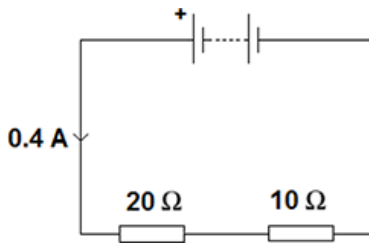


1 An electrical circuit is shown in the figure below.



(a) The current in the circuit is direct current.

What is meant by direct current?

Tick **one** box.

Current that continuously changes direction.

Current that travels directly to the component.

Current that is always in the same direction.

(1)

(b) The equation which links current, potential difference and resistance is:

potential difference = current \times resistance

Calculate the potential difference across the battery in the circuit in the figure above.

.....

Potential difference = V

(3)

(c) The equation which links current, potential difference and power is:

power = current \times potential difference

Calculate the power output of the battery in the figure above.

Give your answer to one significant figure.

.....

Power = W

(2)

(Total 6 marks)

2 A student wants to investigate how the current through a filament lamp affects its resistance.

(a) Use the circuit symbols in the boxes to draw a circuit diagram that she could use.

12 V battery	variable resistor	filament lamp	voltmeter	ammeter

(2)

- (b) Describe how the student could use her circuit to investigate how the current through a filament lamp affects its resistance.

.....

.....

.....

.....

.....

.....

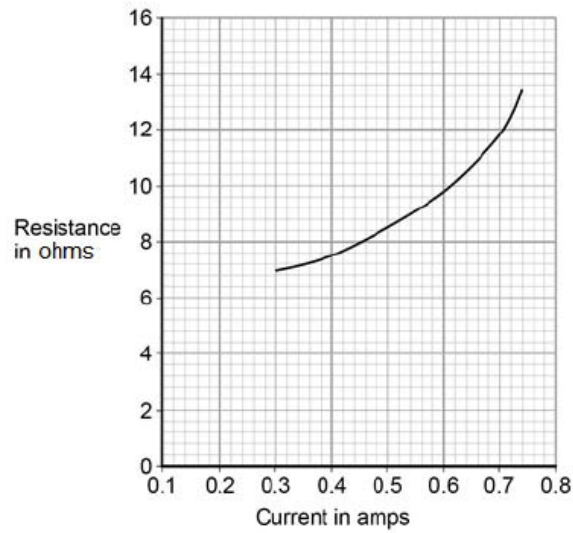
.....

.....

(4)

- (c) The student's results are shown in **Figure 1**.

Figure 1



Describe how the resistance of the filament lamp changes as the current through it increases.

.....

.....

(1)

- (d) Use **Figure 1** to estimate the resistance of the filament lamp when a current of 0.10 A passes through the lamp.

Resistance = Ω

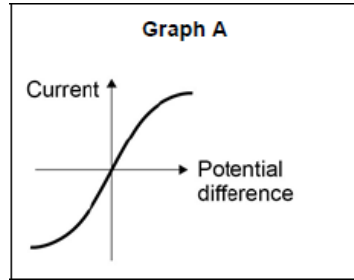
(1)

(e) The current-potential difference graphs of three components are shown in **Figure 2**.

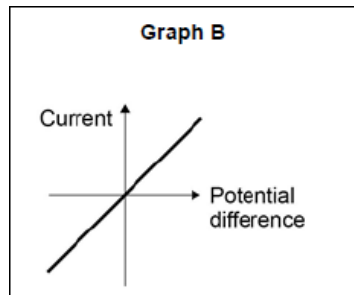
Use answers from the box to identify each component.

diode	filament lamp	light dependent resistor
resistor at constant temperature	thermistor	

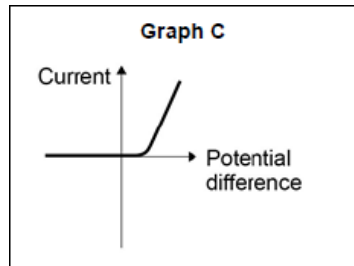
Figure 2



.....



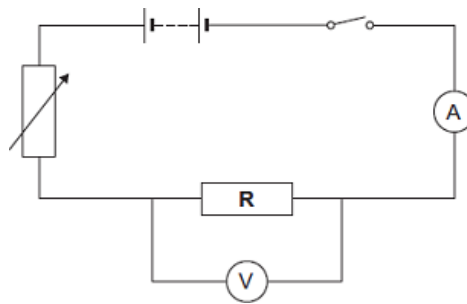
.....



.....

(3)
(Total 11 marks)

3 (a) A resistor is a component that is used in an electric circuit.



(i) Describe how a student would use the circuit to take the readings necessary to determine the resistance of resistor **R**.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(6)

(ii) Explain why the student should open the switch after each reading.

.....

.....

.....

.....

(2)

(iii) In an experiment using this circuit, an ammeter reading was 0.75 A. The calculated value of the resistance of resistor **R** was 16 Ω .

What is the voltmeter reading?

.....

.....

Voltmeter reading = V

(2)

(iv) The student told his teacher that the resistance of resistor **R** was 16 Ω .

The teacher explained that the resistors used could only have one of the following values of resistance.

10 Ω 12 Ω 15 Ω 18 Ω 22 Ω

Suggest which of these resistors the student had used in his experiment.

Give a reason for your answer.

.....
.....
.....
.....

(2)

(b) The diagram shows a fuse.



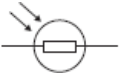
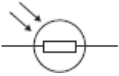


Describe the action of the fuse in a circuit.

.....
.....
.....
.....
.....
.....
.....
.....

(3)
(Total 15 marks)

4 (a) Draw **one** line from each circuit symbol to its correct name.

Circuit symbol	Name
	Diode
	Light-dependent resistor (LDR)
	Lamp
	Light-emitting diode (LED)

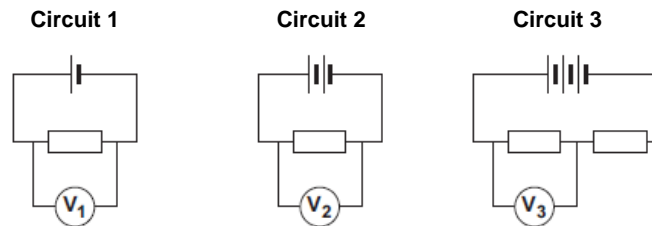
(3)

(b) **Figure 1** shows three circuits.

The resistors in the circuits are identical.

Each of the cells has a potential difference of 1.5 volts.

Figure 1



(i) Use the correct answer from the box to complete the sentence.

half	twice	the same as
-------------	--------------	--------------------

The resistance of **circuit 1** is the resistance of **circuit 3**.

(1)

(ii) Calculate the reading on voltmeter V_2 .

.....

Voltmeter reading $V_2 = \dots\dots\dots$ V

(1)

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

Draw a ring around the correct answer.

V_1

V_2

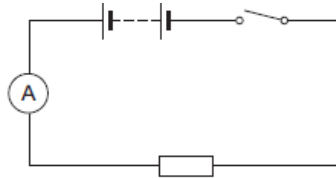
V_3

(1)

(c) A student wanted to find out how the number of resistors affects the current in a series circuit.

Figure 2 shows the circuit used by the student.

Figure 2



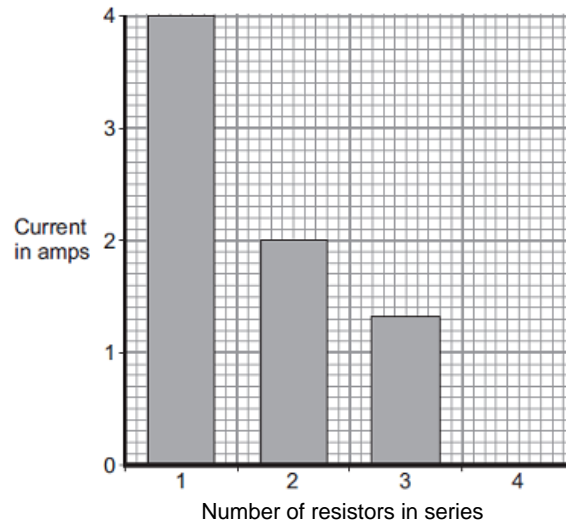
The student started with one resistor and then added more identical resistors to the circuit.

Each time a resistor was added, the student closed the switch and took the ammeter reading.

The student used a total of 4 resistors.

Figure 3 shows three of the results obtained by the student.

Figure 3



(i) To get valid results, the student kept one variable the same throughout the experiment.

Which variable did the student keep the same?

.....

(1)

(ii) The bar chart in **Figure 3** is not complete. The result using 4 resistors is not shown.

Complete the bar chart to show the current in the circuit when 4 resistors were used.

(2)

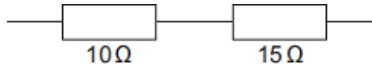
(iii) What conclusion should the student make from the bar chart?

.....

(1)
 (Total 10 marks)

5 (a) Electrical circuits often contain resistors.

The diagram shows **two** resistors joined in series.



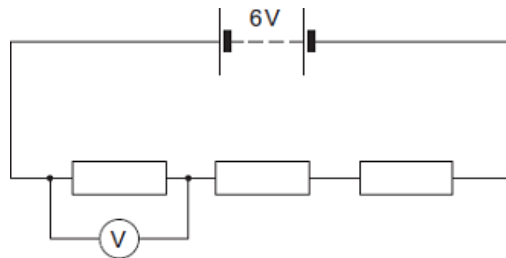
Calculate the total resistance of the **two** resistors.

.....

Total resistance = Ω

(1)

(b) A circuit was set up as shown in the diagram. The three resistors are identical.



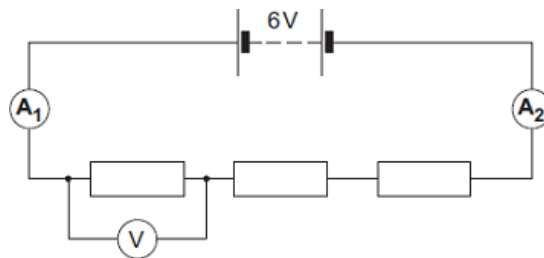
(i) Calculate the reading on the voltmeter.

.....

Reading on voltmeter = V

(2)

(ii) The same circuit has now been set up with two ammeters.



Draw a ring around the correct answer in the box to complete the sentence.

The reading on ammeter **A₂** will be

smaller than
equal to
greater than

 the reading on ammeter **A₁**.

(1)
 (Total 4 marks)

- 6** (a) The diagram shows the information plate on an electric kettle. The kettle is plugged into the a.c. mains electricity supply.

230 V	2760 W
50 Hz	

Use the information from the plate to answer the following questions.

- (i) What is the frequency of the a.c. mains electricity supply?

.....

(1)

- (ii) What is the power of the electric kettle?

.....

(1)

- (b) To boil the water in the kettle, 2400 coulombs of charge pass through the heating element in 200 seconds.

Calculate the current flowing through the heating element and give the unit.

Choose the unit from the list below.

amps

volts

watts

.....

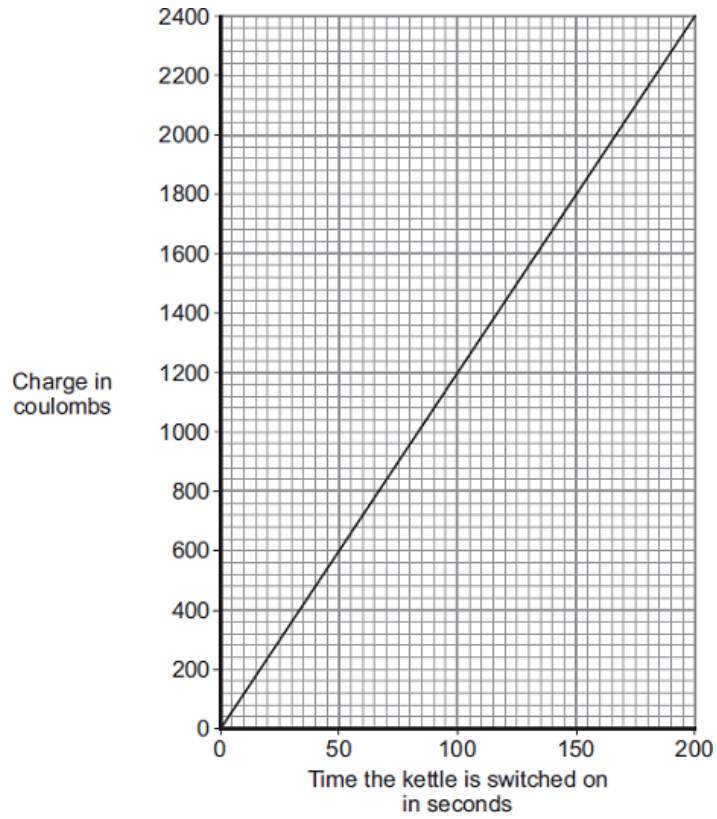
.....

.....

Current =

(3)

- (c) The amount of charge passing through the heating element of an electric kettle depends on the time the kettle is switched on.

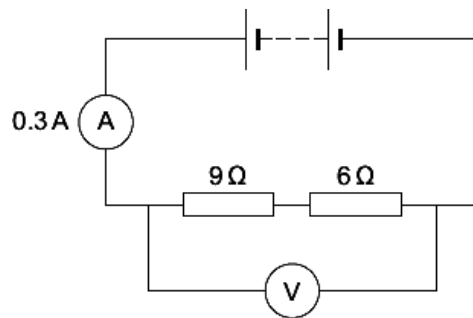


What pattern links the amount of charge passing through the heating element and the time the kettle is switched on?

.....

(2)
 (Total 7 marks)

- 7** (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

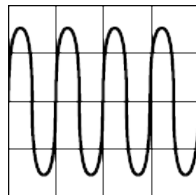
the reading on the ammeter.

(1)

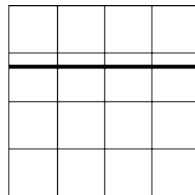
(b) The voltmeter in the circuit is replaced with an oscilloscope.

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

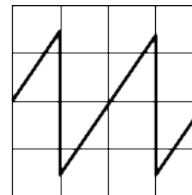
Write your answer, X, Y or Z, in the box.



