

AQA GCSE PHYSICS (HIGHER) • 8463

PHYSICS



EXAM QUESTION PACK

4.2.1 CURRENT, POTENTIAL DIFFERENCE AND RESISTANCE (PACK 2)

SCORE

/235

PERCENTAGE

%

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Q1.

- (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.

$$\text{potential difference} = \text{current} \times \text{resistance}$$

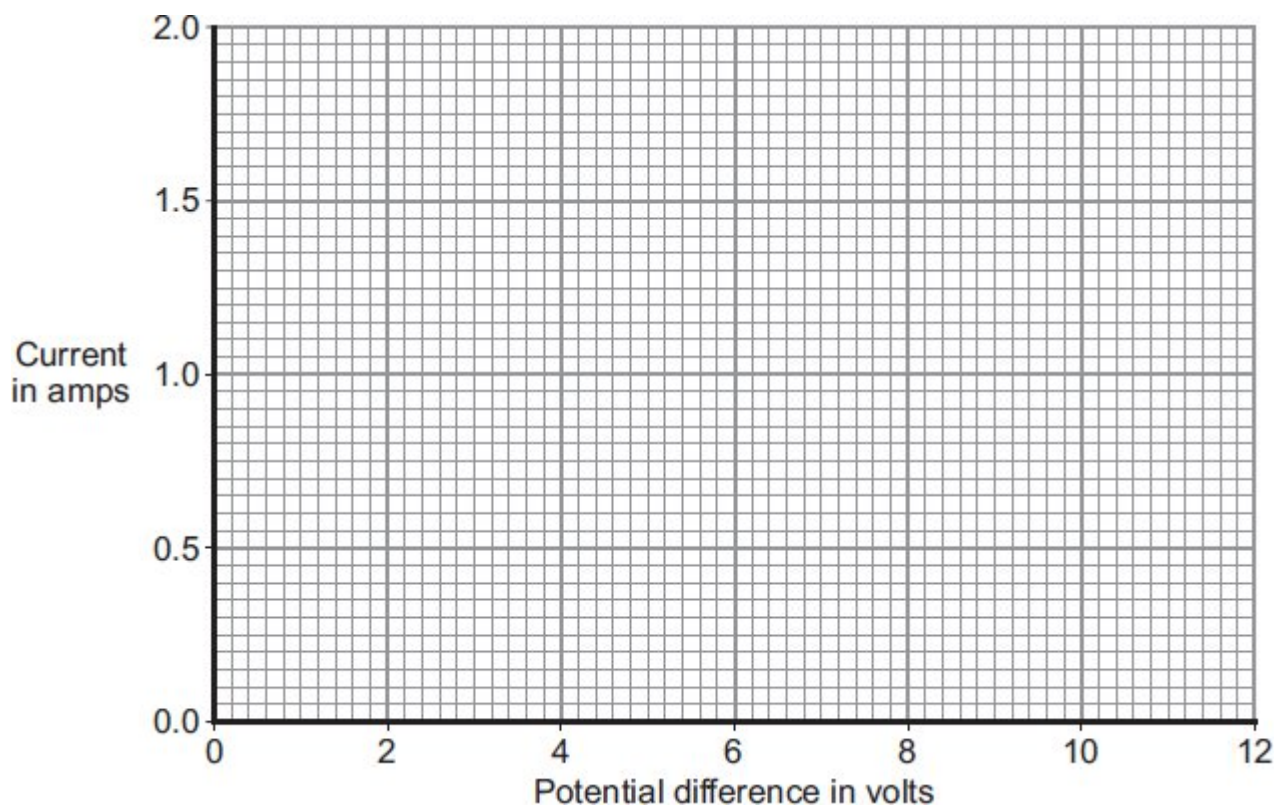
Show clearly how you work out your answer.

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.

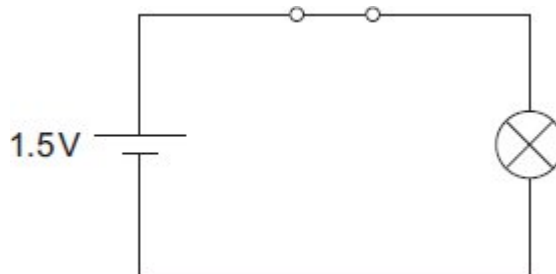


(2)

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

(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.

$\text{energy transformed} = \text{potential difference} \times \text{charge}$
--

Show clearly how you work out your answer.

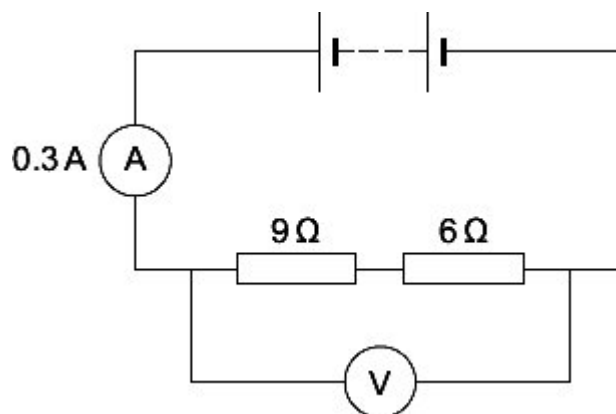
Energy transformed = _____ J

(2)

(Total 7 marks)

Q2.

- (a) The diagram shows a simple circuit.



- (i) Calculate the total resistance of the two resistors in the circuit.

Total resistance = _____ Ω

(1)

- (ii) Calculate the reading on the voltmeter.

Show clearly how you work out your answer.

Voltmeter reading = _____ V

(2)

- (iii) Draw a ring around the correct answer in the box to complete the sentence.

Replacing one of the resistors with a resistor of higher value will

decrease
not change
increase

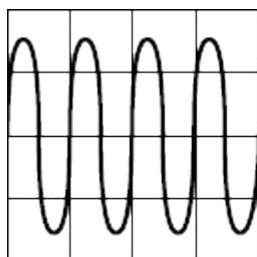
the reading on the ammeter.

(1)

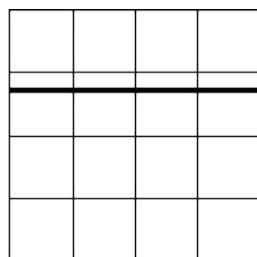
- (b) The voltmeter in the circuit is replaced with an oscilloscope.

Which one of the diagrams, **X**, **Y** or **Z**, shows the trace that would be seen on the oscilloscope?

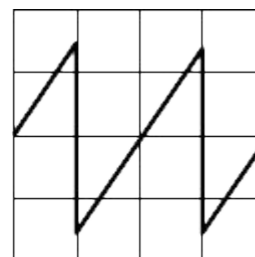
Write your answer, **X**, **Y** or **Z**, in the box.



X



Y



Z

Diagram

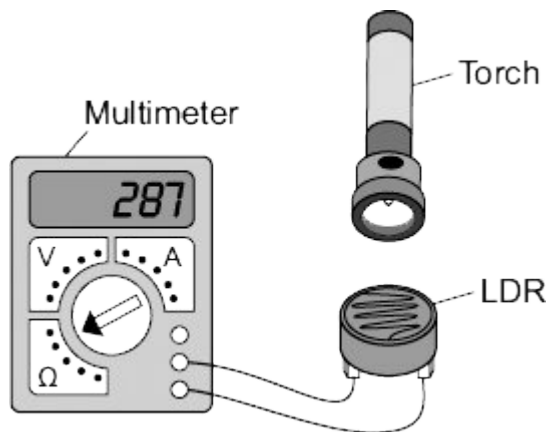
Give a reason for your answer.

(2)

(Total 6 marks)

Q3.

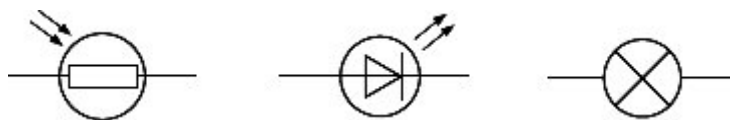
A student used the apparatus below to find out how the resistance of a light-dependent resistor (LDR) depends on light intensity.



The resistance of the LDR was measured directly using a multimeter.

- (a) (i) Which **one** of the following is the correct circuit symbol for a LDR?

Draw a ring around your answer.

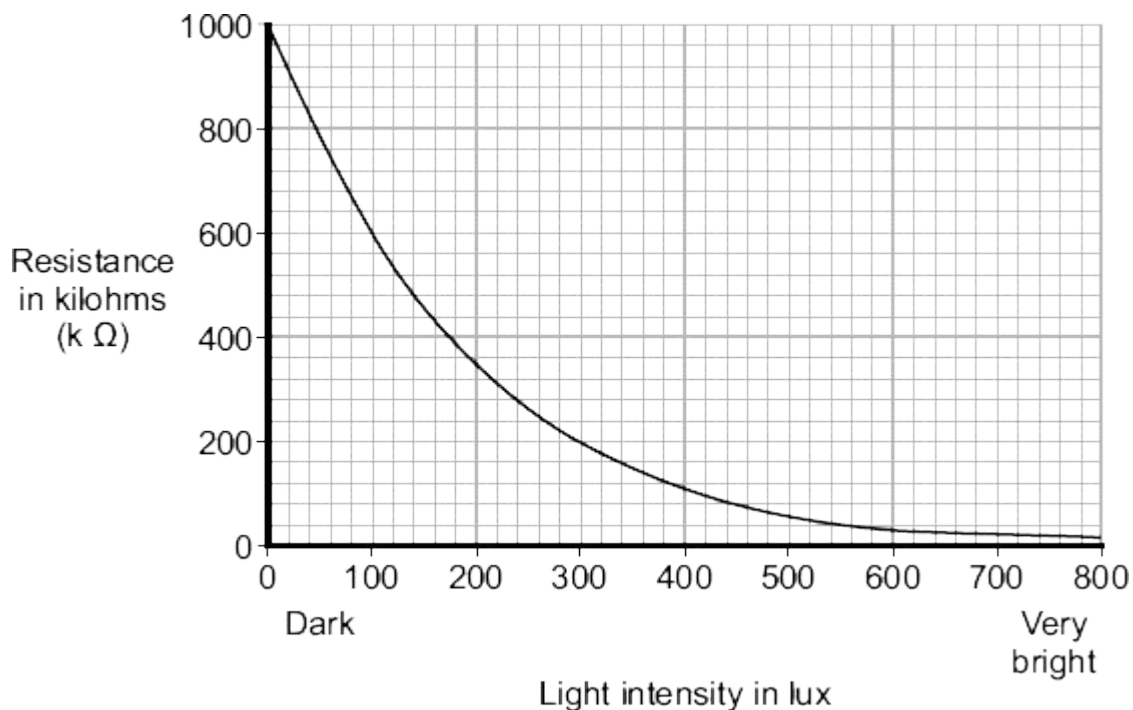


(1)

- (ii) Name **one** factor that will affect the intensity of the light hitting the LDR.

(1)

- (b) The manufacturer of the LDR provides data for the LDR in the form of a graph.



Describe how the resistance of the LDR changes when the light intensity increases from 100 lux to 300 lux.

(2)

- (c) The student only obtained three results. These are given in the table.

Light intensity	Resistance in kilohms
Dark	750
Bright	100
Very bright	1

- (i) The student could **not** use the results to draw a line graph. Why not?

(1)

- (ii) Do the student's results agree with the data the manufacturer provided?

Draw a ring around your answer.

YES

NO

Give a reason for your answer.

(1)

- (d) Which **one** of the following circuits probably includes a LDR?

Tick (✓) **one** box.

A circuit that automatically switches outside lights on when it gets dark.

☐

A circuit that automatically switches central heating on and off.

☐

A circuit that automatically turns lights off when no one is in the room.

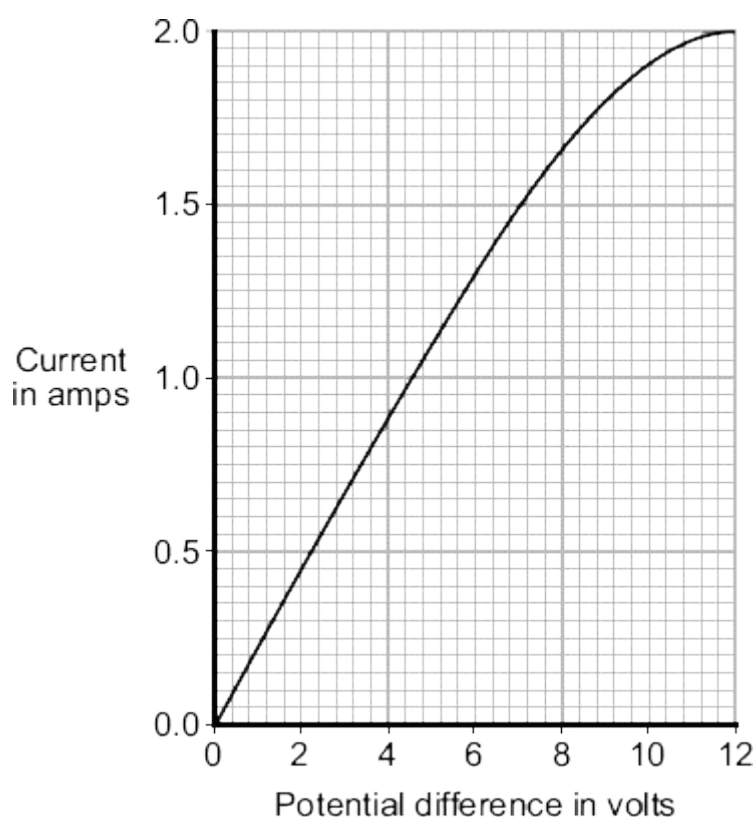
☐

(1)

(Total 7 marks)

Q4.

The graph shows how the electric current through a 12 V filament bulb varies with the potential difference across the bulb.



- (a) What is the meaning of the following terms?

electric current

potential difference

(2)

- (b) The resistance of the metal filament inside the bulb increases as the potential difference across the bulb increases.

Explain why.

(3)

- (c) Use data from the graph to calculate the rate at which the filament bulb transfers energy, when the potential difference across the bulb is 6 V.

Show clearly how you work out your answer.

Rate of energy transfer = _____ W

(2)

(Total 7 marks)

Q5.

- (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.

$$1000 \text{ mA} = 1 \text{ A}$$

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

Resistance = _____

(3)

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

Suggest why.

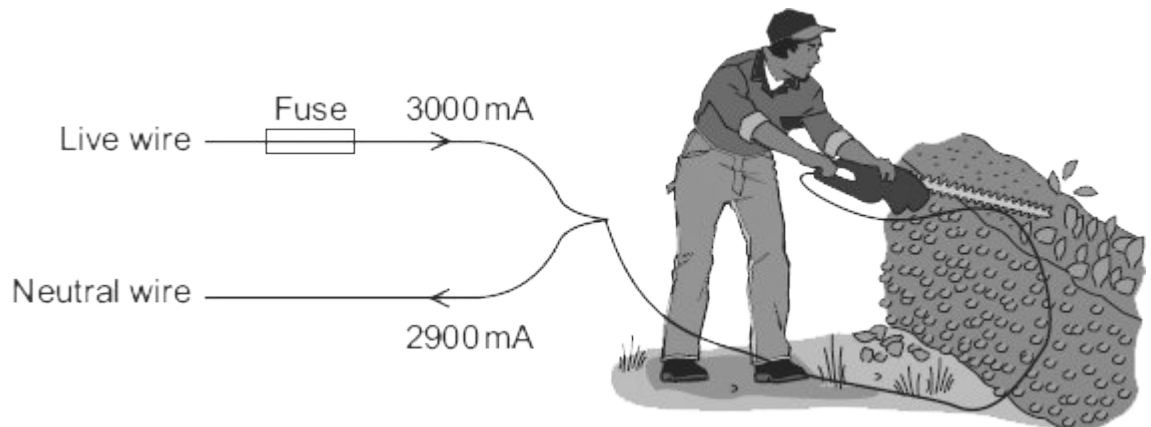
(1)

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

Suggest why.

(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.

