3 A student investigates how the resistance of a thermistor varies with temperature.
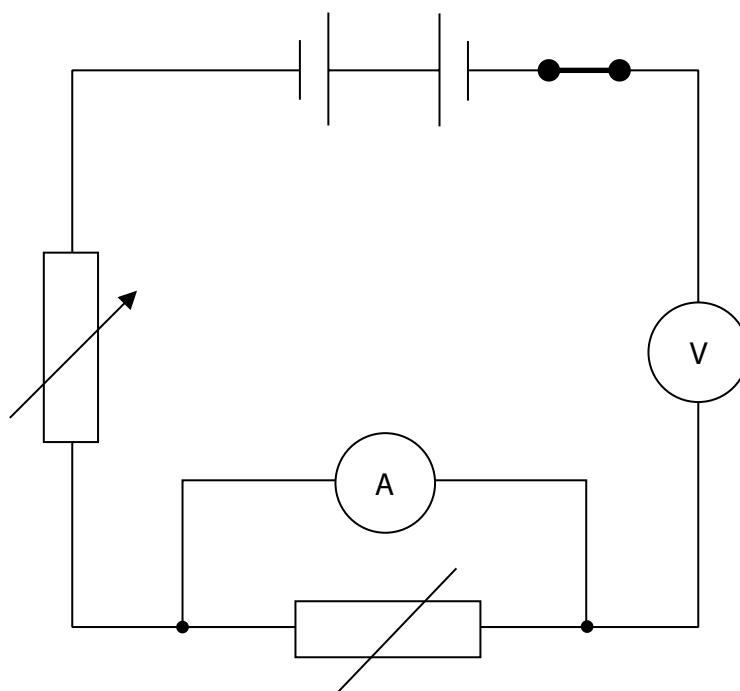
(a) The student sets up the circuit shown in Figure 5 to measure current and voltage.

He finds that it does not work.

Figure 5

Give **three** modifications the student should make to the circuit so that the circuit works correctly.

(3)

1 ....

....

2 ....

....

3 ....

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(b) The student uses the equipment shown in Figure 6 to measure the temperature of the thermistor.
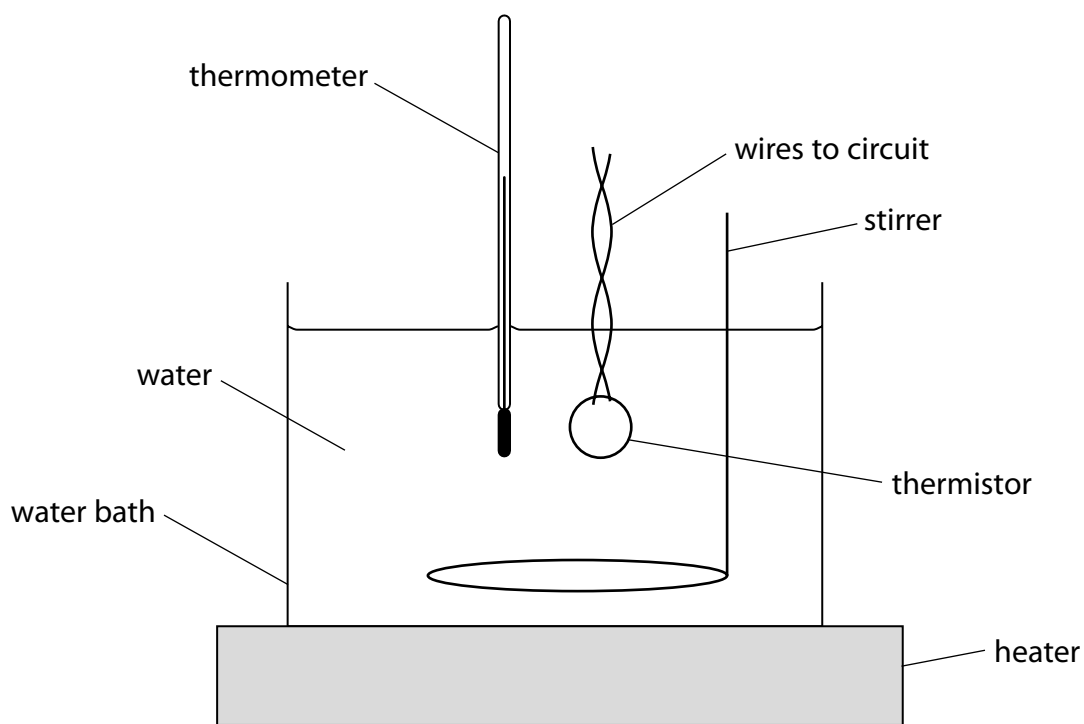
Figure 6