X



Y



Z

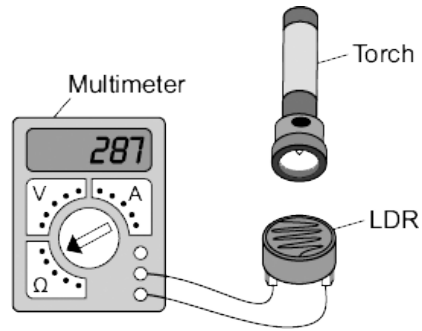
Diagram

Give a reason for your answer.

.....
.....
.....

(2)
(Total 6 marks)

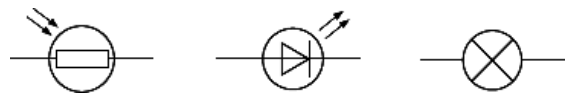
- 8 A student used the apparatus below to find out how the resistance of a light-dependent resistor (LDR) depends on light intensity.



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.



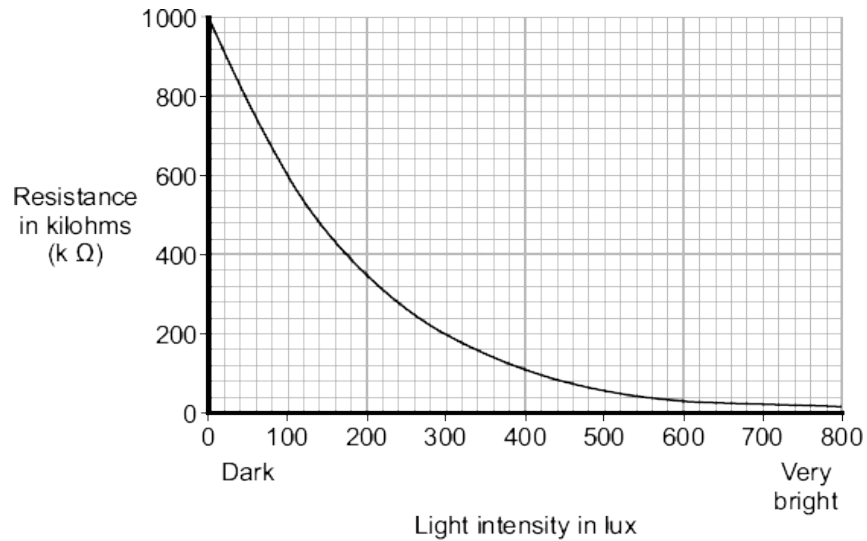
(1)

- (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.

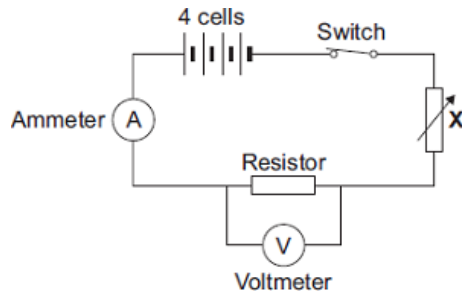
A circuit that automatically switches central heating on and off.

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

(1)

(Total 7 marks)

- 9 (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**

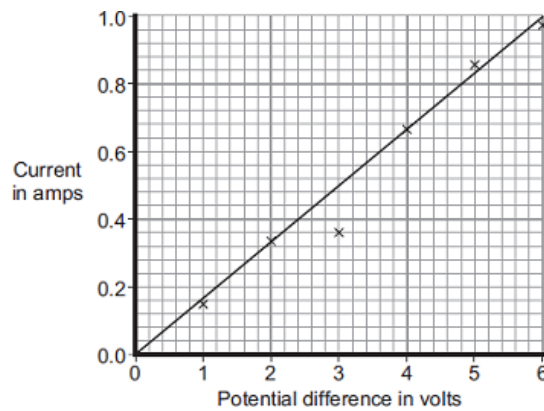
(1)

- (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.

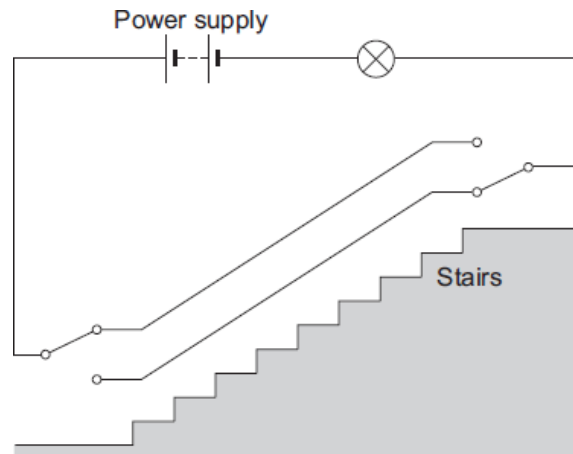
.....
.....

(1)

(Total 7 marks)

10

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 \times resistance
--

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)

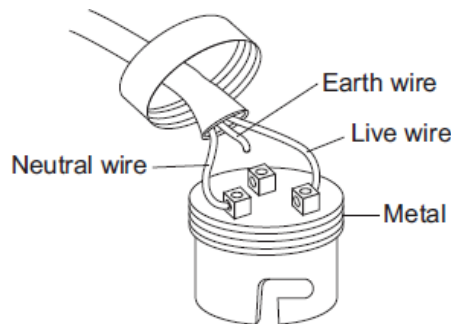
- (b) This type of circuit is also used in real houses. One of the switches is at the top of the stairs, and the other switch is at the bottom of the stairs.

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?

.....

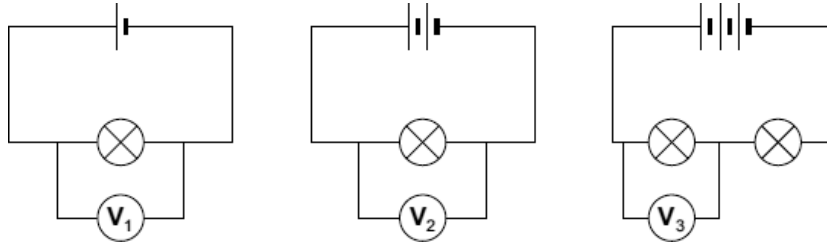
(1)

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

.....

(1)
 (Total 7 marks)

11 (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)

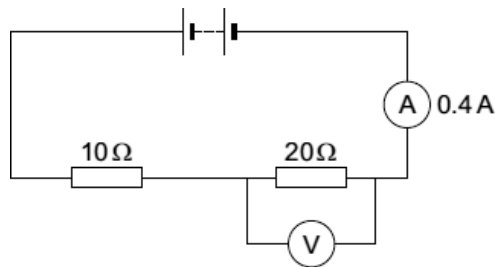
(iii) Which voltmeter, V_1 , V_2 or V_3 , will give the highest reading?

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.

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

Show clearly how you work out your answer.

.....
.....

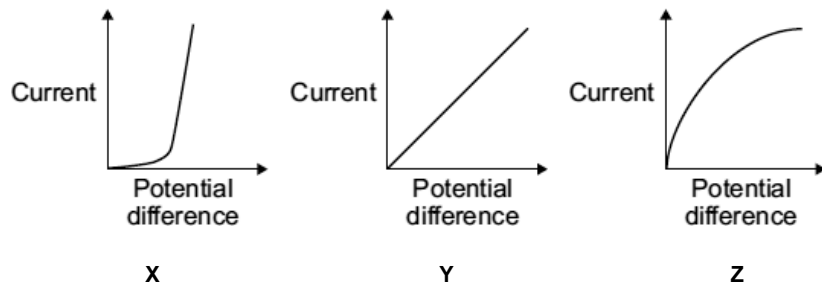
Voltmeter reading = V

(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.

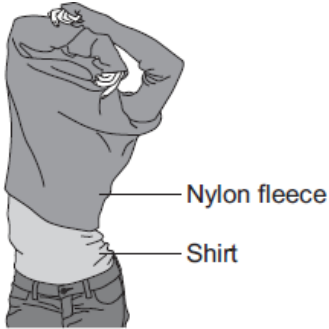


Graph

(1)
(Total 7 marks)

12

(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.

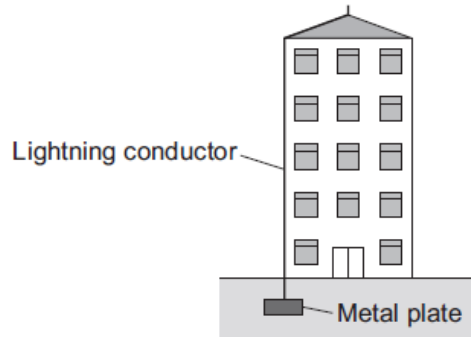
Electrical charges move easily through metals.

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
lower than

 the resistance of the building.

(1)

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

Suggest a reason why.

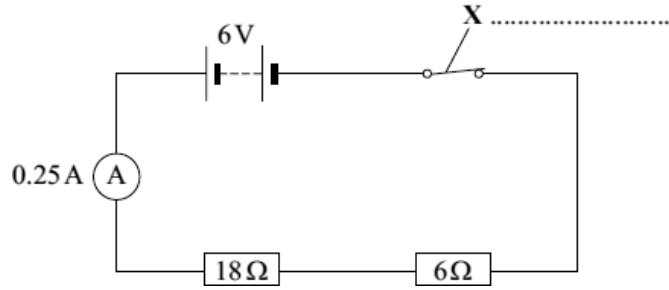
.....
.....

(1)

(Total 8 marks)

13

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.

.....

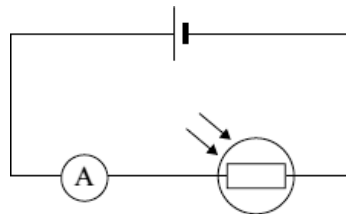
Number of cells =

(1)

(Total 4 marks)

14

The diagram shows a simple circuit.



(a) The circuit includes an LDR.

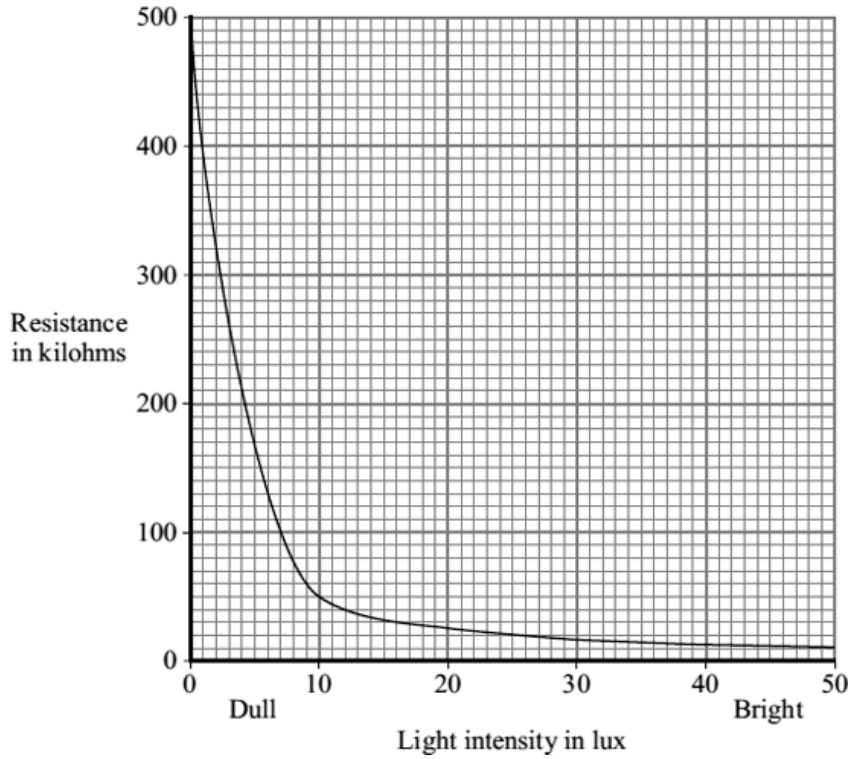
What do the letters LDR stand for?

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
reading on the ammeter.

decrease
not change
increase

the

(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

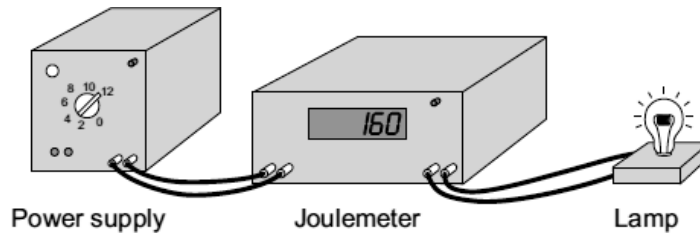
a circuit to switch on security lighting when it gets dark

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

(1)
(Total 7 marks)

15

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)

16

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.

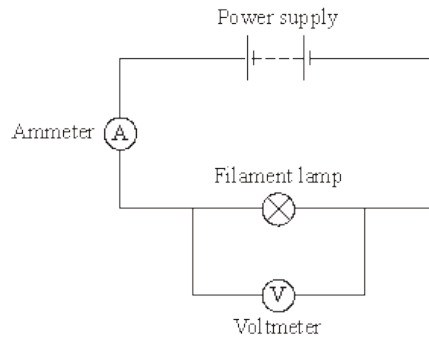
N of the power supply is shared by the components.

O on the potential difference across the resistor.

(Total 3 marks)

17

(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

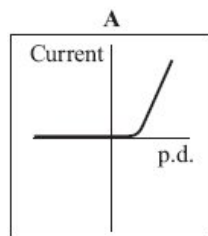
- | |
|------------------|
| increases |
| remains constant |
| decreases |

(1)
(Total 7 marks)

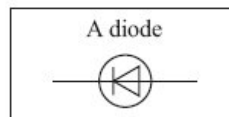
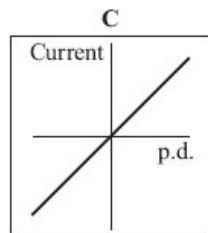
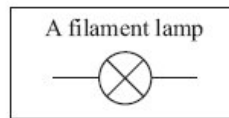
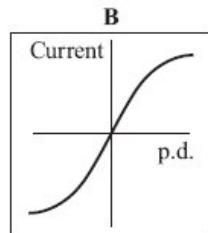
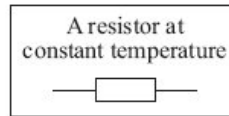
18

(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.

