1 (a) Electrical circuits often contain resistors.

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

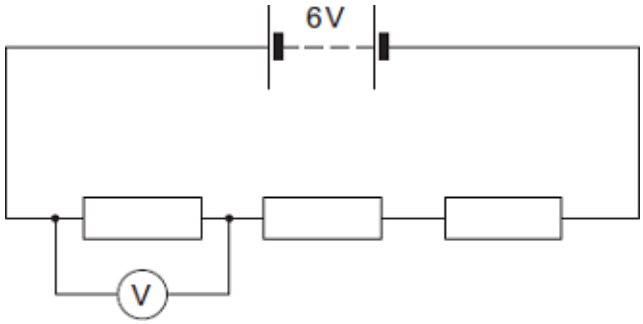
Calculate the total resistance of the **two** resistors.

_____

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.

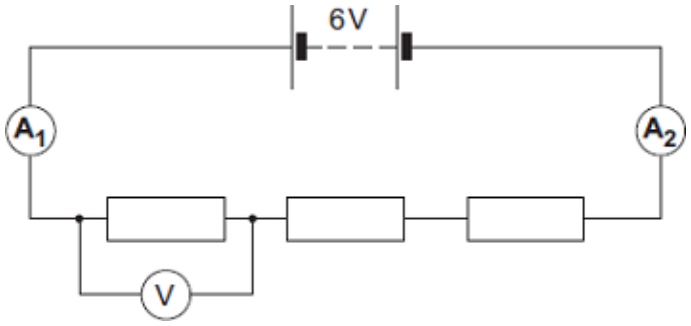
_____

_____

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 $\mathbf{A_2}$ will be

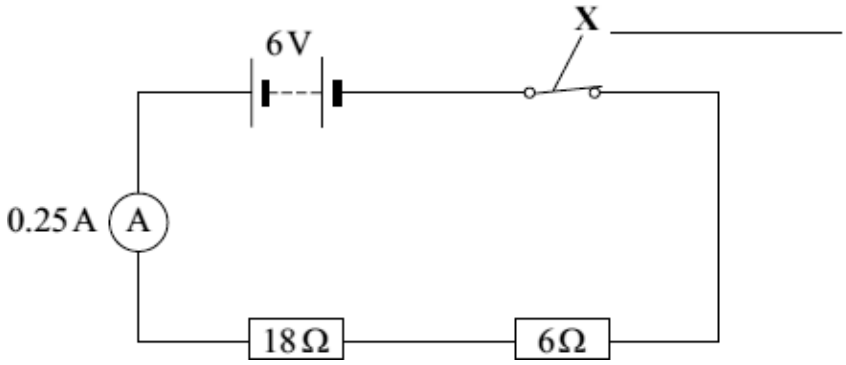
smaller than
equal to
greater than

the reading on ammeter $\mathbf{A_1}$.

(1)

(Total 4 marks)

2 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.

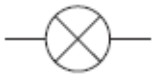
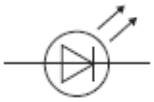
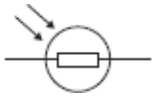
_____

Number of cells = _____

(1)

(Total 4 marks)

3 (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)

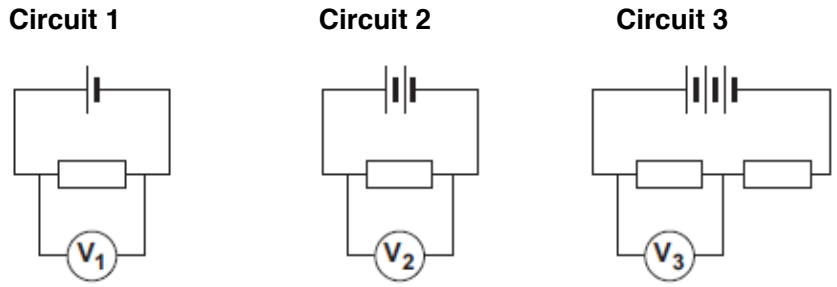
(3)

(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 $\mathbf{V_2}$.

