Cambridge
O Level

Cambridge International Examinations
Cambridge Ordinary Level

CANDIDATE NAME									
CENTRE NUMBER						CANDIDATE NUMBER				

5804803451

PHYSICS **5054/22**

Paper 2 Theory **May/June 2017**

1 hour 45 minutes

Candidates answer on the Question Paper.

No Additional Materials are required.

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 an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.
DO **NOT** WRITE IN ANY BARCODES.

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 in the spaces provided on the Question Paper.

Electronic calculators may be used.
You may lose marks if you do not show your working or if you do not use appropriate units.

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.

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Section A

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

1 A car accelerates from rest in a straight line. During the first 14 s, the acceleration is uniform and the car reaches a speed of 25 m / s.

(a) (i) Calculate the acceleration of the car.

acceleration = ...[2]

(ii) After the first 14 s, the speed of the car continues to increase but the acceleration decreases. From 70 s to 80 s after the start, the car moves at a constant speed of 55 m / s.

On Fig. 1.1, draw a possible speed-time graph for the car.

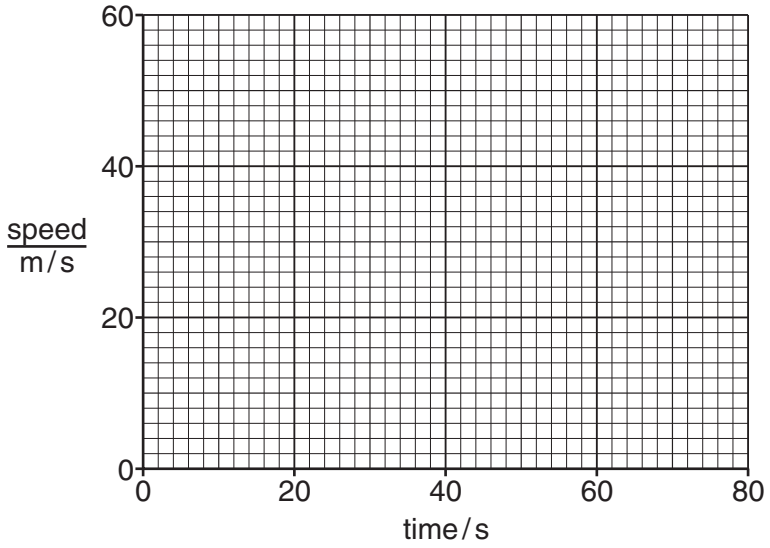


Fig. 1.1

[2]

(b) At a later time, the driver applies the brakes to stop. He is wearing a seat belt and slows down in his seat. A bag on the seat next to him slides forwards, across the seat towards the front of the car.

Using ideas about the forces acting, explain why the driver slows down but the bag slides forwards.

.....

.....

.....

.....[3]

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2 A swing is made by tying rope loosely to the branch of a tree, as shown in Fig. 2.1.

A child swings backwards and forwards several times, starting at the highest point A.

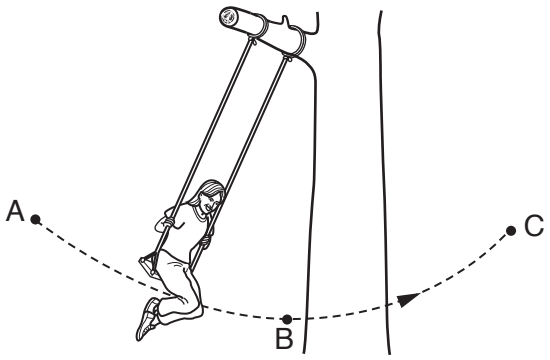


Fig. 2.1

(a) Explain how another child can obtain an accurate measurement of the time for one complete swing.

.....

.....

.....

.....

.....[2]

(b) When the child moves from A to B, she falls a vertical distance of 0.60 m. She loses 240 J of gravitational potential energy. The gravitational field strength g is 10 N/kg.

(i) Calculate the mass of the child.

mass = ...[2]

(ii) Suggest two reasons why her kinetic energy at B is not equal to 240 J.

1. .....

.....

2. .....

