Centre Number	Candidate Number	Name

UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
General Certificate of Education Ordinary Level

PHYSICS **5054/02**

Paper 2 Theory

October/November 2005

1 hour 45 minutes

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

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Section A	
Q9	
Q10	
Q11	
Total	

This document consists of **16** printed pages.

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UNIVERSITY of CAMBRIDGE International Examinations

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Section A

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

1 Fig. 1.1 shows a 0.4 kg mass hanging at rest from a spring.

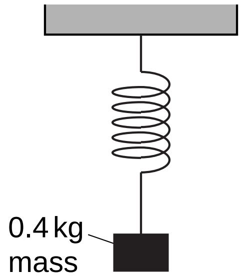

Fig. 1.1

(a) State what is meant by the *mass* of an object.

....

....

.... [1]

(b) **(i)** On Fig. 1.1, draw an arrow showing the direction and the line of action for each of the two forces that act on the mass. Write the name of the force next to each arrow. [2]

(ii) The gravitational field strength is 10 N/kg. Calculate the size of each of the two forces acting on the mass.

first force = ... second force = ... [2]

(c) The mass is pulled downwards. State and explain what happens to the upward force.

....

....

....

....

.... [2]

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2 Fig. 2.1 shows a stationary piston in a cylinder.

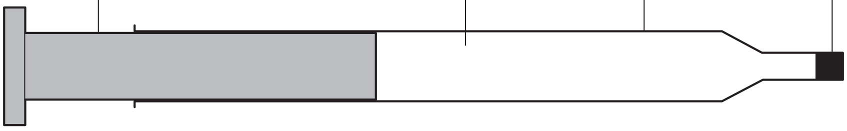

Fig. 2.1

(a) The gas in the cylinder exerts the same pressure on the piston as it does on the sealed end. The sealed end has a smaller cross-sectional area.

Use ideas about molecules to explain why the pressures are the same.

....

....

....

....

.... [2]

(b) The piston is pushed inwards and the temperature of the gas stays constant.

(i) The piston moves 0.10 m. The average force exerted on the piston to compress the gas is 23 N.

Calculate the work done. State the formula that you use.

work done = ... [2]

(ii) The gas in the cylinder starts at a pressure of 1.0×10^5 Pa and has a volume of 100 cm^3. The volume of the gas decreases to 80 cm^3.

Calculate the final pressure of the gas. State the formula that you use.

pressure = ... [3]

[Turn over

3 A student produces wavefronts in a ripple tank to demonstrate refraction, as shown in Fig. 3.1. He places a sheet of glass under the water on the right-hand side of the tank. The arrows show the directions of movement of the wavefronts.

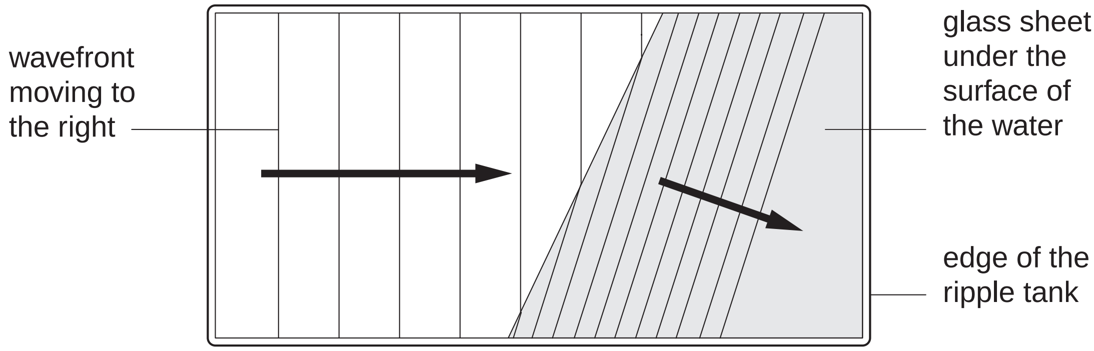

Fig. 3.1

(a) State what is meant by a *wavefront*.

....

....

.... [1]

(b) State what happens to each of the following quantities as the wavefronts change direction.

(i) wavelength ....

.... [1]

(ii) speed ....

.... [1]

(iii) frequency ....

.... [1]

4 X-rays, microwaves, ultra-violet rays and infra-red rays are different types of radiation in the electromagnetic spectrum.

(a) Write the name of one of these types of radiation in each of the boxes, placing them in order of increasing wavelength.

shortest wavelength ⟶ longest wavelength

[2]

(b) State one use of ultra-violet radiation.

....

....

.... [1]

(c) State two properties that are common to all types of radiation in the electromagnetic spectrum.