_____

Voltmeter reading $\mathbf{V_2}$ = _____ V

(1)

(iii) Which voltmeter, $\mathbf{V_1}$, $\mathbf{V_2}$ or $\mathbf{V_3}$, will give the lowest reading?

Draw a ring around the correct answer.

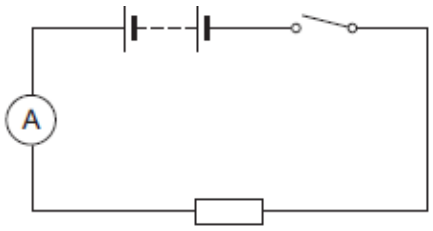
$\mathbf{V_1}$ $\mathbf{V_2}$ $\mathbf{V_3}$

(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



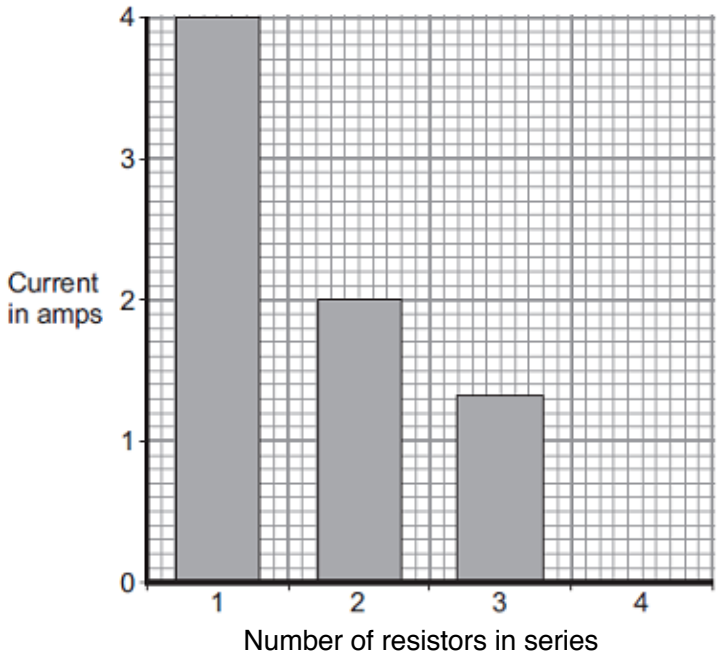
The student started with one resistor and then added more identical resistors to the circuit.

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?

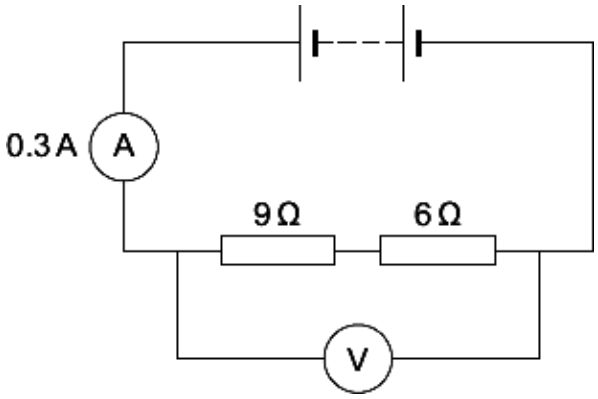
_____

_____

(1)

(Total 10 marks)

4 (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

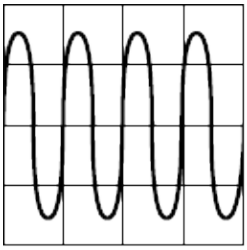
the reading on the ammeter.

(1)

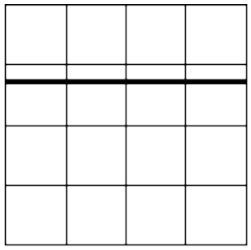
(b) The voltmeter in the circuit is replaced with an oscilloscope.

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

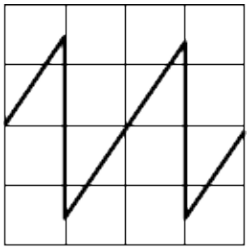
Write your answer, **X**, **Y** or **Z**, in the box.



X



Y



Z

Diagram ☐

Give a reason for your answer.