.....
[2]

3 Fig. 3.1 shows the brake pedal of a car which is connected to a brake cylinder.

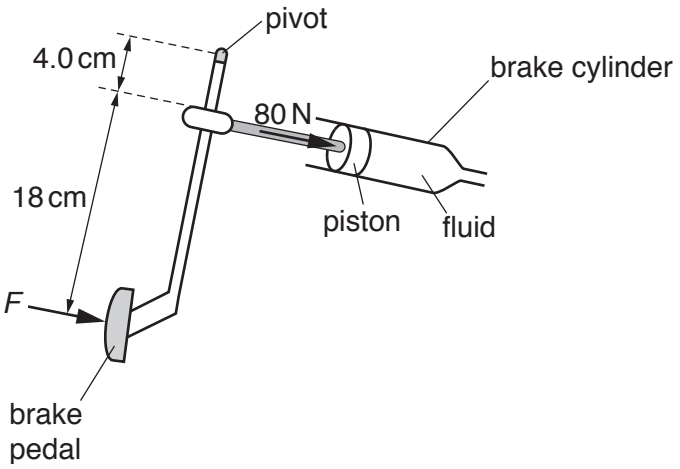


Fig. 3.1 (not to scale)

The brake is pressed with a force *F*. This force produces a moment about the pivot.

Pressing the brake causes a force of 80 N to act on the piston.

(a) Define the term *moment*.

.....

.....[2]

(b) Calculate the force *F* applied to the brake pedal.

F = ...[2]

(c) The cross-sectional area of the piston is 0.0012 m^2.

Calculate the pressure exerted by the brake piston on the fluid.

pressure = ...[2]

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4 Fig. 4.1 shows apparatus used to measure the specific heat capacity of a metal.

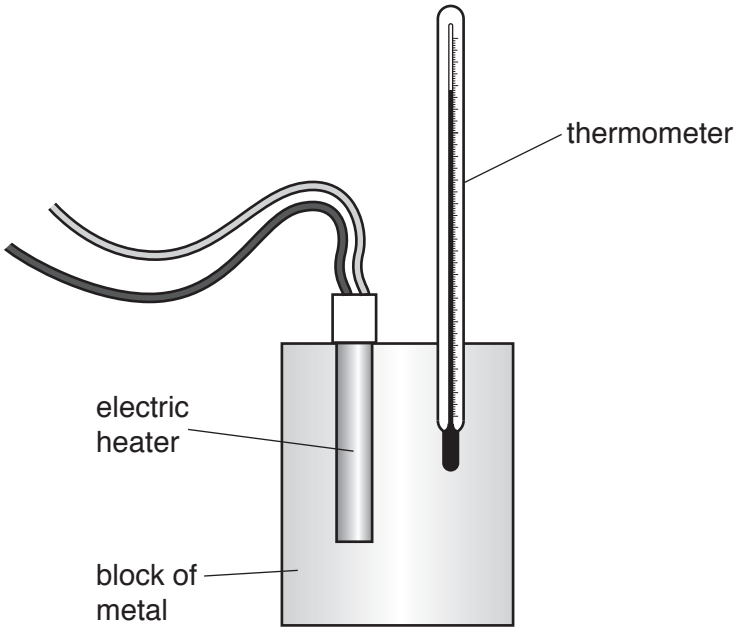


Fig. 4.1

The electric heater is switched on and supplies 17 000 J of thermal energy (heat) to the block of metal. The temperature of the metal rises from 16 °C to 38 °C. The mass of the block of metal is 850 g. No energy is lost from the metal.

(a) Calculate the specific heat capacity of the metal.

specific heat capacity = ...[2]

(b) Calculate the heat capacity of the block of metal.

heat capacity = ...[1]

(c) Explain how thermal energy (heat) is conducted through the metal.

.....

.....

.....[1]

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[Turn over

5 When a sample of a solid is heated, it becomes a liquid and eventually becomes a gas.

(a) Fig. 5.1 shows the arrangement of the molecules in the solid.

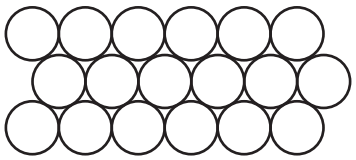


Fig. 5.1

In the space below, draw the arrangement of the molecules in the liquid.

[1]

(b) Complete the table by describing the motion of the molecules in the solid, liquid and gas.

	motion of the molecules
solid	
liquid	
gas	

[3]

(c) Suggest why a gas is able to fill a container but a solid has a fixed shape.

.....

.....

.....

.....

.....[2]

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6 **(a)** Explain the difference between a longitudinal wave and a transverse wave.

You may draw a diagram, if you wish, to help your explanation.

.....

.....

.....

.....

.....[2]

(b) A sound wave has a frequency of 3.8 kHz and a speed of 330 m / s.

(i) Calculate the wavelength of the sound.

wavelength = ...[2]

(ii) A different sound has a frequency of 3.8 Hz.

State and explain whether a human with normal hearing is able to hear this sound.

.....

.....

