	Centre Number	Candidate Number
Candidate Name ______________________		

UNIVERSITY OF CAMBRIDGE LOCAL EXAMINATIONS SYNDICATE

Joint Examination for the School Certificate and General Certificate of Education Ordinary Level

PHYSICS **5054/2**

PAPER 2 Theory

OCTOBER/NOVEMBER SESSION 2001 1 hour 45 minutes

Candidates answer on the question paper.
Additional materials:
Answer paper

TIME 1 hour 45 minutes

INSTRUCTIONS TO CANDIDATES

Write your name, Centre number and candidate number in the spaces at the top of this page and on any separate answer paper used.

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,

1. fasten any separate answer paper used securely to the question paper,
2. enter the numbers of the Section B questions you have answered in the grid below.

INFORMATION FOR CANDIDATES

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

Candidates are reminded that **all** quantitative answers should include appropriate units.

Candidates are advised to show all their working in a clear and orderly manner, as more marks are awarded for sound use of physics than for correct answers.

FOR EXAMINER'S USE	
Section A	
Section B	
TOTAL	

This question paper consists of 12 printed pages and 4 lined pages.

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Section A

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

1 Force is a vector quantity.

(a) State which **two** of the following are also vector quantities.

acceleration, distance, mass, speed, velocity

....[1]

(b) When two forces of 5 N are added, they may produce a resultant force that has any value between 0 and 10 N.

(i) Describe how it is possible to produce a zero resultant force from two forces of 5 N.

....

....

(ii) Describe how it is possible to produce a resultant force of 10 N from two forces of 5 N.

....

....

(iii) In the space below, draw a vector diagram to show how a resultant force of about 5 N may be obtained from the two 5 N forces. Clearly label the forces and the resultant.

[4]

2 A mercury thermometer uses the expansion of mercury to measure temperature. The thermometer is calibrated by placing it in pure melting ice, and then in steam at 100 °C. This is illustrated in Fig. 2.1.

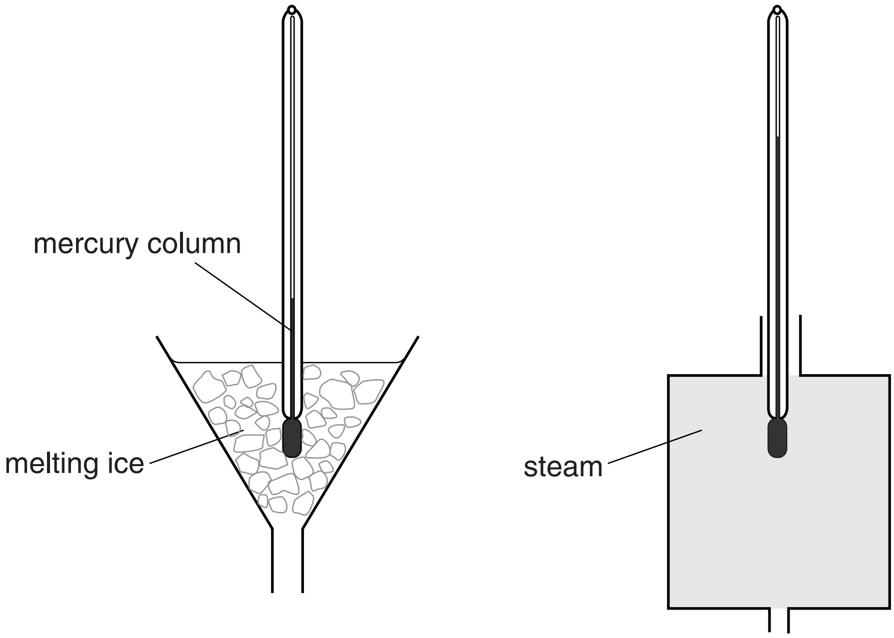

Fig. 2.1

(a) State the temperature of the thermometer when it is in pure melting ice.

....[1]

(b) The length of the mercury column is 4.0 cm in pure melting ice and 28.0 cm in the steam. Calculate the temperature for a length of 22.0 cm.

temperature = ……........................……°C [2]

(c) The heat capacity of the thermometer is 2.4 J/°C. Calculate the amount of energy needed to heat the thermometer from the temperature of pure melting ice to 100 °C.

energy = ……........................……J [1]

(d) State one other physical property of a substance that may be used to measure temperature.

