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Student number

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Name _____

Date _____

Attempt/Time taken _____

GCSE PHYSICS

Topic Paper: 2.1 Current, potential difference and resistance
Part 2

Time allowed: 55 minutes

Materials

For this paper you must have:

- the Periodic Table/Data Sheet, provided as an insert (enclosed)
- a ruler with millimetre measurements
- a calculator, which you are expected to use where appropriate.

Instructions

- Use black ink or black ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- You must answer the questions in the spaces provided. Do not write outside the box around each page or on blank pages.
- All working must be shown.
- Do all rough work in this book. Cross through any work you do not want to be marked.

Information

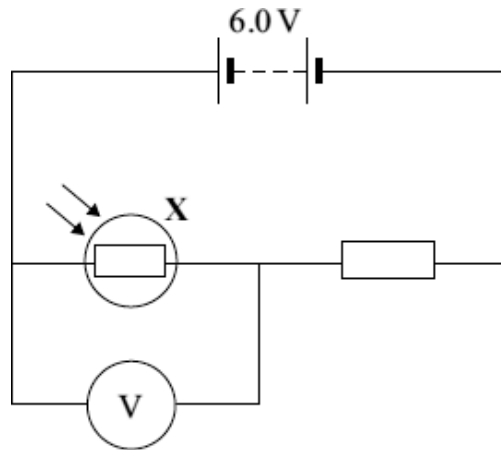
- The Periodic Table/Data Sheet is provided as in insert.
- You are reminded of the need for good English and clear presentation in your answers.
- When answering questions you need to make sure that your answer:
 - is clear, logical, sensibly structured
 - fully meets the requirements of the question
 - shows that each separate point or step supports the overall answer.



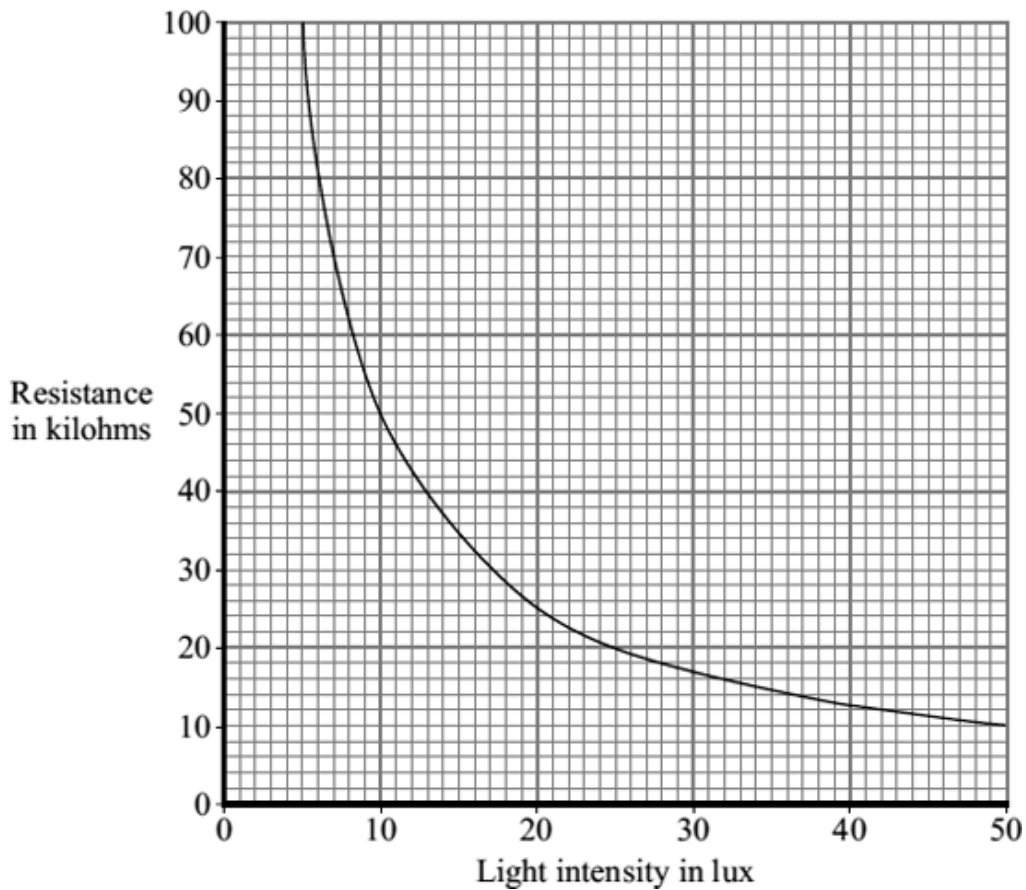
48 Marks



Q6. The diagram shows a simple light-sensing circuit.