.....[1]

7 Fig. 7.1 shows part of a d.c. electric motor.

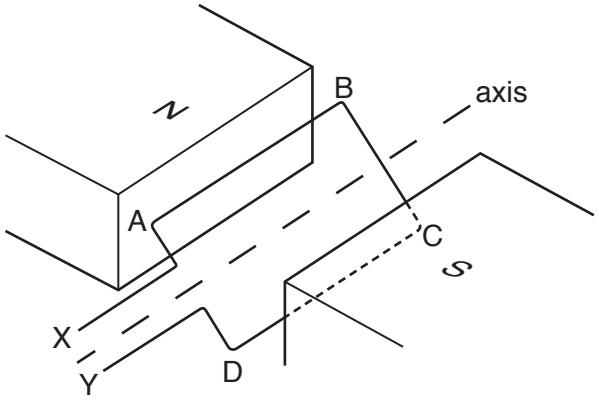


Fig. 7.1

(a) A coil of wire ABCD is placed between the poles of a magnet. Ends X and Y are connected to a commutator and a battery.

(i) State why there is a force on side AB of the coil.

.....

.....[1]

(ii) Describe how the commutator keeps the coil rotating in one direction.

.....

.....

.....

.....

.....[2]

(b) The current in the motor is 2.0 A and the battery has an electromotive force (e.m.f.) of 12 V. In a time of 8.0 s, the motor does 140 J of work.

Calculate

(i) the energy supplied to the motor in 8.0 s,

energy supplied = ...[2]

(ii) the efficiency of the motor.

efficiency = ...[1]

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8 Fig. 8.1 shows charges on a rod and on a cloth.

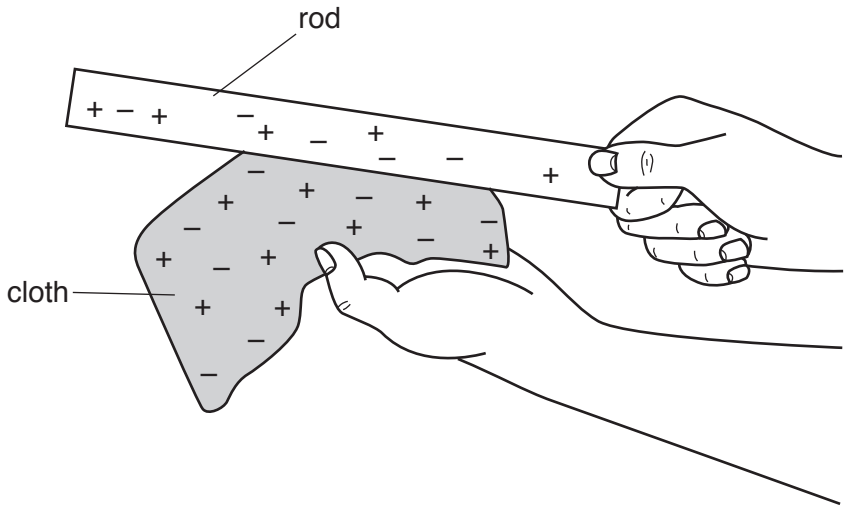


Fig. 8.1

(a) State how Fig. 8.1 shows that the rod and the cloth are uncharged.

.....

.....[1]

(b) The plastic rod becomes negatively charged when rubbed by the cloth.

(i) Describe what happens to the charges on the rod and on the cloth during the charging process.

.....

.....

.....

.....[2]

(ii) Describe a simple experiment to show that the plastic rod is charged.

You may draw a diagram if you wish.

.....

.....

.....

.....

.....[2]

Section B

Answer **two** questions from this section. Answer in the spaces provided.