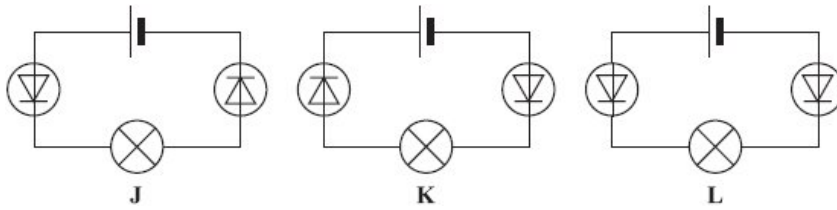


Component



(2)

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



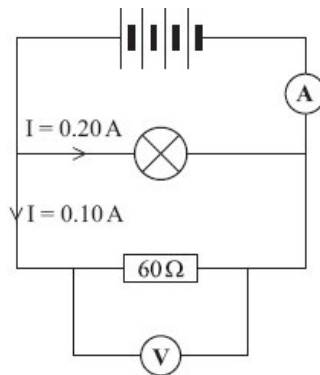
In which **one** of the circuits, **J**, **K** or **L**, would the filament lamp be on?

.....

(1)
(Total 3 marks)

19

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
--------------	----------	--------------

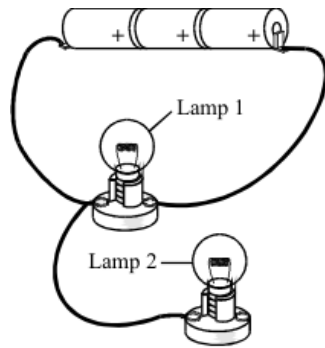
The resistance of the lamp is 60 Ω .

Give a reason for your answer.

.....

(2)
 (Total 5 marks)

20 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.

The current through lamp 2 will be


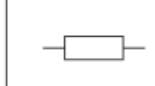
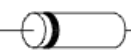
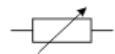
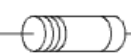



smaller than
the same as
bigger than

 the current through lamp 1.

(1)
 (Total 5 marks)

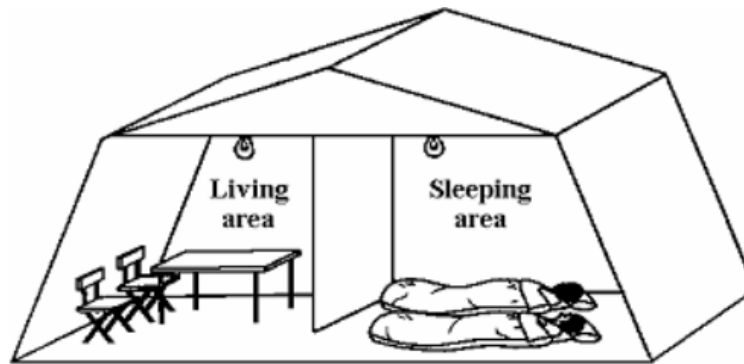
21

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

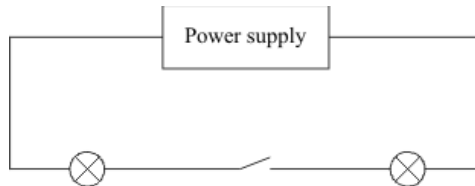
Variable resistor		
Diode		
Resistor		
Lamp		

(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)

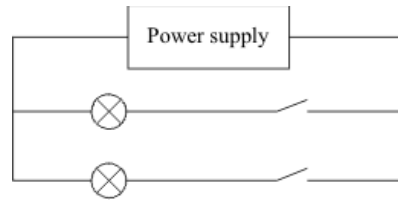
(ii) This is not a good circuit for using in the tent. Why?

.....

.....

(1)

The diagram shows the second circuit used.



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

- 1.
-
- 2.
-

(2)
(Total 6 marks)

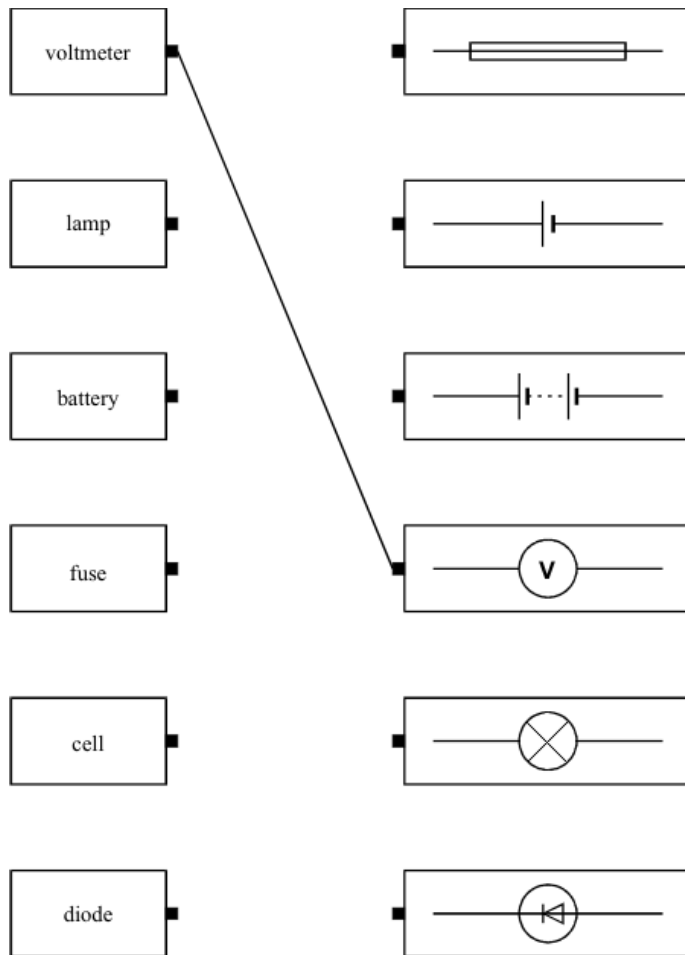
22

(a) Complete the sentence below to name the instrument used to measure electrical current.

The instrument used to measure electrical current is called

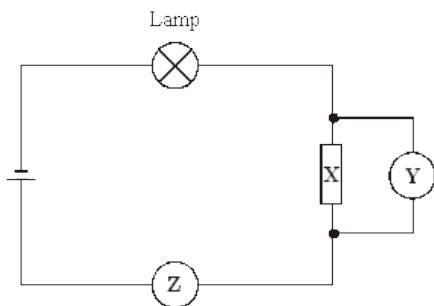
(1)

- (b) In the diagram below each box contains an electrical component or a circuit symbol. Draw straight lines to link each electrical component to its circuit symbol. The first one has been done for you.



(4)
(Total 5 marks)

- 23** The diagram shows a circuit.



- (a) (i) Name component **X**.
- (ii) What does meter **Y** measure?
- (iii) What does meter **Z** measure?

(3)

(b) Which of the equations shows how current, potential difference and resistance are related?

Tick the box against the correct equation.

current = potential difference \times resistance

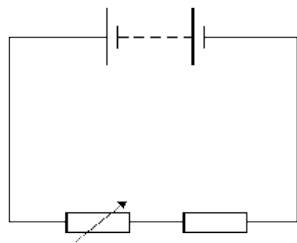
potential difference = current \times resistance

resistance = current \times potential difference

(1)
(Total 4 marks)

24

(a) The diagram shows a simple circuit. Add an ammeter and a voltmeter to the circuit to show how to measure the current through the fixed resistor and the voltage across it.

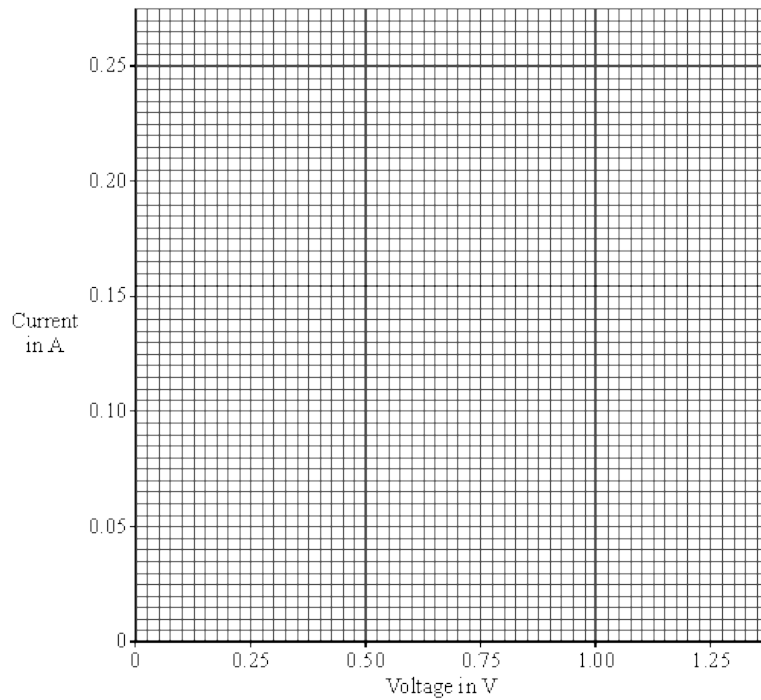


(2)

(b) An experiment using a circuit like the one above was set up. The following results were obtained when the resistance of the variable resistor was decreased.

(i) Draw a graph of the results below.

Voltage across fixed resistor in volts	Current in amps
0.50	0.10
0.75	0.15
1.00	0.20
1.25	0.25



(2)

(ii) Use the graph to find the voltage when the current is 0.05 A.

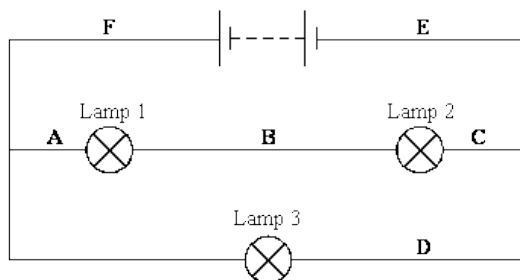
Voltage = V

(1)

(Total 5 marks)

25

The circuit contains three identical lamps.



(a) Complete each of the sentences about the circuit, using one of the phrases in the box.

more than	less than	the same as
-----------	-----------	-------------

(i) The current at **A** is the current at **B**. (1)

(ii) The current at **A** is the current at **D**. (1)

(iii) The current at **F** is the current at **E**. (1)

(iv) The current at **F** is the current at **D**. (1)

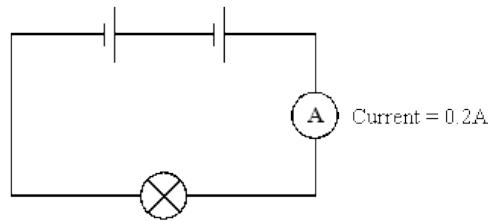
(b) In the circuit, which lamp is brightest?.....

Give a reason for your answer.

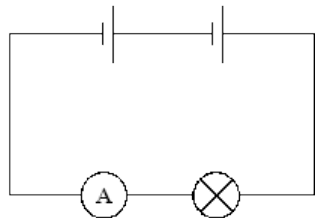
.....

(2)
 (Total 6 marks)

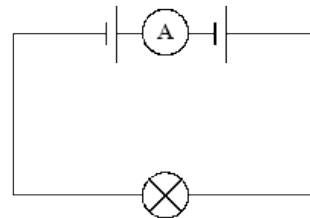
26 The circuit contains two cells, an ammeter and a lamp. The reading on the ammeter is 0.2 A.



(a) What will be the reading on the ammeters in each of the circuits below?



(i) Current is A



(ii) Current is A

(2)

(b) An ammeter was in a series circuit with two cells and a variable resistor.

The ammeter showed a reading of 0.3 A.

(i) Draw a circuit diagram for the circuit.

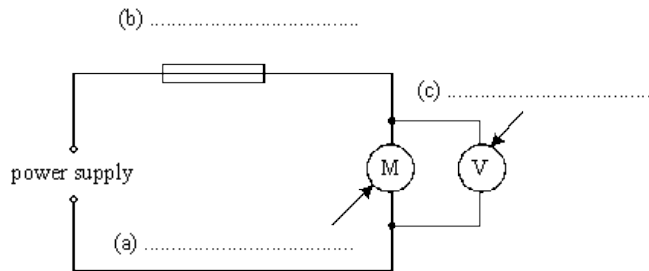
(2)

- (ii) What will happen to the reading on the ammeter if the resistance of the variable resistor is **increased**?

.....

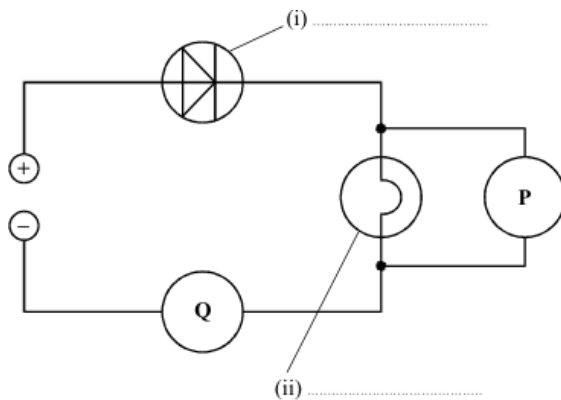
(1)
(Total 5 marks)

- 27** Label the parts of the electric circuit below.



(Total 3 marks)

- 28** The diagram shows an electrical circuit.



- (a) Complete the two labels on the diagram.

(2)

- (b) **P** and **Q** are meters.

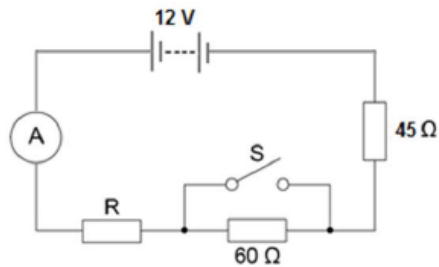
What is meter **P** measuring?

What is meter **Q** measuring?

(2)
(Total 4 marks)

29

A student set up the electrical circuit shown in the figure below.



(a) The ammeter displays a reading of 0.10 A.

Calculate the potential difference across the 45 Ω resistor.

.....
.....

Potential difference = V

(2)

(b) Calculate the resistance of the resistor labelled R.

.....
.....
.....

Resistance = Ω

(3)

(c) State what happens to the total resistance of the circuit and the current through the circuit when switch S is closed.

.....
.....
.....
.....

(2)

(Total 7 marks)

30

If a fault develops in an electrical circuit, the current may become too great. The circuit needs to be protected by being disconnected.

