Candidate Name	Centre Number	Candidate Number

UNIVERSITY OF CAMBRIDGE LOCAL EXAMINATIONS SYNDICATE
General Certificate of Education Ordinary Level

PHYSICS 5054/2

PAPER 2 Theory
MAY/JUNE SESSION 2000 1 hour 45 minutes

Candidates answer on the question paper.
Additional materials:
Answer paper
Electronic calculator and/or Mathematical tables
Ruler 300 mm

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.

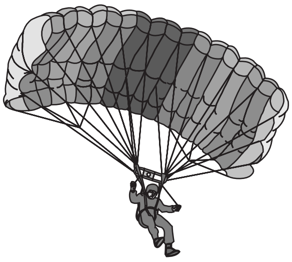
SJF1379 QF06363/3

For Examiner's Use

Section A

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

1 A parachutist jumps from an aircraft and falls through the air. After some time, the parachute opens.



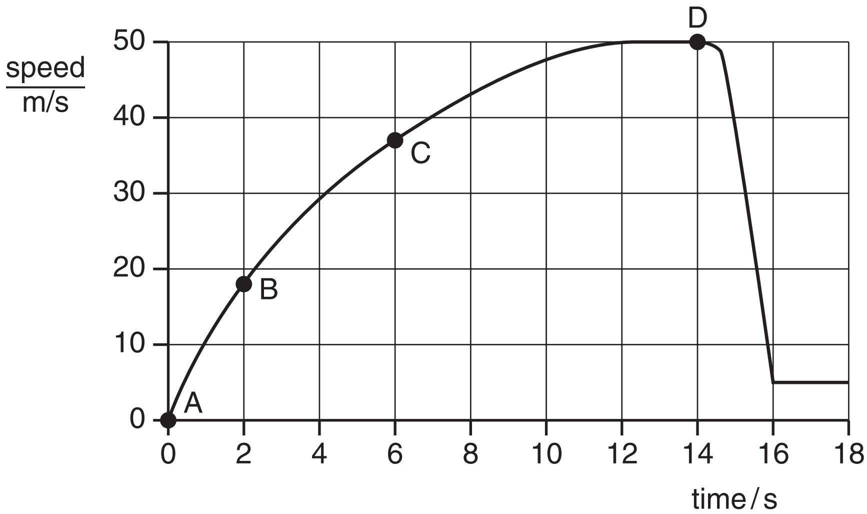


Fig. 1.1

Fig. 1.1 shows how the speed of the parachutist varies with time.

(a) Describe the motion of the parachutist between A and D.

....

....

....

.... [3]

(b) State the value of the terminal velocity before and after the parachute opens.

before parachute opens, terminal velocity = ...

after parachute opens, terminal velocity = ... [1]

(c) Calculate the average value of the acceleration between B and C.

average acceleration = ... [2]

For Examiner's Use

2 Fig. 2.1 shows a piece of glass being lifted by a suction cup.

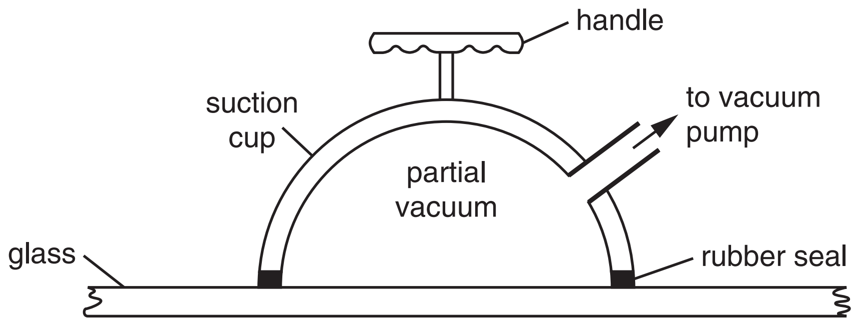


Fig. 2.1

Air is removed from the cup by a vacuum pump and a partial vacuum is created inside the cup. Atmospheric pressure outside pushes the glass on to the cup.

The area of the glass covered by the cup is $0.0025\,m^2$. The pressure inside the cup is reduced to 60 000 Pa. Atmospheric pressure outside is 100 000 Pa.

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

....