(i) Give **one** reason for using the water bath.

(1)

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....

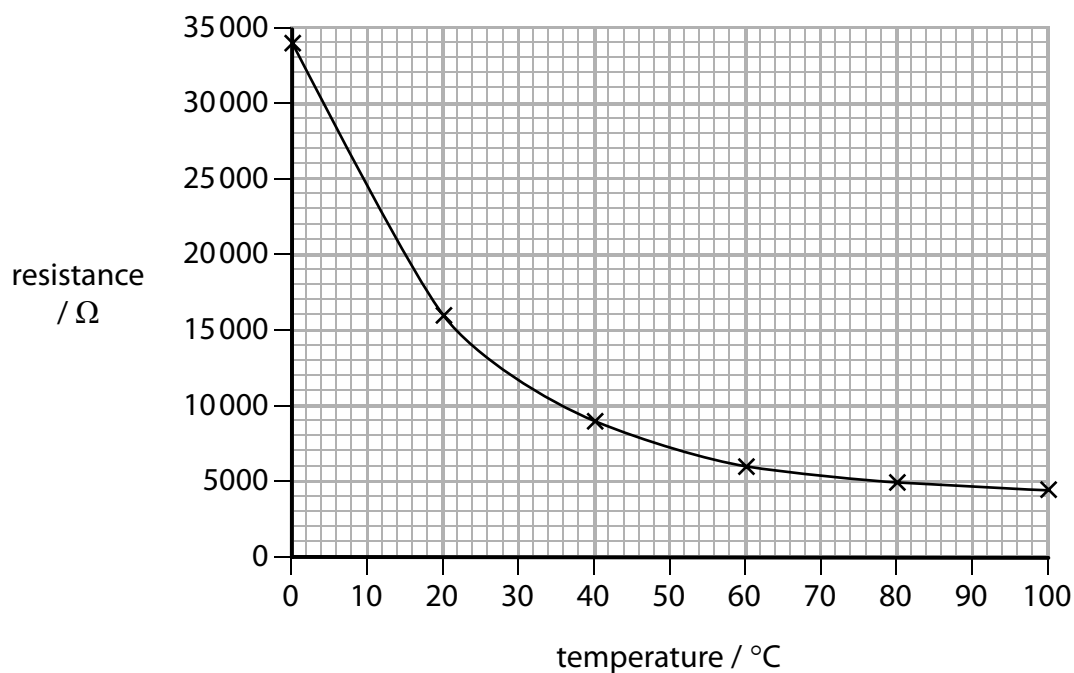(ii) The equipment shown in Figure 6 is for investigations in the temperature range from 20°C to 100°C.

State **one** way the student could develop this experimental procedure to investigate temperatures outside this range.

