Centre Number	Candidate Number	Name

CAMBRIDGE INTERNATIONAL EXAMINATIONS
General Certificate of Education Ordinary Level

PHYSICS **5054/02**

Paper 2 Theory

May/June 2003

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 lined pages provided and, if necessary, continue on the separate Answer Paper provided.

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.

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 **13** printed pages and **3** lined pages.

[Turn over

Section A

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

1   Fig. 1.1 shows the speed-time graph for the first 125 s of the journey of a lorry.
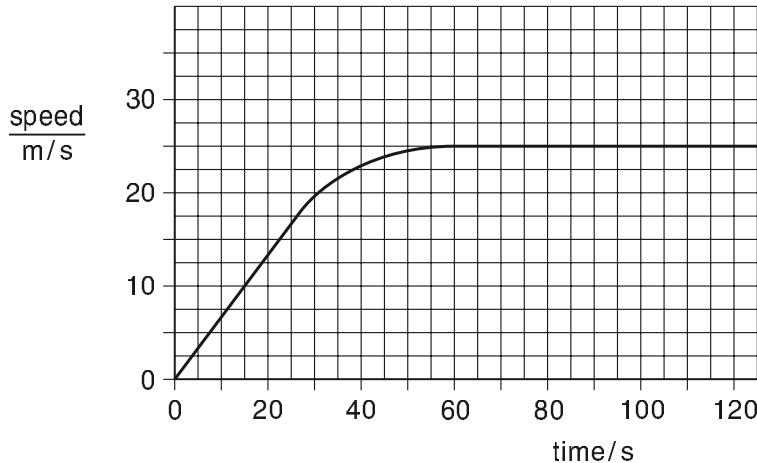
Fig. 1.1

(a) During the motion shown, describe what happens to

   (i)   the speed of the lorry,

   ....

   ....

   ....

   (ii) the acceleration of the lorry.

   ....

   ....

   ....
                                                                                                                                  [4]

(b) Determine the maximum speed of the lorry in m/s and in km/h.

                                                          speed = ... m/s

                                                          speed = ... km/h
                                                                                                                                  [2]

2 Fig. 2.1 shows a manometer used to measure the pressure difference between the air inside a plastic container and the atmosphere outside.
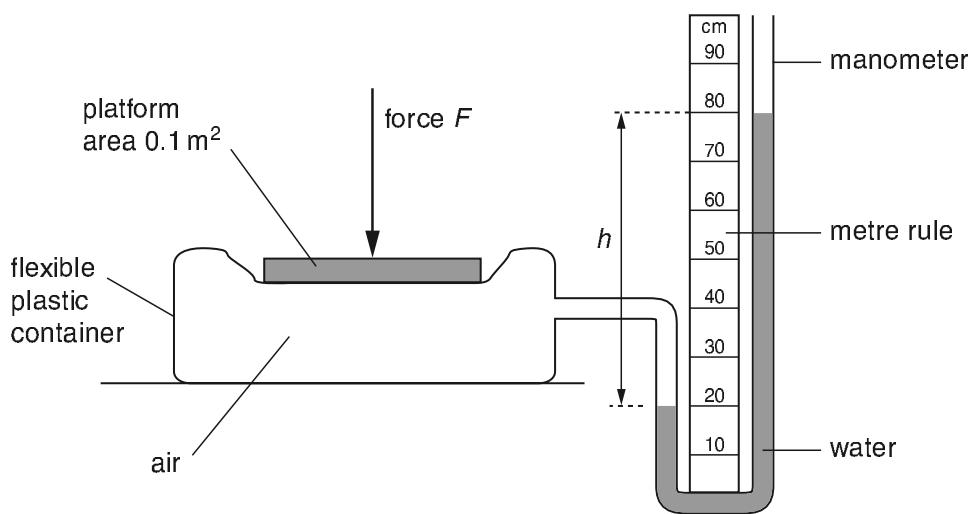

Fig. 2.1

A pressure difference of 100 Pa causes a one centimetre difference in water levels.

