Cambridge
O Level

Cambridge International Examinations
Cambridge Ordinary Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

0895750181

PHYSICS **5054/22**

Paper 2 Theory **October/November 2018**

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.

This document consists of **17** printed pages and **3** blank pages.

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Section A

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

1 Fig. 1.1 shows a satellite travelling at a constant speed in a circular orbit around the Earth.

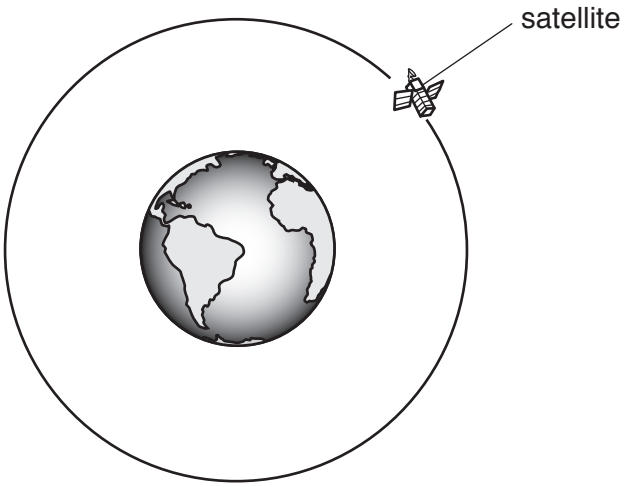


Fig. 1.1 (not to scale)

(a) State how *speed* differs from *velocity*.

.....

..... [1]

(b) As it orbits the Earth, the satellite is experiencing an acceleration.

(i) Explain, in terms of its velocity, why the satellite is accelerating.

.....

.....

..... [2]

(ii) On Fig. 1.1, draw an arrow, starting on the satellite, to show the direction of the satellite's acceleration. [1]

(c) As the satellite orbits the Earth, it experiences a force due to gravitational attraction.

State and explain whether this force does work on the satellite and state whether the energy of the satellite is affected.

.....

.....

.....

..... [2]

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2 A sports car is designed to be very stable when turning a corner at high speed.

Fig. 2.1 shows the position of the centre of mass of the car.

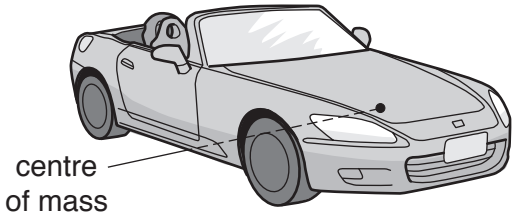


Fig. 2.1

(a) State what is meant by *centre of mass*.

.....

..... [1]

(b) State two features of the design that make the car in Fig. 2.1 stable.

1. .....

2. .....
[2]

(c) Fig. 2.2 shows an irregularly shaped piece of card.

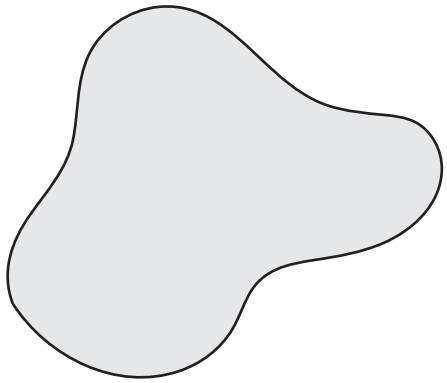


Fig. 2.2

Describe how to determine the position of the centre of mass of the piece of card.

You may draw on Fig. 2.2 or in the blank space.

.....

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.....

.....

.....

.....

..... [3]

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3 Fig. 3.1 shows a cylindrical copper kettle that contains cold water.

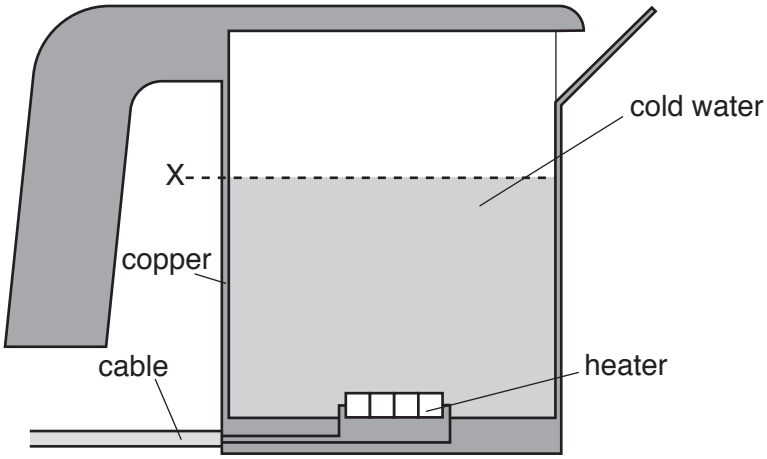


Fig. 3.1

The kettle is used to heat water and there is an electric heater at the base.