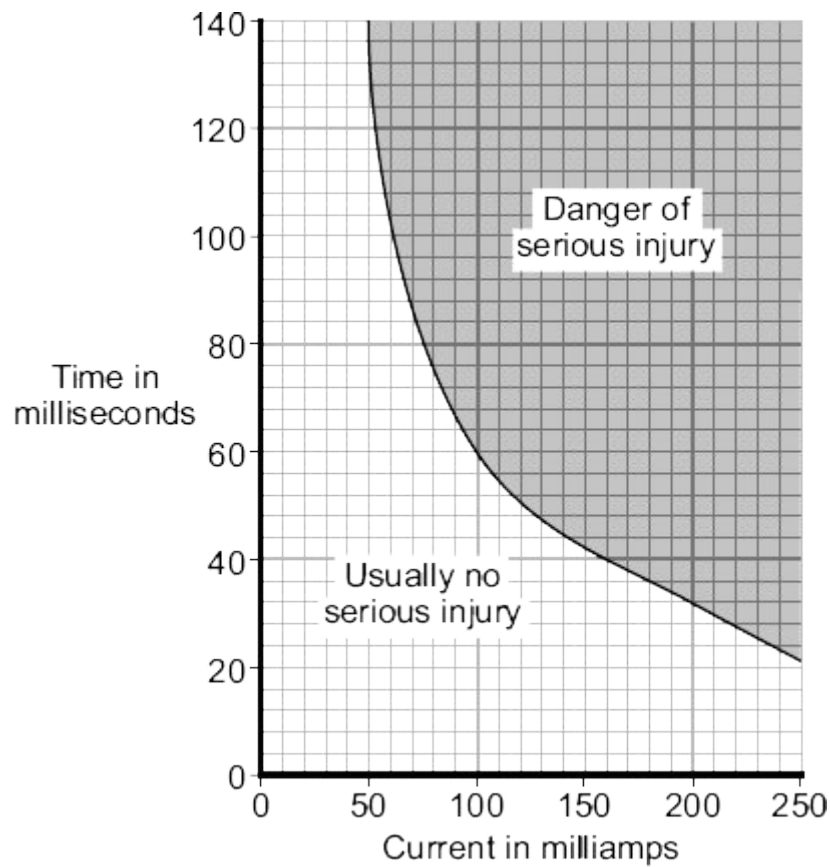


- (i) A faulty appliance or circuit can be switched off by a RCCB or a fuse.

Compare the action of a RCCB with the action of a fuse.

(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.

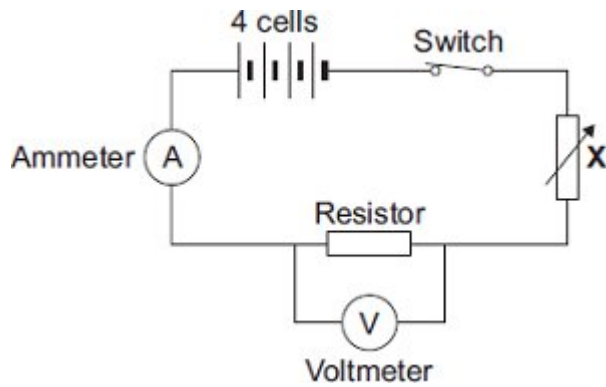
Using information from both the diagram and the graph explain how.

(2)

(Total 10 marks)

Q6.

- (a) The diagram shows the circuit that a student used to investigate how the current through a resistor depends on the potential difference across the resistor.



- (i) Each cell provides a potential difference of 1.5 volts.

What is the total potential difference provided by the four cells in the circuit?

Total potential difference = _____ volts

(1)

- (ii) The student uses the component labelled **X** to change the potential difference across the resistor.

What is component **X**?

Draw a ring around your answer.

light-dependent resistor

thermistor

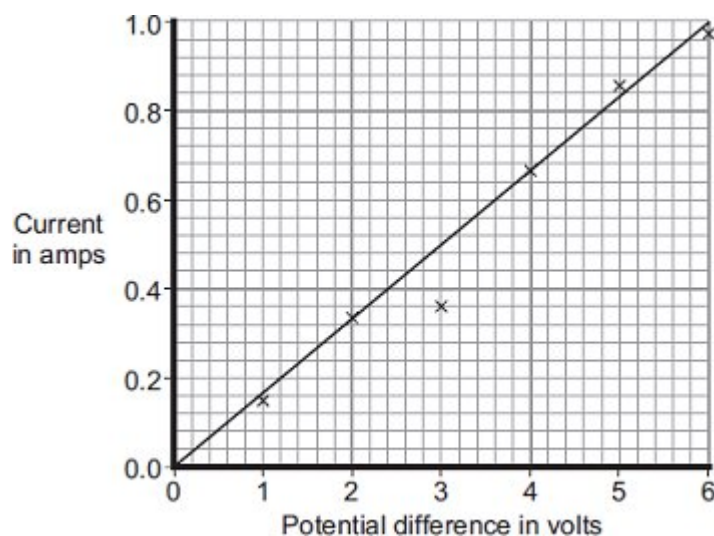
variable resistor

(1)

- (iii) Name a component connected in parallel with the resistor.

(1)

- (b) The results obtained by the student have been plotted on a graph.



- (i) One of the results is anomalous.

Draw a ring around the anomalous result.

(1)

- (ii) Which **one** of the following is the most likely cause of the anomalous result?

Put a tick (✓) in the box next to your answer.

The student misread the ammeter.

☐

The resistance of the resistor changed.

☐

The voltmeter had a zero error.

☐

(1)

- (iii) What was the interval between the potential difference values obtained by the student?

(1)

- (c) Describe the relationship between the potential difference across the resistor and the current through the resistor.

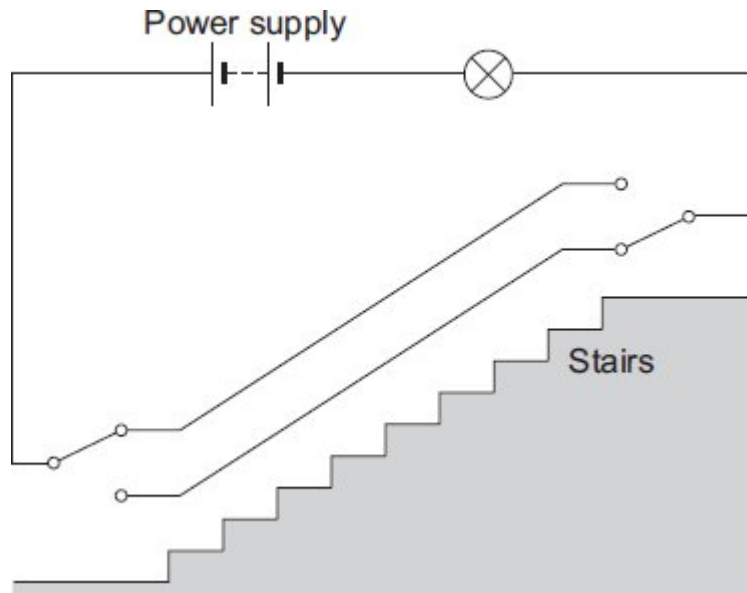
(1)

(Total 7 marks)

Q7.

The diagram shows an electric circuit used in a dolls' house.

The switches are 2-way switches; this means that each switch has a connecting wire that can be in one of two positions.



- (a) (i) With the connecting wire in each switch in the position shown in the diagram, the lamp is off. Why?

(1)

- (ii) When switched on, the lamp has a resistance of $18\ \Omega$ and draws a current of $0.5\ \text{A}$ from the power supply.

Use the equation in the box to calculate the potential difference of the power supply used in the circuit.

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

Potential difference = _____ V

(2)

- (iii) A second, identical lamp is added to the circuit. The two lamps are joined in series.

Calculate the total resistance of the two lamps.

Total resistance = _____ Ω

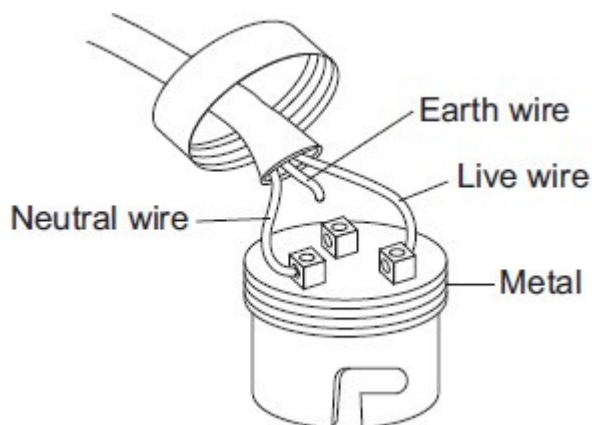
(1)

- (b) This type of circuit is also used in real houses. One of the switches is at the top of the stairs, and the other switch is at the bottom of the stairs.

What is the advantage of using this circuit to switch a lamp on or off, rather than using a more simple circuit that has only one switch?

(1)

- (c) The diagram shows an old type of metal lamp fitting.



The cable has been connected to the lamp fitting in a way that makes the lamp fitting unsafe.

- (i) What is the possible risk to someone touching the lamp fitting while the lamp is switched on?

(1)

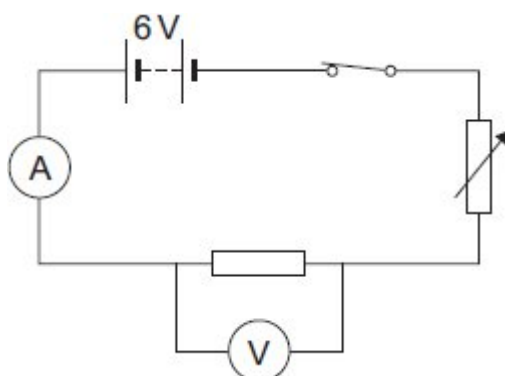
- (ii) What should be done to make **this** lamp fitting safe to use?

(1)

(Total 7 marks)

Q8.

The diagram shows the circuit set up by a student.



- (a) The student uses the circuit to test the following hypothesis:

'The current through a resistor is directly proportional to the potential difference across the resistor.'

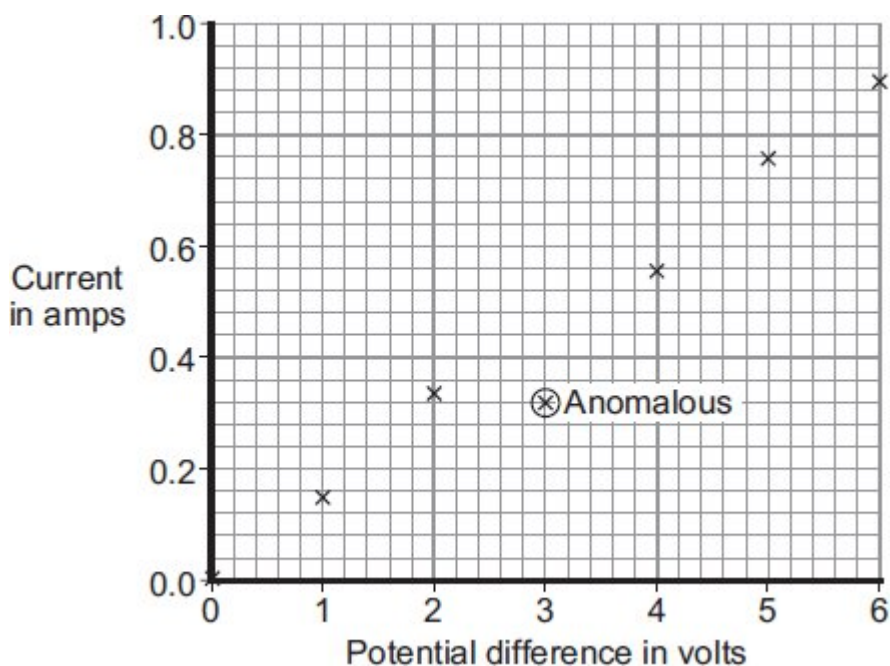
- (i) If the hypothesis is correct, what should the student predict will happen to the current through the resistor when the potential difference across the resistor is doubled?

(1)

- (ii) Name the component in the circuit used to change the potential difference across the resistor.

(1)

- (b) The student used the data obtained to plot the points for a graph of current against potential difference.



- (i) Why has the student plotted the points for a line graph and not drawn a bar chart?

(1)

- (ii) One of the points has been identified by the student as being anomalous.
What is the most likely cause for this anomalous point?

(1)

- (iii) Draw a line of best fit for these points. (1)

- (iv) Does the data the student obtained support the hypothesis?

Give a reason for your answer.

(1)
(Total 6 marks)

Q9.

The picture shows an electric bicycle. The bicycle is usually powered using a combination of the rider pedalling and an electric motor.



- (a) A 36 volt battery powers the electric motor. The battery is made using individual 1.2 volt cells.

- (i) Explain how a 36 volt battery can be produced using individual 1.2 volt cells.

To gain full marks, you must include a calculation in your answer.

(2)

- (ii) The battery supplies a direct current (d.c.).

What is a *direct current (d.c.)*?

(1)

- (iii) When fully charged, the battery can deliver a current of 5 A for 2 hours. The battery is then fully discharged.

Calculate the maximum charge that the battery stores.

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

Charge stored = _____

(3)

- (b) When powered only by the electric motor, the bicycle can carry a 90 kg rider at a maximum speed of 6 m/s. Under these conditions, the maximum distance that the bicycle can cover before the battery needs recharging is 32 km.

The bicycle has a mass of 30 kg.

- (i) Calculate the maximum kinetic energy of the bicycle **and** rider when the rider is not pedalling.

Show clearly how you work out your answer.

Kinetic energy = _____ J

(2)

- (ii) The bicycle can be fitted with panniers (bags) to carry a small amount of luggage.

What effect would fitting panniers and carrying luggage have on the distance the bicycle can cover before the battery needs recharging?

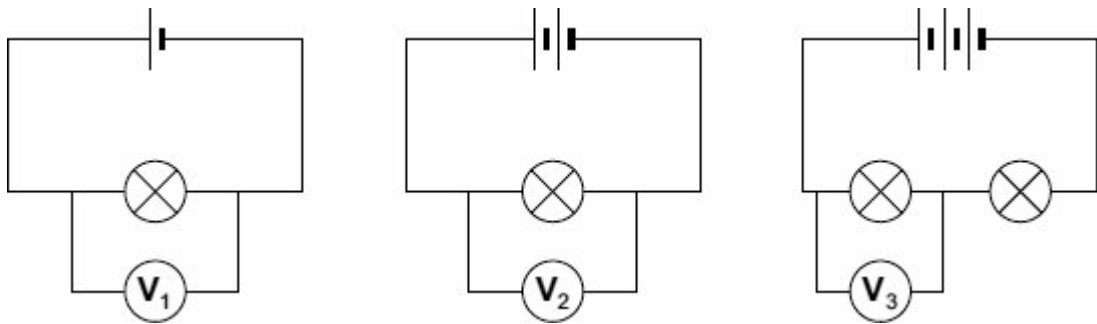
Give a reason for your answer.

(2)

(Total 10 marks)

Q10.

- (a) The lamps in the circuits drawn below are all identical.
Each of the cells has a potential difference of 1.5 volts.



- (i) What is the potential difference across the 3 cells that are joined in series?

Potential difference = _____ V

(1)

- (ii) What will be the reading on the voltmeter labelled V_3 ?

Voltmeter reading V_3 = _____ V

(1)

- (iii) Which voltmeter, V_1 , V_2 or V_3 , will give the highest reading?

Draw a ring around your answer.

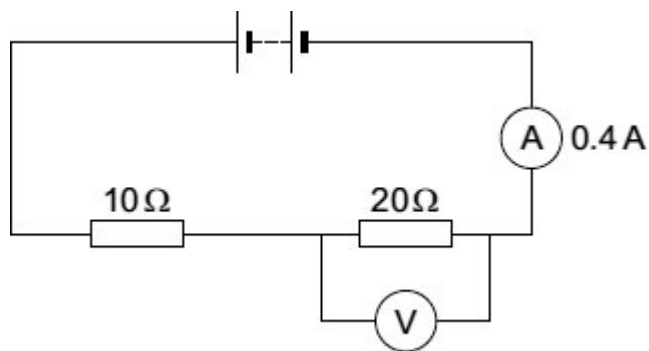
V_1

V_2

V_3

(1)

- (b) The diagram below shows a simple circuit.



- (i) Calculate the total resistance of the two resistors in the circuit.

Total resistance = _____ Ω

(1)

- (ii) Use the equation in the box to calculate the reading on the voltmeter.

potential difference = current $\times$ resistance

Show clearly how you work out your answer.