(a) The graph, supplied by the manufacturer, shows how the resistance of the component labelled **X** varies with light intensity.



(i) What is component **X**?

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(1)

(ii) Use the graph to find the resistance of component **X** when the light intensity is 20 lux.

.....

(1)



(iii) When the light intensity is 20 lux, the current through the circuit is 0.0002 A.

Use the equation in the box to calculate the reading on the voltmeter when the light intensity is 20 lux.

potential difference = current \times resistance
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Show clearly how you work out your answer.

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Voltmeter reading = volts

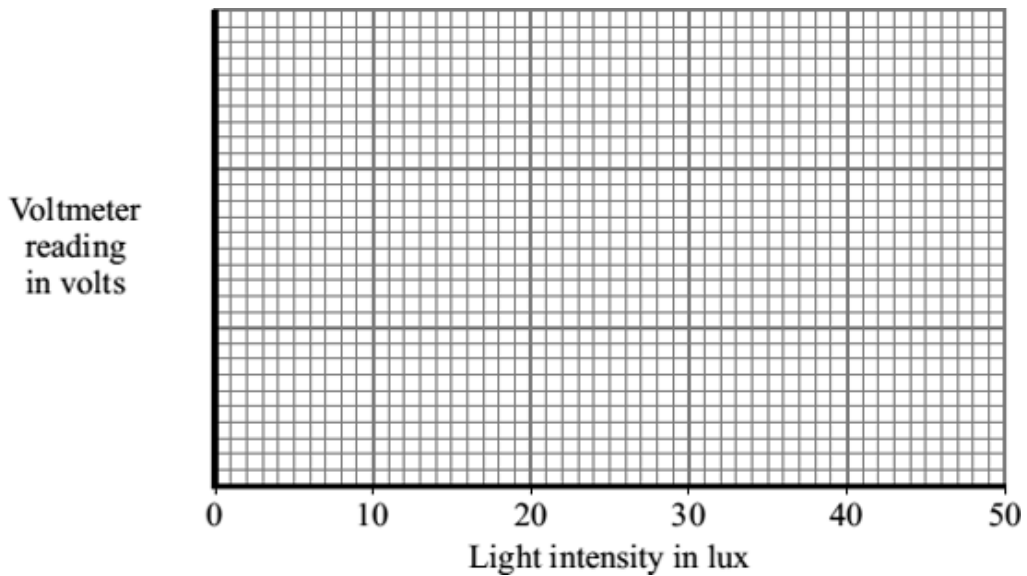
(2)

(b) Use the grid below to show how the voltmeter reading in the light-sensing circuit varies with light intensity.

(i) Add a suitable scale to the *y*-axis (vertical axis).

(1)

(ii) Complete the sketch graph by drawing a line on the grid to show how the voltmeter reading will vary with light intensity.



(2)



- (c) The following passage is taken from the technical data supplied for component **X** by the manufacturer.

For any given light intensity, the resistance of this component can vary by plus or minus 50% of the value shown on the **graph of light intensity and resistance**.

- (i) Calculate the maximum resistance that component **X** could have at 20 lux light intensity.

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Maximum resistance = kilohms

(1)

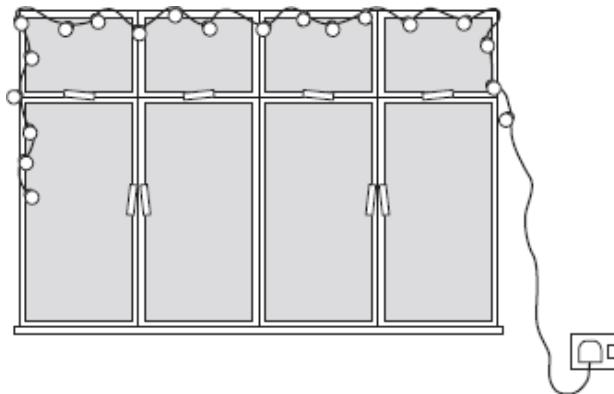
- (ii) Explain why this light-sensing circuit would **not** be used to measure values of light intensity.

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(2)

(Total 10 marks)

Q7. A set of lights consists of 20 lamps connected in series to the 230 V mains electricity supply.



