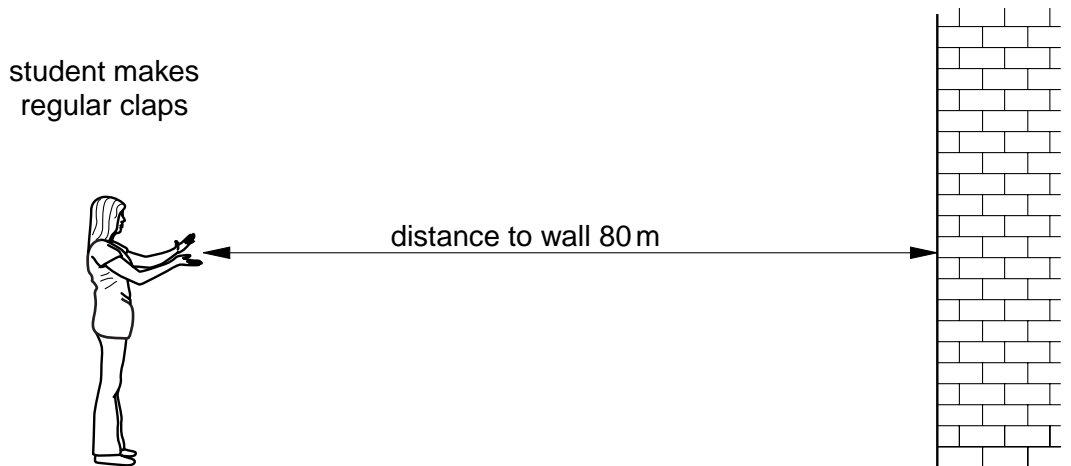regular claps

distance to wall 80 m

Fig. 4.1

The student changes the number of claps made in 1 minute until the reflection of each clap returns to her at exactly the same time as she makes the next clap.

The speed of sound in air is 330 m/s.

(a) Explain what is meant by *speed*.

   ....

   ....[1]

(b) Calculate the time between claps.

   time = …………………….. [3]

(c) Calculate the number of claps in 1 minute.

   number of claps = ……………….. [2]

   [Turn over

5 Fig. 5.1 shows a piece of recording tape passing under the recording head of a tape recorder. An alternating current is passed through the coil. The tape is coated with a magnetic material that becomes magnetised.
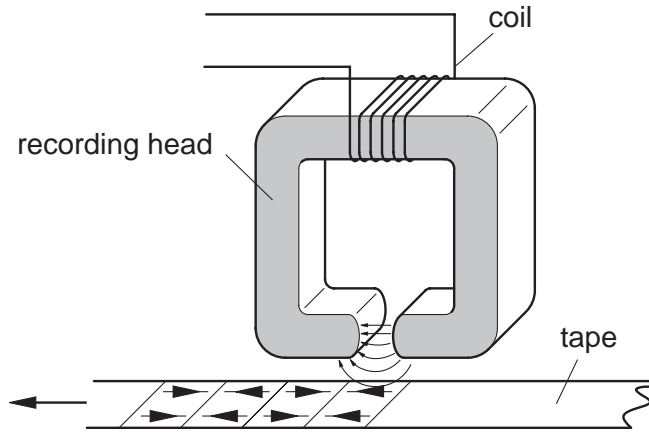

Fig. 5.1

(a) (i) Explain why the tape becomes magnetized.

....

....

....

(ii) Fig. 5.1 shows that sections of the tape are magnetised in opposite directions. Explain why they become magnetised in opposite directions.

....

....

(iii) The tape is moved faster past the recording head. State how this changes the pattern on the tape.

....

....
[3]

(b) (i) Explain why the coating on the tape must be of a permanent magnetic material.

....

....

(ii) State the name of a permanent magnetic material.

....
[2]

6 Fig. 6.1 shows a circuit in which a voltmeter is placed across a resistor.

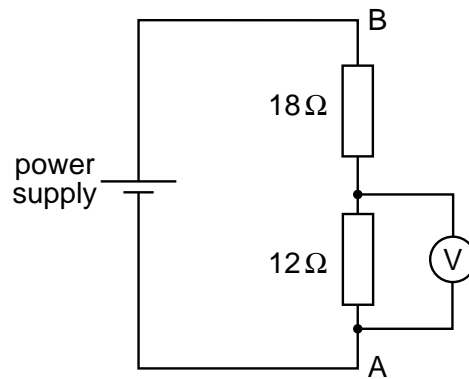**Fig. 6.1**

The potential difference across the 12 Ω resistor is 4.0 V.