_____

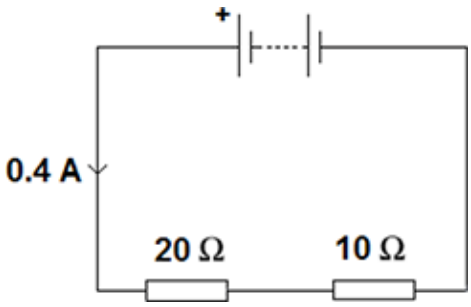
_____

_____

(2)

(Total 6 marks)

5 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 × 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 × potential difference

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

Give your answer to one significant figure.

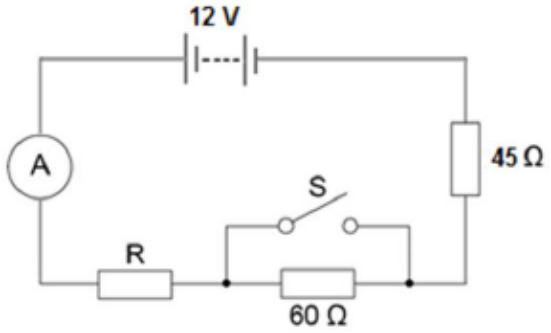
_____

Power = _____ W

(2)

(Total 6 marks)

6 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)

7 The image shows a battery-powered drone.

(a) The battery in the drone can store 97.5 kJ of energy.

When the drone is hovering, the power output of the battery is 65.0 W

Calculate the time for which the drone can hover.

_____

_____

_____

_____

_____

_____

Time = _____ seconds

(3)

(b) The battery powers 4 motors in the drone.

Each motor has a resistance of 1.60 Ω when the power input to each motor is 19.6 W

The 4 motors are connected in parallel with the battery.

Calculate the current through the battery.

_____

_____

_____

_____

_____

_____

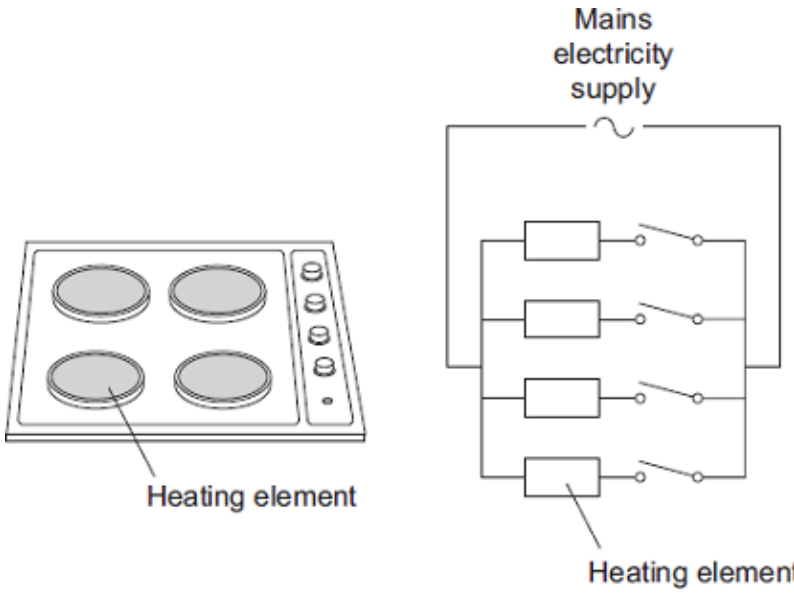
_____

Current = _____ A

(4)

(Total 7 marks)

8 The picture shows an electric cooker hob. The simplified circuit diagram shows how the four heating elements connect to the mains electricity supply. The heating elements are identical.



When all four heating elements are switched on at full power the hob draws a current of 26 A from the 230 V mains electricity supply.

(a) Calculate the resistance of one heating element when the hob is switched on at full power.

Give your answer to 2 significant figures.

_____

_____

_____

Resistance = _____ Ω

(3)

(b) The table gives the maximum current that can safely pass through copper wires of different cross-sectional area.