(a) State and explain the advantage of heating the water from below.

.....

.....

.....

..... [2]

(b) As the water is heated, it expands.

(i) Explain, in terms of molecules, why water expands when it is heated.

.....

.....

.....

..... [2]

(ii) Copper also expands when heated.

State what happens to level X of the water in the kettle. Explain your answer in terms of the expansion of the copper and the water.

.....

.....

..... [1]

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[Turn over

4 A house has several solar panels on the roof.

These panels use energy from the Sun both to generate electricity and to raise the temperature of water that passes through tubes inside the panels.

(a) The panels on the roof of the house have a black surface.

(i) State how energy from the Sun travels through space before it reaches the Earth.

.....

..... [1]

(ii) Explain the advantage of using panels that have a black surface.

.....

.....

.....

..... [2]

(b) On one occasion, the panels are supplying an electric current of 15 A at a voltage of 24 V.

(i) Calculate the electrical energy generated by the panels in one hour.

electrical energy = ... [2]

(ii) In the same time, 51 kg of cold water is pumped through the panels. The temperature of the water increases from 16 °C to 45 °C.

The specific heat capacity of water is 4200 J/(kg °C).

Calculate the increase in thermal energy of the water.

thermal energy increase = ... [3]

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5 Two uncharged conducting spheres, K and L, are mounted on insulating stands.

(a) State how the structure of an insulator differs from that of a conductor and give one example of an insulator.

.....

.....

..... [2]

(b) The two spheres are in contact.

Fig. 5.1 shows a positively-charged insulating rod held next to K.

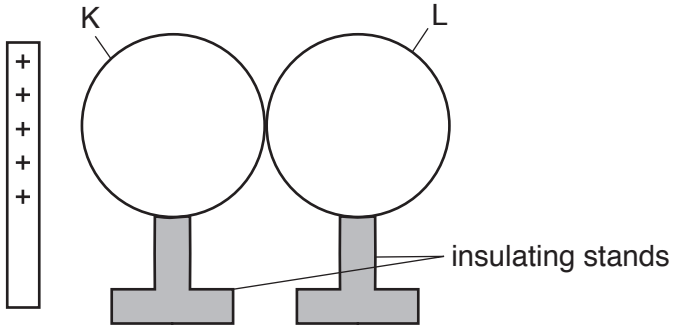


Fig. 5.1

(i) On Fig. 5.1, draw the charges on K and on L. [2]

(ii) Sphere L is moved to the right, a long way from sphere K.

1. The positively charged rod is moved away.

State what happens to the charge on K.

.....

..... [1]

2. An earthing wire is connected to sphere L.

State what happens to the charge on L.

.....

..... [1]

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6 Fig. 6.1 shows a radiation detector placed on a laboratory bench.

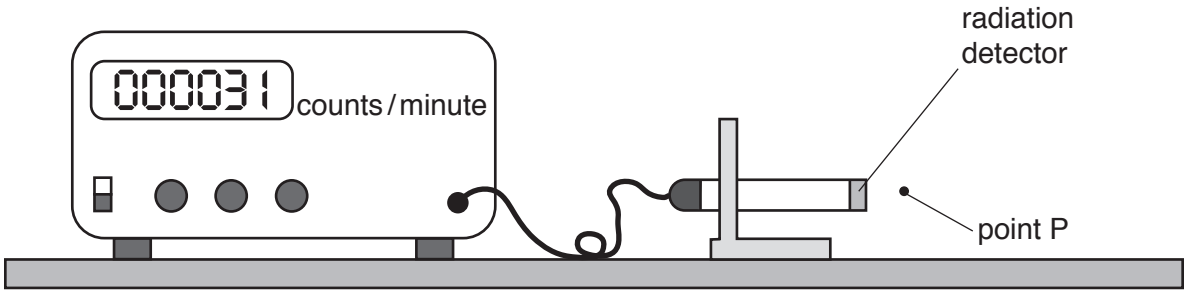


Fig. 6.1

The detector is switched on and six readings of the count rate are recorded.