The voltmeter has three different ranges: 0 to 3.0 V, 0 to 6.0 V and 0 to 30 V. The best range for use in this circuit is 0 to 6.0 V.

(a) Explain why

(i) using the voltmeter on the range 0 to 3.0 V is unsuitable,

....

....

(ii) using the voltmeter on the range 0 to 30 V is unsuitable.

....

....
[2]

(b) (i) Calculate the current in the 12 Ω resistor. State the formula that you use.

current = ...

(ii) Calculate the p.d. between A and B in Fig. 6.1.

p.d. = ...
[5]

7 Fig. 7.1 shows a simple version of an electron-beam tube.
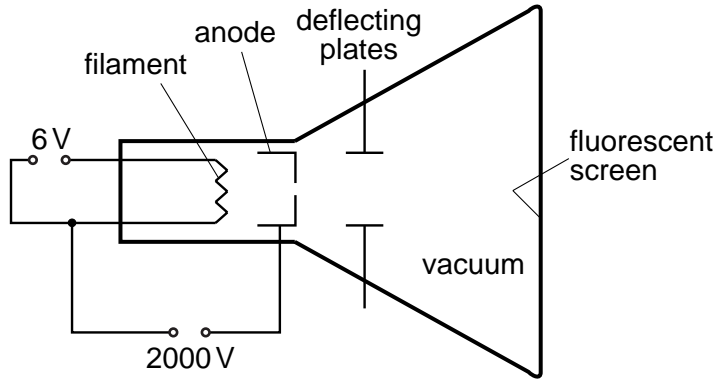
Fig. 7.1

The filament is connected to a 6 V power supply and there is a potential difference of 2000 V between the filament and the anode. As the electron beam hits the fluorescent screen, a spot of light appears on the screen.

(a) Explain why

(i) electrons are emitted from the filament,

....

....

(ii) electrons accelerate after they leave the filament,

....

....

(iii) a vacuum is needed in the tube.

....

....
[3]

(b) An alternating potential difference of very low frequency is applied across the deflecting plates in Fig. 7.1. The spot of light on the screen is seen to move. Describe and explain the movement of the spot.

....

....

....

....[2]

8 The pie chart in Fig. 8.1 shows the relative contributions made by different sources to background radiation.
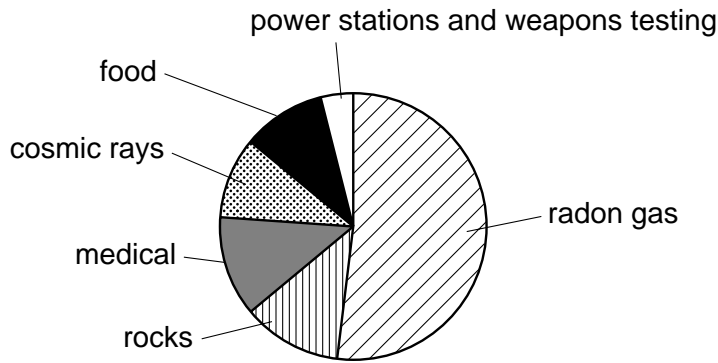
Fig. 8.1

(a) Which source makes the greatest contribution to the background radiation?

....[1]

(b) State one effect of background radiation.

....

....

....[1]

(c) Where do cosmic rays come from?

....

....[1]

(d) The nucleon number (mass number) of $^{220}_{86}$Rn is 220.
Define *nucleon number*.

....

....[1]

(e) Radon ($^{220}_{86}$Rn) decays by the emission of an alpha-particle.
State the proton number (atomic number) and the nucleon number (mass number) of the nucleus left after an alpha-particle is emitted from this nucleus.

proton number ……………………..

nucleon number ……………………..

[2]

Section B

Answer **two** questions from this section.

Use the separate answer paper provided.

9 Fig. 9.1 shows the main parts of an electric grill. An electric current in the heating element causes it to become red hot and to emit visible light and infra-red radiation. The infra-red radiation is used to cook food.
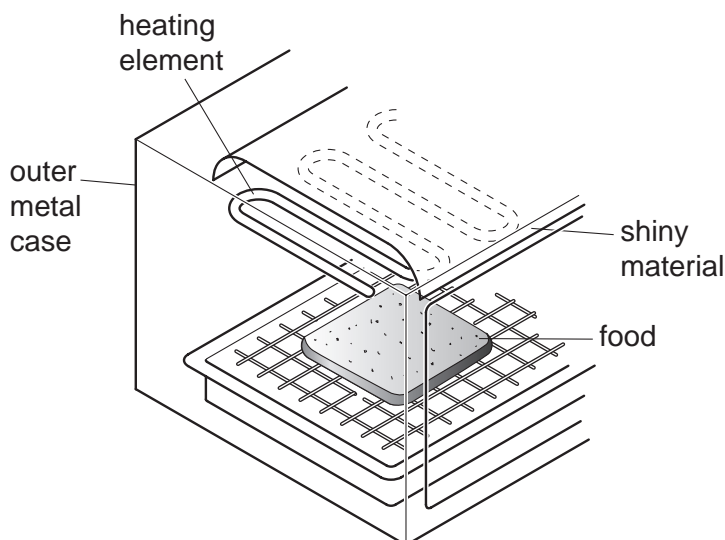
Fig. 9.1