9 Fig. 9.1 shows a man in a room looking into a mirror, as viewed from above.

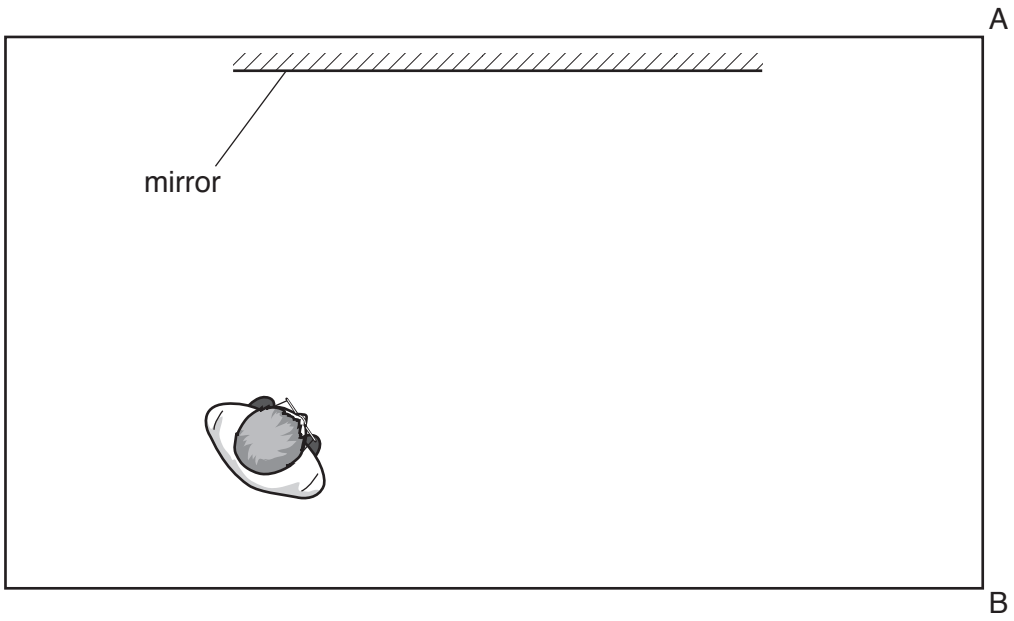


Fig. 9.1

(a) The man can see an image of part of the wall AB in the mirror.

Point C is the point on the wall closest to A that the man can see by reflection in the mirror. This point is not marked on Fig. 9.1.

(i) On Fig. 9.1, find point C and draw a ray of light from C which enables the man to see the image of C. [2]

(ii) On the ray that you have drawn on Fig. 9.1, label the angle of incidence *i* and the angle of reflection *r*. [2]

(iii) One characteristic of the image formed by the mirror is that it is virtual.

1. Explain what is meant by a *virtual* image.

.....

.....

.....[2]

2. State one other characteristic of an image formed by a plane mirror.

.....

.....[1]

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(b) Light travels along optical fibres by total internal reflection.

(i) State two differences between total internal reflection and reflection in a mirror.

1. .....

.....

2. .....

.....

[2]

(ii) The critical angle for light travelling from the material of the fibre to air is 44°.

Calculate the refractive index of the material in the fibre.

refractive index = ...[2]

(iii) Light enters the optical fibre from air with an angle of incidence of 50°.

Calculate the angle of refraction.

angle of refraction = ...[2]

(iv) Optical fibres are used in telecommunications to send large amounts of data.

Pulses of light travel at almost the same speed along a fibre as electrical pulses travel along a metal wire.

State two advantages of using optical fibres rather than wires for transmitting data.

1. .....

.....

2. .....

.....

[2]

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[Turn over

10 (a) Measurements are made of the current in a metal wire and the potential difference (p.d.) across it. Fig. 10.1 shows a graph of the current against the p.d. for the wire.

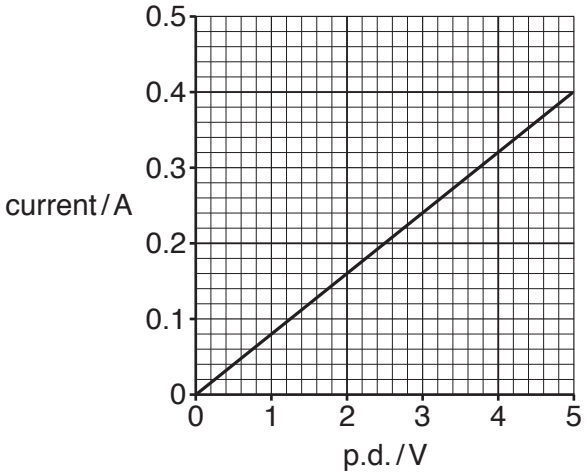


Fig. 10.1

(i) State the relationship between the current and the p.d. for the metal wire.

.....

.....[1]

(ii) State how the graph shows that the temperature of the wire does not change in the experiment.

.....

.....[1]

(iii) Another wire of the same material has the same length as the original wire but has only half the cross-sectional area.

1. Compare the resistance of the new wire and the original wire.

.....

.....[1]

2. On Fig. 10.1, draw the graph for the new wire. [1]

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(b) Three resistors are connected to a d.c. power supply, as shown in Fig. 10.2. The electromotive force (e.m.f.) of the power supply is 6.0 V.