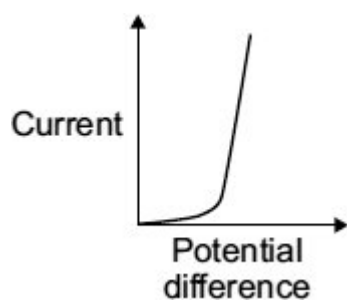
Voltmeter reading = _____ V

(2)

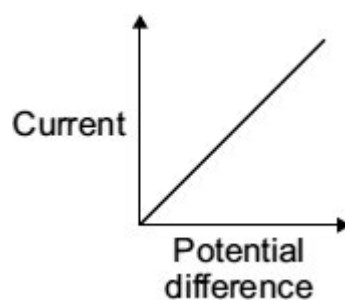
- (iii) The current through a resistor at constant temperature changes when the potential difference across the resistor changes.

Which **one** of the graphs, **X**, **Y** or **Z**, shows how the current changes?

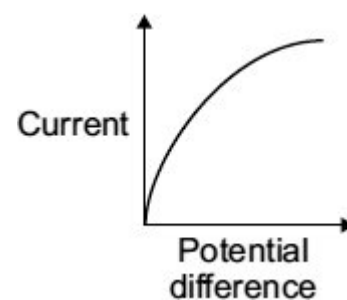
Write your answer, **X**, **Y** or **Z**, in the box.



X



Y



Z

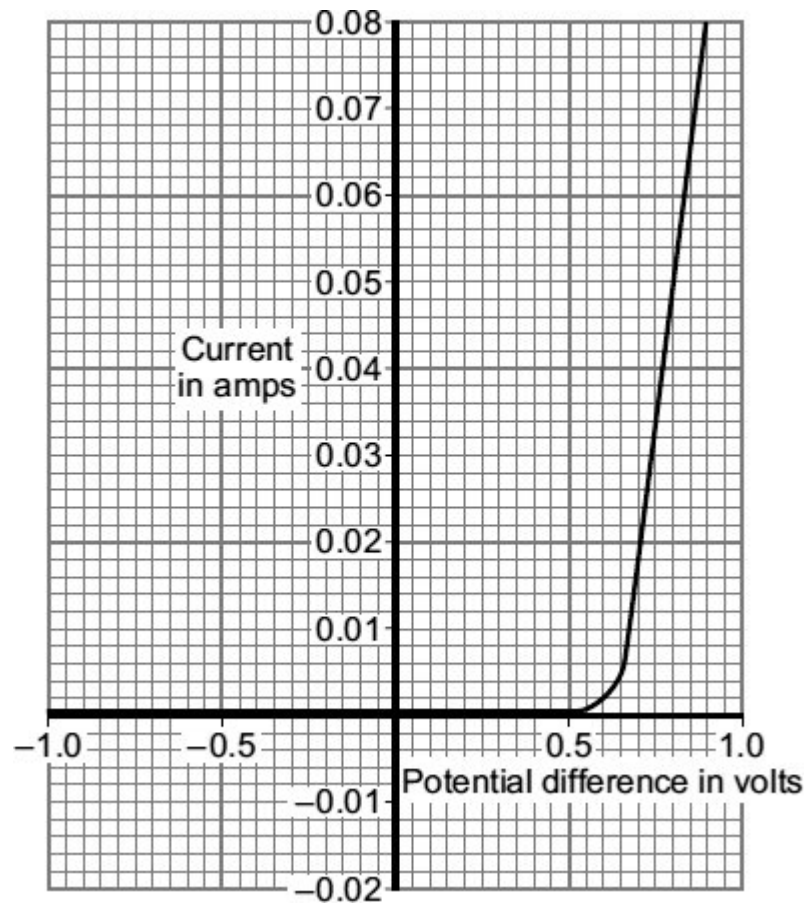
Graph

(1)

(Total 7 marks)

Q11.

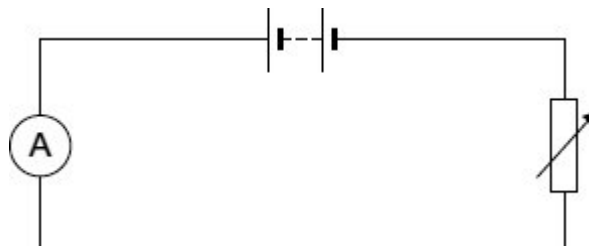
The current-potential difference graph for one type of electrical component is drawn below.



- (a) What is the component?

(1)

- (b) Complete the diagram to show a circuit that can be used to obtain the data needed to plot the graph. Use the correct circuit symbol for each component that you add to the diagram.



(2)

- (c) (i) What is the current through the component when the potential difference across the component is 0.8 volts?

Current _____ amps

(1)

- (ii) Calculate the resistance of the component when the potential difference across it is 0.8 volts.

Show clearly how you work out your answer.

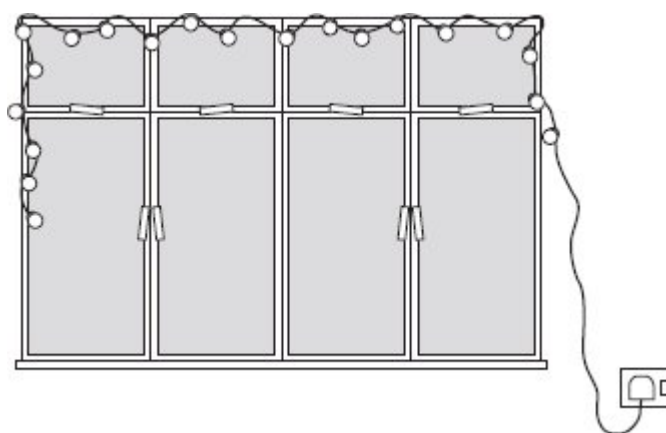
Resistance = _____ Ω

(2)

(Total 6 marks)

Q12.

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) Calculate the charge passing through **one** of the lamps in 5 minutes.

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

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.

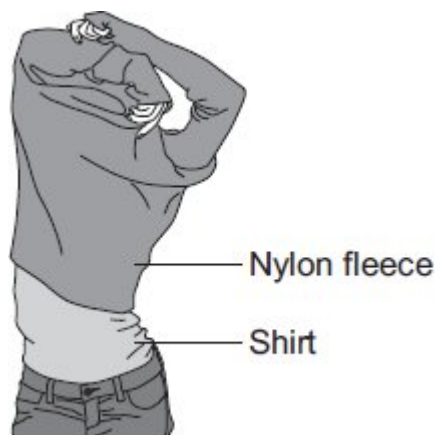
Explain why.

(2)

(Total 6 marks)

Q13.

- (a) A student takes off his nylon fleece and feels a small electric shock.
He realises that this happens because his fleece becomes charged.



Explain why the fleece becomes charged.

(2)

- (b) Only **two** of the following statements are correct.

Put a tick (✓) in the boxes next to the **two** correct statements.

Positively charged objects repel negatively charged objects.

☐

Electrical charges move easily through metals.

☐

Static electricity is safe; it never causes any danger.

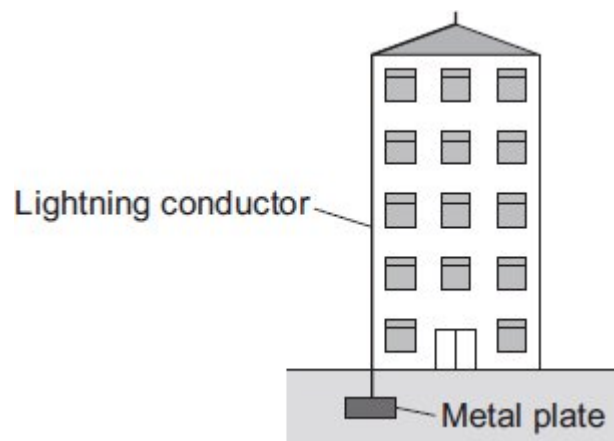
☐

An electric current is a flow of electrical charge.

☐

(2)

- (c) The diagram shows a lightning conductor attached to the side of a tall building.



If the building is struck by lightning, charge flows to earth through the lightning conductor.

- (i) Which of the materials in the list is used to make the lightning conductor?

Draw a ring around your answer.

copper

glass

plastic

Give a reason for your answer.

(2)

- (ii) Complete the sentence by drawing a ring around the correct line in the box.

The resistance of the lightning conductor is

higher than

the same as

the resistance of the building.

lower than

(1)

- (iii) It is almost impossible to test different designs of lightning conductor in controlled experiments during a lightning storm.

Suggest a reason why.

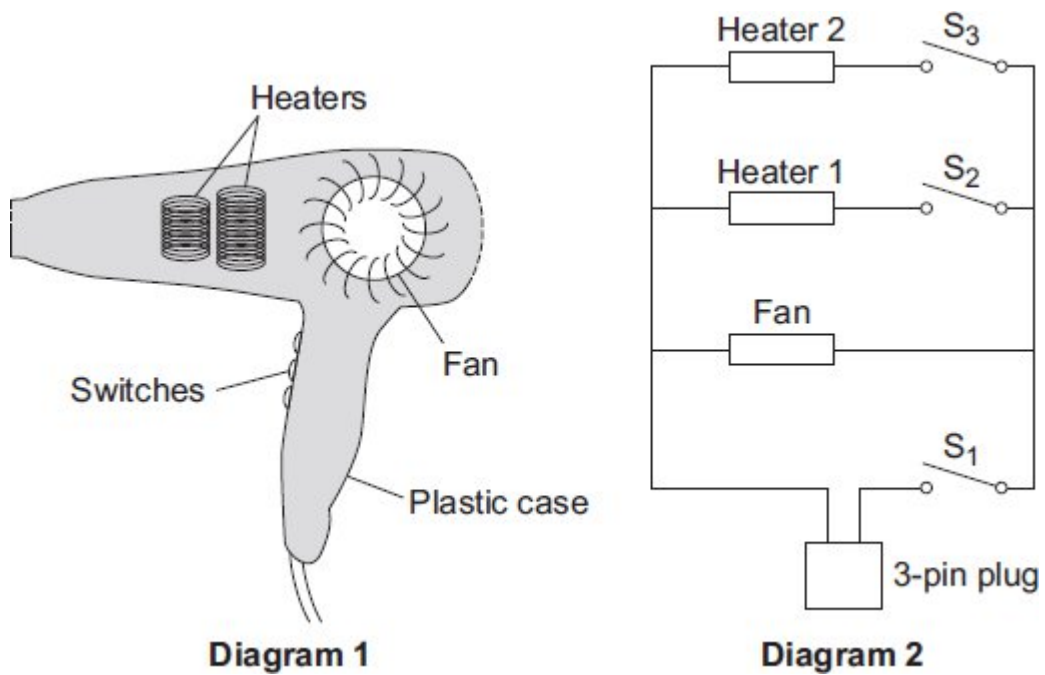
(1)

(Total 8 marks)

Q14.

Diagram 1 shows a hairdryer.

Diagram 2 shows how the heaters and fan of the hairdryer are connected to a 3-pin plug. The hairdryer does not have an earth wire.



- (a) What colour is the insulation around the wire connected to the live pin inside the plug?

(1)

- (b) Why does the hairdryer **not** need an earth wire?

(1)

- (c) All the switches are shown in the OFF position.

(i) Which switch or switches have to be ON to make:

(1) only the fan work; _____

(2) heater 2 work? _____

(2)

(ii) The heaters can only be switched on when the fan is also switched on.

Explain why.

(2)

(d) The table shows the current drawn from the 230 volt mains electricity supply when different parts of the hairdryer are switched on.

	Current in amps
Fan only	1.0
Fan and heater 1	4.4
Fan and both heaters	6.5

Calculate the maximum power of the hairdryer.

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

Maximum power = _____

(3)

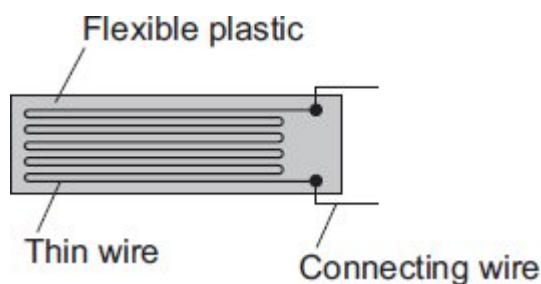
(Total 9 marks)

Q15.

The diagram shows a strain gauge, which is an electrical device used to monitor a changing force.

Applying a force to the gauge causes it to stretch.

This makes the electrical resistance of the wire change.



- (a) (i) Using the correct symbols, **add** to the diagram to show how a battery, an ammeter and a voltmeter can be used to find the resistance of the strain gauge drawn above.

(2)

- (ii) When in use, the strain gauge is always connected to a d.c. power supply, such as a battery.

How is a d.c. (direct current) power supply different from an a.c. (alternating current) power supply?

(1)

- (b) Before any force is applied, the unstretched gauge, correctly connected to a 3.0 V battery, has a current of 0.040 A flowing through it.

- (i) Calculate the resistance of the unstretched gauge.

Show clearly how you work out your answer.

Resistance = _____ Ω

(2)

- (ii) Stretching the gauge causes the current flowing through the gauge to decrease.

What happens to the resistance of the gauge when it is stretched?

(1)

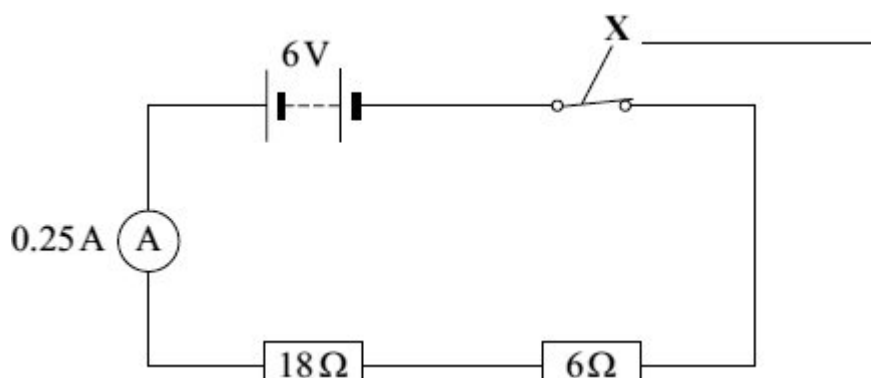
- (iii) What form of energy is stored in the gauge when a force is applied and the gauge stretches?

(1)

(Total 7 marks)

Q16.

A circuit diagram is shown below.



- (a) Use a word from the box to label component X.

fuse	switch	thermistor
-------------	---------------	-------------------

(1)

- (b) Calculate the total resistance of the two resistors in the circuit.

Total resistance = _____ Ω

(1)

- (c) The reading on the ammeter is 0.25 A.

The current through the 6 Ω resistor will be:

bigger than 0.25 A **equal to 0.25 A** **smaller than 0.25 A**

Draw a ring around your answer

(1)

- (d) The 6 V battery is made by correctly joining several 1.5 V cells in series.

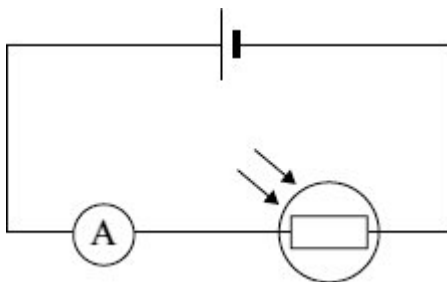
Calculate the number of cells needed to make the battery.

Number of cells = _____

(1)

Q17.

The diagram shows a simple circuit.



- (a) The circuit includes an LDR.