- (a) When the lights are switched on and working correctly, the current through each lamp is 0.25 A.

- (i) What is the total current drawn from the mains supply?

.....

(1)



- (ii) Use the equation in the box to calculate the charge passing through **one** of the lamps in 5 minutes.

$\text{charge} = \text{current} \times \text{time}$

Show clearly how you work out your answer and give the unit.

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Total charge =

(3)

- (b) One of the lamps in the set is a fuse lamp. This contains a filament which melts if a fault occurs. A short time after the lights are switched on, a fault causes the filament inside the fuse lamp to melt and all the lamps go out.

The householder cannot find another fuse lamp so connects a piece of aluminium foil across the contacts inside the fuse lamp holder.

When switched on, the nineteen remaining lamps work.

What the householder has done is dangerous.

Explain why.

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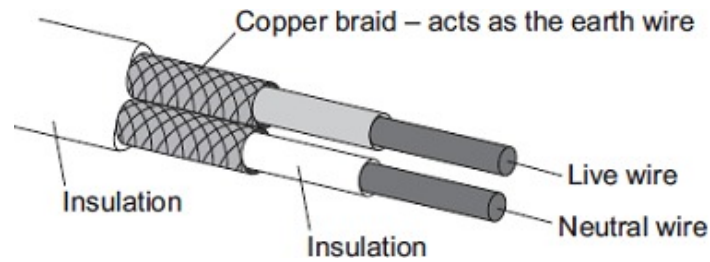
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(2)

(Total 6 marks)



Q8. The diagram shows the structure of a cable. The cable is part of an undersoil heating circuit inside a large greenhouse.



(a) The cable is connected to the mains electricity supply through a residual current circuit breaker (RCCB). If the cable is accidentally cut the RCCB automatically switches the circuit off.

(i) What is the frequency of the mains electricity supply in the UK?

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(1)

(ii) What happens, as the cable is cut, to cause the RCCB to switch the circuit off?

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.....

(2)

(iii) A circuit can also be switched off by the action of a fuse.

Give **one** advantage of using a RCCB to switch off a circuit rather than a fuse.

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.....

(1)

(b) The 230 volt mains electricity supply causes a current of 11 amps to flow through the cable.

(i) Calculate the amount of charge that flows through the cable when the cable is switched on for 2 hours and give the unit.

Use the correct equation from the Physics Equations Sheet.

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Charge =

(3)



(ii) Calculate the energy transferred from the cable to the soil in 2 hours.

Use the correct equation from the Physics Equations Sheet.

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Energy transferred =..... J

(2)

(c) The heating circuit includes a thermistor. The thermistor is buried in the soil and acts as a thermostat to control the increase in the temperature of the soil.

Describe how an **increase** in the temperature of the soil affects the thermistor.

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(2)

(Total 11 marks)

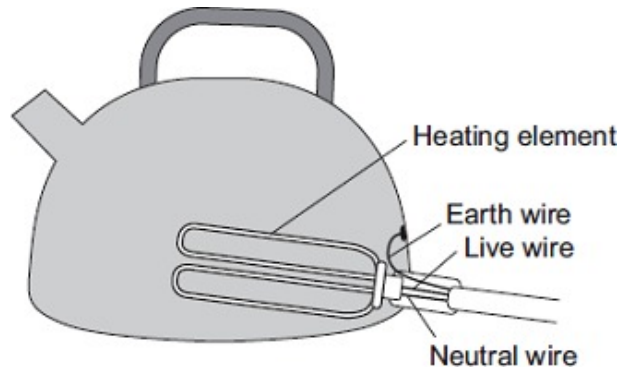
Q9. (a) Describe the difference between an alternating current (a.c.) and a direct current (d.c.).

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(2)



- (b) The diagram shows how the electric supply cable is connected to an electric kettle. The earth wire is connected to the metal case of the kettle.



If a fault makes the metal case live, the earth wire and the fuse inside the plug protect anyone using the kettle from an electric shock.

Explain how.

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(2)
(Total 4 marks)



- Q10.** (a) The picture shows a person using a set of electronic 'Body Fat Scales'. When the person stands on the scales, a small, harmless, electric current passes through the person's body. The scales then calculate the resistance of the person's body and convert the resistance into a *prediction* of body fat content.



- (i) The scales contain two 3 V cells joined in series.

Calculate the resistance of a person's body, if when he stands on the scales, a current of 0.12 mA passes through his body.

1000 mA = 1 A

Use the correct equation from the Physics Equations Sheet.