(a) Infra-red radiation has a longer wavelength than visible light. Both are parts of the electromagnetic spectrum.

    (i) Draw a diagram of the electromagnetic spectrum that shows visible light, infra-red and **three** other parts of the spectrum. Your diagram should put the parts of the spectrum in order of increasing wavelength.

    (ii) Explain why the grill has a layer of shiny material between the heating element and the outer case.

               [7]

(b) For safety, the electric grill is fitted with an earth wire. State where the earth wire is connected to the electric grill and explain how it acts as a safety device. [4]

(c) The current in the heating element is 8.3 A when it is connected to the 230 V mains supply.

    (i) State the equation that links current, power and voltage.

    (ii) Calculate the power rating of the heating element when it is working correctly. Give your answer to an appropriate number of significant figures.

    (iii) A student thinks that if the heating element is connected to a mains supply of 115 V then the power produced is halved. Explain why the student is wrong.

               [4]

10 Fig. 10.1 is a full-scale drawing of a small aluminium bar.
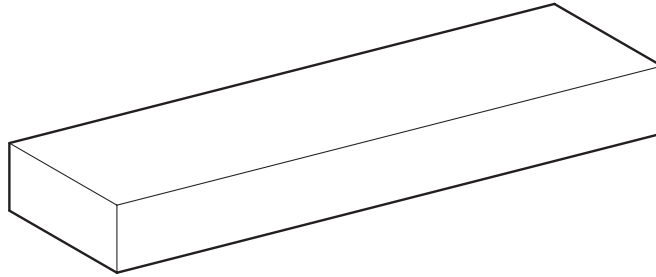
Fig. 10.1

(a) Describe how the density of aluminium may be determined using the bar. In your account

    (i) describe the readings to be taken,

   (ii) state the instruments used to make the readings,

  (iii) describe how the density is calculated from the readings.

[6]

(b) The bar is placed in a small furnace.
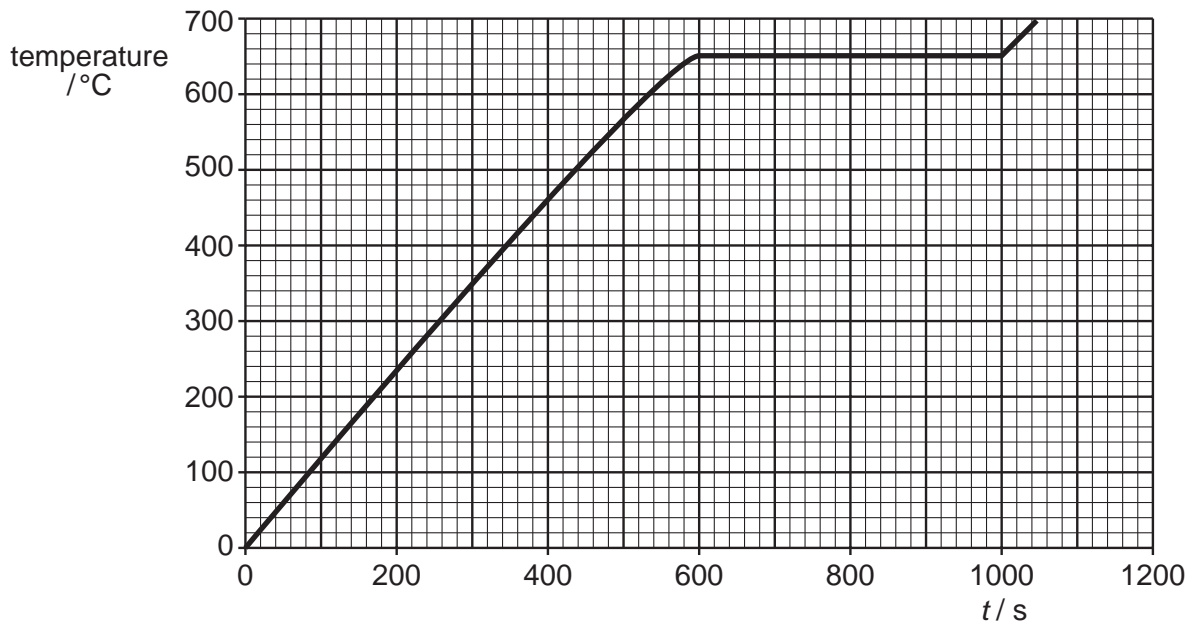Fig. 10.2 shows how the temperature of the bar varies with time t.