Cross-sectional area in mm^2	Maximum safe current in amps
1.0	11.5
2.5	20.0
4.0	27.0
6.0	34.0

The power sockets in a home are wired to the mains electricity supply using cables containing 2.5 mm^2 copper wires. Most electrical appliances are connected to the mains electricity supply by plugging them into a standard power socket.

It would **not** be safe to connect the electric cooker hob to the mains electricity supply by plugging it into a standard power socket.

Why?

_____

_____

_____

_____

(2)

(c) Mains electricity is an alternating current supply. Batteries supply a direct current.

What is the difference between an alternating current and a direct current?

_____

_____

_____

_____

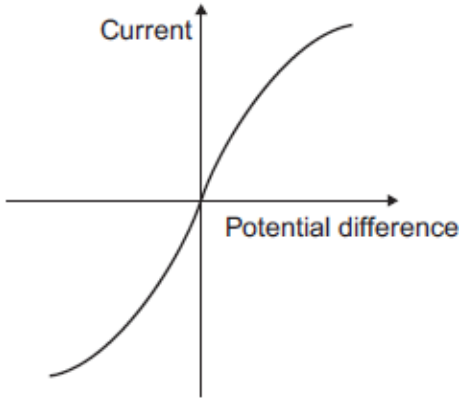
(2)

(Total 7 marks)

9 The current in a circuit depends on the potential difference provided by the cells and the total resistance of the circuit.

(a) **Figure 1** shows the graph of current against potential difference for a component.

Figure 1



What is the name of the component?

Draw a ring around the correct answer.

diode **filament bulb** **thermistor**

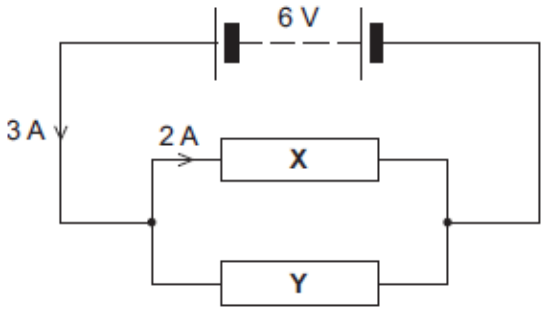
(1)

(b) **Figure 2** shows a circuit containing a 6 V battery.

Two resistors, **X** and **Y**, are connected in parallel.

The current in some parts of the circuit is shown.

Figure 2



(i) What is the potential difference across **X**?

Potential difference across **X** = _____ V

(1)

(ii) Calculate the resistance of **X**.

_____

_____

Resistance of **X** = _____ Ω

(2)

(iii) What is the current in **Y**?

Current in **Y** = _____ A

(1)

(iv) Calculate the resistance of **Y**.

_____

Resistance of **Y** = _____ Ω

(1)

(v) When the temperature of resistor **X** increases, its resistance increases.

What would happen to the:

- potential difference across **X**
- current in **X**
- total current in the circuit?

Tick (✓) **three** boxes.

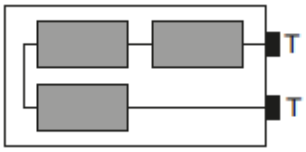
	Decrease	**Stay the same**	**Increase**
Potential difference across **X**			
Current in **X**			
Total current in the circuit			

(3)

(Total 9 marks)

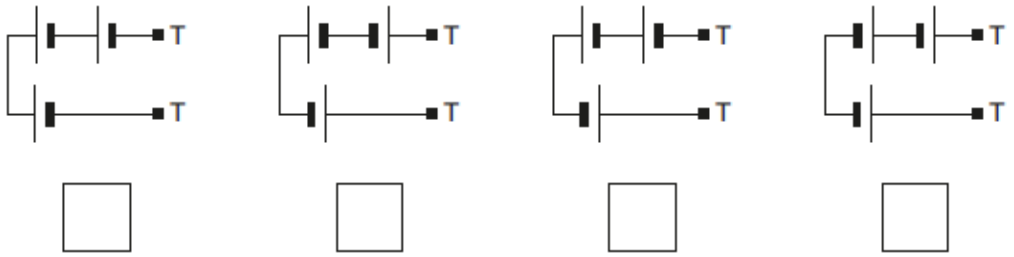
10 (a) **Figure 1** shows the inside of a battery pack designed to hold three identical 1.5 V cells.