....[1]

For Examiner's Use

3 A wave travels along a stretched spring. Fig. 3.1 shows the appearance of the spring at one instant.

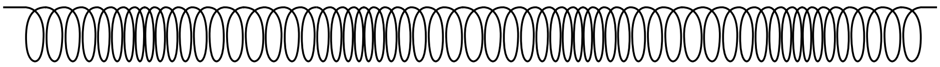

Fig. 3.1

(a) (i) On Fig. 3.1, label one compression.

(ii) Describe what is meant by a compression.

....

....

....

(iii) Sound waves also contain compressions and rarefactions. Give one other similarity between the motion of particles in a sound wave and the motion of coils in the stretched spring.

....

....
[3]

(b) Fig. 3.1 is drawn full scale.

(i) Measure the wavelength of the wave travelling along the spring.

wavelength = ...

(ii) Determine the frequency of the wave, given that the speed of the wave is 75 cm/s. State clearly the formula that you use and give your answer to a suitable number of significant figures.

frequency = ...
[4]

For Examiner's Use

4 A compact disc player uses a lens to focus a parallel beam of light to a point in the disc. The disc should be at the correct height.

10 x scale drawings

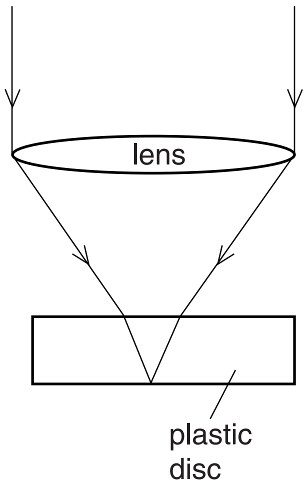

Fig. 4.1

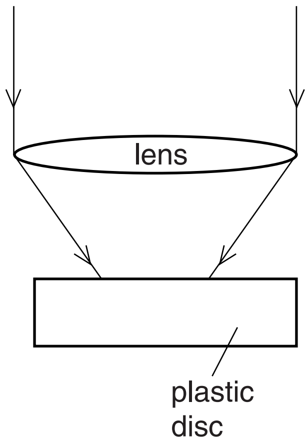

Fig. 4.2

Fig. 4.1 shows the disc in the correct position, and Fig. 4.2 shows the disc 0.5 mm too high. Each drawing is 10 times larger than the true size of the optical system.

(a) Estimate the focal length of the lens.

....[1]

(b) Describe what happens to the light as it enters the plastic disc.

....

....

....

....[2]

(c) **(i)** Complete Fig. 4.2 to show the rays of light inside the plastic disc.

(ii) Measure and state the diameter of the spot of light formed on the bottom of the disc in Fig. 4.2. You should take account of the scale of the diagram.

....

[2]

(d) State one adjustment that may be made to the lens in Fig. 4.2 so that the rays meet at a point on the bottom of the disc.

....[1]

[Turn over

For Examiner's Use

5 Fig. 5.1 shows an electric kettle connected to the 240 V mains supply by a flexible cable. The kettle has a power rating of 2500 W.

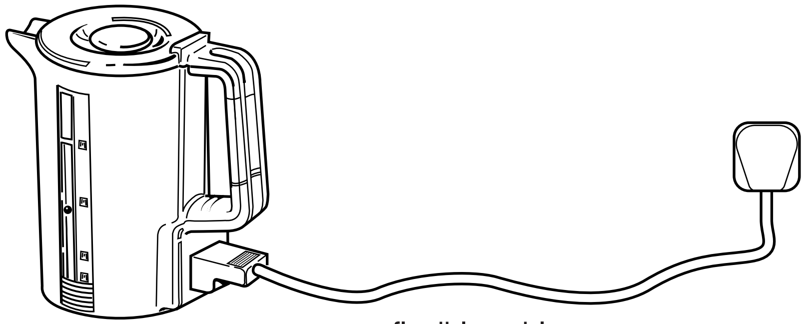

Fig. 5.1

The table shows the maximum current that may be carried safely by wires of various diameters.

wire diameter /mm	maximum current /A
0.50	3
0.75	6
1.00	10
1.25	13
1.50	15

(a) Show that the current in the cable when the kettle is in use is 10.4 A. State clearly any equation that you use.

[2]

(b) **(i)** From the table, select the smallest diameter of wire that can safely be used for this kettle.

....

(ii) Explain why it is dangerous to use a wire thinner than that in **(i)**.

....

....
[3]

(c) Describe one fault that may occur in the flexible cable that will cause the fuse in the plug to melt.

....

....[1]

6 Thunderclouds contain charges. Water drops are carried up by air currents and become charged. Fig. 6.1 shows a positively charged cloud and two drops of water.