A fuse or a circuit breaker may be used to protect the circuit.
One type of circuit breaker is a Residual Current Circuit Breaker (RCCB).

(a) (i) Use the correct answer from the box to complete the sentence.

earth	live	neutral
-------	------	---------

A fuse is connected in the wire.

(1)

(ii) Use the correct answer from the box to complete the sentence.

are bigger	are cheaper	react faster
------------	-------------	--------------

RCCBs are sometimes preferred to fuses because they

(1)

(iii) RCCBs operate by detecting a difference in the current between two wires.

Use the correct answer from the box to complete the sentence.

earth and live	earth and neutral	live and neutral
-----------------------	--------------------------	-------------------------

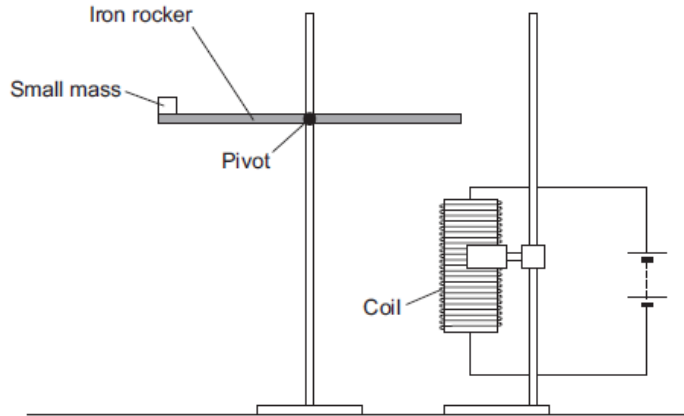
The two wires are the wires.

(1)

- (b) An RCCB contains an iron rocker and a coil.

A student investigated how the force of attraction, between a coil and an iron rocker, varies with the current in the coil.

She supported a coil vertically and connected it in an electrical circuit, part of which is shown in the figure below .



She put a small mass on the end of the rocker and increased the current in the coil until the rocker balanced. She repeated the procedure for different masses.

Some of her results are shown in the table below.

Mass in grams	Current needed for the rocker to balance in amps
5	0.5
10	1.0
15	1.5
20	2.0

- (i) State **two** extra components that must have been included in the circuit in the figure above to allow the data in the above table to be collected.

Give reasons for your answers.

.....

.....

.....

.....

.....

.....

.....

.....

(4)

(ii) A teacher said that the values of current were too high to be safe.

Suggest **two** changes that would allow lower values of current to be used in this investigation.

Change 1

.....

Change 2

.....

(2)
(Total 9 marks)

31 Electrical circuits have resistance.

(a) Draw a ring around the correct answer to complete the sentence.

When the resistance of a circuit increases, the current in the circuit

- | |
|-----------------|
| decreases. |
| increases. |
| stays the same. |

(1)

(b) Use the correct answer from the box to complete each sentence.

a filament bulb	an LED	an LDR
------------------------	---------------	---------------

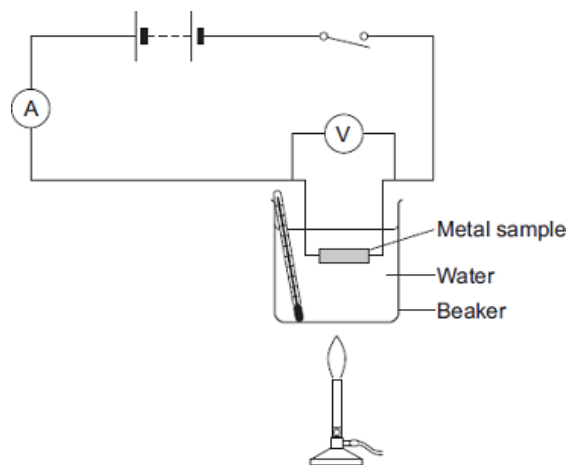
An electrical component which has a resistance that increases as the temperature increases is

An electrical component which emits light only when a current flows through it in the forward direction is

(2)

(c) When some metals are heated the resistance of the metal changes.

The equipment for investigating how the resistance of a metal changes when it is heated is shown in the diagram.



In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.

Describe an investigation a student could do to find how the resistance of a metal sample varies with temperature. The student uses the equipment shown.

Include in your answer:

- how the student should use the equipment
- the measurements the student should make
- how the student should use these measurements to determine the resistance
- how to make sure the results are valid.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

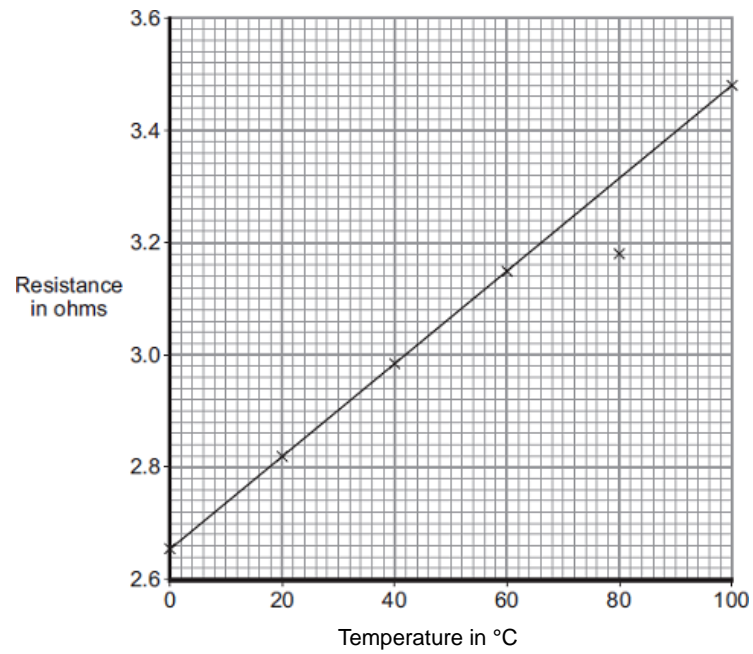
(6)

(d) The table shows some data for samples of four metals **P**, **Q**, **R** and **S**.

The metal samples all had the same cross-sectional area and were the same length.

Metal sample	Resistance at 0°C in ohms	Resistance at 100°C in ohms
P	4.05	5.67
Q	2.65	3.48
R	6.0	9.17
S	1.70	2.23

A graph of the results for one of the metal samples is shown.



(i) Which metal sample, **P**, **Q**, **R** or **S**, has the data shown in the graph?

(1)

(ii) One of the results is anomalous. Circle this result on the graph.

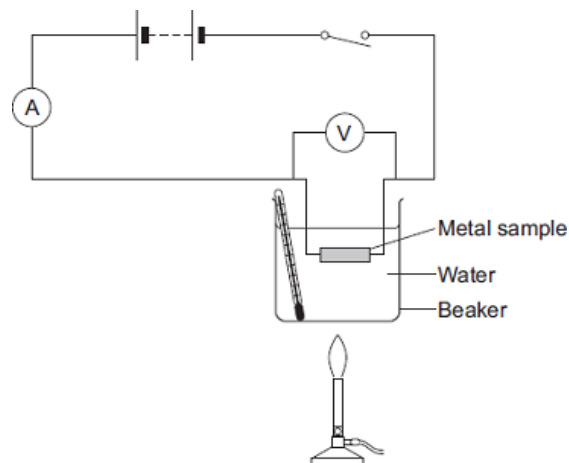
(1)

(iii) Suggest a reason for the anomalous result.

.....

(1)

(iv) The same equipment used in the investigation could be used as a thermometer known as a 'resistance thermometer.'



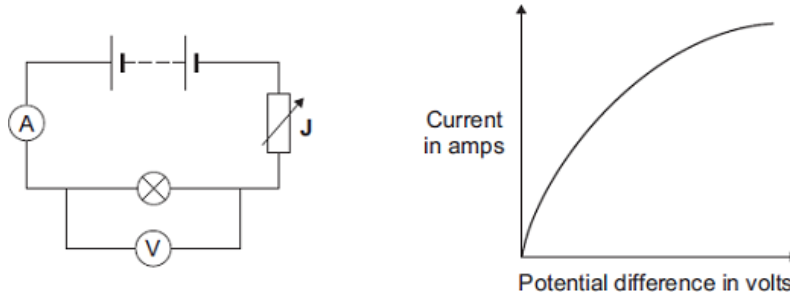
Suggest **two** disadvantages of using this equipment as a thermometer compared to a liquid-in-glass thermometer.

- 1
-
- 2
-

(2)
(Total 14 marks)

32

(a) The diagram shows the circuit used to obtain the data needed to plot the current–potential difference graph for a filament bulb.



(i) Why is the component labelled 'J' included in the circuit?

-
-

(1)

(ii) The resistance of the bulb increases as the potential difference across the bulb increases. Why?

-
-

(1)

(iii) The bulb is at full brightness when the potential difference across the bulb is 12 V. The current through the bulb is then 3 A.

Calculate the power of the bulb when it is at full brightness and give the unit.

-
-
-

Power =

(3)

- (b) *In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.*

The table gives data about two types of light bulb people may use in their homes.

Type of light bulb	Energy efficiency	Cost of one light bulb	Average lifetime in hours
Halogen	10%	£1.95	2 000
Light Emitting Diode (LED)	32%	£11.70	36 000

Both types of light bulb produce the same amount of light.

Evaluate, in terms of cost and energy efficiency, the use of the two types of light bulb.

To gain full marks you must compare both types of light bulb and conclude which light bulb would be the best to use.

.....

.....

.....

.....

.....

.....

.....

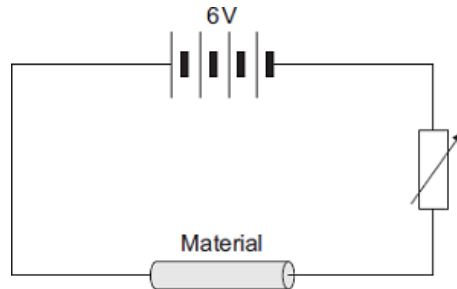
.....

.....

.....

(6)
(Total 11 marks)

- 33** (a) The diagram shows the circuit used to investigate the resistance of a sample of a material. The diagram is not complete; the ammeter and voltmeter are missing.



- (i) Draw the symbols for the ammeter and voltmeter on the diagram in the correct places.
- (ii) How can the current through the material be changed?

.....

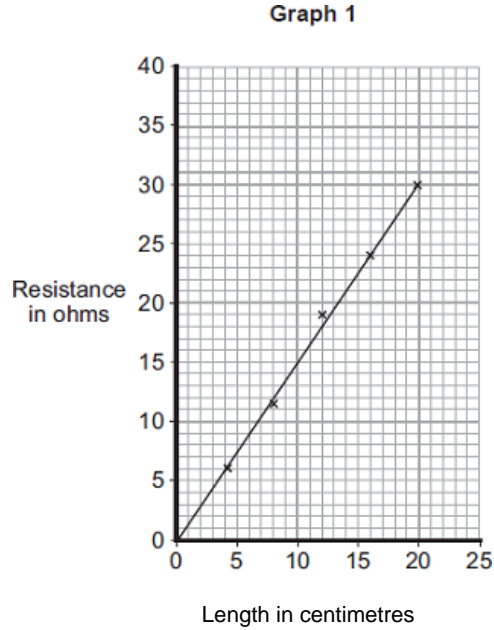
.....

(2)

(1)

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

Graph 1 shows how the resistance changes with length.



- (i) The current through a 25 cm length of conducting putty was 0.15 A.

Use **Graph 1** to find the resistance of a 25 cm length of conducting putty.

Resistance = ohms

(1)

- (ii) Use your answer to **(b) (i)** to calculate the potential difference across a 25 cm length of conducting putty.

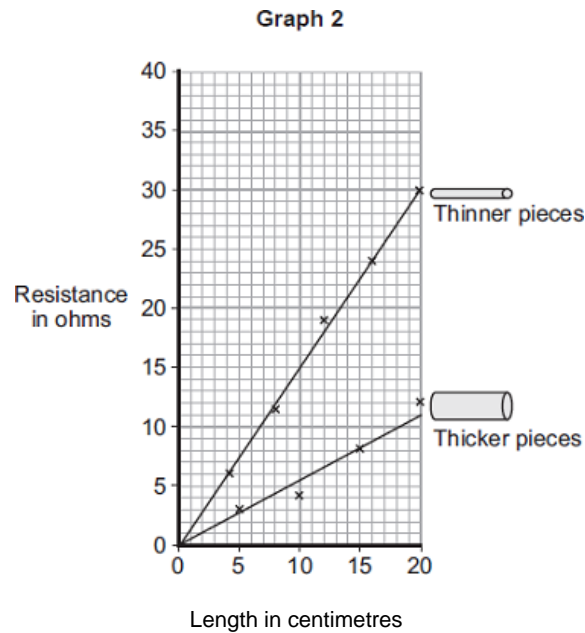
Show clearly how you work out your answer.

.....

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**.



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

.....

(1)

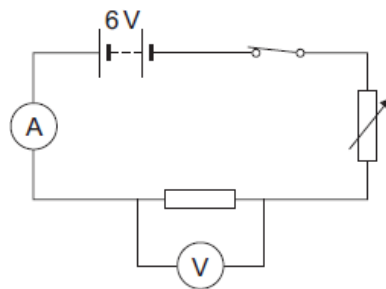
- (ii) Name **one** error that may have reduced the accuracy of the results.

.....

(1)

(Total 8 marks)

34 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?

.....

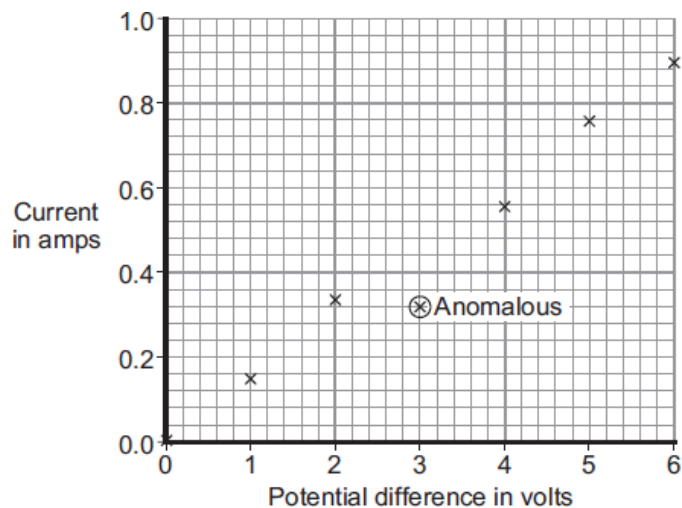
(1)

- (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)

35

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.