(ii) Calculate the greatest weight of glass that can be lifted with this cup.

weight = ...
[4]

(b) State two changes that would allow a suction cup to lift a heavier piece of glass.

1. ....

2. .... [2]

[Turn over

For Examiner's Use

3 **(a)** State what is meant by the *thermal expansion* of a solid.

....

.... [1]

(b) Fig. 3.1 shows a metal rim and a wheel. The inside diameter of the metal rim is slightly smaller than the diameter of the wheel. When heated and placed over the wheel, the rim fits easily.

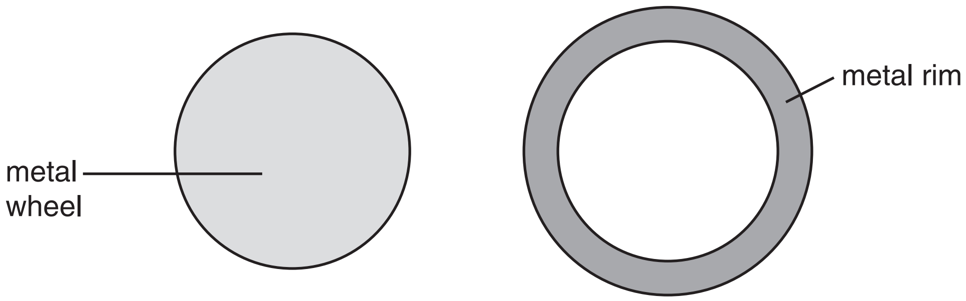


Fig. 3.1

(i) Describe what happens to the distance between atoms in the rim and to the motion of these atoms when the rim is being heated.

....

....

....

....

(ii) Explain why the metal rim will now fit tightly on the wheel when in everyday use.

....

....

....

[3]

For Examiner's Use

4 A person running in a race generates, on average, 800 J of heat energy every second. Half of this heat energy is lost from the body by the evaporation of water.

(a) Explain, in terms of molecules, how the loss of water by evaporation cools the body.

....

....

....

.... [2]

(b) Calculate the mass of water evaporated from the body in a 2 hour race.

The specific latent heat of vaporisation of water is 2.25×10^6 J/kg.

mass = ... [3]

For Examiner's Use

5 Fig. 5.1 shows a coil of wire wound on a piece of soft iron. A magnet is rotated in the gap in the soft iron as shown.

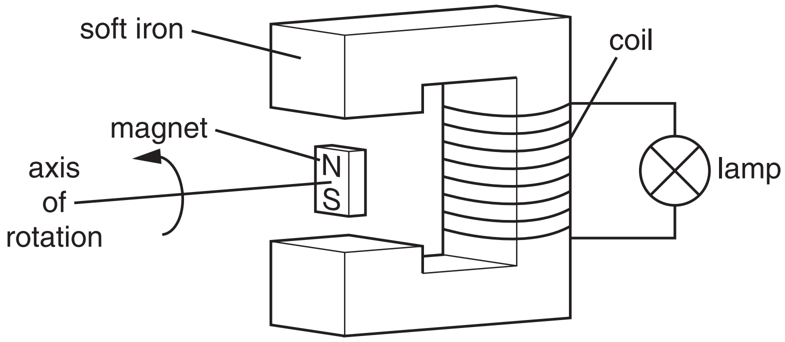


Fig. 5.1

When the magnet rotates, the lamp connected to the coil glows. The magnet takes 0.20 s to make one complete revolution.

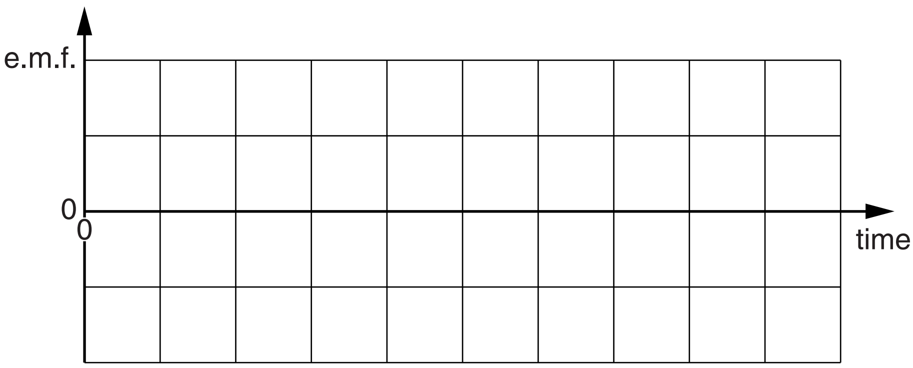
(a) Explain why an e.m.f. is produced in the coil when the magnet rotates.