The table in Fig. 6.2 shows the readings obtained.

reading number	1	2	3	4	5	6
count rate / counts/minute	31	36	29	32	31	33

Fig. 6.2

(a) Using all the readings obtained, determine an average value for the background count rate.

background count rate = ... [1]

(b) Fig. 6.1 shows a point P which is a very short distance from the end of the radiation detector. A sample of the radioactive isotope cobalt-60 is placed at P. The average value of the count rate obtained is now 975 counts / minute.

The average count rate is determined with different objects between the radiation detector and the sample. The table in Fig. 6.3 shows the results obtained.

object	average count rate / counts / minute
no object	975
four sheets of paper	976
0.50 mm thickness sheet of aluminium	117
2.0 cm thickness sheet of lead	52

Fig. 6.3

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(i) Indicate, by placing ticks (✓) in the appropriate boxes, the radiation emitted by cobalt-60.

☐ alpha-particles ☐ beta-particles ☐ gamma rays

[1]

(ii) This radiation is produced when a nucleus of cobalt-60 ($^{60}_{27}$Co) decays into a nucleus of the daughter product X. Product X is not radioactive.

Determine

1. the number of protons in a nucleus of X,

number of protons = ... [1]

2. the number of neutrons in a nucleus of X.

number of neutrons = ... [1]

(c) The half-life of cobalt-60 is 5.3 years.

(i) State what is meant by *half-life*.

.....

.....

..... [2]

(ii) When there is a lead sheet between the detector and the sample, the average count rate is obtained from six readings taken at one-minute intervals. The six readings are given in the table in Fig. 6.4.

reading number	1	2	3	4	5	6
count rate / counts / minute	61	46	43	56	49	57

Fig. 6.4

There are reasons for suggesting that the variation in these readings is random and not because the number of cobalt-60 atoms in the sample is decreasing.

State two of these reasons.

1. .....

.....

2. .....

.....

[2]

7 Fig. 7.1 shows the structure of a transformer.

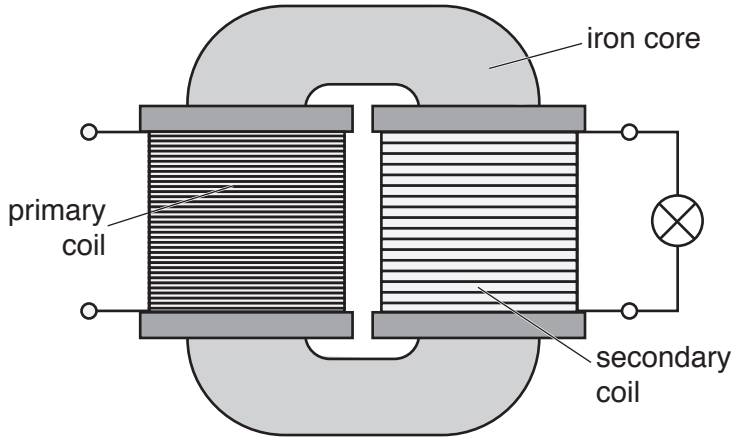


Fig. 7.1

A lamp is connected to the secondary coil.

(a) Explain why the core of the transformer is made from iron.

.....

.....

..... [2]

(b) When there is an alternating current (a.c.) in the primary coil, the lamp is lit.

When there is a direct current (d.c.) in the primary coil, the lamp is **not** lit.

(i) State two ways in which an alternating current differs from a direct current.

1. .....

.....

2. .....

.....

[2]

(ii) Explain why the lamp is **not** lit when there is a direct current in the primary coil.

.....

.....

.....

..... [2]

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Section B

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

8 During a game of cricket, a player hits a ball with a bat. The ball then travels vertically upwards, as shown in Fig. 8.1.