1. ....

....

2. ....

.... [2]

5 This question is about the sound produced by a mobile phone and the energy changes while it is operating.

(a) The sound produced by a ringing phone consists of two notes, one after the other.

Fig. 5.1 shows the trace on an oscilloscope screen produced by the first of the notes.

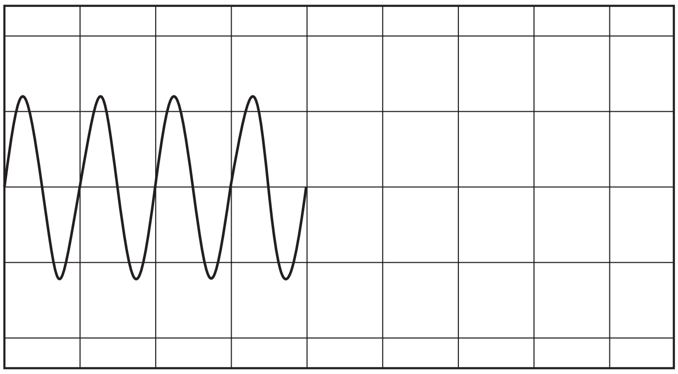

Fig. 5.1

The second note is louder and has a higher pitch.

(i) On Fig. 5.1, continue the trace to show what happens when the second note is sounding. [1]

(ii) Explain the differences between the two traces.

....

....

....

....

.... [2]

(b) The mobile phone contains a rechargeable battery.

Energy is stored inside the battery as it is charged.

Describe the useful energy change that takes place inside the battery as it is charged from the mains.

....

....

.... [2]

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6 An electrostatic generator is used to produce sparks, as shown in Fig. 6.1.

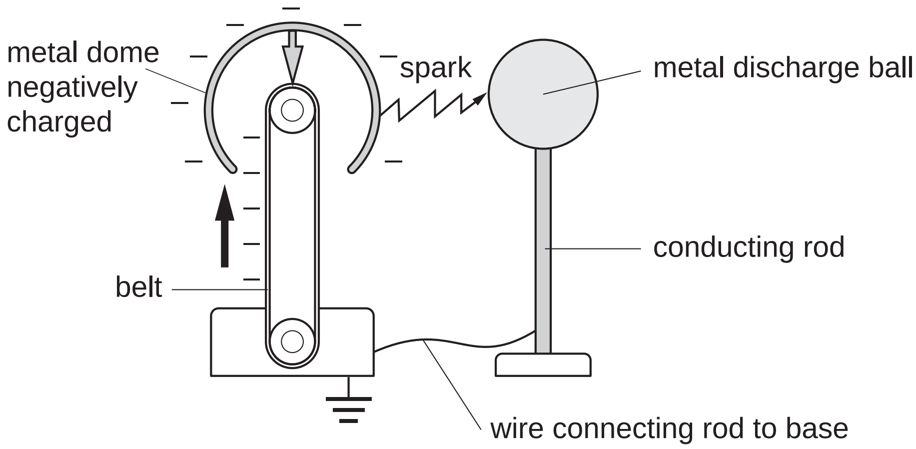


Fig. 6.1

The belt carries negative charge to the dome, making the dome negatively charged.

(a) Before a spark is produced, the discharge ball becomes positively charged.

(i) Describe and explain the movement of electrons in the discharge ball and in the rod as the ball becomes charged.

....

....

....

.... [2]

(ii) On Fig. 6.1, mark with an X where there is the most positive charge on the discharge ball. [1]

(b) A spark jumps between the dome and the discharge ball when there is enough negative charge on the dome.

A charge of 0.00016 C flows in the spark in a time of 0.012 s.

Calculate the average current in the spark. State the equation that you use.

current = ... [3]