....

....

.... [2]

(b) Using the axes provided, sketch a graph to show how the e.m.f. produced in the coil varies with time. Mark a scale along the time axis. [2]



(c) State two changes that increase the size of the e.m.f. produced. The parts of the apparatus shown in Fig. 5.1 may be altered.

1. ....

2. .... [2]

6 Fig. 6.1 shows a circuit set up to test whether electrical resistance changes when temperature rises.

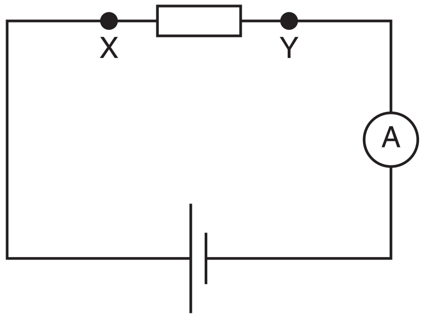


Fig. 6.1

Two components, a length of metal wire and a thermistor, are tested. They are each tested in turn, by placing them between terminals X and Y. As the temperature changes, the current readings on the ammeter are noted. The results are shown in the table.

component under test	current at 0 °C / A	current at 50 °C / A	current at 100 °C / A
metal wire	0.100	0.090	0.080
thermistor	0.002	0.004	0.080

(a) **(i)** On Fig. 6.1, draw a voltmeter to show how it is connected to measure the potential difference across XY.

(ii) State how you would use the apparatus to obtain a value for the resistance of the component.

....

....

(iii) State whether the resistance of each of the components **increases** or **decreases** as it is heated.

1. metal wire ....

2. thermistor ....

[4]

(b) The current through each component changes with temperature. The current values are used to set up a temperature scale. Each circuit then acts as a thermometer, reading temperatures between 0 °C and 100 °C. Using information from the table, state, giving a reason in each case, which component would make a thermometer with

(i) the greater sensitivity,

component .... reason ....

....

(ii) the greater linearity.

component .... reason ....

.... [2]

7 Fig. 7.1 shows a ripple tank being used to investigate waves on water.

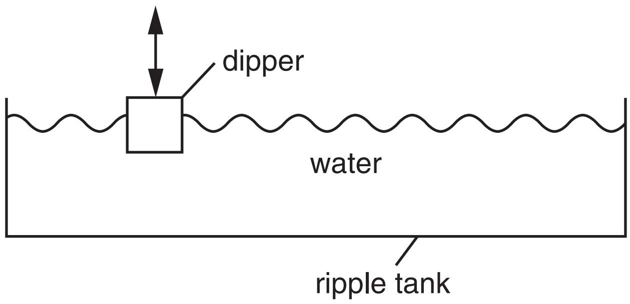


Fig. 7.1

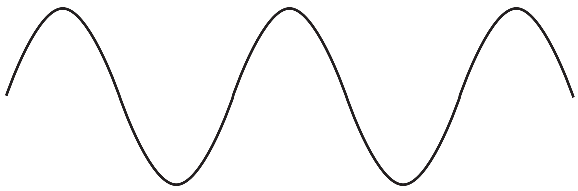


Fig. 7.2 full scale

The dipper moves up and down 20 times in one second. Fig. 7.2 shows, to full scale, a sideways view of the wave on the surface of the water at one instant.

(a) **(i)** Determine the wavelength of the wave in Fig. 7.2.

wavelength = ...

(ii) Calculate the speed of the water wave. State clearly the equation you use.

speed = ...

[4]

(b) The dipper is now made to move up and down 40 times in one second. The speed of the water wave is unchanged.

(i) On Fig. 7.2, draw the sideways view of the new wave.

(ii) State the value of the new wavelength of the wave.

wavelength = ...