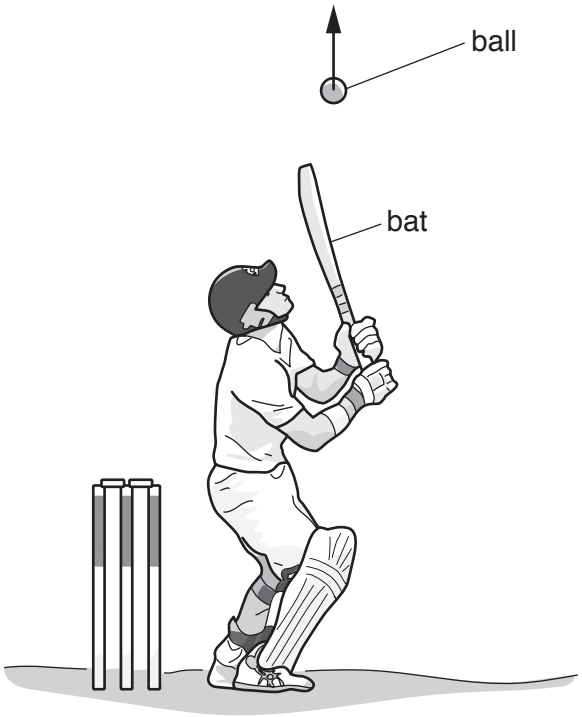


Fig. 8.1

The speed of the ball as it leaves the bat is 8.7 m/s.

(a) The mass of the ball is 0.16 kg.

(i) **1.** State what is meant by *mass*.

.....

..... [1]

2. State the name of a measuring instrument that is used to determine mass.

.....

..... [1]

(ii) Calculate the kinetic energy of the ball as it leaves the bat.

kinetic energy = ... [3]

(b) Fig. 8.2 is the velocity-time graph for the ball.

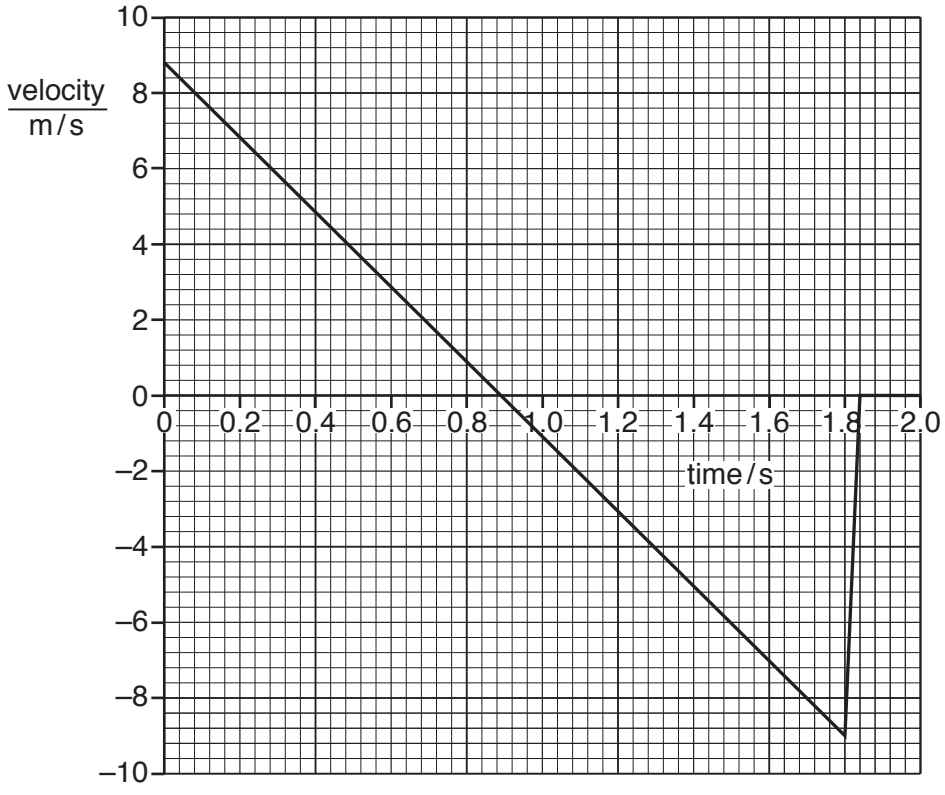


Fig. 8.2

(i) Fig. 8.2 shows that immediately after being hit, the ball has a negative acceleration.