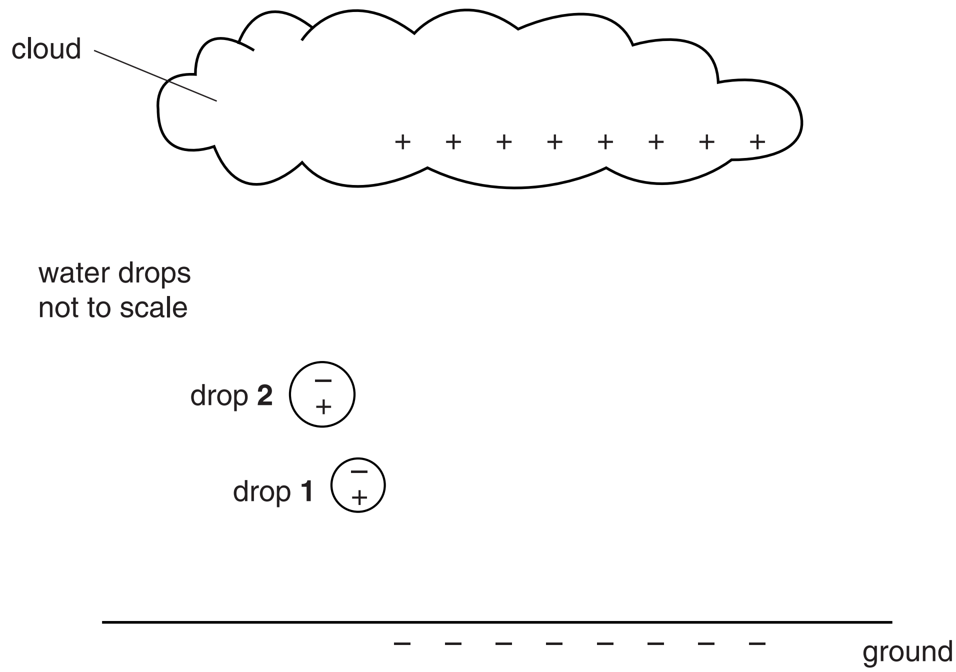

Fig. 6.1

(a) Draw lines of force to show the electric field between the cloud and the ground. You may ignore the drops. [2]

(b) Fig. 6.1 shows the charge distribution on the two drops when they are in the electric field between the cloud and the ground. Drop **1** moves upwards and briefly touches drop **2**.

(i) Explain what happens to the charges on the two drops as they touch.

....

....

(ii) Having touched, the drops now separate. State what charges will now be found on drop **1** and on drop **2**.

drop **1** ....

drop **2** ....
[2]

(c) The build-up of charge on the cloud causes a large potential difference between the cloud and the ground. Explain, in terms of energy, what is meant by *potential difference.*

....

....[1]

7 When a magnet is pushed into the solenoid in Fig. 7.1 the ammeter records a brief current.

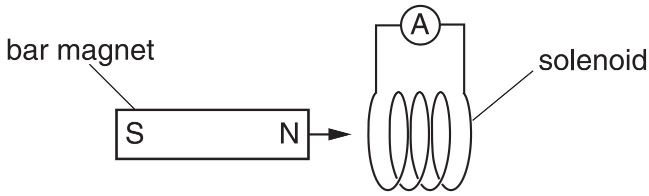

Fig. 7.1

(a) **(i)** Explain why a current is produced.

....

....

....

(ii) State the magnetic pole produced at the left-hand end of the solenoid.

....[3]

(b) State what is observed when

(i) the magnet is pulled out of the solenoid,

....

(ii) the magnet is stationary inside the solenoid.

....[2]

8 **(a)** Some atoms are radioactive. Explain what is meant by *radioactive*.

....

....

....

....[2]

(b) Some hospital equipment is sterilised using gamma-rays. State two properties of gamma-rays that make them suitable for this use.

1. ....

....

2. ....

....[2]

(c) Explain why radioactive sources should only be handled at a distance from the body.

....

....

....

....[2]

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 Fig. 9.1 shows part of the boiler of a steam engine, which has a valve to allow steam to escape when the pressure is high.