(1)

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....
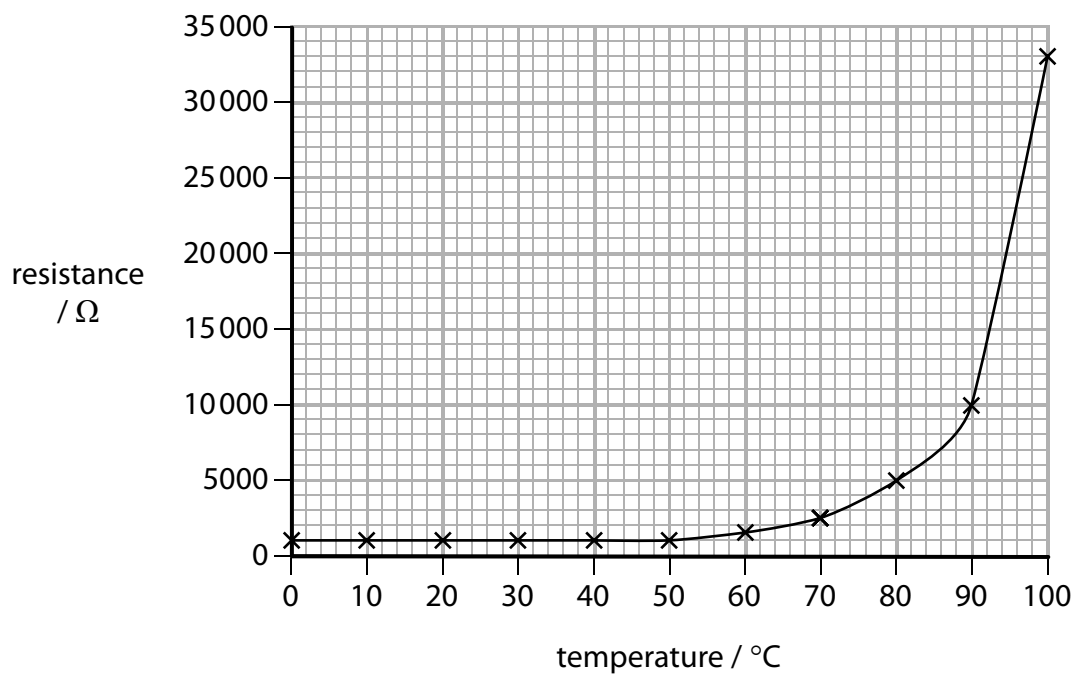
(c) The student takes measurements for two other components, **A** and **B**.

The results for both these components are shown in Figure 7.

Component A

Component B

Figure 7

(i) Compare and contrast how the resistances of component **A** and component **B** vary with temperature.

(3)

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(ii) Component **A** is connected to a 12V supply.

Which of these is the current in component **A** when the temperature is 80 °C?

(1)

☒ **A** $I = 12 \times 5000$

☒ **B** $I = \dfrac{12}{5000}$

☒ **C** $I = \dfrac{12^2}{5000}$

☒ **D** $I = \sqrt{\left(\dfrac{12}{5000}\right)}$

(Total for Question 3 = 9 marks)

Heating a greenhouse
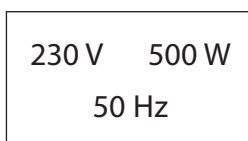
3 A greenhouse contains an electric heater.

(a) The heater makes good use of the heating effect of an electric current.

Give an example of a device where the heating effect of an electric current is a **disadvantage**.

(1)

....

....

(b) This label is attached to the heater.

| 230 V   500 W |
| 50 Hz |

Use this information to calculate the expected current in the heater.

(3)

current = ... A

(c) Complete the sentence by putting a cross (⊠) in the box next to your answer.

The potential difference across the heater can be measured either in volts or in

(1)

⊠ **A**   amps per ohm

⊠ **B**   amps per joule

⊠ **C**   coulombs per ohm

⊠ **D**   joules per coulomb

(d) When a charge flows in a resistor, the resistor becomes hot.

Explain why the resistor becomes hot.

(2)

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....

....