Figure 1



Which **one** of the arrangements shown in **Figure 2** would give a 4.5 V output across the battery pack terminals **T**?

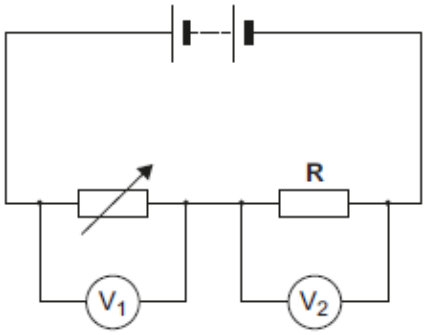
Figure 2



(1)

(b) **Figure 3** shows a variable resistor and a fixed value resistor connected in series in a circuit.

Figure 3



Complete **Figure 3** to show how an ammeter would be connected to measure the current through the circuit.

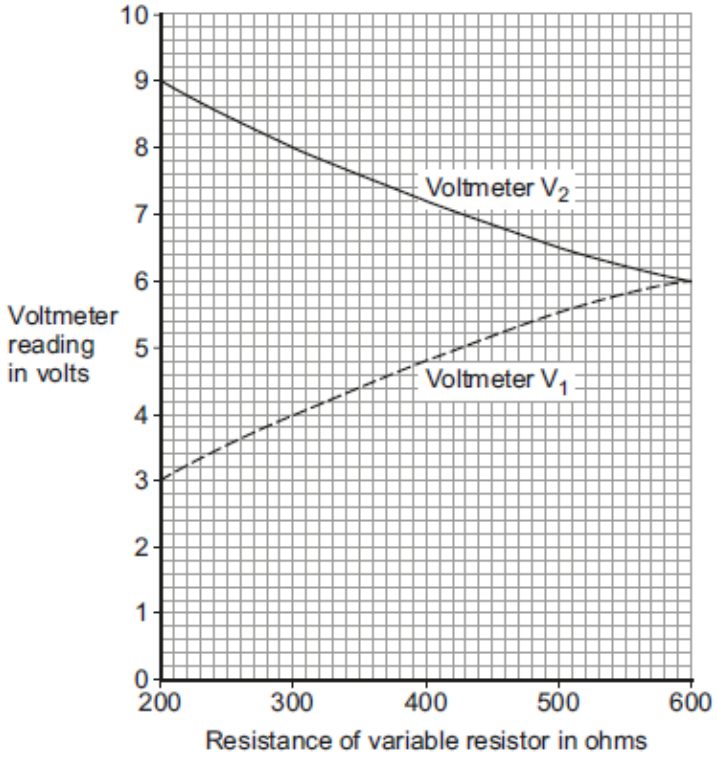
Use the correct circuit symbol for an ammeter.

(1)

(c) The variable resistor can be adjusted to have any value from 200 ohms to 600 ohms.

Figure 4 shows how the reading on voltmeter $\mathbf{V_1}$ and the reading on voltmeter $\mathbf{V_2}$ change as the resistance of the variable resistor changes.

Figure 4



(i) How could the potential difference of the battery be calculated from **Figure 4**?

Tick (✓) **one** box.

9 + 3 = 12 V ☐

9 – 3 = 6 V ☐

9 ÷ 3 = 3 V ☐

Give the reason for your answer.

_____

_____

(2)

(ii) Use **Figure 4** to determine the resistance of the fixed resistor, **R**.

Resistance of R = _____ Ω

Give the reason for your answer.

_____

_____

(2)

(iii) Calculate the current through the circuit when the resistance of the variable resistor equals 200 Ω.