1. State the name given to a negative acceleration.

..... [1]

2. State how the graph shows that the ball has a negative acceleration.

.....

..... [1]

(ii) Using Fig. 8.2, determine

1. the time at which the ball stops moving upwards,

time = ... [1]

2. the distance travelled before the ball stops moving upwards.

distance = ... [2]

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(iii) Suggest why the graph, in Fig. 8.2, is almost vertical when time = 1.84 s.

.....

..... [1]

(iv) Fig. 8.2 shows that the ball remains stationary after a time of 1.84 s.

Describe the energy change that is occurring at a time of 1.84 s.

.....

.....

..... [2]

(c) For this ball moving in the way shown, the effect of air resistance is negligible.

When a ball with a much smaller mass is hit vertically upwards at the same speed, air resistance produces a noticeable effect on its motion.

Suggest two ways in which the velocity-time graph for the ball with a smaller mass differs from Fig. 8.2.

1. .....

.....

2. .....

.....
[2]

9 Both sound and ultrasound are waves that travel in solids, liquids and gases.

(a) State how sound differs from ultrasound.

.....

..... [1]

(b) Sound and ultrasound are longitudinal waves that consist of compressions and rarefactions.

(i) Explain what is meant by a wave and describe how a longitudinal wave differs from a transverse wave.

.....

.....

.....

.....

..... [3]

(ii) Fig. 9.1 represents a longitudinal wave of frequency 25 000 Hz travelling in oil.

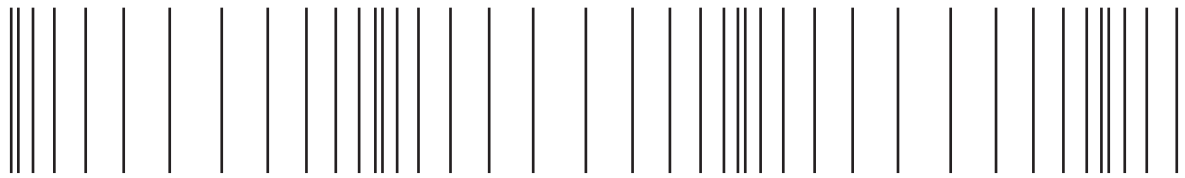


Fig. 9.1 (full scale)

1. On Fig. 9.1, mark two points at the centre of two different rarefactions and label each one R. [1]

2. On Fig. 9.1, draw a double-headed arrow to indicate a distance that is equal to one wavelength of the wave. [1]

3. Measure the length of the arrow drawn on Fig. 9.1 and use it to determine the speed of the wave in oil.

speed = ... [2]

(c) A sound wave travelling in a liquid, passes into air.

(i) State what happens to the speed of the sound wave as it enters the air.

..... [1]

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(ii) The wave in the liquid travels towards the surface at an angle. Fig. 9.2 shows the centres of the compressions of the sound wave in the liquid.

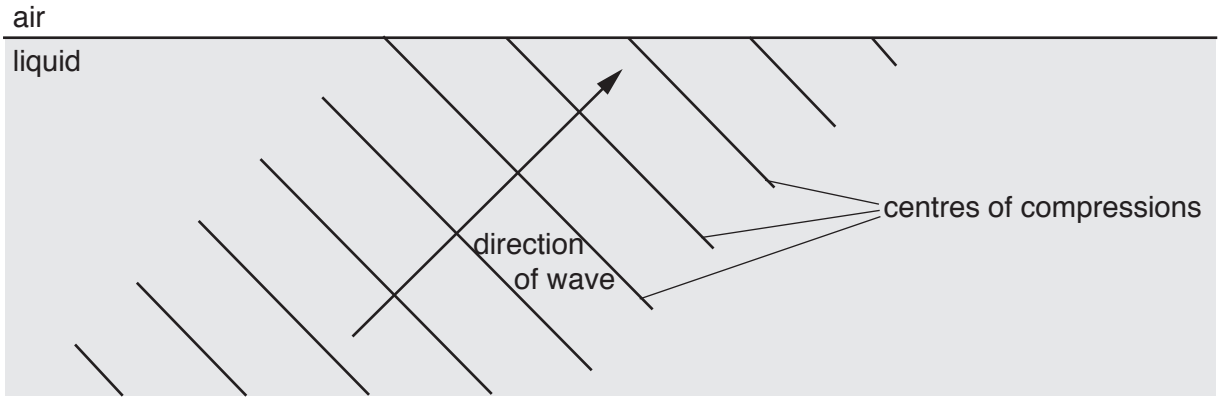


Fig. 9.2

Some compressions shown have reached the liquid-air boundary. The parts of these compressions in the air are not shown on Fig. 9.2.