[Turn over

7 Fig. 7.1 shows a coil of wire wound around a rectangular tube.

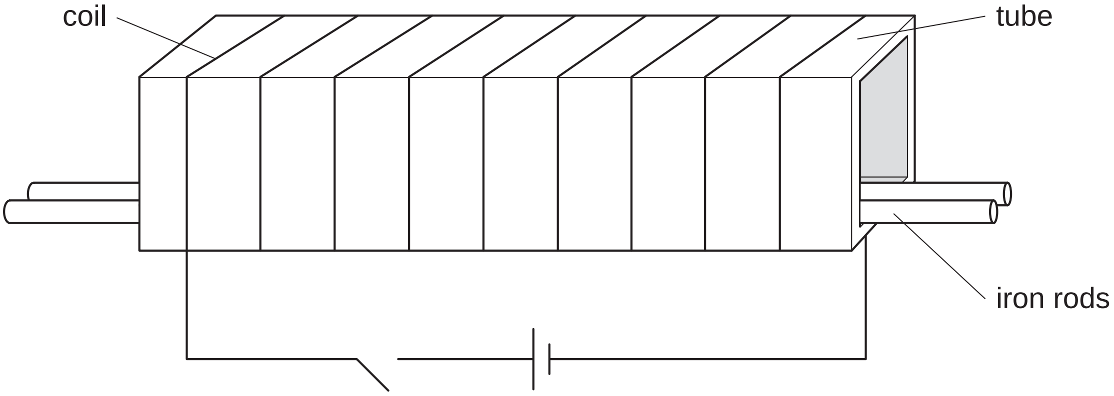


Fig. 7.1

(a) Two iron rods are placed next to each other at the bottom of the tube. When the current is switched on, the two rods repel each other. They move to the sides of the tube.

Explain why the two iron rods repel.

....

....

....

.... [2]

(b) An iron rod and a similar copper rod are placed next to each other at the bottom of the tube. State and explain what, if anything, happens to the rods when the current is switched on.

....

....

....

.... [2]

8 Fig. 8.1 is a half-scale diagram of a radioactive source stored in a safe way.

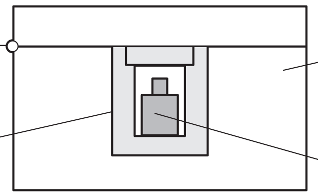


Fig. 8.1

(a) The source emits alpha-particles, beta-particles and gamma-rays.

A teacher handles the box. Explain how the teacher is completely protected from the alpha- and beta-particles but only partially protected from the gamma-rays.

....

....

....

.... [2]

(b) Describe and explain how the teacher should remove the source from the box safely.

....

....

....

.... [2]

(c) The source is brought near a radiation detector.

(i) Name a suitable detector.

.... [1]

(ii) Describe how you would use the detector to show that the source emits particles at random.

....

....

....

.... [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 an electric kettle.

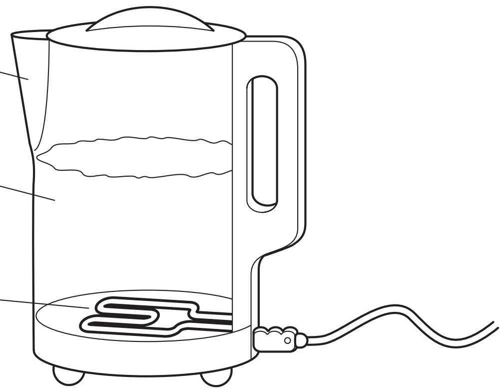


Fig. 9.1

(a) The body of the kettle is plastic but the outside casing of the heating element is metal.

(i) Explain why a fuse is included in the circuit and explain what happens when the fuse blows. [3]

(ii) Explain why the metal casing of the heating element is connected to earth. [2]

(b) The electrical power input to the kettle is 2000 W and the kettle is used for 6 minutes (0.1 hour).

Calculate

(i) the electrical energy, in J, supplied to the kettle. State clearly the formula that relates power, energy and time. [3]

(ii) the electrical energy, in kW h, supplied to the kettle. [2]

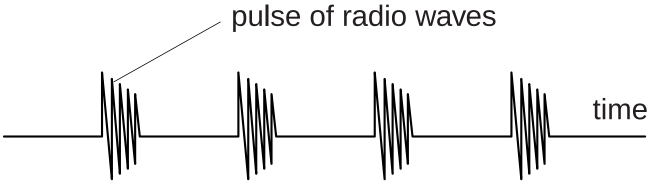
(iii) the cost of using the kettle if 1 kW h costs 8 cents. [2]

(c) When the kettle is switched off, the water cools down. Explain, in molecular terms, how evaporation causes a loss of energy from the water. [3]

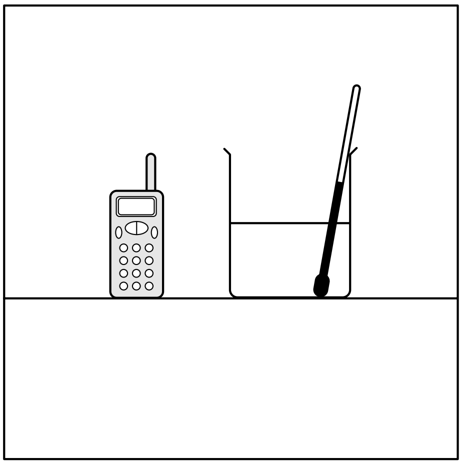
10 A student uses a mobile phone. He is concerned that the energy of the radio waves may cause a temperature rise in his brain. To investigate this effect, he calculates and tries to measure the heating effect of the phone on a nearby glass beaker of water.