Show clearly how you work out your answer and give the unit.

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Resistance =

(3)

- (ii) The scales can only produce a *prediction* of body fat content and not an accurate measurement.

Suggest why.

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(1)



- (iii) It is recommended that the scales are **not** used immediately after a person has drunk a large amount of water.

Suggest why.

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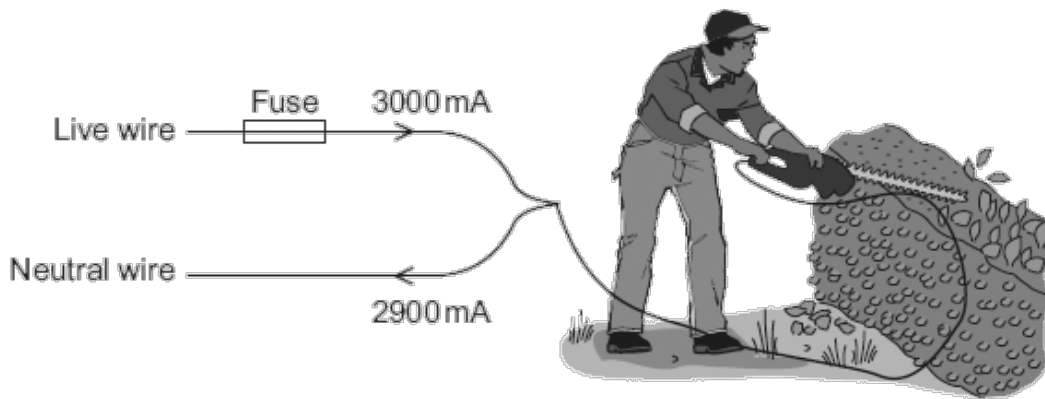
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(2)

- (b) The diagram shows how someone could get an electric shock from accidentally cutting into an electric cable. If this happens, and a Residual Current Circuit Breaker (RCCB) is being used, the circuit will switch off automatically.



- (i) A faulty appliance or circuit can be switched off by a RCCB or a fuse. Compare the action of a RCCB with the action of a fuse.

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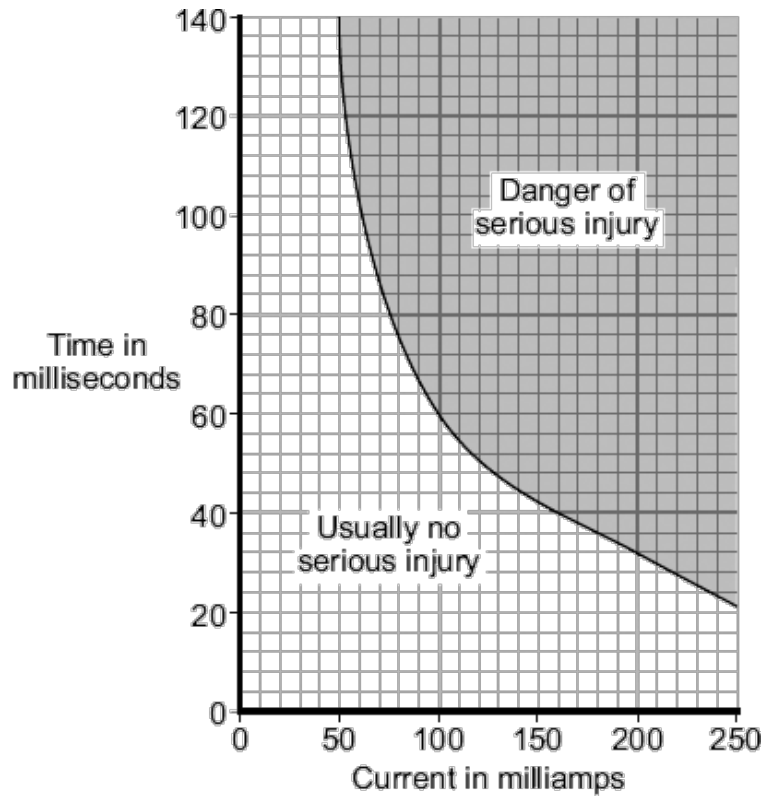
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(2)

- (ii) The graph shows how the severity of an electric shock depends on the size of the current and the time that the current flows through the body.



Using the RCCB helps prevent an electric shock seriously injuring the person using the hedge trimmers.

Using information from both the diagram and the graph explain how.