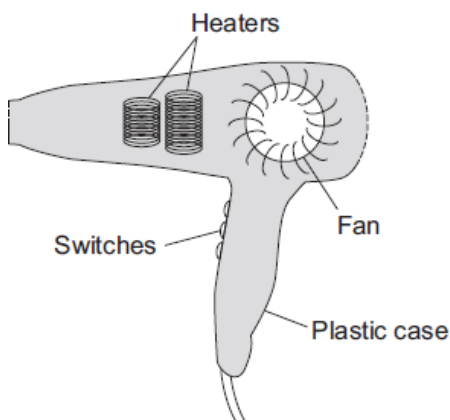


Diagram 1

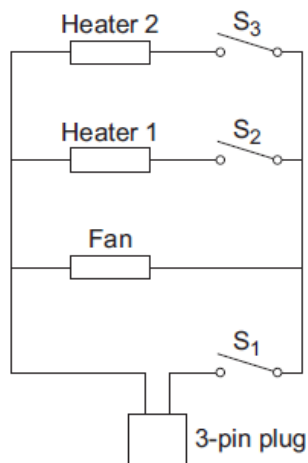


Diagram 2

(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.

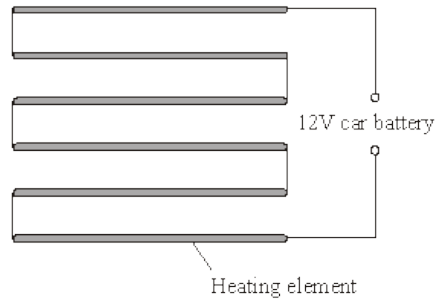
.....

Maximum power =

(3)
 (Total 9 marks)

36

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 5Ω . The current passing through each element is 0.4 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)

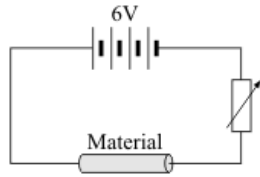
- (iv) How is the 12 volt potential difference of the car battery shared between the six heating elements?

.....

(1)
 (Total 5 marks)

37

- (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?

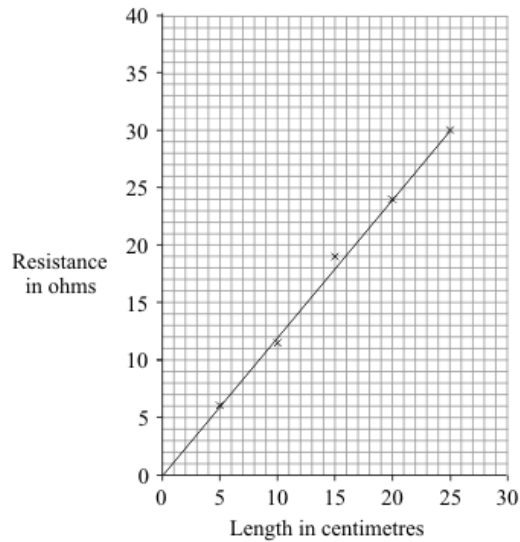
.....

(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.

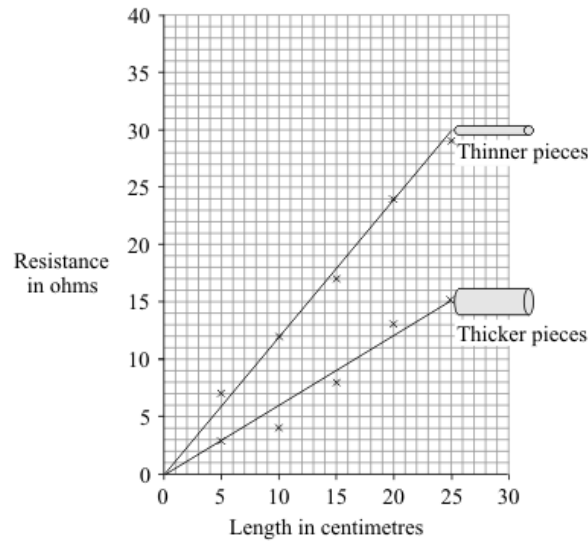
Show clearly how you work out your answer.

.....

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?

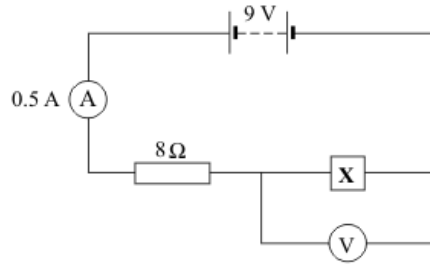
.....

(1)

(Total 10 marks)

38

(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

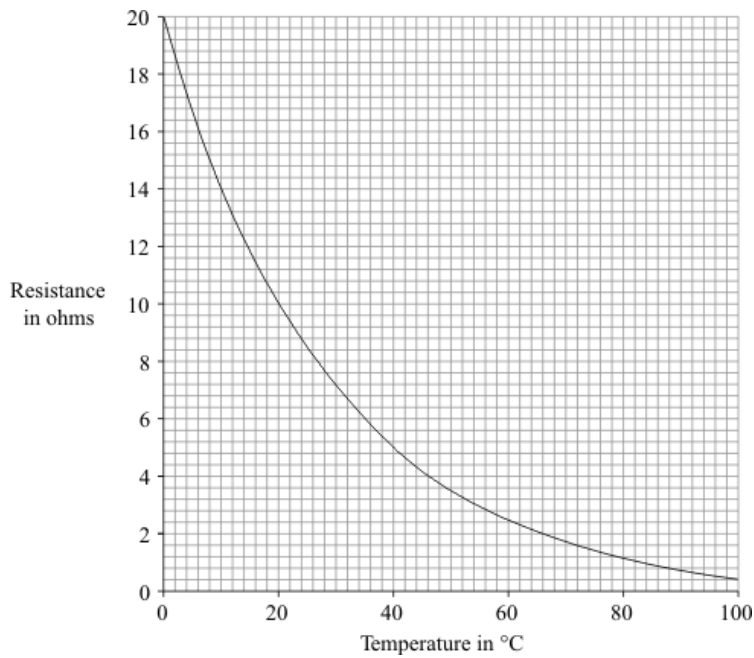
(2)

(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

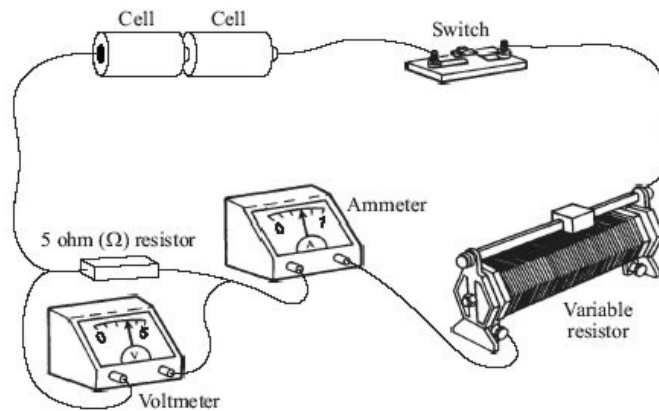
60 °C to 80 °C

80 °C to 100 °C

(1)
(Total 5 marks)

39

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.

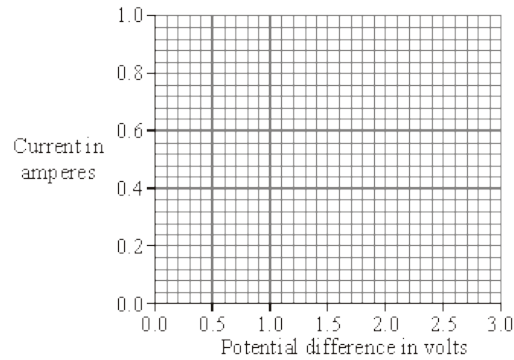
.....

.....

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?

.....

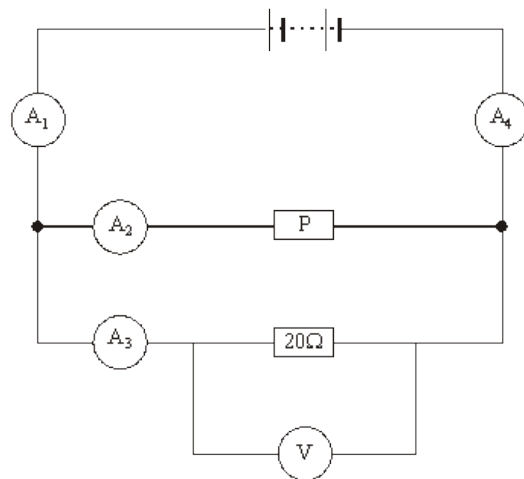
.....

(1)

(Total 8 marks)

40

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 Ω.

The resistance of **P** is equal to 20 Ω.

The resistance of **P** is less than 20 Ω.

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 =

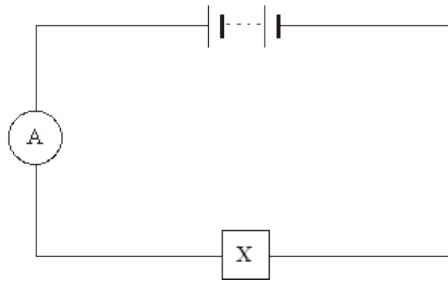
(2)

(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.

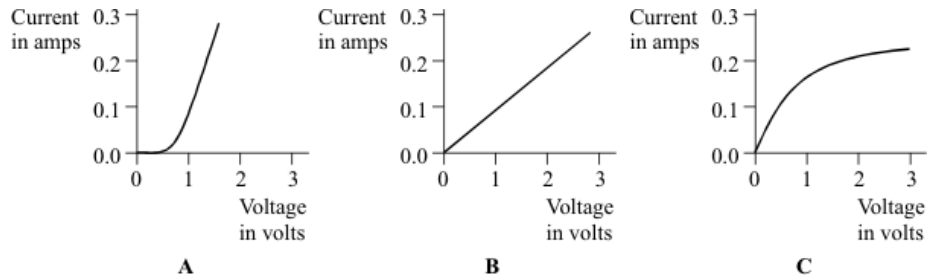
.....

.....

(2)
(Total 10 marks)

41

(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.

.....

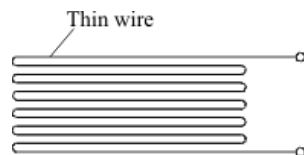
.....

.....

.....

(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.

.....

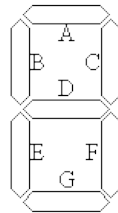
Resistance = (3)

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

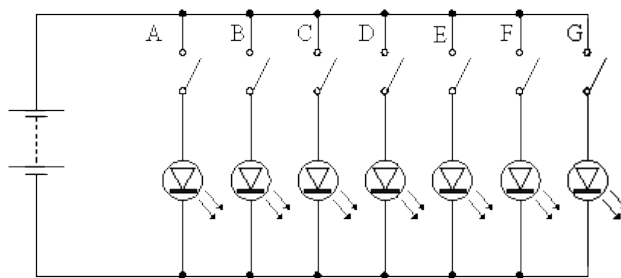
.....

(1)
 (Total 11 marks)

42 Some electronic calculators use light emitting diodes (LEDs) to display numbers. Each number in a display consists of up to seven LEDs. The LEDs are arranged as shown in the diagram below. The different numbers are formed by switching different LEDs on at the same time. The LEDs are labelled A to G.



A simplified circuit to provide power to the LEDs is shown below.



(a) Explain why each LED has its own switch.

.....
 (2)

(b) What number is displayed when all switches except E are closed?

..... (1)

(c) Which switches would be open if the number 3 is to be displayed?

.....

(1)

(d) Which of the numbers 0 to 9 draws least current from the battery? Explain your answer.

Number

Explanation

.....

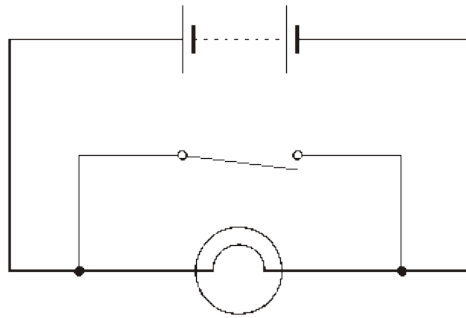
.....

(2)

(Total 6 marks)

43

The circuit diagram below shows a battery connected to a lamp and a switch.



(a) State what happens to the lamp when:

(i) the switch is open (OFF);

.....

(ii) the switch is closed (ON).

.....

(2)

(b) When the switch is closed what problem is caused in the circuit?

.....

.....

.....

(1)

(c) In the space below draw a circuit diagram to show how the switch should be correctly connected to the lamp and battery.

(1)

(Total 4 marks)

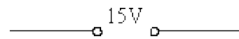
44

A student investigates how the current flowing through a filament lamp changes with the voltage across it.

She is given a filament lamp and connecting wires.

She decides to use a 15V power supply, a variable resistor, an ammeter, a voltmeter and a switch.

(a) Complete the circuit diagram to show how she should set up the circuit.

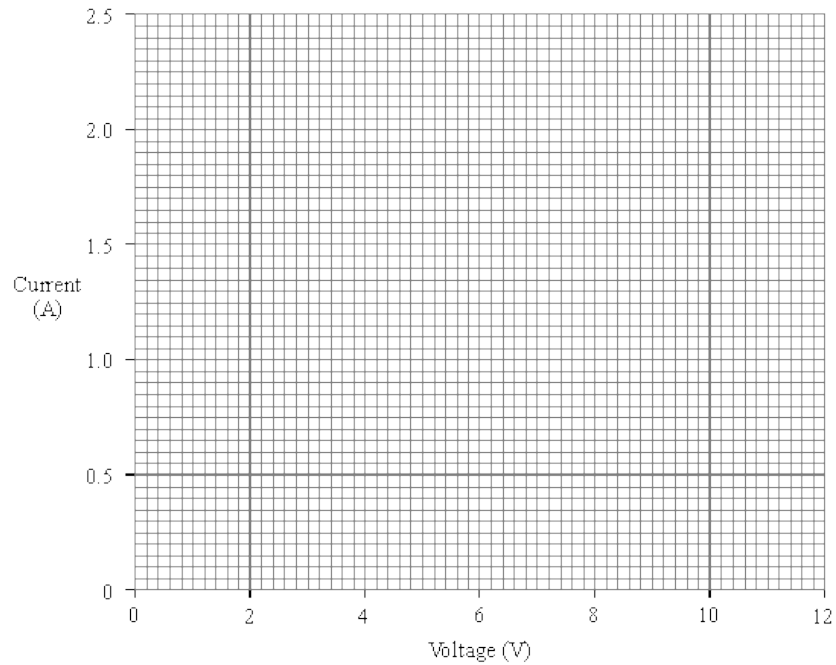


(4)

(b) The student obtains the following results.