(a) Using Fig. 2.1, determine the pressure difference in Pa shown by the manometer.

pressure difference = ...Pa   [1]

(b) State what changes, if any, occur to the distance h in Fig. 2.1 if

(i) the manometer tube is narrower,

....

(ii) a liquid denser than water is used in the manometer.

....

[2]

(c) The pressure difference measured by the manometer is caused by the force F. This force is the weight of a student standing on the platform. The cross-sectional area of the platform is 0.1 m^2.

(i) State the formula that relates pressure, force and area.

....

(ii) Calculate the weight of the student.

weight = ...

[3]

[Turn over

**3** Fig. 3.1 illustrates the arrangement of the molecules of a substance in its solid, liquid and gaseous states.
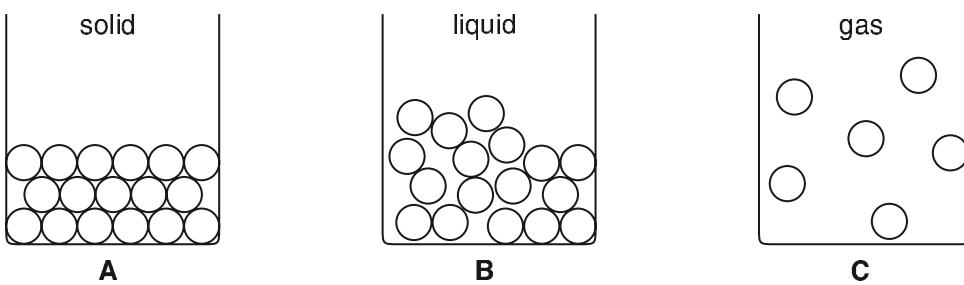
Fig. 3.1

(a) State which arrangement, **A**, **B** or **C**, contains molecules with the most energy.

....[1]

(b) Explain, in terms of the forces between the molecules and their separation, why

  (i) gases are easier to compress than liquids,

  ....

  ....

  ....[2]

  (ii) latent heat is needed to change the substance from solid to liquid.

  ....

  ....

  ....[2]

(c) Define the term *specific latent heat of fusion* of a substance.

  ....

  ....

  ....

  ....

  ....[2]

4 Fig. 4.1 shows an incorrect electromagnetic spectrum drawn by a student. The parts of the spectrum and the wavelengths are in the wrong order. The values of the wavelengths do not match the correct parts of the spectrum.

short wavelength						long wavelength
microwaves	radio waves	ultraviolet	infra-red	gamma rays	X-rays	visible
10^3 m	10^{-14} m	10^{-10} m	10^{-8} m	10^{-2} m	10^{-6} m	10^{-5} m

Fig. 4.1

(a) On Fig. 4.2, complete the table of the electromagnetic spectrum. Radio waves and their correct wavelength have been inserted for you.

short wavelength						long wavelength
						radio waves
						10^3 m

[3]

Fig. 4.2

(b) State the speed of all electromagnetic waves in a vacuum.

....[1]

(c) State two uses that are made of infra-red radiation.

....

....

....[2]

[Turn over

5 Electrostatic charges can be placed on objects by friction.

(a) State the name of the charged particle that is transferred from one object to another in this process.