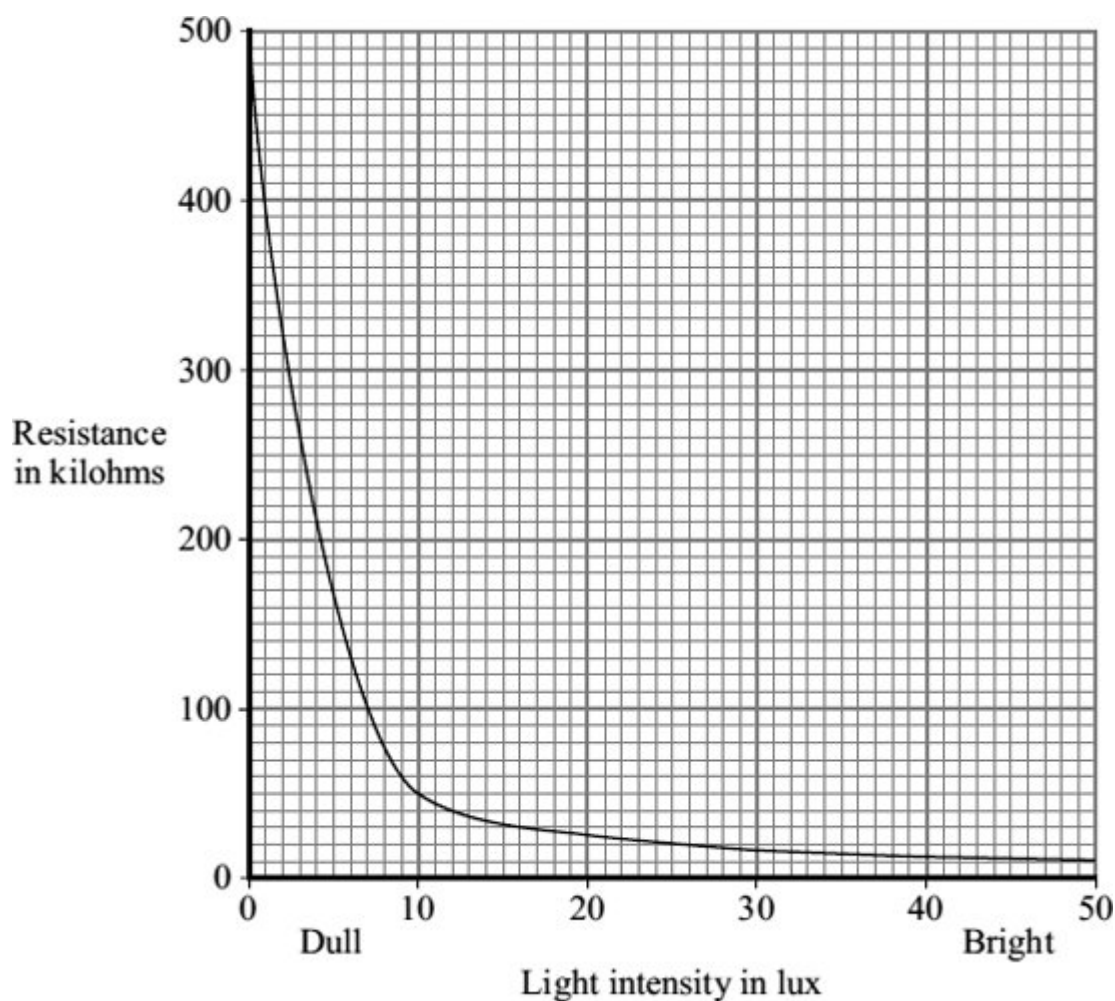
What do the letters LDR stand for?

Draw a ring around your answer.

Light-dependable resistor light-dependent resistor light-direct resistor

(1)

- (b) The graph shows how the resistance of an LDR changes with light intensity.



Describe in detail how the resistance of the LDR changes as the light intensity increases from 0 to 50 lux.

(3)

- (c) (i) Complete the following sentence by drawing a ring around the correct line in the box.

A decrease in the light intensity of light on the LDR will

decrease

not change

increase

the

reading on the ammeter.

(1)

- (ii) Give a reason for your answer to part (c)(i).

(1)

- (d) An LDR can be used to switch a circuit on and off automatically.

In which **one** of the following would an LDR be used?

Put a tick (✓) in the box next to your answer.

a circuit to switch on central heating when it gets cold

☐

a circuit to switch on security lighting when it gets dark

☐

a circuit to switch on a water sprinkler when the soil in a greenhouse is dry

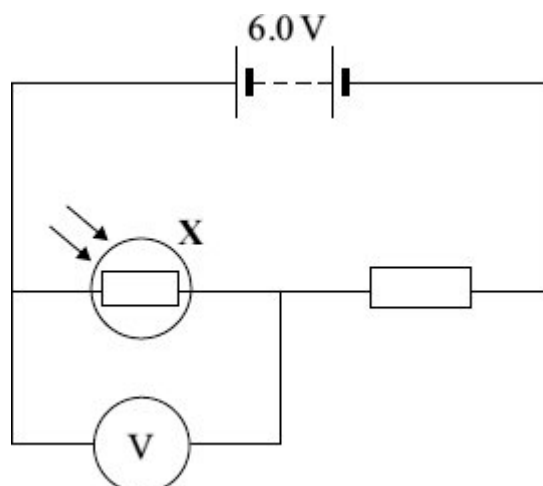
☐

(1)

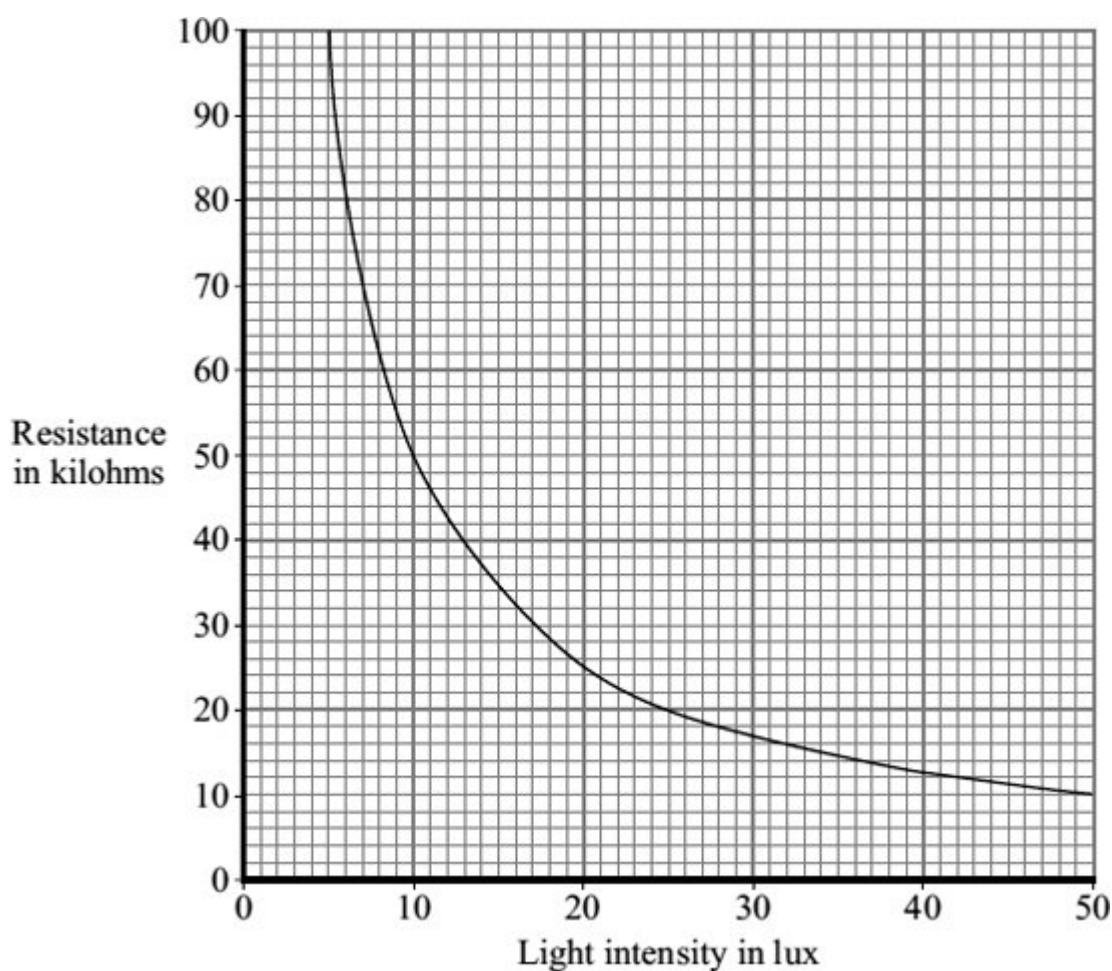
(Total 7 marks)

Q18.

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**?

(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.

Calculate the reading on the voltmeter when the light intensity is 20 lux.

Show clearly how you work out your answer.

Voltmeter reading = _____ volts

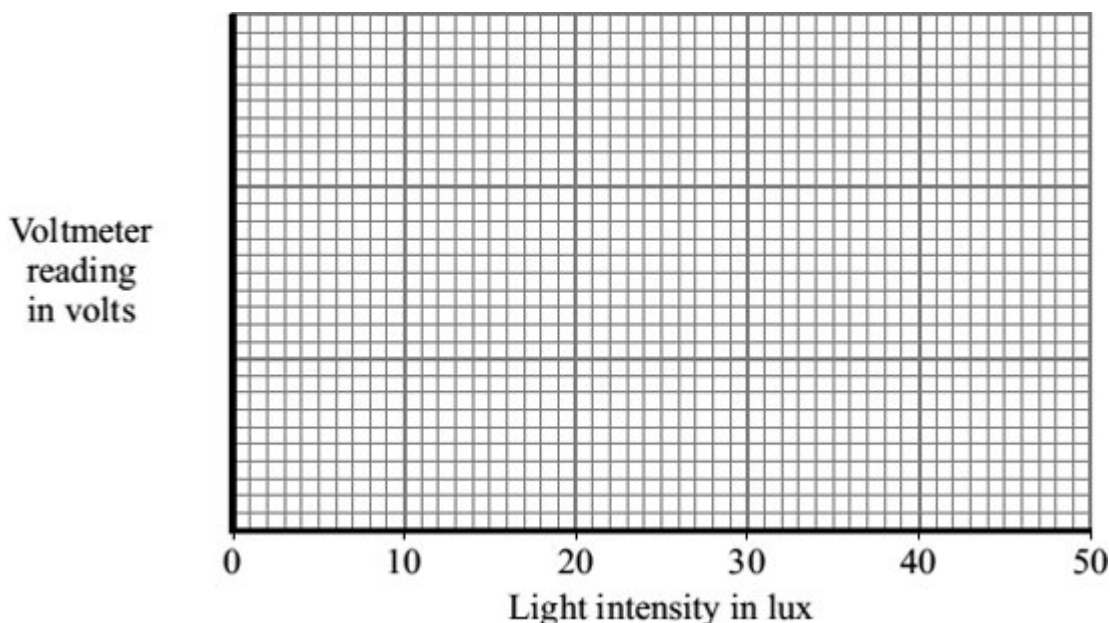
(2)

- (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.

Maximum resistance = _____ kilohms

(1)

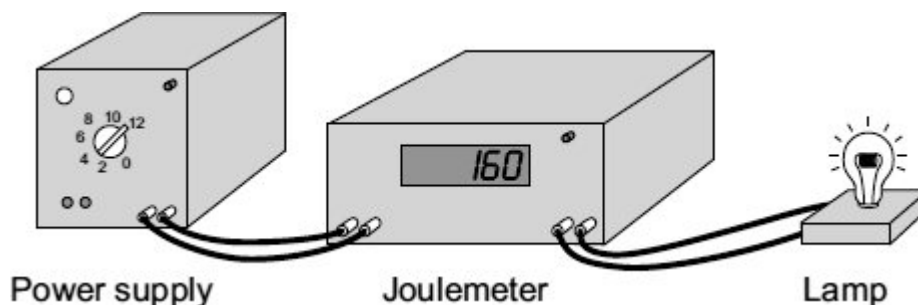
- (ii) Explain why this light-sensing circuit would **not** be used to measure values of light intensity.

(2)

(Total 10 marks)

Q19.

A student used a joulemeter to measure the energy transformed by a lamp.



The student set the joulemeter to zero, and then switched on the power supply.

After 120 seconds (2 minutes), the reading on the joulemeter had increased to 2880.

- (a) In the space below, draw the circuit symbol used to represent a lamp.

(1)

- (b) (i) Use the equation in the box to calculate the power of the lamp.

$$\text{power} = \frac{\text{energy transformed}}{\text{time}}$$

Show clearly how you work out your answer.

Power = _____ (2)

(ii) Which **one** of the following is the unit of power?

Draw a ring around your answer.

joule

newton

watt

(1)

(c) Complete the following sentence using one of the phrases from the box.

larger than

the same as

smaller than

If the lamp was left switched on for 10 minutes, the amount of energy transformed would be _____ the amount of energy transformed in 2 minutes.

(1)

(Total 5 marks)

Q20.

Complete each of the following sentences, **A**, **B**, **C**, **D** and **E**, by choosing the correct ending from **K**, **L**, **M**, **N** or **O**.

The first one has been done for you.

A The current through a resistor depends _____

B A direct current _____

C In a series circuit, the potential difference _____

D An alternating current _____

E In a parallel circuit, the potential difference _____

K _____ across each component is the same.

L _____ is supplied by a cell or battery.

M _____ is constantly changing direction.

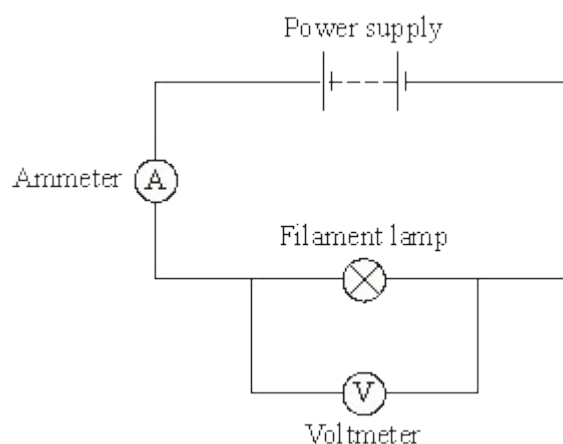
N _____ of the power supply is shared by the components.

O _____ on the potential difference across the resistor.

(Total 3 marks)

Q21.

- (a) The diagram shows the circuit used by a student to measure the power of a filament lamp.



Name a component connected in parallel with the filament lamp.

(1)

- (b) By adding another component to the circuit, the student is able to obtain a range of ammeter and voltmeter readings.

Ammeter reading in amps	Voltmeter reading in volts
0.10	1.0
0.15	2.0
0.20	4.0
0.25	7.0
0.30	11.0

- (i) Which **one** of the following components did the student add to the circuit?

Draw a ring around your answer.

fuse

switch

variable resistor

(1)

- (ii) What is the range of ammeter readings taken by the student?

from _____ amps to _____ amps

(1)

- (iii) Use the data in the table and the equation in the box to calculate the **maximum** power of the filament lamp.

$$\frac{\text{power}}{(\text{watt, W})} = \frac{\text{current}}{(\text{ampere, A})} \times \frac{\text{potential difference}}{(\text{volt, V})}$$

Show clearly how you work out your answer.

Power = _____ W

(3)

- (c) Complete the following sentence by drawing a ring around the correct line in the box.

As the temperature of a filament lamp increases, its resistance

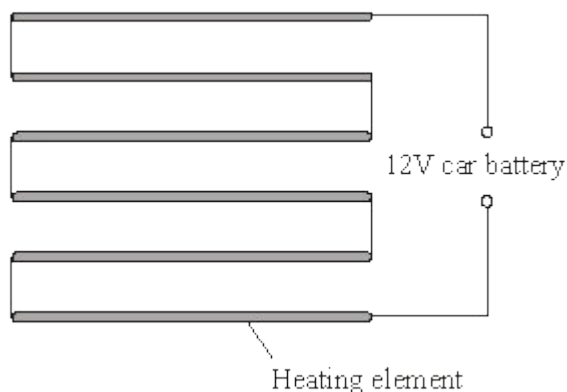
increases
remains constant
decreases

(1)

(Total 7 marks)

Q22.

The diagram shows a simple type of car rear window heater. The six heating elements are exactly the same.



Each heating element has a resistance of $5\ \Omega$. The current passing through each element is $0.4\ \text{A}$.

- (i) Calculate the total resistance of the six heating elements.

Show clearly how you work out your answer.

Total resistance = _____ ohms

(2)

- (ii) Why is the current passing through each element the same?

(1)

- (iii) What is the total current passing through the whole circuit?

(1)

- (iv) How is the 12 volt potential difference of the car battery shared between the six heating elements?