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(2)
(Total 10 marks)



- Q11.** (a) The resistance of a 24 W, 12 V filament lamp depends on the current flowing through the lamp. For currents up to 0.8 A, the resistance has a constant value of 2.5 Ω .
- (i) Use the equation in the box to calculate the potential difference across the lamp when a current of 0.8 A flows through the lamp.

potential difference = current \times resistance
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Show clearly how you work out your answer.

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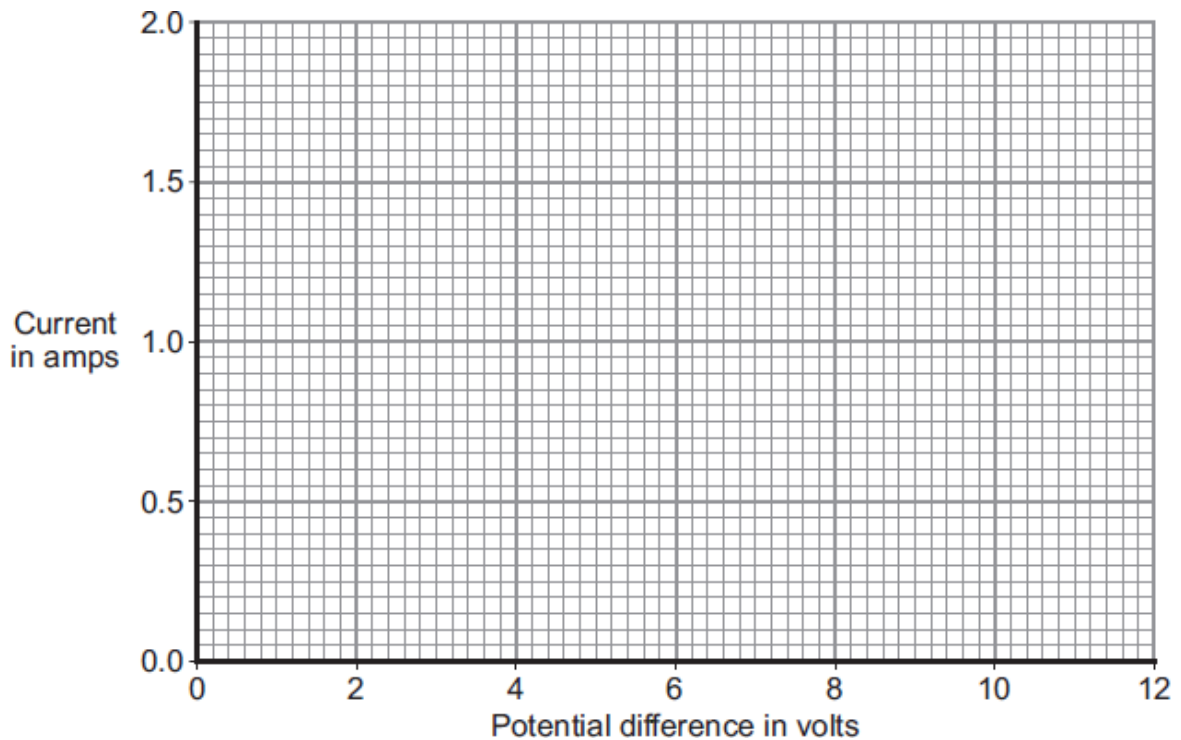
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Potential difference = V

(2)

- (ii) When the potential difference across the lamp is 12 V, the current through the lamp is 2 A.

On the axes below, draw a current–potential difference graph for the filament lamp over the range of potential difference from 0 to 12 volts.



(2)

- (iii) Why does the resistance of the lamp change when the current through the lamp exceeds 0.8 A?

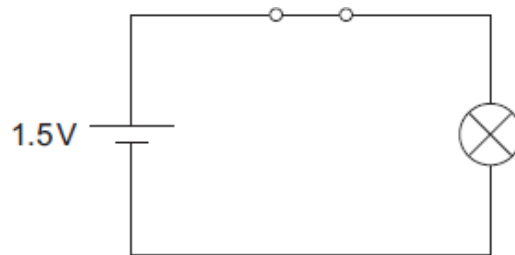
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(1)



- (b) The lamp is now included in a circuit. The circuit is switched on for 2 minutes. During this time, 72 coulombs of charge pass through the lamp.



Use the equation in the box to calculate the energy transformed by the lamp while the circuit is switched on.

$\text{energy transformed} = \text{potential difference} \times \text{charge}$
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Show clearly how you work out your answer.

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.....

Energy transformed = J

(2)
(Total 7 marks)