[2]

For Examiner's Use

8 Fig. 8.1 shows an apparatus that demonstrates electrostatic charging. Perspex is an insulator.

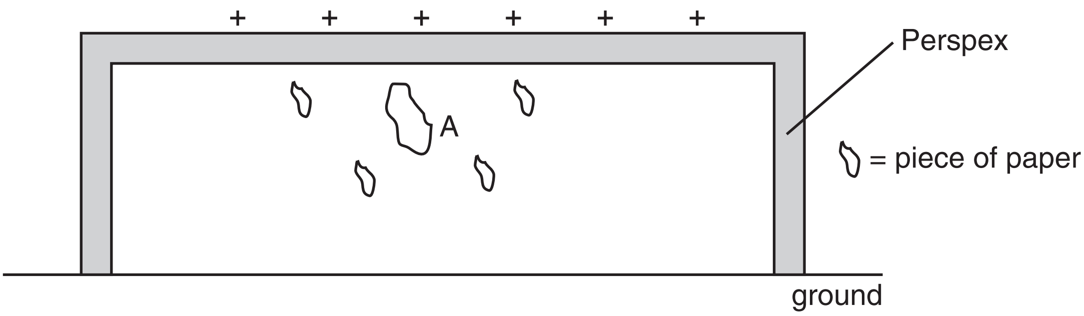


Fig. 8.1

When rubbed with a cloth, the top of the Perspex becomes positively charged. The small pieces of paper jump up and stick to the lower surface of the Perspex.

(a) Explain, in terms of the movement of electrons, why the Perspex becomes positively charged when rubbed with a cloth.

....

....

.... [2]

(b) State the unit in which charge is measured.

.... [1]

(c) Charges are induced on the pieces of paper by the charge on the Perspex. On Fig. 8.1, draw the charges induced on the piece of paper labelled A. [2]

(d) Explain why the pieces of paper jump up.

....

....

.... [1]

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)** A radioactive source emits α-particles only.

(i) Describe, with the aid of a diagram, an experiment that demonstrates that the source emits α-particles but not β-particles.

(ii) Describe how you would demonstrate that the radioactive emission from the source is random.

(iii) State one safety precaution that you would take when handling any radioactive source.

[8]

(b) A radioactive isotope of radon (Rn-220) is represented as $^{220}_{86}\mathrm{Rn}$. The nucleon number (mass number) of this nuclide is 220 and the proton number (atomic number) is 86. Radon-220 decays into polonium (Po-216) by the emission of an α-particle.

(i) State the number of neutrons in a nucleus of Rn-220.

(ii) The nuclear equation that represents the decay of Radon-220 is written as

$$^{220}_{86}\mathrm{Rn} \rightarrow \,^{\dots}_{\dots}\alpha + \,^{216}_{\dots}\mathrm{Po}.$$

Copy this equation and complete it by adding the missing nucleon number and proton number for the α-particle and the missing proton number for the polonium nucleus.

(iii) During the decay, there is an apparent decrease in mass of 1.14×10^{-29} kg. Calculate the energy released in the decay. [speed of light = 3.0×10^{8} m/s]

[7]

10 **(a)** Draw a labelled diagram of the basic structure of a cathode-ray oscilloscope. [6]

(b) Describe how electrons in the oscilloscope are

(i) emitted,

(ii) given kinetic energy. [4]

(c) Fig. 10.1 shows a trace obtained on an oscilloscope screen.

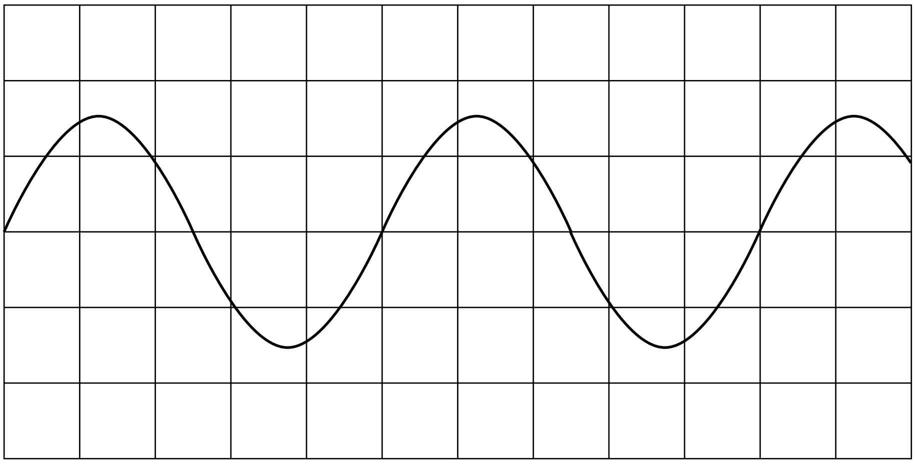


Fig. 10.1

The time-base is set at 10 ms/cm.