Information from manufacturer

constant input power 0.20 W



The mobile phone emits pulses of radio waves.
Each pulse of waves has energy 0.00012 J.
There are 216 pulses of waves in 1.0 s



The phone is used for 360 s when next to a glass beaker containing 50 g of water.

(a) Calculate

(i) the number of pulses of radio waves produced during the phone call, [2]

(ii) the total energy of the radio waves emitted during the phone call, [2]

(iii) the maximum temperature rise produced in 50 g of water if all of the energy calculated in **(ii)** is absorbed by the water. The specific heat capacity of water is 4.2 J/(g °C). [3]

(b) The manufacturer gives the input power of the phone as 0.20 W.

(i) Calculate the energy supplied by the battery when the phone is used for 360 s. [2]

(ii) Calculate the fraction of the energy supplied by the battery that is converted into radio wave energy during the phone call. [1]

(c) The student uses the mercury-in-glass thermometer shown in Fig. 10.1.

He does not detect any temperature rise in the water in the beaker when the phone is used.

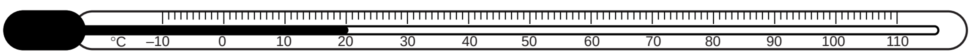


Fig. 10.1

(i) Describe how you would check the 0 °C and 100 °C points on the thermometer. [2]

(ii) Explain why the thermometer is not sensitive enough to detect the temperature rise. [1]

(iii) State and explain one change that will make a mercury-in-glass thermometer more sensitive. [2]

11 Fig. 11.1 shows how the currents in a lamp L and in a wire W vary with the potential difference (p.d.) applied.

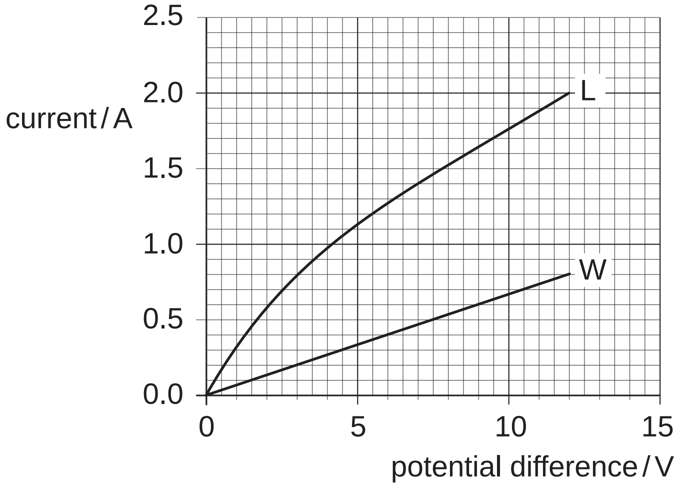


Fig. 11.1

(a) **(i)** Draw a diagram of the circuit that you would use to take the readings of current and p.d. for the lamp. State the range you would choose for the voltmeter. [5]

(ii) Describe how the resistance of the lamp L varies as the p.d. increases. [1]

(b) **(i)** Fig. 11.2 shows the lamp L and the wire W connected in series. The current in the circuit is 0.8 A.

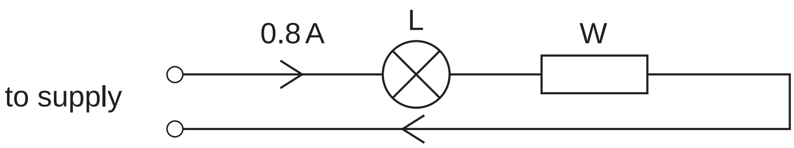


Fig. 11.2

Determine, using the graph or by calculation,

1. the p.d. across L,

2. the p.d. across W,

3. the p.d. of the supply,

4. the resistance of the lamp L in Fig. 11.2. [5]

(ii) Fig. 11.3 shows the lamp and wire connected in parallel.

A p.d. of 12 V is connected across them.

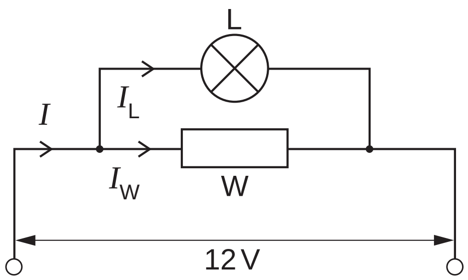


Fig. 11.3

Determine, using the graph or by calculation,

1. the current I_W in the wire W,

2. the current I_L in the lamp L,

3. the total current I in the circuit,

4. the resistance of the wire W. [4]

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