VOLTAGE (V)	0.0	3.0	5.0	7.0	9.0	11.0
CURRENT (A)	0.0	1.0	1.4	1.7	1.9	2.1

(i) Plot a graph of current against voltage.



(3)

(ii) Use your graph to find the current when the voltage is 10V.

Current A

(1)

- (iii) Use your answer to (ii) to calculate the resistance of the lamp when the voltage is 10V.

.....

Resistance Ω

(2)

- (c) (i) What happens to the resistance of the lamp as the current through it increases?

.....

- (ii) Explain your answer.

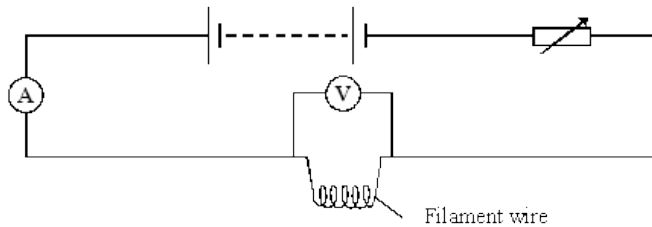
.....

(2)

(Total 12 marks)

45

A bulb heats up when an electric current passes through the filament wire. The current was measured when different voltages were applied across the filament wire shown in the diagram below.



- (a) (i) Look at the circuit diagram. How was the voltage changed?

.....

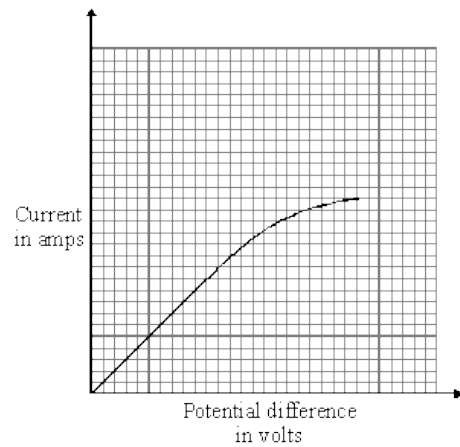
(1)

- (ii) Write an equation that shows the relationship between *current*, *potential difference* and *resistance*.

.....

(1)

- (b) The graph shows how the current through the filament wire changed as the potential difference across it changed.



- (i) Describe the effect of increasing the potential difference on the current flowing through the filament wire.

.....

(2)

- (ii) Explain this effect in terms of the resistance of the filament wire.

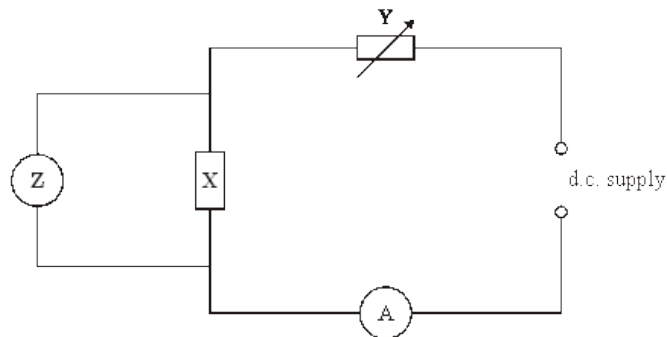
.....

(2)

(Total 6 marks)

46

The current through component X is measured when different voltages are applied across it.



- (a) Name the component labelled Y in the circuit.

.....

(1)

- (b) What type of meter is Z?

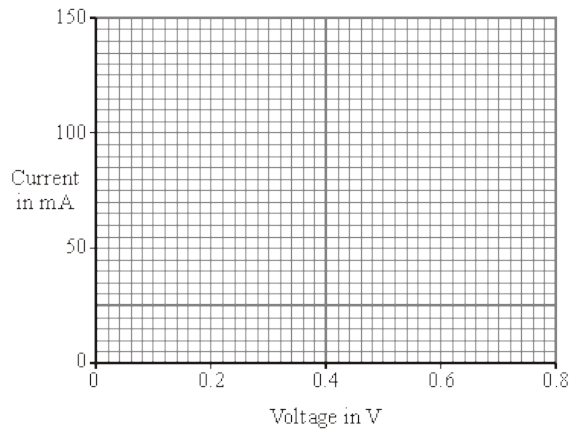
.....

(1)

(c) The table shows the measurements obtained in this experiment.

Voltage in V	0	0.2	0.4	0.6	0.8
Current in mA	0	0	50	100	150

Draw a graph of the measurements.



(2)

(d) Use the shape of the graph to name component X.

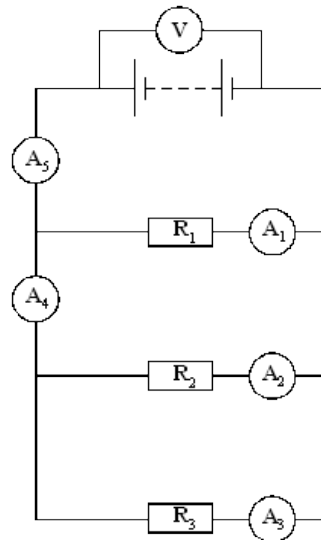
.....

(1)

(Total 5 marks)

47

A circuit was set up as shown in the diagram.



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

Ammeter	Reading on ammeter in amps
A_1	0.2
A_2	0.6
A_3	0.3
A_4	
A_5	

(2)

- (b) The reading on the voltmeter is 12 V.

What is the resistance of R_2 ?

Show your working and include the correct unit.

.....

.....

.....

Resistance =

(3)

- (c) In the circuit above, the resistor R_2 burned out and current stopped flowing in it. There was no other change to the circuit.

Complete the table below to show the readings on the ammeters after this took place.

Ammeter	Reading on ammeter in amps
A_1	0.2
A_2	0.0
A_3	
A_4	
A_5	

(3)

(Total 8 marks)

48

In a hairdryer circuit there is a heater and a motor. It is important that the motor is always running when the heater is switched on.

(a) Using the symbols shown below only **once** each, draw a circuit for a hairdryer.



(2)

(b) Modern hairdryers are described as *double insulated*.

Explain what this term means.

.....

.....

.....

(2)

(c) On a modern hairdryer handle it states:

1600 W 230 V 50 Hz

(i) [A] Write an equation which shows the relationship between current, power and voltage.

.....

(1)

[B] Calculate the current in the hairdryer when it is on full power. Show clearly how you get your answer.

.....

.....

Current = A

(2)

(ii) [A] Write an equation which shows the relationship between current, resistance and voltage.

.....

(1)

[B] The resistance of the heater is 20 ohms. Calculate the resistance of the motor. Show clearly how you get your answer.

.....

.....

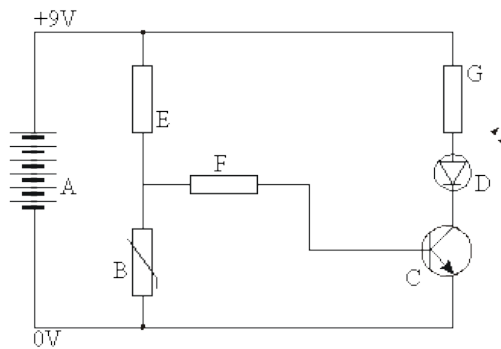
Resistance = ohms

(2)

(Total 10 marks)

49

The diagram shows an electronic circuit.

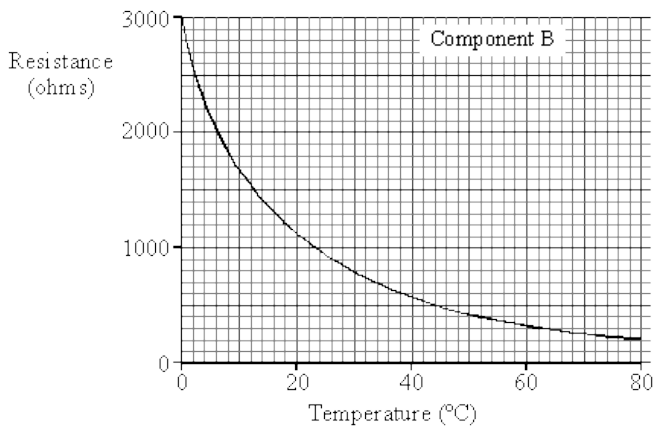


(a) Write down the names of the components in the list below.

- A =
- B =
- C =
- D =
- E, F and G =

(5)

(b) The graph shows how the resistance of component B depends on its temperature.



Describe, in as much detail as you can, how the resistance of component B changes as its temperature rises from 0°C to 80°C.

-
-
-
-
-

(4)

(c) At what temperature does component B have a resistance of 1000 ohms?

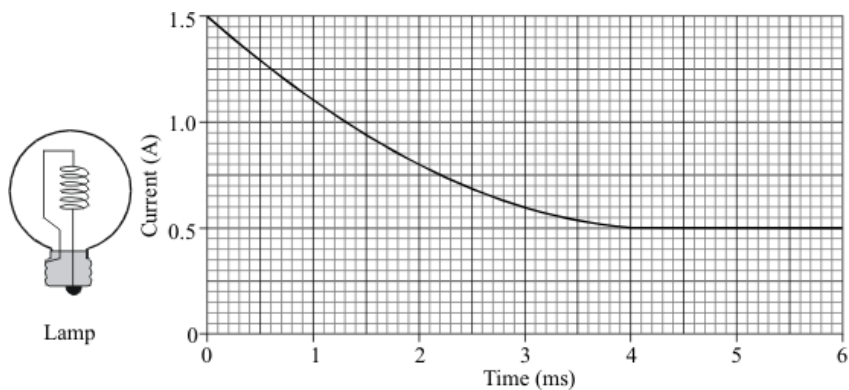
Answer °C .

(2)

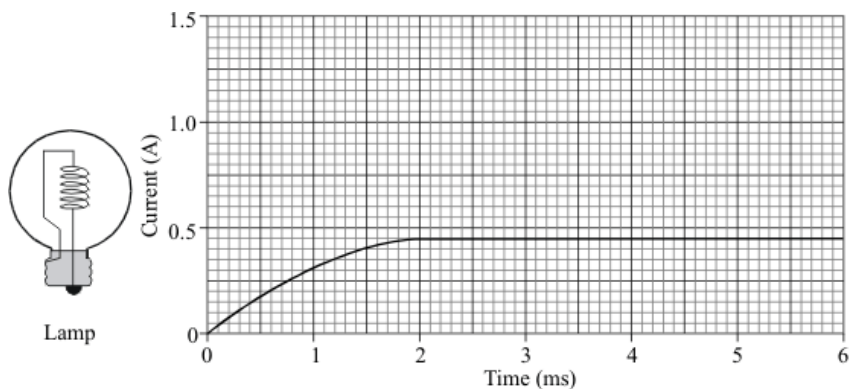
(Total 11 marks)

50

A computer is set up to produce a graph of the current through an electric lamp during the first few milliseconds after it is switched on.



The lamp is modified then tested in the same way.



(a) Describe **three** differences in the way the lamp behaves after it has been modified.

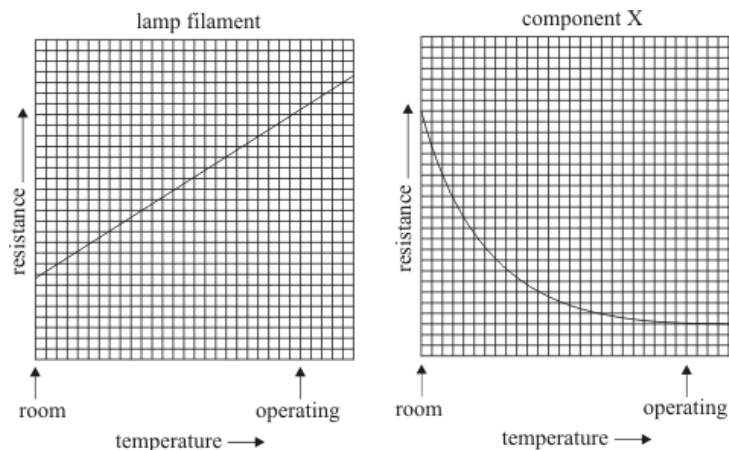
1.
2.
3.

(3)

(b) The current through the modified lamp depends on the total resistance of the filament and component X.

The smaller this total resistance is, the greater the current.

The following graphs show how the resistance of the lamp filament and component X change as the lamp heats up to its operating temperature.



Use the information shown on the graphs to explain the behaviour of the modified lamp.

.....

.....

.....

.....

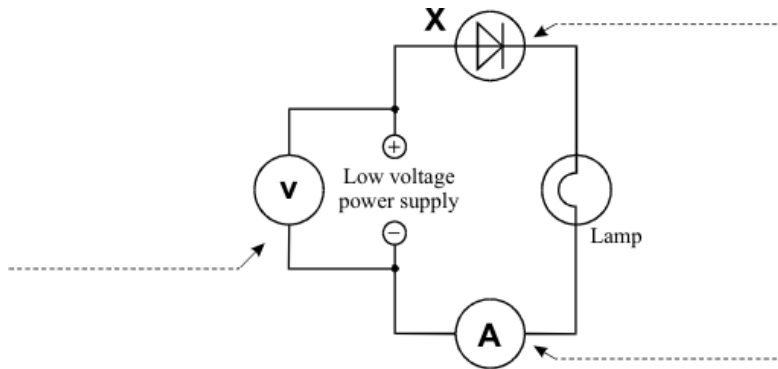
.....

.....

(4)
(Total 7 marks)

51

(a) Add the missing labels to the diagram.