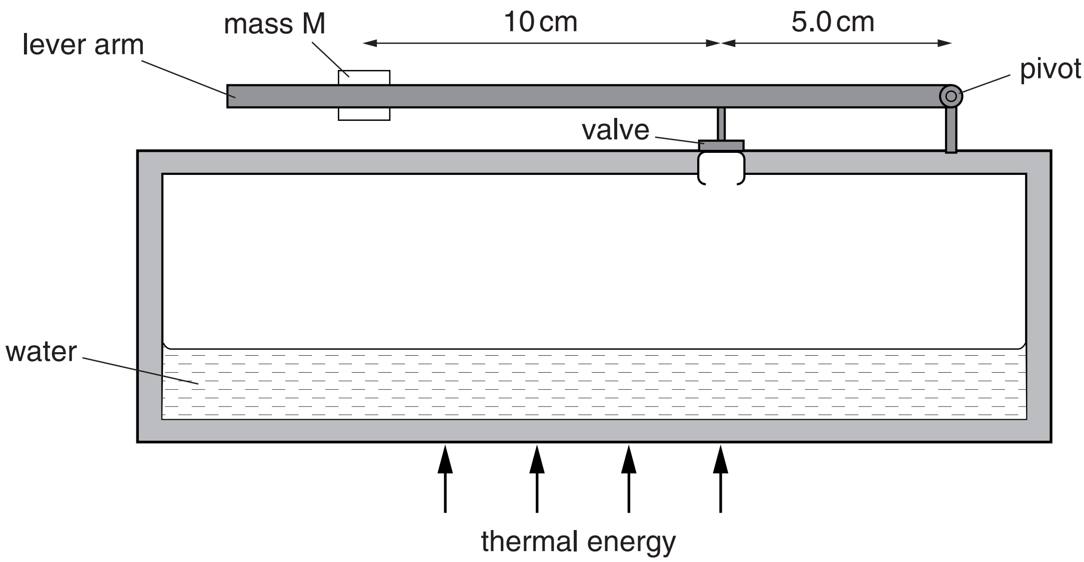

Fig. 9.1

Thermal energy is transferred into the boiler by conduction through the walls. The water then evaporates, increasing the pressure inside the boiler. If the pressure becomes too high the valve opens and allows steam to escape.

(a) **(i)** Explain how molecules transfer energy through the walls by conduction.

(ii) State what happens to the kinetic energy and to the potential energy of a water molecule as it evaporates.

(iii) Explain how the steam molecules exert a pressure on the boiler walls.

[6]

(b) When the pressure inside the boiler reaches 3.0×10^5 Pa above atmospheric pressure, the valve opens. The surface area of the valve in contact with the steam is 2.0×10^{-4} m^2.

(i) Calculate the resultant upward force required on the valve for it to open.

(ii) Using your answer to **(i)**, calculate the value of the mass M needed to balance the lever arm. Distances are given on Fig. 9.1. You may ignore the weight of the lever arm itself. Take the gravitational force on a mass of 1 kg to be 10 N.

(iii) State two changes to the components shown in Fig. 9.1 that will allow steam to escape through the valve at a lower pressure.

[9]

10 (a) Fig. 10.1 shows a simple relay. Fig. 10.2 shows a reed relay. Both are drawn to the same scale.