_____

_____

_____

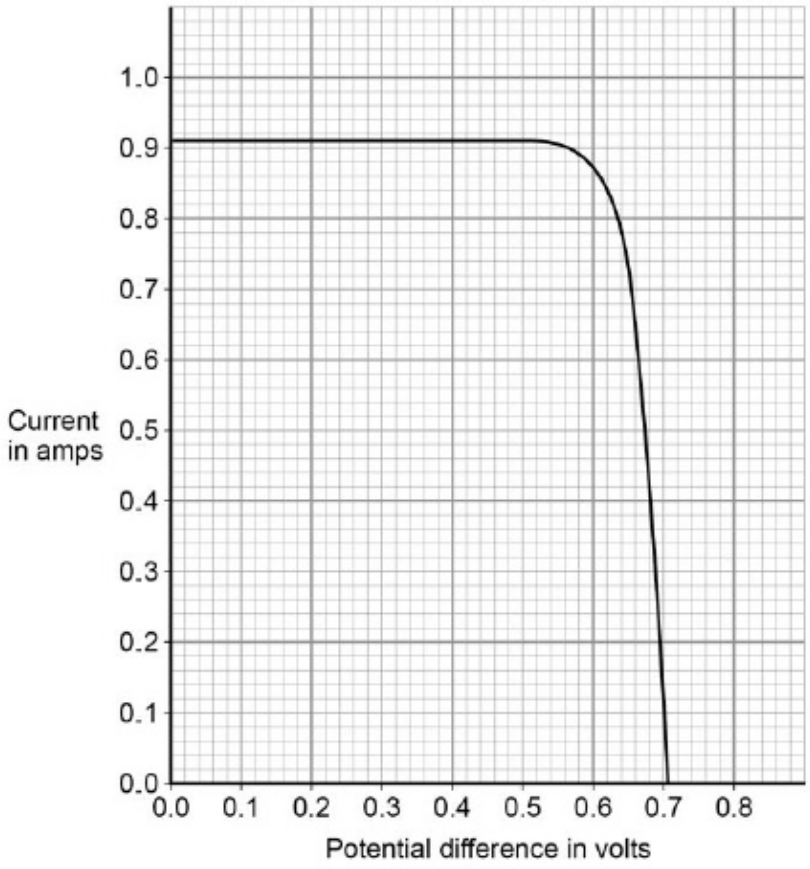
Current = _____ A

(3)

(Total 9 marks)

11 **Figure 1** shows a graph of current against potential difference for a solar cell when light of intensity 450 W/m^2 is incident on it.

Figure 1



(a) Determine the power output of the solar cell when the potential difference is 0.5 V

Use data from **Figure 1**.

_____

_____

_____

_____

_____

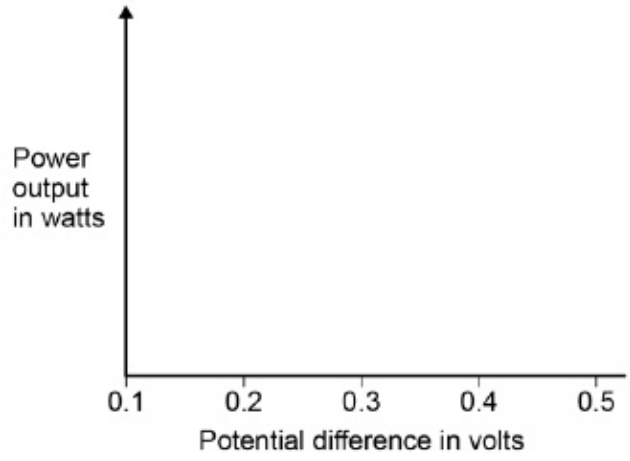
Power = _____ W

(3)

(b) Draw a sketch graph on **Figure 2** to show how the power output of the solar cell varies with potential difference between 0.1 V and 0.5 V

No values need to be included on the vertical axis.

Figure 2



(2)

(c) The maximum power output of this solar cell is 0.52 W

When the light intensity is 450 W/m^2 the cell has an efficiency of 0.15 at the maximum power output.

Calculate the area of the solar cell.

_____

_____

_____

_____

_____

_____

Area = _____ m^2

(4)

(d) A householder has four solar cells.

Each of the solar cells has a resistance of 0.78 Ω

Explain how the solar cells should be connected so that the total resistance is as low as possible.

_____

_____

_____

_____

(2)

(Total 11 marks)