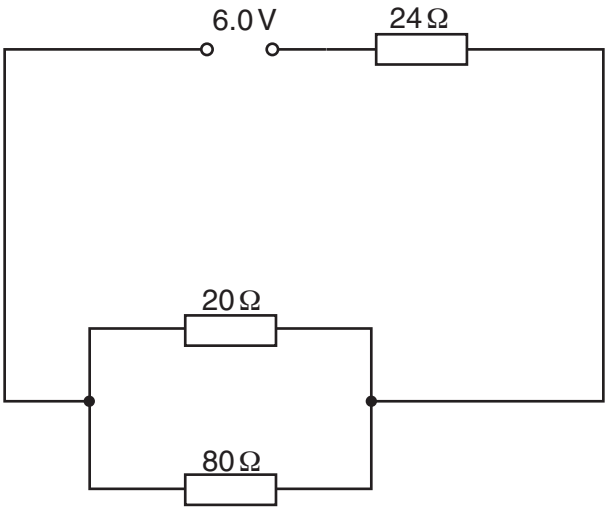


Fig. 10.2

(i) Calculate

1. the total resistance of the circuit,

resistance = ...[2]

2. the current supplied by the power supply,

current = ...[2]

3. the p.d. across the 20 Ω resistor.

p.d. = ...[2]

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[Turn over

(ii) The d.c. power supply is a battery that contains a number of cells. Each cell has an electromotive force (e.m.f.) of 1.5 V.

1. State what is meant by the *electromotive force (e.m.f.)* of a cell.

.....

.....

.....[1]

2. In the space below, draw a diagram to show how four of these cells are connected to make a battery of e.m.f. 6.0 V. Mark the positive terminal of the battery.

[2]

3. In another arrangement to produce a battery of e.m.f. 6.0 V, eight cells of e.m.f. 1.5 V are connected. In this arrangement, some cells are connected in series and some in parallel.

In the space below, draw a diagram to show how the eight cells are connected to make the battery.

[1]

(c) State one advantage of using a battery made from cells in parallel rather than a single cell.

.....

.....[1]

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11 One source of background radiation is cosmic rays.

The cosmic rays that enter the Earth's atmosphere are known as primary cosmic rays. Most of these rays are fast-moving protons or fast-moving alpha-particles.

Both the Earth's magnetic field and the Earth's atmosphere reduce the number of primary cosmic rays that reach the Earth's surface.

(a) (i) Name a source of background radiation apart from cosmic rays.

.....

.....[1]

(ii) State one effect of background radiation.

.....

.....[1]

(iii) State the number of protons and the number of neutrons in an alpha-particle.

number of protons .....

number of neutrons .....

[2]

(iv) Explain how the Earth's atmosphere reduces the number of alpha-particles that reach the surface.

.....

.....[1]

(v) Fig. 11.1 shows an area where there is a uniform magnetic field into the page.

On Fig. 11.1, draw a diagram to show the deflection of an alpha-particle by this magnetic field.

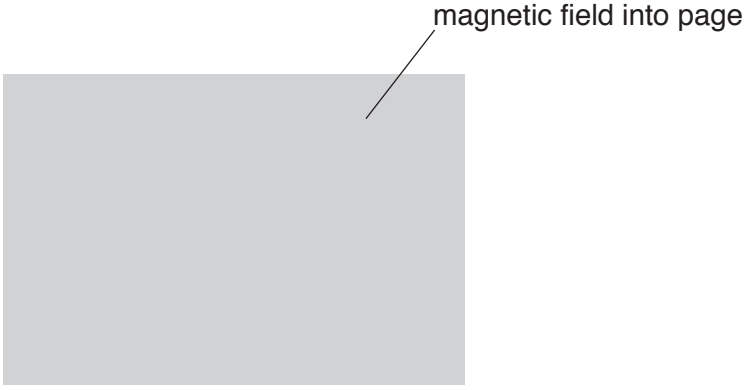


Fig. 11.1

[2]

(b) Primary cosmic rays produce carbon-14 in the atmosphere. The half-life of carbon-14 is 5700 years.

(i) Define the term *half-life*.

.....

.....[2]

(ii) A specimen of wood is found to contain 25 000 atoms of carbon-14. An otherwise identical specimen taken from a living tree is found to contain 200 000 atoms of carbon-14.

Determine the age of the specimen that contains 25 000 atoms of carbon-14.

age = ...[2]

(iii) State why it is not possible to use the amount of carbon-14 to date a specimen that is 570 000 years old.

.....

.....[1]

(c) Carbon-14 is one of the isotopes of carbon. Another isotope is carbon-12.

(i) Describe how a nucleus of carbon-14 differs from a nucleus of carbon-12.

.....

.....

.....[2]

(ii) Describe one similarity in the structure of the nuclei of these isotopes.

.....

.....

.....[1]

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