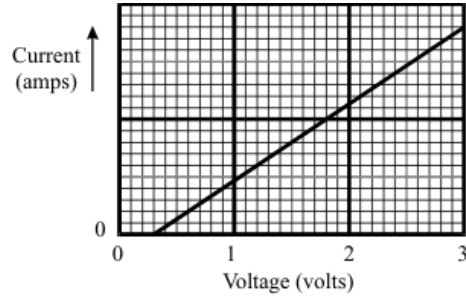


(3)

(b) Some students use the circuit shown above.

They want to find out how the current through component X changes as they change the voltage.

The graph shows their results.



Describe, as fully as you can, what happens to the current through component X as the students increase the voltage.

.....

.....

.....

.....

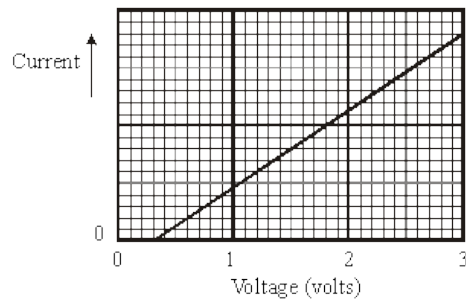
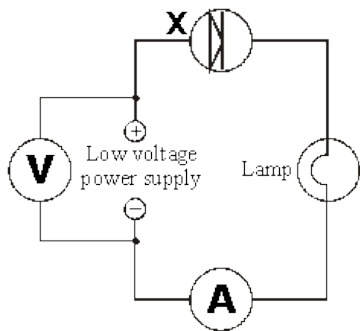
.....

(4)
(Total 7 marks)

52

Some students want to find out how the current through component X changes with the voltage they use.

The diagram shows their circuit. The graph shows their results.



(a) Describe, as fully as you can, what happens to the current through component X as the students increase the voltage.

.....

.....

.....

(4)

(b) The students want to find out whether component X allows the same current to flow through it in the opposite direction.

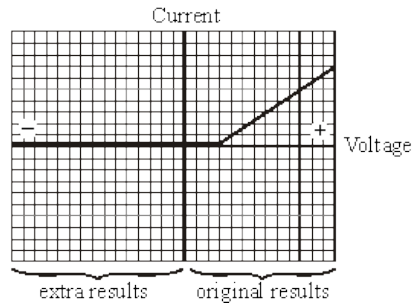
(i) How should they change the circuit to test this?

.....

(1)

(ii) The graph shows the students' extra results.

What do the extra results tell you?

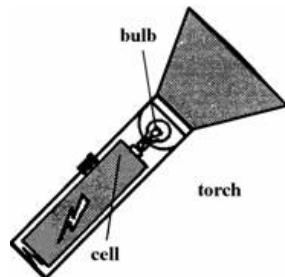


.....

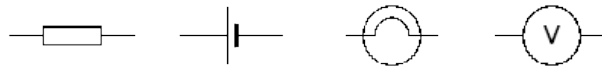
(1)
 (Total 6 marks)

53

A small torch uses a single cell to make the bulb light up.

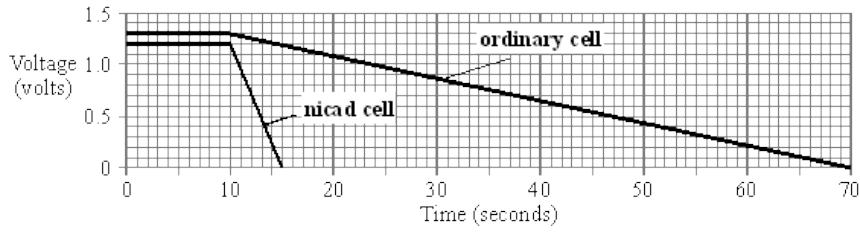


(a) Label the symbol for a cell and the symbol for a bulb (lamp)



(2)

- (b) The graphs show the voltage across two different types of cell as they transfer the last bit of their stored energy through the torch bulb.



Describe the differences that the graphs show between the two types of cell.

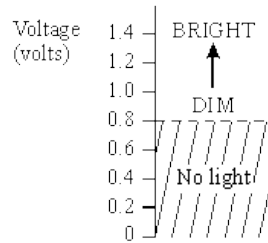
.....

.....

.....

(3)

- (c) The diagram shows how bright the torch bulb is for different voltages.



From the point when the voltage of each cell starts to fall, how long will the bulb stay lit:

- (i) with the ordinary cell?

.....

- (ii) with the nicad cell?

.....

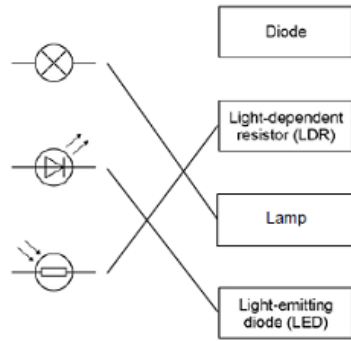
(4)
(Total 9 marks)

Mark schemes

1	(a) current that is always in the same direction	1
	(b) total resistance = 30 (Ω)	1
	$V = 0.4 \times 30$	1
	12 (V)	1
	<i>allow 12 (V) with no working shown for 3 marks an answer of 8 (V) or 4 (V) gains 2 marks only</i>	
	(c) $P = 0.4 \times 12 = 4.8$	1
	5 (W)	1
	<i>allow 5 (W) with no working shown for 2 marks allow 4.8 (W) with no working shown for 1 mark</i>	
		[6]
2	(a) battery, lamp and ammeter connected in series with variable resistor	1
	voltmeter in parallel with (filament) lamp	1
	(b) Level 2 (3–4 marks): A detailed and coherent description of a plan covering all the major steps is provided. The steps are set out in a logical manner that could be followed by another person to obtain valid results.	
	Level 1 (1–2 marks): Simple statements relating to relevant apparatus or steps are made but they may not be in a logical order. The plan would not allow another person to obtain valid results.	
	0 marks: No relevant content	
	Indicative content	
	<ul style="list-style-type: none"> • ammeter used to measure current • voltmeter used to measure potential difference • resistance of variable resistor altered to change current in circuit or change potential difference (across filament lamp) • resistance (of filament lamp) calculated or $R = V / I$ statement • resistance calculated for a large enough range of different currents that would allow a valid conclusion about the relationship to be made 	4
	(c) (as current increases) resistance increases (at an increasing rate)	1
	(d) any value between 6.3 and 6.9 (Ω)	1
	(e) A: Filament lamp	1
	B: Resistor at constant temperature	1
	C: Diode	1
		[11]

3	(a) (i) any six from:		6
	• switch on		
	• read both ammeter and voltmeter		
	<i>allow read the meters</i>		
	• adjust variable resistor to change the current		
	• take further readings		
	• draw graph		
	• (of) V against I		
	<i>allow take mean</i>		
	• $R = V / I$		
	<i>allow take the gradient of the graph</i>		
	(ii) resistor would get hot if current left on		1
	so its resistance would increase		1
	(iii) 12 (V)		
	<i>0.75 × 16 gains 1 mark</i>		2
	(iv) 15 (Ω)		1
	16 is nearer to that value than any other		1
	(b) if current is above 5 A / value of fuse		1
	fuse melts		
	<i>allow blows / breaks</i>		
	<i>do not accept exploded</i>		1
	breaks circuit		1
			[15]

4 (a)



allow 1 mark for each correct line if more than one line is drawn from any symbol then all of those lines are wrong

3

(b) (i) half

1

(ii) 3(V)

1

(iii) V_1

1

(c) (i) potential difference / voltage of the power supply

accept the power supply

accept the voltage / volts

accept number of cells / batteries

accept (same) cells / batteries

do not accept same ammeter / switch / wires

1

(ii) bar drawn – height 1.00)A

ignore width of bar

allow 1 mark for bar shorter than 3rd bar

2

(iii) as the number of resistors increases the current decreases

1

[10]

5 (a) 25(Ω)

1

(b) (i) 2(V)

allow 1 mark for showing a correct method, ie 6 / 3

2

(ii) equal to

1

[4]

6 (a) (i) 50 (Hz)

1

(ii) 2760 (W)

1

(b) 12

allow 1 mark for correct substitution, ie 2400/200

or

allow 1 mark for 2760/230 provided no subsequent step shown

2

amps

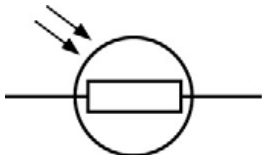
1

- (c) the charge is directly proportional to the time switched on for
accept for 1 mark the longer time (to boil), the greater amount of charge
or positive correlation
or they are proportional

2 [7]

- 7** (a) (i) 15 1
- (ii) 4.5 or their (a)(i) x 0.3 correctly calculated
allow 1 mark for correct substitution, ie 0.3 x 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]

- 8** (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 kΩ to 200 kΩ
accept by 400 kΩ 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]

- 9** (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)
accept every volt 1
- (c) as one increases so does the other
or
 directly proportional
or
 positive correlation
*accept a numerical description, eg when one doubles the other also
 doubles* 1 [7]

- 10** (a) (i) circuit not complete
accept circuit is broken
accept switch / s are open / off 1
- (ii) 9
*allow 1 mark for correct substitution, ie 0.5×18 provided no
 subsequent step shown* 2
- (iii) 36 1
- (b) can be switched on / off from top or bottom of stairs 1

- (c) (i) (electric) shock
accept fitting becomes live
accept answers giving a possible consequence of electric shock, eg death 1
- (ii) connect the earth wire 1 [7]

- 11** (a) (i) 4.5 1
- (ii) 2.25 or their (a)(i) ÷ 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]

- 12** (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]

13

- (a) switch

allow answer circled in box

1

- (b) 24

1

- (c) equal to 0.25 A

1

- (d) 4

1

[4]

14

- (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]

15

(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

allow 1 mark for correct substitution ie $\frac{2800}{120}$

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]

16

L

N

M

K

all four in the correct order

2 marks for 2 correct

1 mark for 1 correct

[3]

17

(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

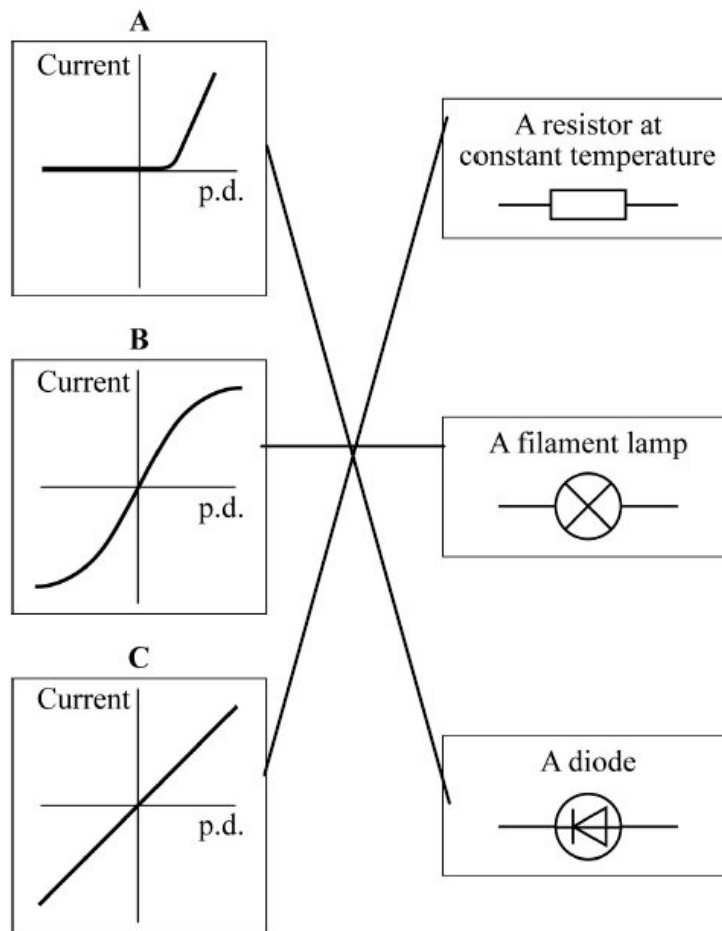
(c) increases

1

[7]

18

(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


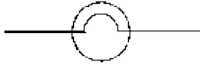
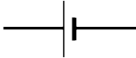
[3]

19

- (a) (i) 6 1
 (ii) 6 (volts) 1
accept their (a) (i) ignore any units
 - (b) 0.30 1
accept 0.3
 - (c) smaller(than) 1
accept correct alternatives to smaller than e.g. less than
- a bigger current flows through the lamp 1
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*

[5]

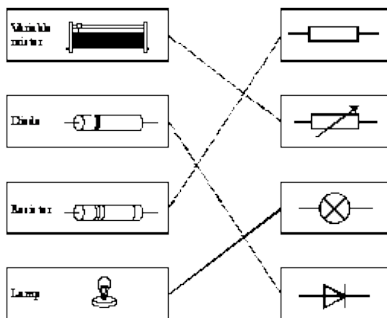
20

- (a) circuit symbol for a lamp correct 1

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 1
polarity of cells must be correct (+ to -) but cells may be either way around
- (b) 4.5 1
- (c) the same as 1
accept any clear indication of the correct answer

[5]

21

(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]

22

(a) ... ammeter

for 1 mark

1

(b) 5 right

gains 4 marks

4 right

gains 3 marks

3 right

gains 2 marks

2 right

gains 1 mark

4

[5]

- 23** (a) (i) resistor 1
- (ii) voltage / potential difference / volts / v 1
- (iii) current / amps / A 1
- (b) potential difference = current \times resistance 1
no mark if more than one box ticked
- [4]**

- 24** (a) ammeter anywhere in series in the circuit
accept just letter A or box with A
- voltmeter across **or** in parallel with the fixed resistor only
accept just letter V or box with V 2
- (b) (i) four correct plots
deduct one for any incorrect plot
- a straight line through the points
no requirement to extrapolate through origin
*do not credit bar charts unless correct line drawn **or** correct points* 2
- (ii) 0.25
ecf rule applies if graph is wrongly plotted 1
- [5]**

- 25** (a) (i) the same as 1
- (ii) less than 1
- (iii) the same as 1
- (iv) more than 1
- (b) 3
accept D
- because there is more **or** twice the current in this part of the circuit
or the resistance is less
- accept only one lamp to go through, (not two) **or** on its own not sharing the voltage **or** energy with another*
*do not credit one lamp to go through **or** sharing current* 2
- [6]**

26	(a) (i) 0.2	1	
	(ii) 0.2	1	
	(b) (i) a series circuit must contain two cells the correct way round and an ammeter <i>accept the components in any order in the series circuit but there must be no obvious gaps in the wires at corners or joins</i>	1	
	the symbol for a variable resistor a rectangle with a diagonal arrow drawn through it <i>accept a diagram for a 'slide resistor'</i>	1	
	(ii) decrease	1	[5]
27	(a) motor	1	
	(b) fuse or circuit breaker	1	
	(c) voltmeter <i>each for 1 mark</i>	1	[3]
28	(a) (i) diode <i>[Do not accept 'rectifier' or LED]</i>		
	(ii) lamp / bulb / light <i>each for 1 mark</i>	2	
	(b) • P = voltage / potential difference / p.d. / volts / V <i>[Allow 'Voltmeter']</i> • Q = current / amperes / amps / A <i>[Allow 'ammeter']</i> <i>each for 1 mark</i>	2	[4]
29	(a) $V = 0.10 \times 45$	1	
	4.5 (V)	1	
	(b) $R = 12 / 0.10$	1	
total resistance = 120 (Ω)	1		

$$R = 120 - 105 = 15 (\Omega)$$

1

(c) (total) resistance decreases

1

(so) current increases

1

[7]

30

(a) (i) live

1

(ii) react faster

1

(iii) live and neutral

1

(b) (i) ammeter

1

to measure current

accept to measure amps

1

plus any **one** from:

- variable resistor (1)
to vary current (1)
accept variable power supply
accept change or control
- switch (1)
to stop apparatus getting hot / protect battery
or
to reset equipment (1)
- fuse (1)
to break circuit if current is too big (1)

2

(ii) any **two** from:

- use smaller mass(es)
- move mass closer to pivot
- reduce gap between coil and rocker
- more turns (on coil) *coil / loop*
- iron core in coil
accept use smaller weight(s)

2

[9]

31

(a) decreases

1

(b) a filament bulb

allow bulb

1

an LED

1

- (c) Marks awarded for this answer will be determined by the Quality of Communication (QoC) as well as the standard of the scientific response.