....
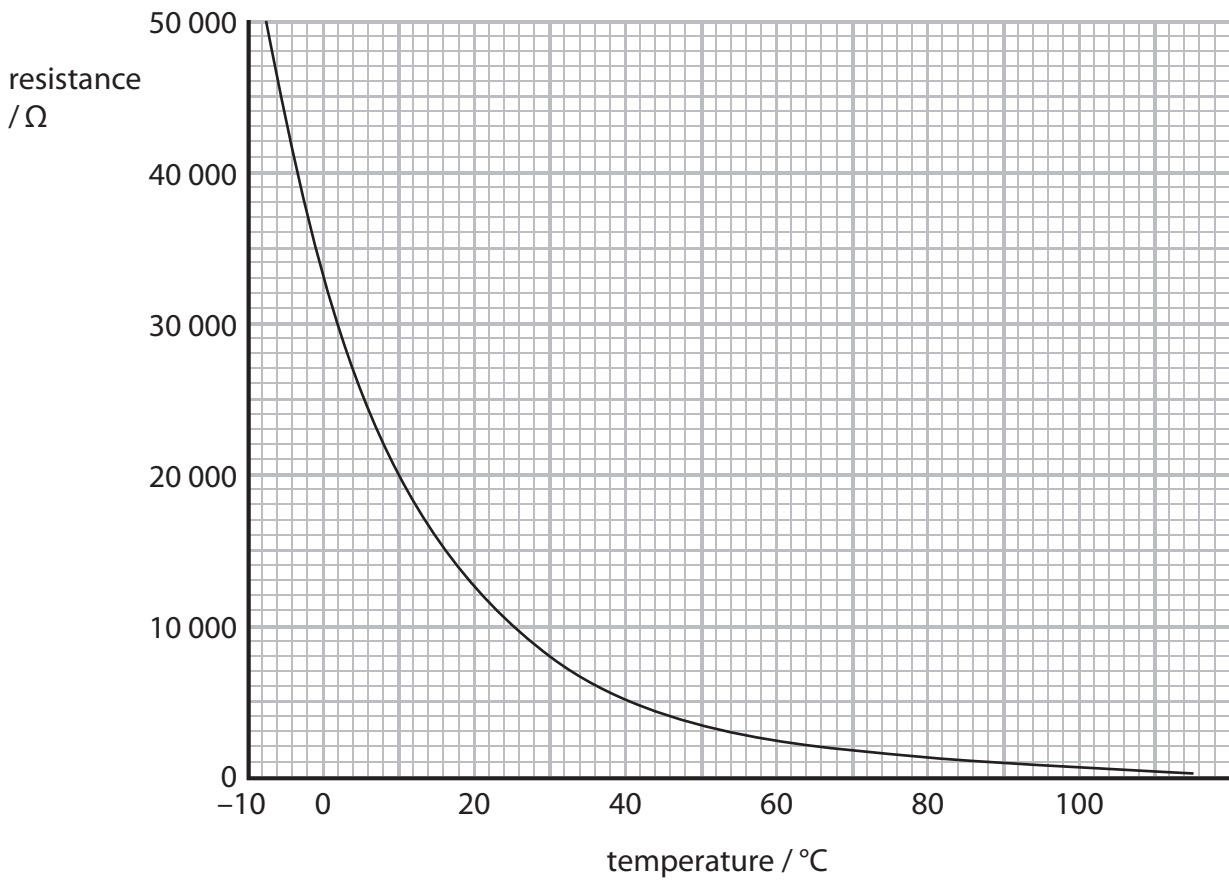
(e) A thermistor is used to control the heater.
The graph shows how the resistance of the thermistor changes with temperature.

When the temperature is 10 °C, the current in the thermistor is 0.60 mA.

Calculate the potential difference across the thermistor at 10 °C.