....[1]

(b) Fig. 5.1 shows petrol (gasolene) being pumped into a can. Electrostatic charges build up on the petrol and the pipe.
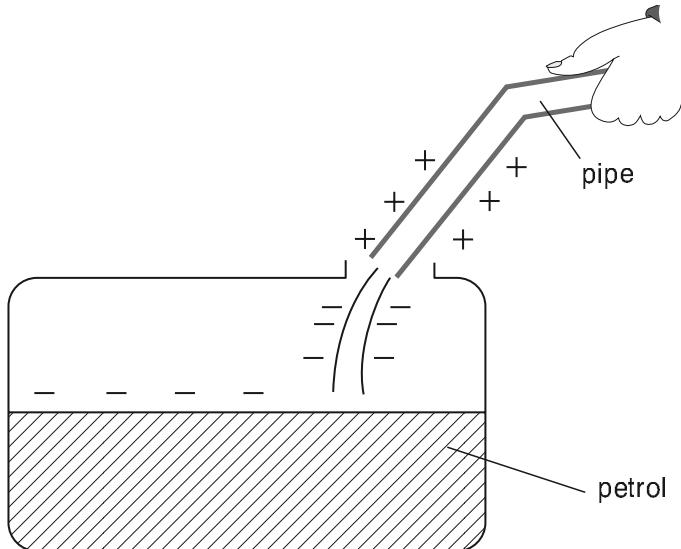

Fig. 5.1

(i) Explain why this is dangerous.

....

....

....

....[2]

(ii) State what can be done to stop the electrostatic charge building up in this way.

....

....[1]

6 The lamps in a house are connected in parallel to the mains supply.

(a) On Fig. 6.1, draw three lamps and their switches connected to the mains supply.

fuse

live

neutral
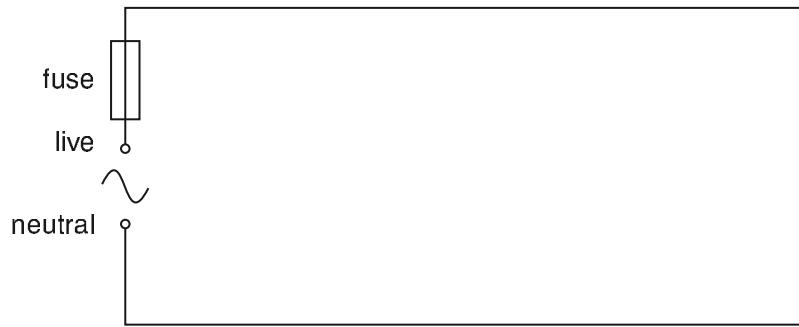
Fig. 6.1

[3]

(b) Each lamp is labelled 240 V, 30 W. Calculate the current in one lamp when it is operating correctly.

current = ...[2]

(c) State the current from the mains supply when the three lamps are switched on.

current = ...[1]

[Turn over

7   Fig. 7.1 shows the colour-coded bands on a resistor. The table in Fig. 7.2 shows the colour
     code.

bands   1 2 3
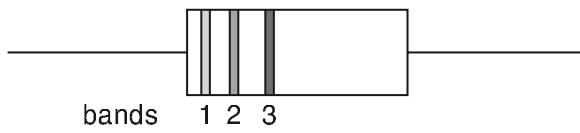
Fig. 7.1

digit or multiplier	colour
0	black
1	brown
2	red
3	orange
4	yellow
5	green
6	blue
7	violet
8	grey
9	white

Fig. 7.2

(a) State the colours on the first three bands of a $4700\,\Omega$ resistor.

colour of band 1 ....

colour of band 2 ....

colour of band 3 ....

[2]

(b) EITHER

Fig. 7.3 shows a 4700 Ω resistor connected in series with a variable resistor. The variable resistor can have any value between 0 and 4700 Ω.
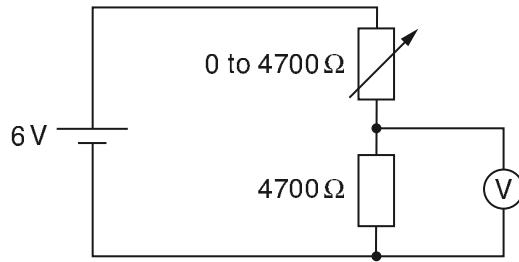
Fig. 7.3

As the resistance of the variable resistor is altered, determine

(i) the largest reading on the voltmeter, ...