(1)

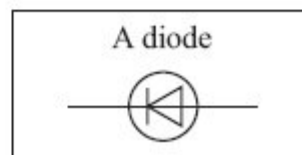
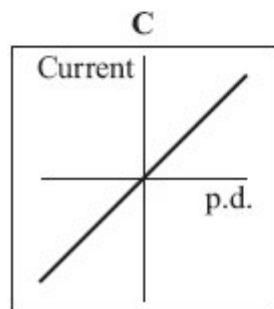
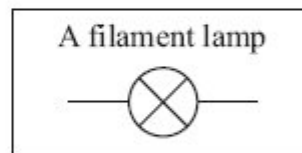
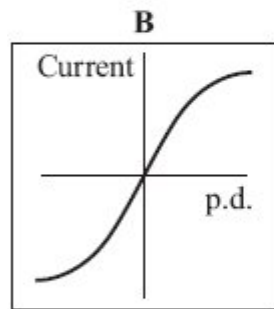
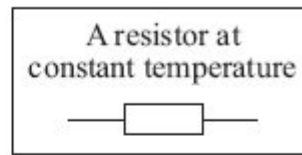
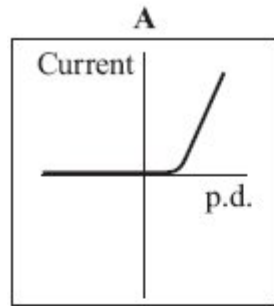
(Total 5 marks)

Q23.

- (a) The graphs, **A**, **B** and **C**, show how the current through a component varies with the potential difference (p.d.) across the component.

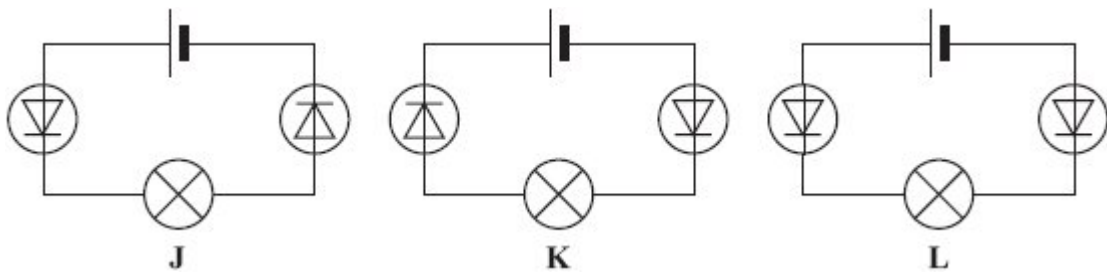
Draw a line to link each graph to the correct component.
Draw only **three** lines.

Component



(2)

(b) Each of the circuits, **J**, **K** and **L**, include two diodes.



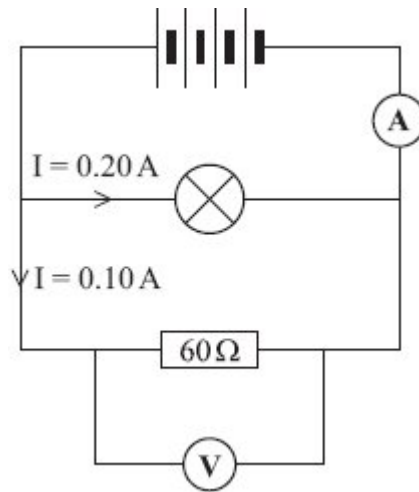
In which **one** of the circuits, **J**, **K** or **L**, would the filament lamp be on?

(1)

(Total 3 marks)

Q24.

A circuit was set up as shown in the diagram.



(a) Each cell provides a potential difference of 1.5 volts.

(i) What is the total potential difference provided by the four cells in the circuit?

Total potential difference = _____ volts

(1)

(ii) What will be the reading on the voltmeter?

(1)

(b) The current through the lamp is 0.20 amps.
The current through the resistor is 0.10 amps.

What is the reading on the ammeter?

Reading on ammeter = _____ amps

(1)

(c) Use a phrase from the box to complete the following sentence.

greater than	equal to	smaller than
---------------------	-----------------	---------------------

The resistance of the lamp is _____ 60Ω .

Give a reason for your answer.

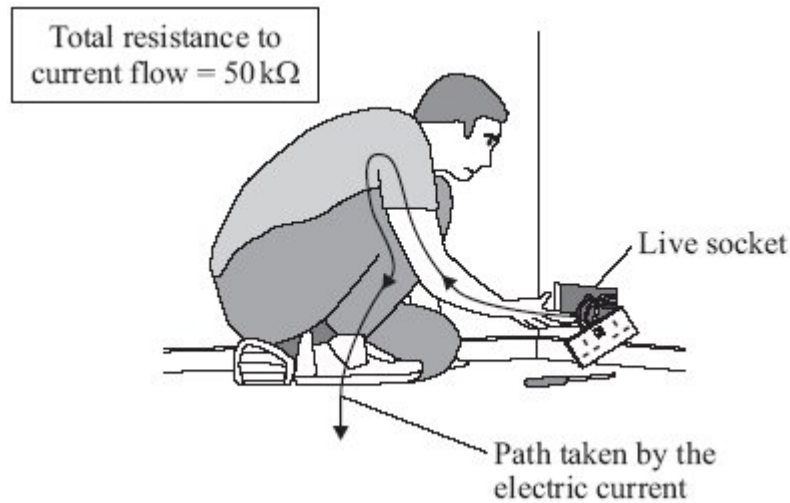
(2)

(Total 5 marks)

Q25.

The diagram shows someone accidentally touching the live wire inside a dismantled 230 volt mains electricity socket.

A current flows through the person giving him an electric shock.



- (a) (i) Calculate the current that will flow through the person.

Show clearly how you work out your answer.

Current = _____ A

(2)

- (ii) Rubber is a good insulator.

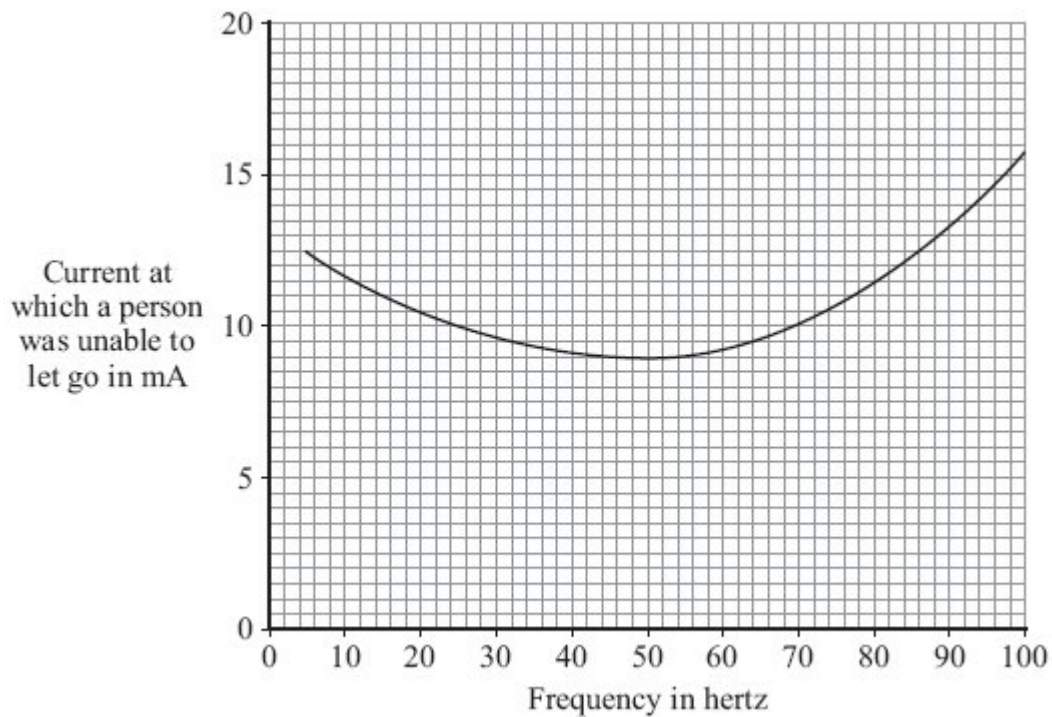
Explain why it is a good idea for electricians to wear rubber soled boots when working.

(2)

- (b) If the current flowing through a person is too high, the person cannot let go of the electrical source.

Different people were tested to see whether the ability to let go of an electrical source depended on the frequency of the current.

The results of the test are shown in the graph.



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

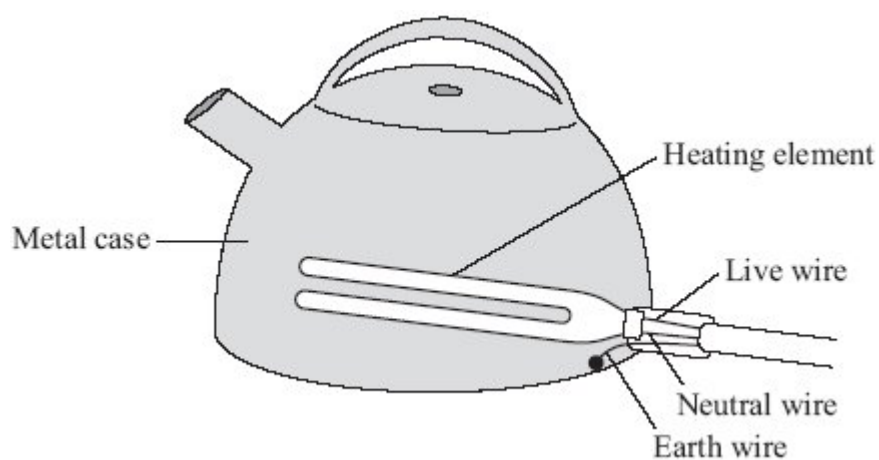
(1)

- (ii) From a safety point of view, is the frequency of the UK mains electricity supply suitable?

Give a reason for your answer.

(1)

- (c) 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.

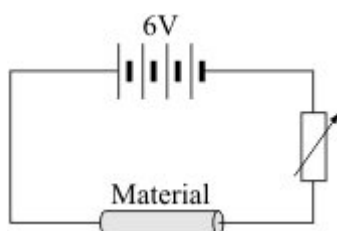
Explain how.

(2)

(Total 8 marks)

Q26.

- (a) The diagram shows the circuit used to investigate the resistance of a material. The diagram is incomplete; the ammeter and voltmeter are missing.



- (i) Draw the symbols for the ammeter and voltmeter on the diagram in the correct places.

(2)

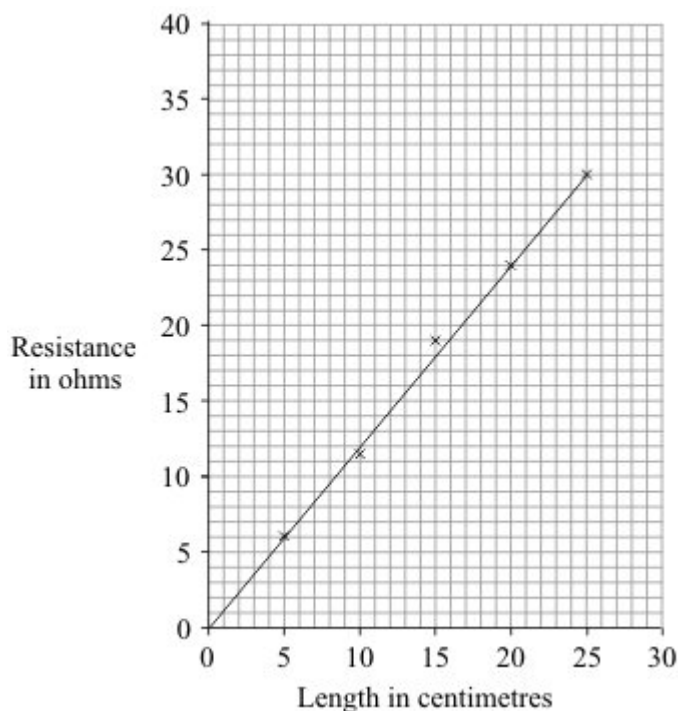
- (ii) How can the current through the material be changed?

(1)

- (b) The material, called conducting putty, is rolled into cylinders of different lengths but with equal thicknesses.

Graph 1 shows how the resistance changes with length.

Graph 1



- (i) Why has the data been shown as a line graph rather than a bar chart?

(1)

- (ii) The current through a 30 cm length of conducting putty was 0.15 A.

Use **Graph 1** to find the resistance of a 30 cm length of conducting putty.

Resistance = _____ ohms

(1)

- (iii) Use your answer to (b)(ii) to calculate the potential difference across a 30 cm length of conducting putty.

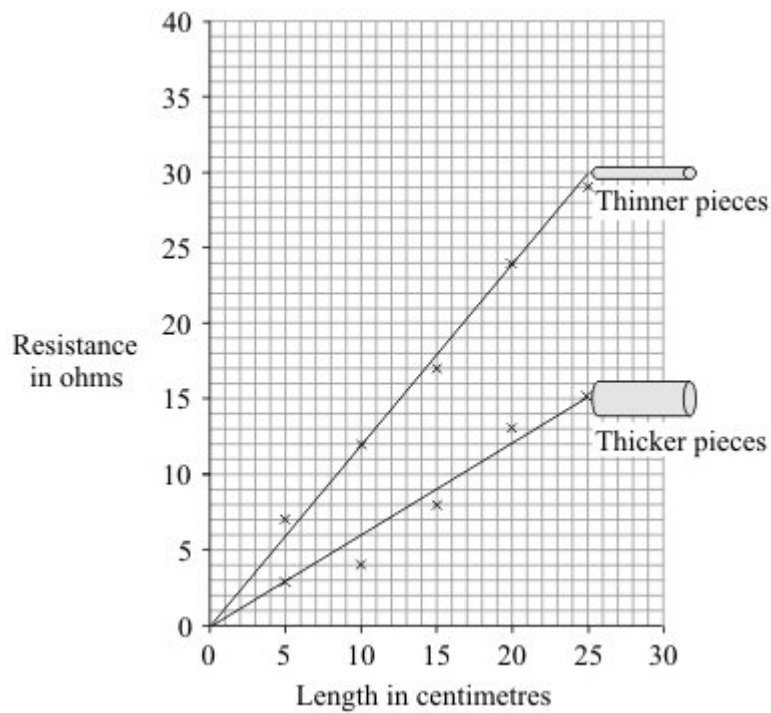
Show clearly how you work out your answer.

Potential difference = _____ volts

(2)

- (c) A second set of data was obtained using thicker pieces of conducting putty. Both sets of results are shown in **Graph 2**.

Graph 2



- (i) What is the relationship between the resistance and the thickness of the conducting putty?

(1)

- (ii) Name **one** error that may have reduced the accuracy of the results.

(1)

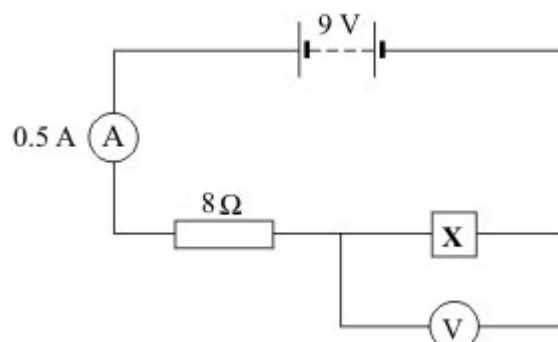
- (iii) How could the reliability of the data have been improved?

(1)

(Total 10 marks)

Q27.

- (a) The circuit diagram drawn below includes a component labelled **X**.



- (i) Calculate the potential difference across the 8 ohm resistor.

Show clearly how you work out your answer.