On Fig. 9.2, draw the parts of these compressions that are in the air. [3]

(d) Describe, in outline, how ultrasound is used in cleaning.

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.....

.....

..... [3]

10 A student sets up the circuit shown in Fig. 10.1 in a laboratory at room temperature.

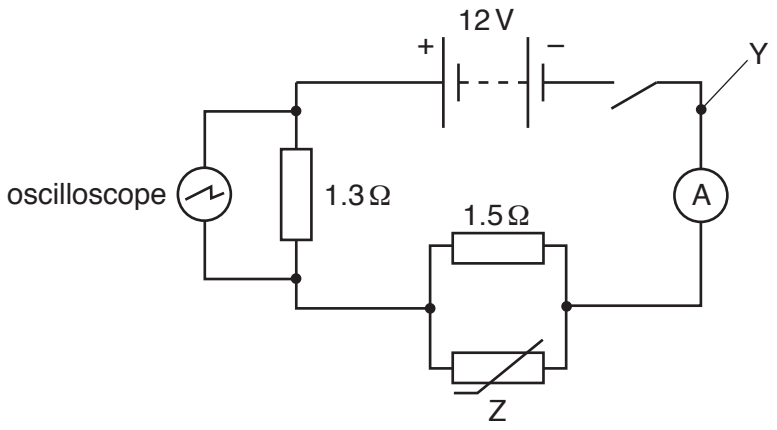


Fig. 10.1

The electromotive force (e.m.f.) of the battery is 12 V.

The switch is closed.

(a) The connecting wires in the circuit are made from copper covered by insulating plastic.

State the name of the particles that flow in the copper and state the direction in which they are flowing at point Y in the circuit.

.....

.....

..... [2]

(b) At room temperature, the resistance of component Z is 6.0 Ω.

(i) State the name of component Z.

..... [1]

(ii) Calculate the resistance of the whole circuit.

resistance = ... [3]

(iii) Calculate the current measured by the ammeter.

current = ... [2]

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(iv) The current in the ammeter is I_A, the current in the 1.5 Ω resistor is I_R and the current in component Z is I_Z.

Write down an equation that relates I_A, I_R and I_Z.

..... [1]

(c) Fig. 10.2 shows the screen of the oscilloscope.

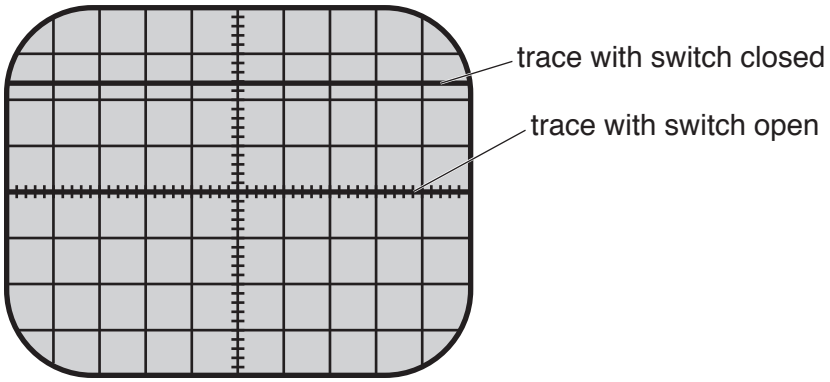


Fig. 10.2

Before the switch is closed, the trace is a horizontal line across the middle of the screen, as shown in Fig. 10.2. When the switch is closed, the trace remains horizontal and moves up the screen.

Component Z is heated.

State and explain what is observed on the oscilloscope screen as the temperature of Z increases.

.....

.....

.....

.....

.....

..... [4]

(d) The 12 V battery is made from cells of electromotive force (e.m.f.) 1.5 V which are all in series.

(i) Calculate the number of 1.5 V cells that make up the battery.

number = ... [1]

(ii) State the e.m.f. of a battery made by connecting all of these cells in parallel.

e.m.f. = ... [1]

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