(ii) the smallest reading on the voltmeter. ....

[2]

OR

(i) Draw the circuit symbol for an OR gate.

(ii) Complete the truth table for an OR gate.

input 1	input 2	output
0	0	
0	1	
1	0	
1	1	

[2]

[Turn over

8 Hydrogen nuclei fuse together in the Sun. The nucleus of one isotope of hydrogen contains one proton and has the nuclide notation $^{1}_{1}$H. Other isotopes of hydrogen have the nuclide notations $^{2}_{1}$H and $^{3}_{1}$H.

(a) State the number of protons and the number of neutrons in a nucleus of each of the two other isotopes of hydrogen.

$^{2}_{1}$H ....

....

$^{3}_{1}$H ....

....[2]

(b) Nuclei may fuse when they come together.

(i) Explain why nuclei do not easily come together.

....

....

....

(ii) Explain why nuclei are able to come together in the centre of the Sun.

....

....

....
[4]

Section B

Answer **two** questions from this section.

Use the lined pages provided and, if necessary, continue
on the separate sheets available from the Supervisor.

9 A falling metal hammer is used to drive a hollow steel post into the ground, as shown in Fig. 9.1.
The hammer is lifted by an electric motor and then falls freely to hit the baseplate.
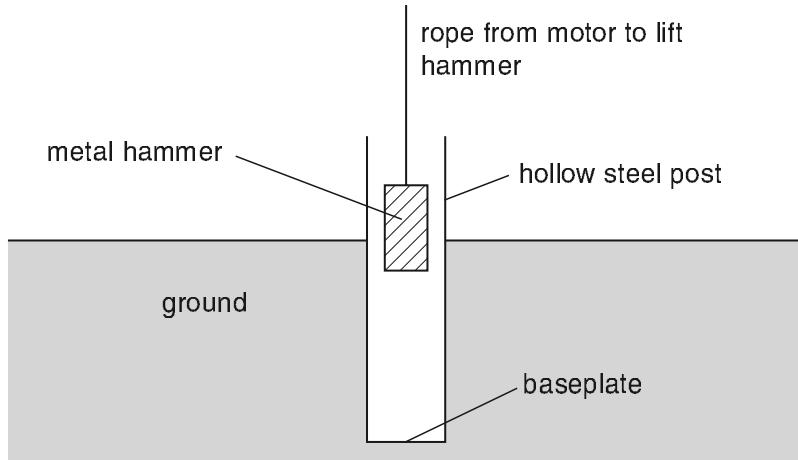
Fig. 9.1

(a) (i) State the law of conservation of energy.

(ii) State the energy conversions that take place as the hammer falls, starting from the initial
potential energy of the hammer before it is dropped.

[4]

(b) The metal hammer has a mass of 1500 kg and it hits the baseplate with a speed of 8.0 m/s.

(i) Calculate the kinetic energy of the hammer as it hits the baseplate.

(ii) State the initial potential energy of the hammer.

(iii) Calculate the height above the baseplate from which the hammer is dropped. Take g as
10 N/kg.

[6]

(c) (i) In raising the hammer, the electric motor uses more energy than that stated in **(b)(ii)**.
State and explain **two** reasons why the motor uses more energy.

(ii) State one change to the equipment in Fig. 9.1 that would cause the baseplate to move
further into the ground each time the hammer falls.

[5]

[Turn over

10 A student compares the efficiency of two electric water heaters in the kitchen. Each heater consists of a tank to contain the water and an electrical heating element to heat the water.

The two tanks are different, but each tank contains the same amount of water and is heated by the same type of electrical heating element.