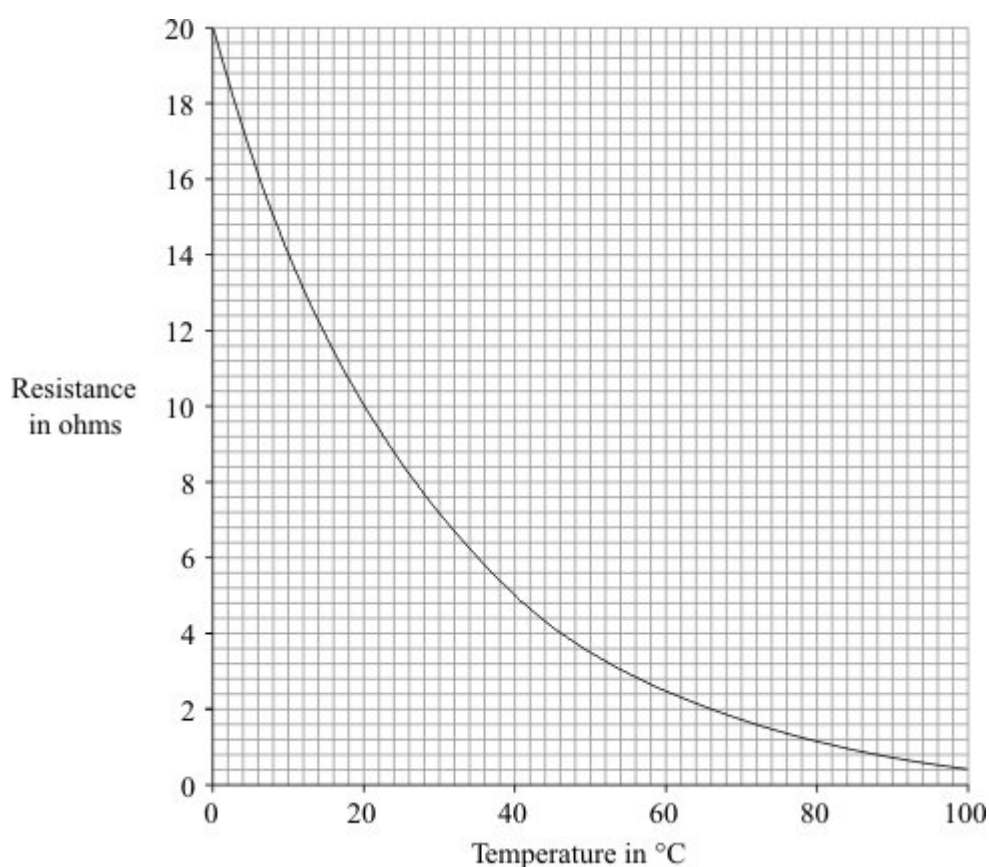
Potential difference = _____ volts

(2)

- (ii) What is the potential difference across component **X**?

(1)

- (b) The graph shows how the resistance of component **X** changes with temperature.



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

(1)

- (ii) Over which range of temperatures does the resistance of component **X** change the most?

Put a tick (✓) next to your choice.

0 °C to 20 °C

☐

20 °C to 40 °C

☐

40 °C to 60 °C

☐

60 °C to 80 °C

☐

80 °C to 100 °C

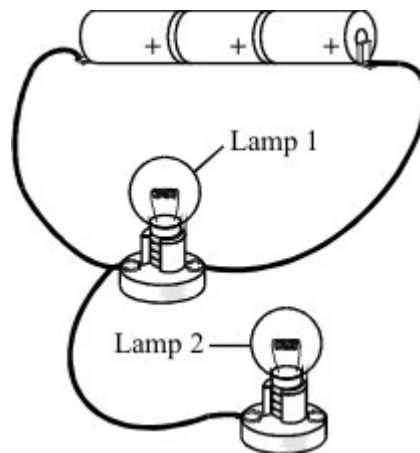
☐

(1)

(Total 5 marks)

Q28.

The drawing shows three identical cells and two identical lamps joined in a circuit.



- (a) Use the correct symbols to draw a circuit diagram for this circuit.

(3)

- (b) Each of the cells provides a potential difference (voltage) of 1.5 volts. What is the total potential difference (voltage) provided by all three cells?

_____ volts

(1)

- (c) Complete this sentence by crossing out the **two** lines in the box that are wrong.

smaller than
the same as
bigger than

The current through lamp 2 will be _____ the current through lamp 1.

(1)

(Total 5 marks)

Q29.

A set of Christmas tree lights is made from twenty identical lamps connected in series.



- (a) Each lamp is designed to take a current of 0.25 A. The set plugs directly into the 230 V mains electricity supply.

- (i) Write down the equation that links current, potential difference and resistance.

(1)

- (ii) Calculate the resistance of **one** of the lamps. Show clearly how you work out your final answer and give the unit.

Resistance = _____

(4)

- (iii) What is the total resistance of the set of lights?

Total resistance = _____

(1)

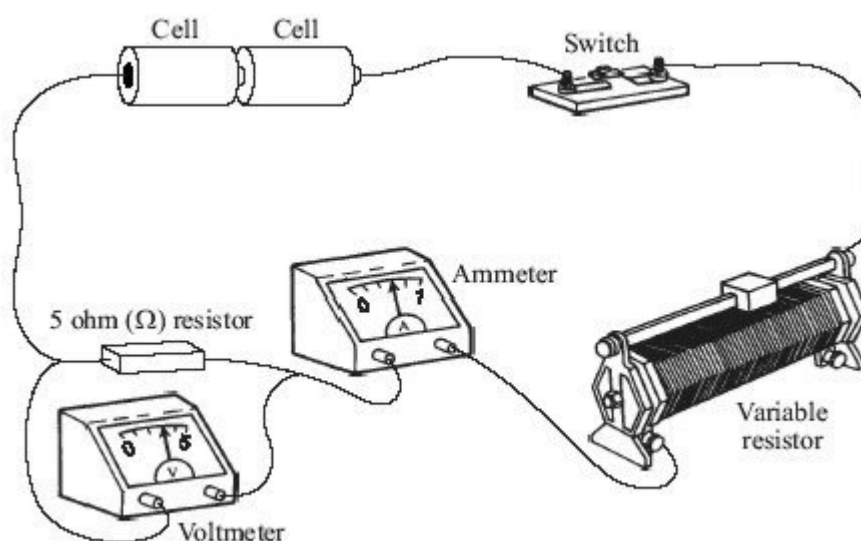
- (b) How does the resistance of a filament lamp change as the temperature of the filament changes?

(1)

(Total 7 marks)

Q30.

The drawing shows the circuit used to investigate how the current through a 5 ohm (Ω) resistor changes as the potential difference (voltage) across the resistor changes.



- (a) Draw, in the space below, a circuit diagram of this circuit. Use the correct symbols for each part of the circuit.

(2)

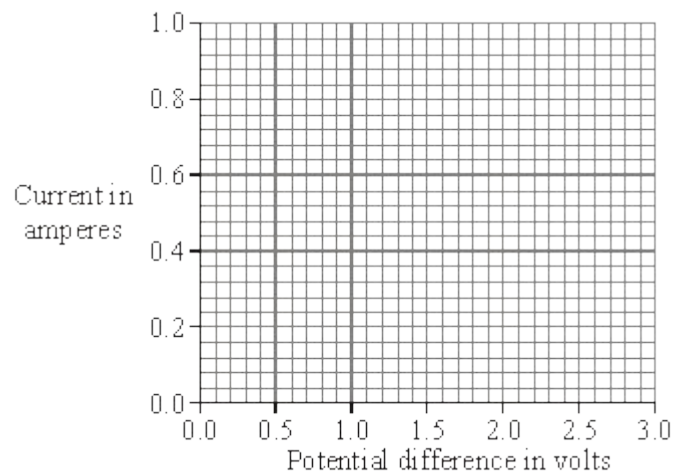
- (b) (i) Write down the equation that links current, potential difference and resistance.

_____ (1)

- (ii) Calculate the potential difference across the 5 ohm (Ω) resistor when the current through the resistor equals 0.4 A. Show clearly how you work out your final answer.

potential difference = _____ volts (2)

- (iii) Complete the graph to show how the current through the resistor changes as the potential difference across the resistor increases from 0 V to 3 V. Assume the resistor stays at a constant temperature.



(2)

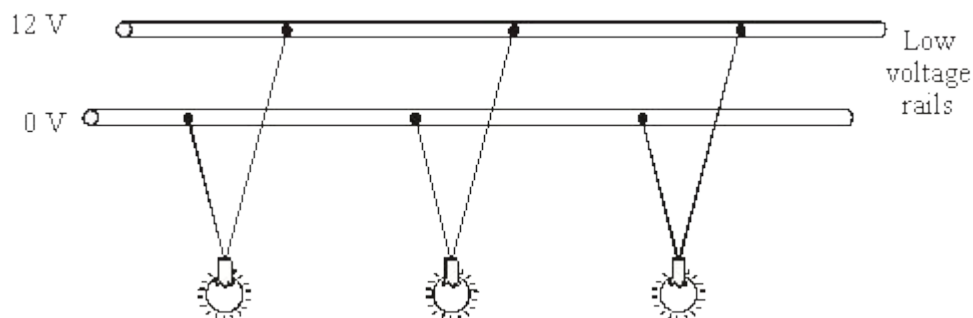
- (c) The resistor is replaced by a 3 V filament lamp. The resistance of the lamp increases as the potential difference across it increases. Why?

(1)

(Total 8 marks)

Q31.

The diagram shows a 12 volt lighting system. Each lamp has a power of 32 watts.



- (i) Write down the equation that links current, potential difference and power.

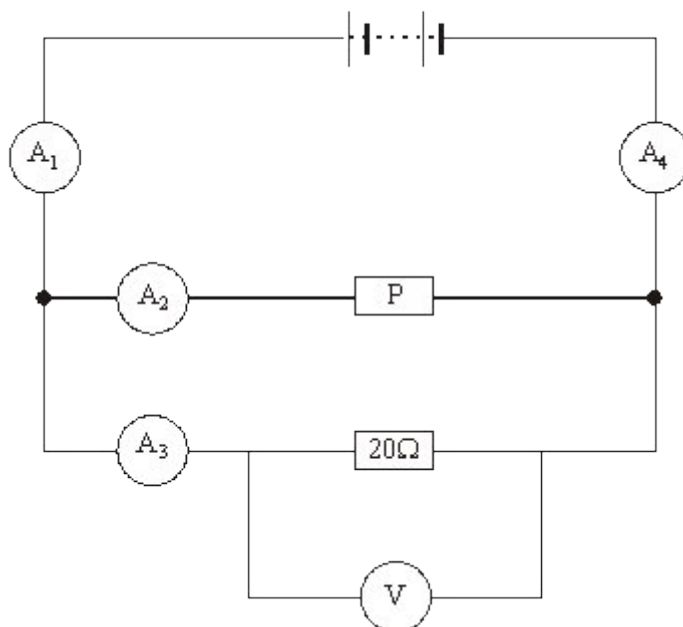
_____ (1)

- (ii) Calculate the input current to the lighting system. Show clearly how you work out your answer.

current = _____ A (2)
(Total 3 marks)

Q32.

The circuit shown has four identical ammeters.



- (a) The table gives the current through two of the ammeters.
- (i) Complete the table to show the current through the other two ammeters.

Ammeter	Reading on ammeter in amps
---------	----------------------------

A_1	
A_2	0.2
A_3	0.3
A_4	

(2)

- (ii) Which **one** of the following statements is correct. Tick (✓) the box next to your choice.

The resistance of **P** is more than $20\ \Omega$.

☐

The resistance of **P** is equal to $20\ \Omega$.

☐

The resistance of **P** is less than $20\ \Omega$.

☐

Give a reason for your choice.

(2)

- (b) (i) Write down the equation that links current, potential difference and resistance.

(1)

- (ii) Calculate the reading on the voltmeter. Show clearly how you work out your answer.

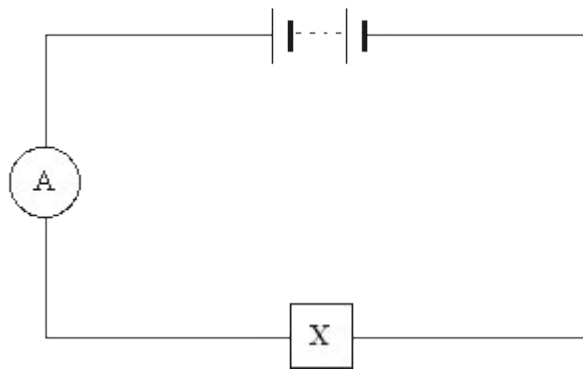
Voltmeter reading = _____ volts.

(2)

- (iii) State the potential difference of the power supply.

(1)

- (c) A second circuit contains an unknown component labelled **X**.



As component **X** is heated, the reading on the ammeter goes up.

What is component **X**?

Give a reason for your answer.

(2)
(Total 10 marks)

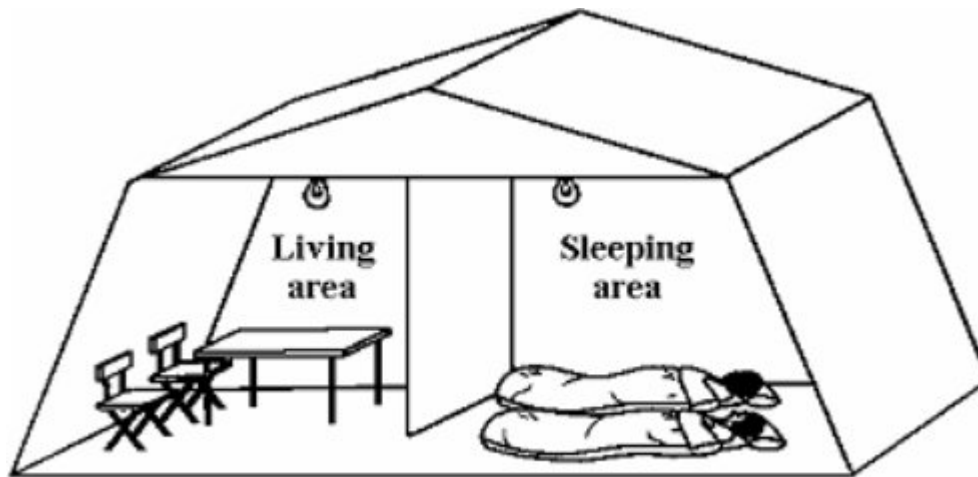
Q33.

- (a) Draw lines to join the picture to the correct circuit symbol. The lamp has been done for you.

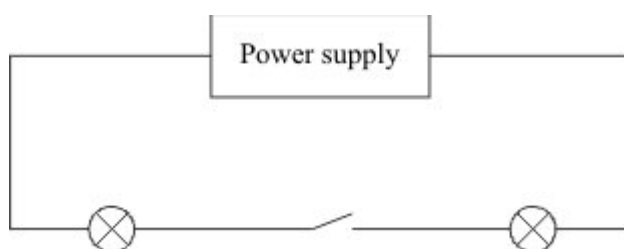
Variable resistor 	
Diode 	
Resistor 	
Lamp 	

(2)

- (b) A family tent is to be fitted with a simple lighting circuit.



The diagram shows the first circuit used.



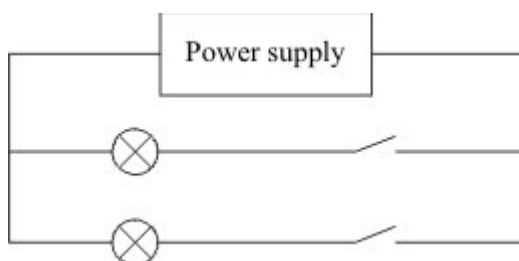
- (i) Are the lamps connected in series or in parallel?

(1)

- (ii) This is not a good circuit for using in the tent. Why?

(1)

The diagram shows the second circuit used.



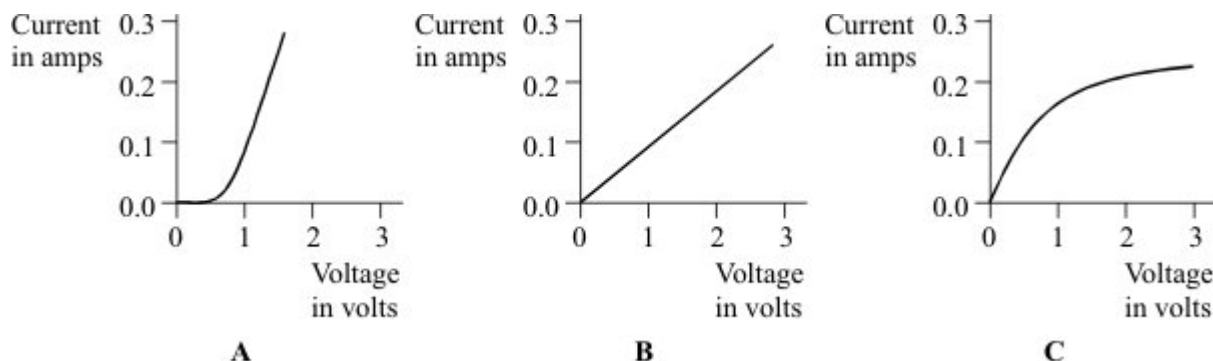
- (iii) Give **two** reasons why this circuit is better than the first circuit.