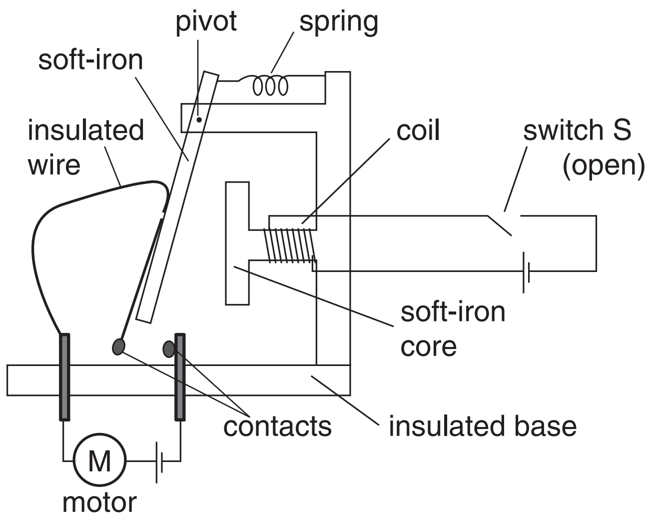

Fig. 10.1

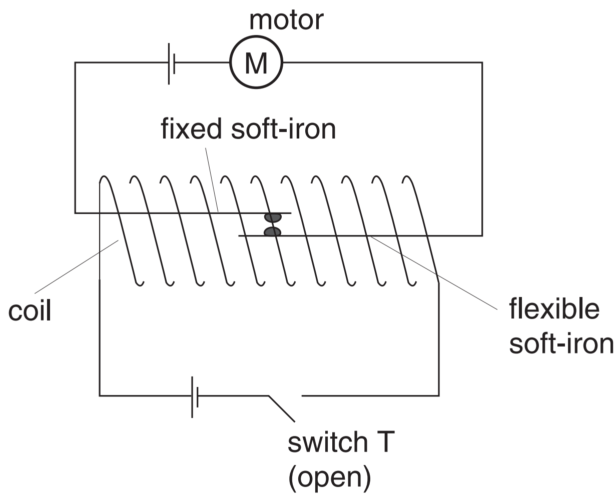

Fig. 10.2

Explain in detail why

(i) closing switch S in Fig. 10.1 causes the motor M to start,

(ii) closing switch T in Fig. 10.2 causes the motor M to start,

(iii) the reed relay in Fig. 10.2 switches faster than the simple relay in Fig. 10.1.

[8]

(b) Fig. 10.3 includes a thermistor in series with the relay coil. The motor switches on when the temperature changes.

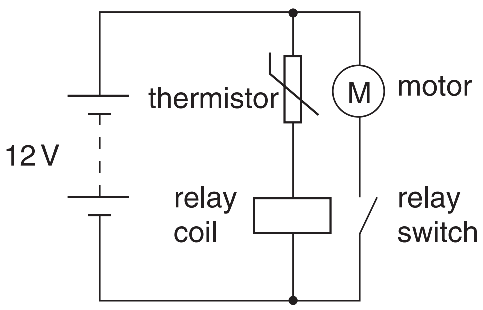

Fig. 10.3

(i) The temperature of the thermistor rises. State the effect on
1. the resistance of the thermistor,
2. the current in the relay coil.

(ii) The relay switches when the current through the coil is 0.10 A and the potential difference across the coil is 2.0 V.
As the relay switches, calculate
1. the resistance of the relay coil,
2. the potential difference across the thermistor,
3. the resistance of the thermistor.

[7]

11 Fig. 11.1 shows the variation with time of the speed of a car as it travels along a level road. The car brakes when the time $t = 20$ s, and comes to rest when $t = 24$ s.

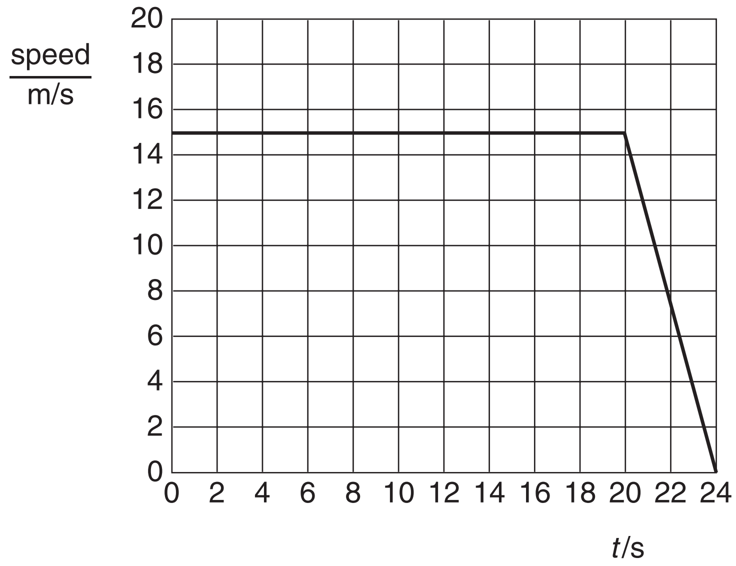

Fig. 11.1

The car has a mass of 800 kg and the forward driving force on the wheels is 1200 N.

(a) For the first 20 s of the motion shown in Fig. 11.1 calculate

(i) the distance travelled,

(ii) the work done by the driving force,

(iii) the power supplied by the driving force.

[6]

(b) **(i)** Calculate the kinetic energy of the car while it is travelling at the constant top speed.

(ii) When the car is travelling at a constant speed there is no change in its kinetic energy.
1. Explain why the car engine is needed to maintain this constant speed.
2. Suggest what happens to the energy that is provided by the engine.

[5]

(c) During braking the speed of the car decreases uniformly. The engine no longer provides a driving force.

(i) Calculate the deceleration of the car between $t = 20$ s and $t = 24$ s.

(ii) Calculate the total braking force acting on the car during this period.

(iii) Explain why the power dissipated in the brakes to slow the car is greater at the beginning of the braking period than at the end.

[4]

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