Fig. 10.1 shows part of the tank from the heater that is less efficient, and Fig. 10.2 shows the heater that is more efficient.
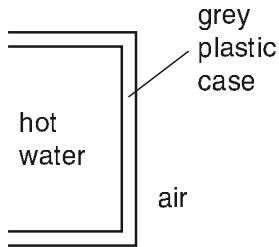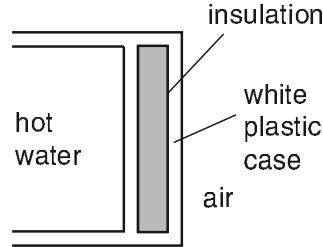

Fig. 10.1   **Fig. 10.2**

(a) Energy is lost by **conduction**, **convection** and **radiation** from each water heater.

  (i) Describe what happens to the molecules of the plastic case in Fig. 10.1 during **conduction**.

  (ii) Describe what happens to the molecules of the air outside the heater in Fig. 10.1 during **convection**.

[2]

(b) (i) Explain how the more efficient heater in Fig. 10.2 reduces the energy lost by conduction, convection and radiation.

  (ii) State two advantages of using an efficient water heater in a kitchen.

[5]

(c) When one heater is switched on, 15 kg of cold water at 20 °C is heated to 56 °C in ten minutes. The electrical heater is rated 5000 W, 230 V. The specific heat capacity of water is 4200 J/(kg °C).

  (i) Calculate the increase in the internal energy (heat) of the water in ten minutes.

  (ii) Calculate the electrical energy input to the heater in ten minutes.

  (iii) Calculate the efficiency of the heater.

[8]

11 Ultrasound may be used to measure the depth of the sea. Fig. 11.1 shows a pulse of ultrasound sent down to the sea bed and the reflected pulse returning to the ship.
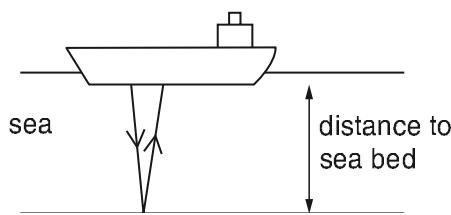

Fig. 11.1

(a) Describe what is meant by *ultrasound*. [2]

(b) Fig. 11.2 is a cathode-ray oscilloscope (c.r.o.) trace of the pulses of ultrasound sent from the ship and the reflected pulses.
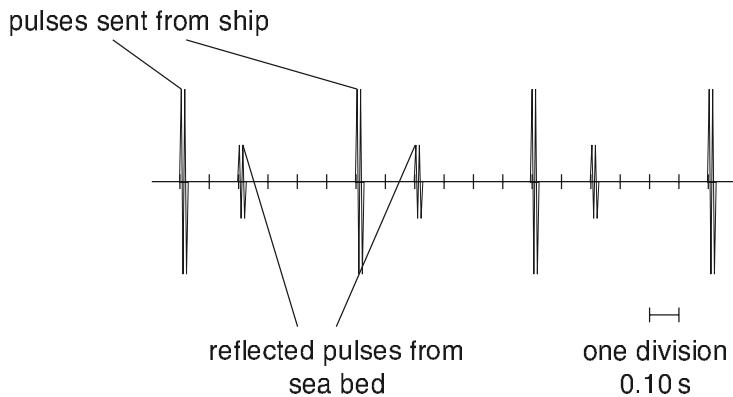

Fig. 11.2

The speed of ultrasound in water is 1500 m/s and the wavelength of the ultrasound wave is 0.030 m. The time-base setting for the *x*-axis on the c.r.o. is 0.10 s/division.

Calculate

(i) the frequency of the ultrasound wave,

(ii) the time taken for the ultrasound pulse to reach the sea bed,

(iii) the distance to the sea bed.

[7]

(c) The ship moves to a place where the sea is deeper.

(i) State and explain two changes that would occur to the reflected pulses on the c.r.o. trace. You may give diagrams of the old and new traces to show the changes.

(ii) When the sea is more than 450 m deep, the ultrasound pulses must be sent out less often. Using data from Fig. 11.2, explain why this is necessary.

[6]

[Turn over