1. _____

2. _____

Q34.

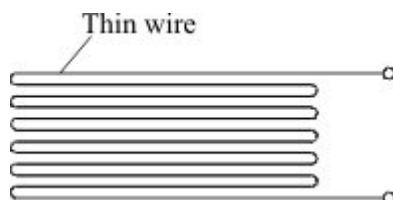
- (a) The diagram shows the voltage-current graphs for three different electrical components.



Which **one** of the components **A**, **B** or **C** could be a 3 volt filament lamp? Explain the reason for your choice.

(3)

- (b) Using the correct symbols draw a circuit diagram to show how a battery, ammeter and voltmeter can be used to find the resistance of the wire shown.



(3)

- (c) When correctly connected to a 9 volt battery the wire has a current of 0.30 amperes flowing through it.

- (i) Give the equation that links current, resistance and voltage.

(1)

- (ii) Calculate the resistance of the wire. Show clearly how you work out your answer and give the unit.

Resistance = _____

(3)

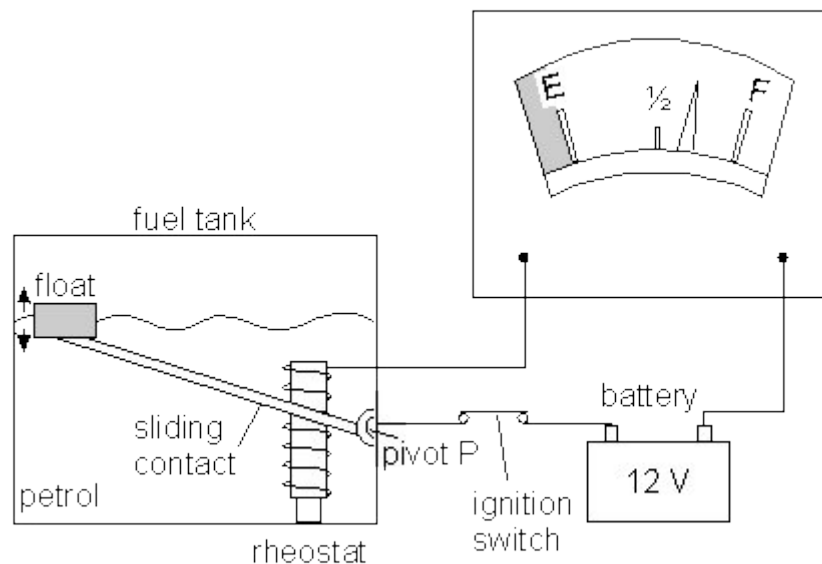
- (iii) When the wire is heated, the current goes down to 0.26 amperes. State how the resistance of the wire has changed.

(1)

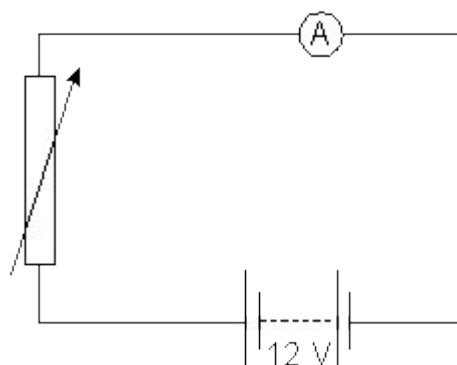
(Total 11 marks)

Q35.

The diagram below shows how one type of fuel gauge in a car works. A sliding contact makes contact with a resistance wire wound in a coil (rheostat). It is connected to a float via a pivot P. When the petrol level changes the circuit resistance changes. This causes the pointer in the fuel gauge to move and show how much petrol is in the petrol tank.



The circuit diagram is shown below.



The petrol gauge is an ammeter. Explain why the reading on the ammeter falls as the petrol is used.

(Total 3 marks)

Mark schemes

Q1.

(a) (i) 2

allow 1 mark for correct substitution i.e. 0.8×2.5 provided no further step shown

2

(ii) straight line drawn from origin to 2, 0.8
or
their (a)(i), 0.8

1

curve from 2, 0.8 to 12,2

or

their (a)(i) 0.8 to 12,2

accept curve from 2, 0.9 to 12,2

or

their (a)(i) 0.9 to 12,2

'convex' curve required

accept a curve that flattens between 10 and 12V

1

(iii) filament / lamp gets hot

accept temperature increases

1

(b) 108

allow 1 mark for correct substitution i.e. 1.5×72 provided no further step shown

2

[7]

Q2.

(a) (i) 15

1

(ii) 4.5 or their (a)(i) $\times 0.3$ correctly calculated

allow 1 mark for correct substitution, ie 0.3×15 /their (a)(i), provided no subsequent step

2

(ii) decrease

1

(b) Y

accept any correct indication

reason only scores if Y is chosen

accept voltage for p.d.

1

(only one that) shows a direct current / p.d.

or

a battery / cell gives a direct current

accept both X and Z are a.c.

or

a battery/cell gives a constant current/p.d.

accept it's a constant current/p.d.

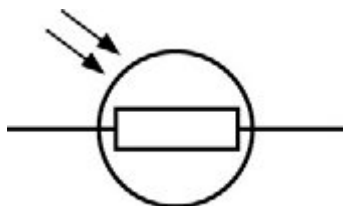
it is not changing is insufficient

1

[6]

Q3.

- (a) (i) correct symbol ringed



1

- (ii) accept any suggestion that would change light intensity, eg:

- torch on or off
accept power of torch
do not accept watts / wattage of torch
- distance between torch and LDR
- lights in room on or off
- shadow over the LDR

1

- (b) resistance decreases

1

from 600 k Ω to 200 k Ω

accept by 400 k Ω

1

- (c) (i) no numbers for light intensity
or
light intensity is categoric / a description / not continuous
not enough results is insufficient

1

- (ii) YES

mark is for the reason

both show that resistance increases with decreasing (light) intensity / brightness

accept they both get the same results / pattern

1

- (d) A circuit that automatically switches outside lights on when it gets dark.

1

[7]

Q4.

- (a) electric current
(rate of) flow of (electric) charge / electrons

accept $I = \frac{Q}{t}$
with Q and t correctly named

1

potential difference

work done / energy transferred per coulomb of charge
(that passes between two points in a circuit)

accept $V = \frac{W}{Q}$
with W and Q correctly named

1

- (b) metals contain free electrons (and ions)

accept mobile for free

1

as temperature of filament increases ions vibrate faster /
with a bigger amplitude

accept atoms for ions
accept ions/atoms gain energy
accept vibrate more for vibrate faster
do not accept start to vibrate

1

electrons collide more (frequently) with the ions

or

(drift) velocity of electrons decreases

do not accept start to collide
accept increasing the p.d. increases the temperature (1 mark)
and
(and) resistance increases with temperature (1 mark) if no other marks scored

1

- (c) 7.8

allow 1 mark for obtaining value 1.3 from graph
or allow 1 mark for a correct calculation using an incorrect current in the range 1.2-1.6 inclusive

2

[7]

Q5.

- (a) (i) 50 000

allow 1 mark for correct substitution, ie

$$6 = 0.00012 \times R$$

or
$$6 = 0.12 \times R$$

*or answers of 25 000 or 50 gain 1 mark**or allow 1 mark for an incorrect answer caused by one error only ie using 3V or an incorrect conversion of current*

2

ohm / Ω *an answer 50k Ω gains 3 marks*

1

- (ii) (body) resistance changes

or

body fat/resistance affected by (many) factors

accept named factor, eg age, gender, height, fitness, bone structure, muscle, drinking water related to body fat / resistance

1

- (iii) gives misleading / wrong/inaccurate value

do not credit if specifically linked to a change in mass / weight

1

(because) high water content changes body resistance

*accept a specific change to resistance**water changes body mass is insufficient*

1

- (b) (i) RCCB – detects difference between current in live and neutral (wires)
-
- accept RCCB can be reset*

1

fuse – (overheats and) melts

accept blows for melts

1

- (ii) switches the circuit / hedge trimmers off within 60 milliseconds

*allow for 1 mark the RCCB / it is (very) fast.**do not accept the bigger the current the faster the RCCB switches off*

2

[10]**Q6.**

- (a) (i) 6

1

- (ii) variable resistor

		1
	(iii) voltmeter	
		1
(b)	(i) point at 3 V ringed	1
	(ii) The student misread the ammeter.	1
	(iii) 1 (volt)	
	<i>accept every volt</i>	1
(c)	as one increases so does the other or directly proportional or positive correlation <i>accept a numerical description, eg when one doubles the other also doubles</i>	1

[7]

Q7.

(a)	(i) circuit not complete <i>accept circuit is broken</i> <i>accept switch / s are open / off</i>	1
	(ii) 9 <i>allow 1 mark for correct substitution, ie 0.5×18 provided no subsequent step shown</i>	2
	(iii) 36	1
(b)	can be switched on / off from top or bottom of stairs	1
(c)	(i) (electric) shock <i>accept fitting becomes live</i> <i>accept answers giving a possible consequence of electric shock, eg death</i>	1
	(ii) connect the <u>earth</u> wire	1

[7]

Q8.

(a)	(i) also double <i>increases is insufficient</i>
-----	---

- 1
- (ii) variable resistor
accept rheostat / potentiometer
- 1
- (b) (i) the data / results / variables are continuous
accept data / results / variables are not categoric / discrete
- 1
- (ii) misreading the ammeter
do not accept misreading the meter / results
do not accept misreading the ammeter and / or voltmeter
reading / human error is insufficient
- 1
- (iii) straight line from the origin drawn passing close / through
 points at 1 V, 5 V, 6 V and ignoring anomalous point
do not accept line drawn 'dot-to-dot'
- 1
- (iv) yes
mark is for the reason
- supports prediction
or
 (straight) line passes through the origin
accept a mathematical argument, eg when p.d. went from 2
to 4 the current went from 0.3 to 0.6
it's directly proportional is insufficient
- 1

[6]

Q9.

- (a) (i) (connect) 30 (cells)
- 1
- in series
- 1
- (ii) current always flows in the same direction
or
 current only flows one way
- 1
- (iii) 36 000
allow 1 mark for correctly converting 2 hours to 7200
seconds
answers 10 or 600 score 1 mark
- 2
- coulombs / C
do not accept c
- 1

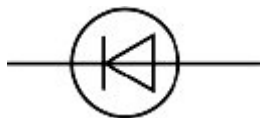
- (b) (i) 2160
allow 1 mark for correct substitution, ie $\frac{1}{2} \times 120 \times 6^2$
answers of 1620 or 540 score 1 mark 2
- (ii) reduce it 1
- any **one** from:
- draws a larger current (from battery)
 - motor draws greater power (from battery)
accept energy per second for power
accept more energy needed to move the bicycle
 - greater resistance force (to motion) / air resistance / drag / friction
accept less streamlined
more mass to carry is insufficient 1
- [10]**

Q10.

- (a) (i) 4.5 1
- (ii) 2.25 or their (a)(i) $\div 2$ correctly calculated 1
- (iii) V_2 1
- (b) (i) 30 1
- (ii) 8
allow 1 mark for correct substitution
ie 0.4×20
allow 1 mark for answers of 4 or 12 2
- (iii) Y 1
- [7]**

Q11.

- (a) diode
accept LED 1
- (b) all symbols correct
must include at least voltmeter and diode 1



diode

allow ecf from part (a) if the component is not identified as a diode

allow symbol without the line through triangle

ignore polarity of diode

voltmeter in parallel with component added in series

*any additional components must not affect the ability to measure **V** and **I** for the diode / their (a)*

1

(c) (i) 0.05

accept 50 mA

accept between 0.048 and 0.050 inclusive

1

(ii) 16

0.8

their (c)(i) correctly calculated gains both marks

allow 1 mark for correct transformation and substitution

$\frac{0.8}{0.05}$ or $\frac{0.8}{\text{their (c)(i)}}$

allow 17 if using 0.048

2

[6]

Q12.

(a) (i) 0.25 (A)

1

(ii) 75

allow 1 mark for converting 5 minutes to 300 seconds

or allow 1 mark for correct substitution

ie 0.25×300

allow 1 mark for an answer 1.25

allow 1 mark only for their (a)(i) $\times 300$ correctly calculated

2

coulombs or C

*do **not** accept c*

1

(b) any **two** from:

- fault not repaired
accept if a fault was to occur
- larger current will (still) flow
- aluminium foil will not melt (if a fault)

accept aluminium foil needs a higher current / charge to melt

- wiring will overheat / (may) cause a fire
accept idea of fire hazard
*do **not** accept explode etc*

2

[6]

Q13.

- (a) fleece rubs against shirt
it refers to the fleece

1

or

friction (between fleece and shirt)

(causing) electrons to transfer from one to the other
accept a specific direction of transfer
*do **not** accept charge for electrons*
positive electrons negates this mark
movement of protons negates this mark

1

- (b) Electrical charges move easily through metals.

1

An electric current is a flow of electrical charge.

1

- (c) (i) copper
reason only scores if copper chosen

1

(good electrical) conductor

accept it is a metal

any mention of heat conduction negates this mark

1

- (ii) lower than

1

- (iii) accept any sensible suggestion, eg:

- too many variables (to control)
- lightning strikes / storms are random / unpredictable
- do not know which building will be struck
- do not know when a building will be struck
- do not know when lightning will happen
- (very) difficult to create same conditions in a laboratory
- lightning storms are not the same

it is not safe is insufficient
*do **not** accept lightning does not strike the same place twice*

1

[8]

Q14.

(a) brown

1

(b) outside / case is plastic / an insulator

accept is double insulated

accept non-conductor for plastic

*do **not** accept it / hairdryer is plastic*

1

(c) (i) (1) S_1

and no other

1

(2) S_1 and S_3

both required, either order

1

(ii) S_1 must be ON (for either heater to work)

*do **not** accept reference to 'fan' switch*

1

S_1 switches the fan on

1

(d) 1495

*allow **1** mark for correct substitution*

ie, 6.5×230

2

watt(s) or W

*an answer of 1.495 kW gains **3** marks*

although the unit is an independent mark for full credit

the unit and numerical value must be consistent

accept joules per second or J/s

1

[9]

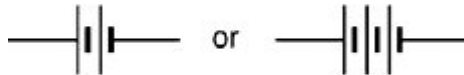
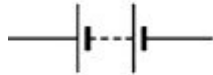
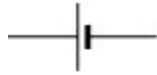
Q15.

(a) (i) ammeter and battery **in series** with the **gauge**

symbols must be correct

ignore a voltmeter drawn in series

accept



not



or cells reversed to cancel out

1

voltmeter in parallel with the gauge

symbol must be correct

accept a freestanding circuit

diagram provided strain gauge is labelled or a resistor symbol used for the strain gauge

1

(ii) d.c. flows only in one direction

a.c. changes direction is insufficient

1

(b) (i) 75

this answer only

allow 1 mark for correct substitution **and** transformation,

$$\text{ie resistance} = \frac{3.0}{0.040}$$

2

(ii) increases

1

(iii) elastic / strain potential

do **not** accept potential

1

[7]

Q16.

(a) switch

allow answer circled in box

1

(b) 24

1

- (c) equal to 0.25 A 1
- (d) 4 1

[4]

Q17.

- (a) a light-dependent resistor 1
- (b) any **three** from:
- resistance starts at 500 (kilohms)
 - (resistance) falls rapidly as intensity increases from 0
accept resistance falls
accept brightness for intensity
 - (resistance) halves between 10 and 20 lux
 - (resistance) falls slightly between 20 and 50 lux
or
 - (resistance) almost constant / levels out between 20 and 50 lux
 - at 50 lux, resistance = 10 (kilohms)
for full credit the word resistance must be used correctly at least once
an answer resistance falls as intensity increases gains 2 marks - this may be combined with one of the bullet point marks for full credit 3
- (c) (i) decrease 1
- (ii) resistance increases
this can score without (c)(i) 1
- (d) A circuit to switch on security lighting when it gets dark. 1

[7]

Q18.