(i) Determine the time for one complete oscillation on the screen.

(ii) Calculate the frequency of the signal applied to the oscilloscope.

(iii) With the same signal applied to the oscilloscope, the time-base setting is altered to 20 ms/cm. State what effect this has on the trace shown on the screen.

[5]

11 A water bath is kept warm by an electric heater placed inside the water, as shown in Fig. 11.1. The heater switches on when the temperature of the water is 40 °C or below, and switches off when the temperature reaches 45 °C.

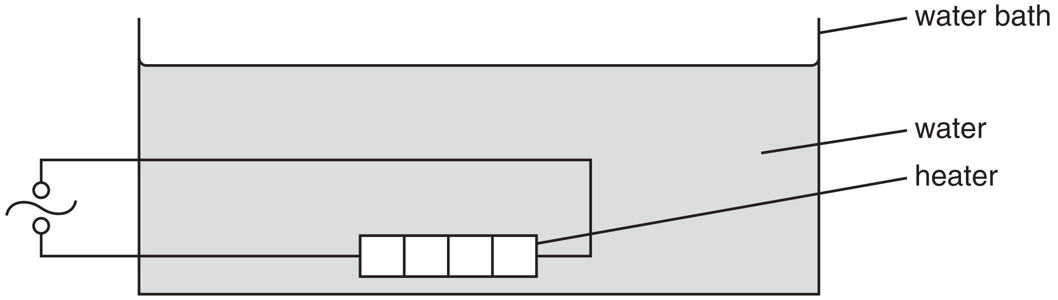


Fig. 11.1

(a) Energy from the heater warms all of the water in the tank by means of convection currents.

(i) Explain in detail how convection currents are formed.

(ii) Describe an experiment that you could perform to demonstrate a convection current in a liquid or in a gas. In your account, draw a diagram showing the convection current.

[6]

(b) The variation with time of the temperature of the water in the tank is shown in Fig. 11.2.

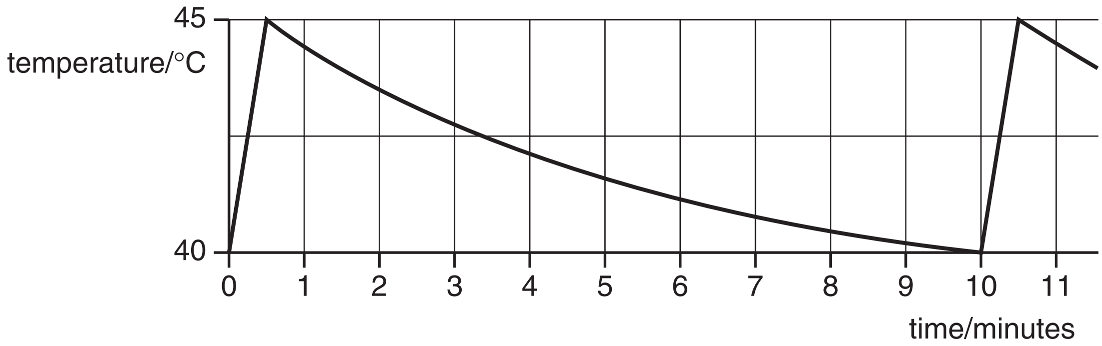


Fig. 11.2

The water bath contains 3.0 kg of water and the specific heat capacity of water is 4200 J/(kg °C).

(i) Show that the energy needed to warm the water from 40 °C to 45 °C is 63 000 J.

(ii) Show that the power of the heater is 2100 W. You may assume that all of the energy from the heater is used to raise the temperature of the water.

(iii) In every hour, the heater is on for 3 minutes. Calculate the amount of energy in kW h used by the heater in one hour.

[7]

(c) Describe two ways by which the water cools down while the heater is switched off. [2]

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