0 marks

No relevant content.

Level 1 (1–2 marks)

There is a basic description of the method. This is incomplete and would not lead to any useful results.

Level 2 (3–4 marks)

There is a description of the method which is almost complete with a few minor omissions and would lead to some results.

Level 3 (5–6 marks)

There is a detailed description of the method which would lead to valid results.

To gain full marks an answer including graph, or another appropriate representation of results, must be given.

examples of the physics points made in the response:

- read V and I
- read temperature
- apply heat
 - allow hot water to cool*
- read V and I at least one other temperature
- determine R from V / I
- range of temperatures above 50 °C

extra detail:

- use thermometer to read temperature at regular intervals of temperature
- remove source of heat and stir before taking readings
- details of attaining 0 °C or 100 °C
- last reading taken while boiling
- graph of R against T
- at least 3 different temperatures

6

- (d) (i) Q

1

- (ii) (80, 3.18)

1

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

- measurement of V too small
- measurement of I too big
- incorrect calculation of R
- thermometer misread
 - allow misread meter*
 - ignore any references to an error that is systematic*

1

- (iv) any **two** from:

- not portable
 - allow requires a lot of equipment allow takes time to set up*
- needs an electrical supply
- cannot be read directly
 - accept it is more difficult to read compared to liquid-in-glass*

2

[14]

32

- (a) (i) to obtain a range of p.d. values
accept increase / decrease current / p.d. / voltage / resistance
accept to change / control the current / p.d. / voltage / resistance
to provide resistance is insufficient
a variable resistor is insufficient
*do **not** accept electricity for current*

1

- (ii) temperature of the bulb increases
accept bulb gets hot(ter)
accept answers correctly
expressed in terms of collisions between (free) electrons and ions / atoms
bulb gets brighter is insufficient

1

- (iii) 36
allow 1 mark for correct substitution, ie 12×3 provided no subsequent step shown

2

watt(s) / W
accept joules per second / J/s
*do **not** accept w*

1

- (b) Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should also refer to the information in the [Marking guidance](#), and apply a 'best-fit' approach to the marking.

0 marks

No relevant content.

Level 1 (1-2 marks)

There is a basic comparison of either a cost aspect or an energy efficiency aspect.

Level 2 (3-4 marks)

There is a clear comparison of either the cost aspect or energy efficiency aspect

OR

a basic comparison of both cost and energy efficiency aspects.

Level 3 (5-6 marks)

There is a detailed comparison of both the cost aspect and the energy efficiency aspect.

For full marks the comparisons made should support a conclusion as to which type of bulb is preferable.

Examples of the points made in the response:

cost

- halogen are cheaper to buy
simply giving cost figures is insufficient
- 6 halogen lamps cost the same as one LED
- LEDs last longer
- need to buy 18 / more halogen lamps to last the same time as one LED
- 18 halogens cost £35.10
- costs more to run a halogen than LED
- LED has lower maintenance cost (where many used, eg large departmental store lighting)

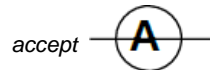
energy efficiency

- LED works using a smaller current
- LED wastes less energy
- LEDs are more efficient
- LED is 22% more energy efficient
- LED produces less heat
- LED requires smaller input (power) for same output (power)

6 [11]

33

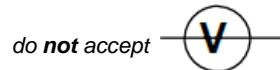
- (a) (i) ammeter symbol correct and drawn in series



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 pd / accept change the voltage

accept increase / decrease for change

1

- (b) (i) 37.5 (Ω)
accept answer between 36 and 39 inclusive

1

- (ii) 5.6(25) **or** their (b)(i) $\times 0.15$
*allow 1 mark for correct substitution ie 37.5 **or** their (b)(i) $\times 0.15$ provided no subsequent step shown*

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
*do **not** accept pieces of putty not the same unless qualified*
 - meter has a zero error
*do **not** accept systematic / random error*
accept any sensible source of error eg putty at different temperatures
*do **not** accept human error without an explanation*
*do **not** accept amount of putty not same*

1
[8]

34

- (a) (i) also double
increases is insufficient 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]

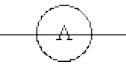
35

- (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]
- 36** (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]

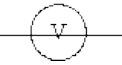
37

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

accept 
do **not** accept lower case a

1

voltmeter symbol correct and drawn in parallel with the material

do **not** accept 

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]

38

(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

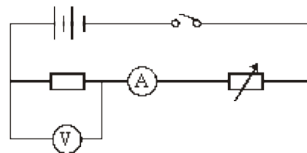
(ii) 0°C to 20°C

1

[5]

39

(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]

40

(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

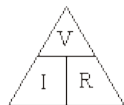
a smaller current goes through P / A_2 (than 20 Ω)

*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

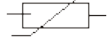
(ii) 6
allow 1 mark for correct substitution

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]

41

(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

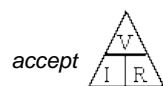
voltmeter only in parallel with wire or battery
all in series or ammeter in parallel neither of these two marks
awarded

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 $V = C \times R$




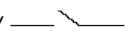
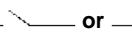
if subsequent method correct

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]**

- 42** (a) to switch on/off independently OWTTE
for 1 mark each 2
- (b) 9
for 1 mark 1
- (c) B and E
for 1 mark 1
- (d) 1
 Two/least number of LED used
for 1 mark each 2
- [6]**

- 43** (a) (i) the lamp will be on/will give out light 1
- (ii) the lamp will be off/will not give out any light 1
- (b) (very) large current flows
or damage the battery/overheat the battery
or short circuit
or wire get hot 1
- (c) switch connected in series with lamp and battery 1
- [4]**

- 44** (a) 4 symbols correct accept
(accept  for bulb; lose 1 mark if line through symbols, lose 1 mark if circuit incorrect, switch may be open or closed)
*(allow  **or** )*
gains 1 mark 4

but

all correct

gains 2 marks

ammeter in series with lamp

for one mark

voltmeter in parallel with lamp / lamp and switch / lamp, switch and ammeter

for one mark

- (b) (i) 5 points correctly plotted
allow (0, 0) correct if graph goes through the origin even if no x or O
gains 1 mark

but

6 points correctly plotted

gains 2 marks

smooth curve through points – not straight line / curve + straight line

for one mark

3

- (ii) 2 (A)

allow ± 0.05 ($\frac{1}{2}$ square) from candidates' graph

for one mark

1

- (iii) $R = V / I$ **or** $R = 10 / 2$

gains 1 mark

but

$R = 5$ (Ohms) ecf

gains 2 marks

2

- (c) (i) resistance increases

for one mark

- (ii) temperature (of filament) has increased / filament gets hot

for one mark

2

[12]

45

- (a) (i) variable resistor

accept rheostat

1

- (ii) potential difference = current \times resistance

*accept $V = IR$ **or** any correct combinations*

1

- (b) (i) as the potential difference increases, the current increases

accept it increases

1

at low values of the potential difference the current is (directly) proportional

accept at low values of the potential difference (the filament) obeys Ohm's law

1

or
at higher values of potential difference the current is not (directly) proportional

or
*accept at higher values of the potential difference (the filament)
does not obey Ohm's law
accept it increases but not proportionally for 2 marks*

the resistance (of the filament) increases 1

the temperature (of the filament) increases 1

[6]

46 (a) variable resistor
accept rheostat 1

(b) voltmeter 1

(c) straight line correct between 0.2 and 0.8
if line incorrect, or no line, and correct plots 0.2 to 0.8 award 1 mark 2

(d) diode / rectifier 1

[5]

47 (a) 0.9 1

1.1
accept the value of $A_4 + 0.2$ 1

(b) $V = I R$ or $12 = 0.6 R$ or $\frac{12}{0.6} = ?$
*accept $V = A R$
 $V = I \times \text{ohm's sign}$
do not credit Ohm's law triangle* 2

$R = 20$
correct numerical answer earns both marks
ohms 1

- (c) $A_3 = 0.3$
 $A_4 = 0.3$
accept the same numeric value as A_3
 $A_5 = 0.5$
accept the value of $A_4 + 0.2$

3

[8]

48

- (a) series circuit
all four components must be included
if a battery included the neatness mark may still be awarded
 1
 circuit fully functional **or** properly connected
this is the neatness mark
do not credit a parallel circuit with one switch controlling both components
 1
- (b) case **or** outer parts are made of plastic **or** insulator **or** non-metallic
 1
 there is no electrical pathway between inner and outer insulation
accept no connection between inner and outer part
do not credit two layers of insulation
 1
- (c) (i) [A] power = voltage \times current
*accept $P = V I$ **or***
 $W = V \times A$
or any transformation
 1
- [B] $1600 \div 230 = \text{current}$
 1
 6.96 **or** 7
accept with no working for two marks
accept 6.95
in [A] award a mark for a triangle if calculation correctly performed
 1
- (ii) [A] voltage = current \times resistance
*accept $V = I R$ **or** any transformation*
 1
- [B] $230 \div 7 = \text{overall } R = 33$
accept $230 \div 6.96 = \text{overall } R = 33$
 1
 resistance of motor = $33 - 20 = 13$
accept with no working for two marks
do not credit negative answer
accept consequential errors from c(i)
in [A] award a mark for a triangle if calculation correctly performed
 1

[10]

49

- (a) A = battery (of cells)/cells/cell
- B = thermistor/temperature dependent resistor
- C = transistor
- D = LED/light emitting diode
- E, F, G = resistors

each for 1 mark

5

- (b) *ideas that* (resistance) falls from 3000 to 200 units – ohms/Ω – referred to at least once

each for 1 mark

(credit quickly at first then more slowly with 2 marks) (max 4 for part (b))

4

- (c) any figure in the range 22 – 26 (inclusive)

gains 1 mark

but 24

gains 2 marks

2

[11]

50

- (a) current rises/starts lower/starts from zero

for 1 mark

*ideas that: **

smaller/only 0.45 (A) change in current

quicker/only 2 (ms) for current to settle

slightly lower/0.45 (A) final current

maximum only 0.45 (A) rather than 1.5 (A)

(*must **compare** e.g. “only...” or state figure from first graph)

any 2 for 1 further mark each

3

- (b) resistance of filament rises as temperature rises/higher at operating temperature
- resistance of X falls as temperature rises/low(er) at operating temperature
- total resistance stays roughly the same as temperature rises
- so current stays roughly the same as temperature rises
- (must be related to previous point)*

resistance of X falls faster at first than resistance of filament rises

so current rises *(must be related to previous point)*

operating resistance slightly increased

so operating current slightly reduced

(must be related to previous point)

resistance of X high at start

so current zero/low

each gains 1 mark

(must be related to previous point)

(to a maximum of 4)

4

[7]

51

- (a) • diode
- voltmeter
- ammeter

for 1 mark each

3

(b) *idea that*

- current increases or goes up (with voltage)
gains 1 mark
- 'It' refers to current
but current increases steadily (with voltage)
gains 2 marks
- (*allow in proportion*) – but not simply a description of the shape of the graph
gains 1 mark
- no current at first
but no current until voltage is more than 0.3 (volts)
gains 2 marks

4

[7]

52

(a) *idea that*

it/current increases (with voltage)
gains 1 mark

but
current increases steadily (with voltage)
(allow in proportion)
gains 2 marks

4

no current at first
gains 1 mark

but
no current until voltage is more than 0.3 (volts)
gains 2 marks

(b) (i) reverse component X/power supply/change battery round
for 1 mark

(ii) *idea that*
X doesn't conduct in opposite/let current through/no current
(in opposite direction)
(credit X is a diode)
for 1 mark

2

[6]

53

(a) cell and bulb / light correctly labelled
for 1 mark each

2

(b) ordinary cell has higher voltage (normally / at start)
for 1 mark

or
ordinary cell 1.3V nicad 1.2V (normally / at start)

voltage of ordinary cell falls more slowly (*accept* lasts longer)

gains 1 mark

but

as above with relevant quantification e.g. falls to zero in 60 seconds compared to 6 seconds e.g. falls to zero in 70 seconds compared to 16 seconds – from time zero

or

nicad falls to zero 10 times as fast

gains 2 marks

3

- (c) (i) answer in range 32-34 (seconds) (inclusive)

gains 1 mark

but

answer in range 22-24 (seconds) (inclusive)

gains 2 marks

- (ii) 12 (seconds)

gains 1 mark

but

2 (seconds)

units not required in (c)

gains 2 marks

4

[9]