Fig. 10.2

    (i) State what happens to the bar between $t = 600\,s$ and $1000\,s$.

   (ii) Explain what effect the energy supplied to the bar has on its molecules between $t = 0$ and $1000\,s$.

  (iii) The mass of the bar is $0.030\,kg$ and the specific heat capacity of aluminium is $880\,J/(kg\,°C)$. Calculate the energy supplied to the bar between $t = 0$ and $600\,s$.

  (iv) Between $t = 600\,s$ and $1000\,s$ the furnace supplies 30 joules of energy per second to the bar. Calculate the specific latent heat of fusion of aluminium.

[9]

11 Fig. 11.1 shows a children's ride. A carriage containing children is pulled up the slope by a motor. The carriage stops at A and then runs down through B, C and D without further input of energy. Between D and E the carriage turns through a bend at constant speed, as shown in Fig. 11.2. At E, brakes are applied and the carriage slows to a stop at F. The height of the ride is 30 m at A and 10 m at C.
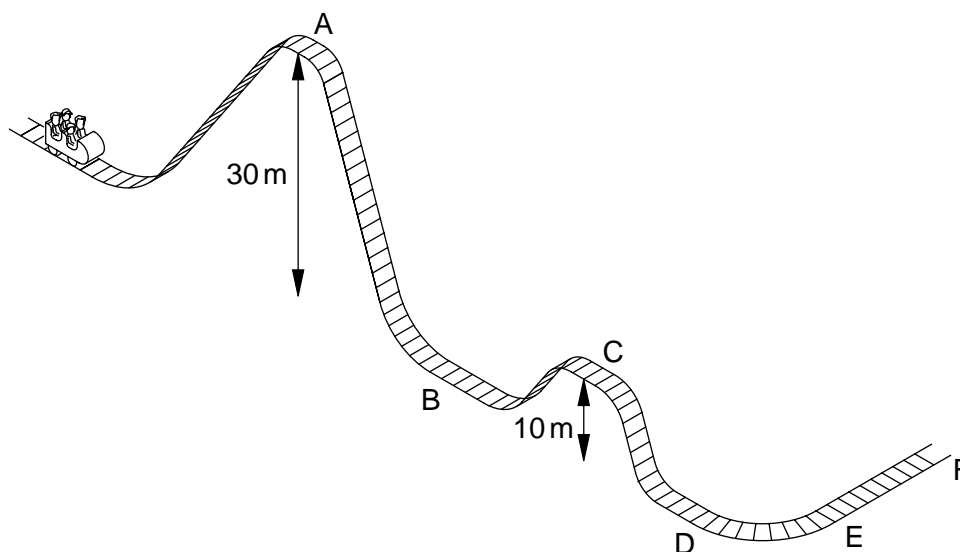

Fig. 11.1

The mass of the carriage and children is 500 kg.
Take the gravitational field strength as 10 N/kg.

(a) (i) Discuss the energy changes that occur in the ride from A to D.

(ii) Calculate the maximum potential energy of the carriage and children.

(iii) Assuming that there is no friction between A and C, determine the kinetic energy of the carriage and children at C. Show your working.

[9]

(b)
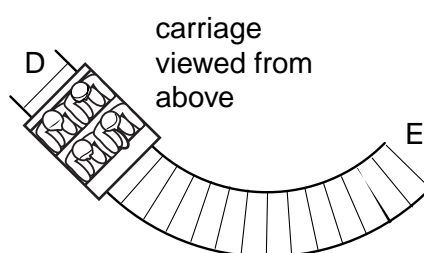
Fig. 11.2

Between D and E, the carriage goes round part of a horizontal circle at constant speed. During this time the velocity of the carriage changes.

(i) Explain how the carriage can have a constant speed but a changing velocity.

(ii) State the direction of the force that acts on the carriage to make it move round the curve.

[3]

(c) Between E and F, a frictional force of 3000 N acts to slow the carriage. Calculate the deceleration of the carriage. [3]