- (a) (i) light dependent resistor / LDR
accept ldr 1
- (ii) 25 (kilohms)
accept 24 - 26 inclusive
accept 25 000 Ω 1
- (iii) 5 (V) or their (a)(ii) correctly converted to ohms $\times 0.0002$ correctly calculated

allow **1** mark for converting 25 kΩ /
their (a)(ii) to ohms

or

allow **1** mark for correct substitution
ie $0.0002 \times 25(000)$

or $0.0002 \times$ their (a)(ii)

allow an incorrect conversion from kilohms providing this is
clearly shown

2

- (b) (i) linear scale

using all of the available axis

must cover the range 4 - 6 v

or their (a)(iii) - 6 v and lie within the range 0 - 15 inc.

1

- (ii) negative gradient line

do **not** allow lines with both positive and negative gradients

1

passing through 20 lux and their (a)(iii)

only scores if the first mark is awarded

only scores if line does not go above 6 volts

1

- (c) (i) 37.5 (kΩ) or their (a)(ii) + 50 % (a)(ii) correctly calculated

1

- (ii) light intensity value would be unreliable / not accurate

1

due to variation in resistance value

accept because resistance varies by $\pm 50 \%$

accept tolerance of resistor is too great

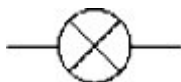
do **not** accept results are not accurate

1

[10]

Q19.

- (a)



accept 'the humpback bridge' symbol

accept circle with cross but no lines

if more than one symbol drawn, no mark unless lamp is
labelled

1

- (b) (i) 24

$\frac{2800}{120}$

allow **1** mark for correct substitution ie

allow **1** mark for an answer 1440

ignore any unit

2

(ii) watt

1

(c) larger than

accept correct indication inside the box

accept an answer meaning larger than ie greater than

1

[5]

Q20.

L

N

M

K

all four in the correct order

2 marks for 2 correct

1 mark for 1 correct

[3]

Q21.

(a) voltmeter

and no other

*do **not** accept voltage*

1

(b) (i) variable resistor

1

(ii) 0.10 – 0.30

accept 0.1 – 0.3

accept 0.3 – 0.1

accept 0.30 – 0.10

1

(iii) 3.3 (W)

allow 1 mark for correct data choice

allow 2 marks for substitution of correct data i.e. 0.30×11.0

the following answers gain 2 marks

0.10 / 0.30 / 0.80 / 1.75

allow 1 mark for substitution of incorrect of data incorrectly calculated e.g.

$0.20 \times 4.0 = 0.6$ scores 1 mark

3

(c) increases

1

Q22.

(i) 30

allow 1 mark for showing correct method i.e. 5×6 or $12 \div 0.4$

2

(ii) connected in series

insufficient they are not connected in parallel

1

(iii) 0.4

1

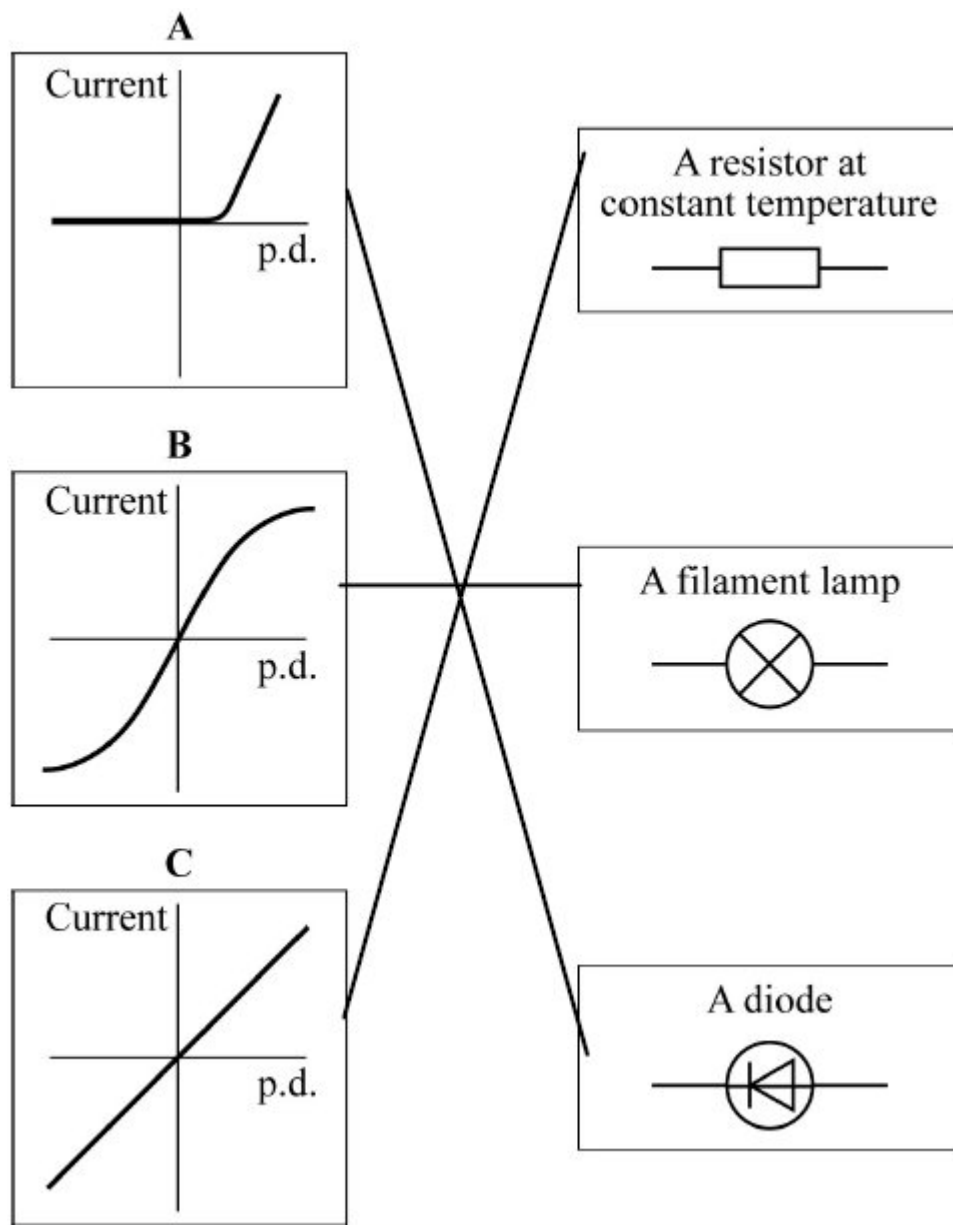
(iv) equally/ evenly

*the same is insufficient
allow credit for candidates that correctly mention pd across
the connecting wires
accept (nearly) 2 V (each)*

1

[5]

Q23.(a) **three** lines drawn correctly



allow 1 mark for 1 correct line

if more than one line goes from a graph, both are incorrect

2

(b) J

1

[3]

Q24.

(a) (i) 6

1

(ii) 6 (volts)

accept their (a) (i) ignore any units

1

(b) 0.30

accept 0.3

1

- (c) smaller(than) 1
accept correct alternatives to smaller than e.g. less than
- a bigger current flows through the lamp
only accept if 'smaller than' is given
accept converse
accept a correct calculation
accept resistance is half of 60
accept resistance = 30 (Ω)
*do **not** accept answers in terms of p.d* 1
- [5]

Q25.

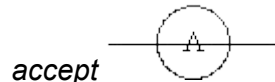
- (a) (i) 0.0046 2
accept 4.6 mA
allow 1 mark for correct substitution and transformation

$$\text{i.e. current} = \frac{230}{50000}$$
an answer of 4.6 gains 1 mark
- (ii) • increases overall resistance 1
 • (in event of a shock) gives a smaller current
accept gives smaller shock
*do **not** accept no shock/current* 1
- (b) (i) 50 (hertz) 1
ignore units
- (ii) NO has the lowest current at which people cannot let go
answer and reason needed
accept a sensible reason in terms of their answer to (b) (i)
 or YES changing the frequency changes the current by only a small amount 1
- (c) a current flows through from the live wire/metal case to the earth wire
accept a current flows from live to earth
*do **not** accept on its own if the current is too high*
 this current causes the fuse to melt
accept blow for melt 2

[8]

Q26.

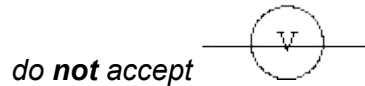
- (a) (i) ammeter symbol correct and drawn in series



do **not** accept lower case a

1

voltmeter symbol correct and drawn in parallel with the material



1

- (ii) adjust / use the variable resistor

accept change the resistance

or change the number of cells

accept battery for cell

accept change the p.d / accept change the voltage

accept increase / decrease for change

1

- (b) (i) data is continuous (variable)

1

- (ii) 36 (Ω)

correct answer only

1

- (iii) 5.4 or their (b)(ii) $\times$ 0.15

allow **1** mark for correct substitution

2

- (c) (i) the thicker the putty the lower the resistance

answer must be comparative

accept the converse

1

- (ii) any **one** from:

- measuring length incorrectly
accept may be different length
- measuring current incorrectly
do **not** accept different currents
- measuring voltage incorrectly
do **not** accept different voltage
- ammeter / voltmeter incorrectly calibrated
- thickness of putty not uniform
- meter has a zero error
accept any sensible source of error eg putty at different temperatures

do **not** accept human error without an explanation
do **not** accept pieces of putty not the same unless qualified
do **not** accept amount of putty not same
do **not** accept systematic / random error

1

(iii) repeat readings

accept check results again
accept do experiment again
accept do it again
accept compare own results with other groups
do **not** accept take more readings

1

[10]

Q27.

(a) (i) 4 (V)

allow 1 mark for correct substitution

2

(ii) 5 (V) or (9 – their (a)(i)) correctly calculated

e.c.f

do **not** allow a negative answer

1

(b) (i) thermistor

c.a.o

1

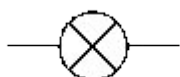
(ii) 0°C to 20°C

1

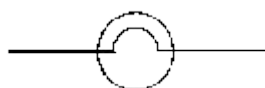
[5]

Q28.

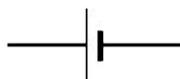
(a) circuit symbol for a lamp correct



accept



accept any standard of drawing providing circuit would work



1

circuit symbol for a cell correct

1

2 lamps drawn in parallel with 3 cells

polarity of cells must be correct (+ to –) but cells may be either way around

1

(b) 4.5

1

(c) the same as

accept any clear indication of the correct answer

1

[5]

Q29.

(a) (i) potential difference = current $\times$ resistance

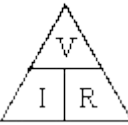
*accept voltage **or** pd for potential difference*

accept $V = I \times R$

accept correct transformation

*do **not** accept $V = C \times R$*

*do **not** accept $V = A \times R$*

accept  *provided*

subsequent use of Δ correct

*do **not** accept an equation expressed in units*

1

(ii) 46

credit correct transformation for 1 mark

allow 1 mark for use of 11.5 V or division of final resistance by 20

a final answer of 920 gains 2 marks only

3

ohm(s)

accept symbol Ω

*do **not** accept Ω s*

unit / symbol mark can be awarded in (iii) provided unit / symbol is omitted in (ii)

1

(iii) 920 (ohms) **or** their (a)(ii) $\times$ 20

1

(b) as temperature increases, resistance increases

accept hotter for temperature increase

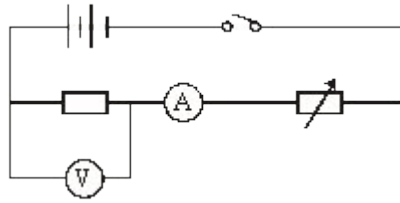
*do **not** accept a reference to resistance only i.e. it / resistance goes up*

1

[7]

Q30.

- (a) all symbols correct



accept push switch symbol switch may be open or closed
any lines through symbols = 0 marks

1

correct circuit drawn

polarity of cells not relevant provided they are joined correctly

1

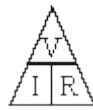
voltmeter must be across resistor only

two cells are required in the diagram
ignore the order of the components
allow small gaps in circuit
omission of any component = 0 marks

1

- (b) (i) potential difference = current $\times$ resistance

accept voltage or p.d. for potential difference
accept $V = I \times R$



accept provided I R subsequent use correct

do **not** accept C for current

1

- (ii) 2

allow 1 mark for correct substitution
wrong working loses both marks

2

- (iii) straight line drawn through the origin

judge by eye

straight line passes through $I = 0.4$, $V =$ their (b)(ii) / 2 **and** 0.0

this mark may be awarded if all points shown including these
points are correct even if no line is drawn
N.B. a curve scores 0 marks

1

- (c) temperature increases

accept filament lamp / it gets hotter
allow heat for temperature

1

[8]

Q31.

- (i) power = potential difference $\times$ current

accept voltage for potential difference

accept $P = V \times I$

or correct transposition



accept provided subsequent method correct

1

- (ii) 8

allow 1 mark for correct substitution or transformation or an answer 2.67 / 2.7

2

[3]

Q32.

- (a) (i) $A_1 = 0.5$

ignore any units

1

$$A_4 = 0.5$$

allow 1 mark for $A_1 = A_4 \neq 0.5$

1

- (ii) the resistance of **P** is more than 20 Ω

1

a smaller current goes through P / A_2 (than 20 Ω)

dependent on getting 1st mark correct

accept converse

1

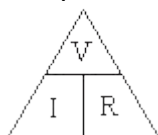
- (b) (i) potential difference = current $\times$ resistance

accept pd / voltage for potential difference

accept $V = I \times R$, correct symbols and correct case only

accept volts = amps $\times$ ohms

accept



provided subsequent method is correct

allow combination of

physical quantities and named units

allow voltage = $I \times R$

1

- (ii) 6

allow 1 mark for correct substitution

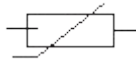
2

- (iii) 6

accept their (b)(ii)

1

(c) thermistor or



accept correct circuit symbol
allow phonetic spelling

1

resistance goes down (as temperature of thermistor goes up)

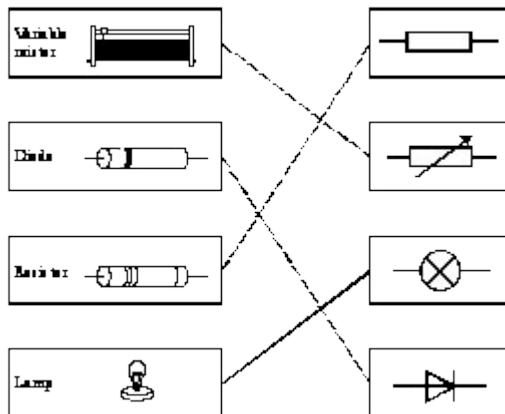
do **not** accept changes for goes down
do **not** accept an answer in terms of current only
answers in terms of other components are incorrect

1

[10]

Q33.

(a) all 3 lines drawn correctly



(1 only correct, 1 mark)

deduct one mark if more than one line from or to a single box

2

(b) (i) series

1

(ii) any **one** from:

- both lamps **or** lights must be on together
 - if one blows, the other goes out
 - switch controls both bulbs
- do **not** accept bulbs dimmer

1

(iii) any **two** from

- each lamp **or** light can be switched on independently
- if one lamp blows the other stays on

- switching the second lamp on does not affect brightness of first **or** bulbs brighter (than in first circuit) or energy explanation

2

[6]

Q34.

(a) C

award mark if A and B identified as not filament lamp

1

resistance increases

negated by wrong statement e.g. current goes down

1

as the lamp gets hot

*accept as current (through lamp) **or** voltage (across lamp) increases*

*do **not** accept non-ohmic reason independent of choice of component*

1

(b) ammeter wire and battery only in series

non standard symbols acceptable if correctly identified (labelled) for ammeter, voltmeter and battery

1

voltmeter only in parallel with wire **or** battery

*all in series **or** ammeter in parallel neither of these two marks awarded*

1

all symbols correct

ignore lines drawn through centres of symbols

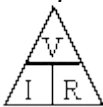
1

(c) (i) voltage = current $\times$ resistance

accept $V = I \times R$

accept volts = amps $\times$ ohms

*do **not** accept $V = C \times R$*

accept 

if subsequent method correct

1

(ii) 30

accept correct substitution for 1 mark (9/0.3)

2

ohms

accept correct symbol Ω

1

(iii) goes up

must be a comparison

accept calculation if answer is larger than c (ii)

1

[11]

Q35.

level drops as petrol used;
causes circuit resistance to increase;
causes current to decrease

for 1 mark each

or if change not specified;

(one correct and two vague statements gains 2 marks,

three vague statements gains 1 mark)

e.g. level changes;)

so resistance changes;) = 1 mark

so current changes)

[3]