(3)

potential difference = ... V

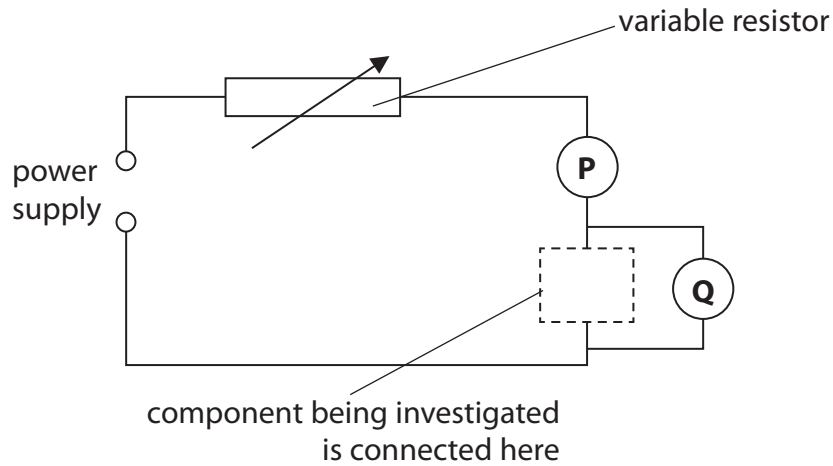**(Total for Question 3 = 10 marks)**

Answer ALL questions.

Some questions must be answered with a cross in a box ⊠. If you change your mind about an answer, put a line through the box ⊠ and then mark your new answer with a cross ⊠.

Electrical resistance

1   (a) Some students investigate the electrical resistance of different components using this circuit.

(i)   Which row of the table is correct for both meters **P** and **Q**?

Put a cross (⊠) in the box next to your answer.

(1)

		meter P is	meter Q is
⊠	**A**	an ammeter	an ammeter
⊠	**B**	an ammeter	a voltmeter
⊠	**C**	a voltmeter	a voltmeter
⊠	**D**	a voltmeter	an ammeter

(ii) One of the components being investigated is a 12 ohm resistor.
When it is in the circuit, the ammeter reading is 0.50 A.

Calculate the voltmeter reading.

(2)

voltmeter reading = ... V

P41748A0420

(iii) The students reduce the resistance of the variable resistor.
State what happens to the readings on each of the meters **P** and **Q**.

(2)

....

....

....

....

(iv) The students then reduce the voltage of the power supply.
State what happens to the current in the circuit.

(1)

....

(b) The graphs **L**, **M** and **N** each show how the current in a component varies with
the potential difference (voltage) across that component.
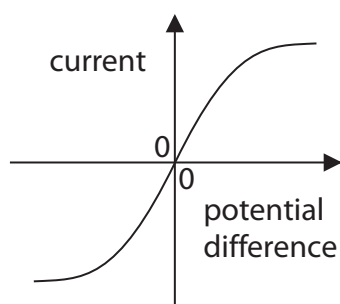
L
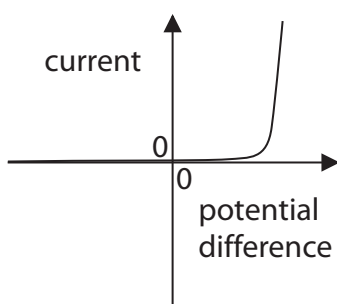
M
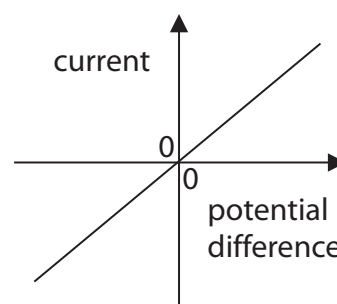
N

Match each graph with the symbol of the component to which it applies.
Draw lines to connect each symbol with its correct graph.

(2)
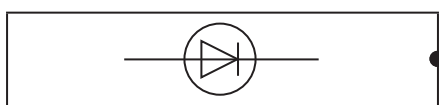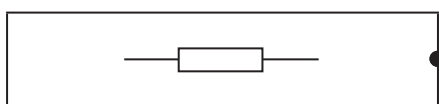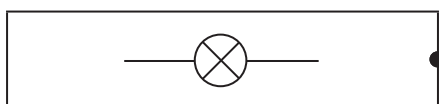
component symbol   **graph**

graph **L**

graph **M**

graph **N**

(Total for Question 1 = 8 marks)

Electric circuits

5 (a) The diagram shows an electric circuit with two resistors, R and S.
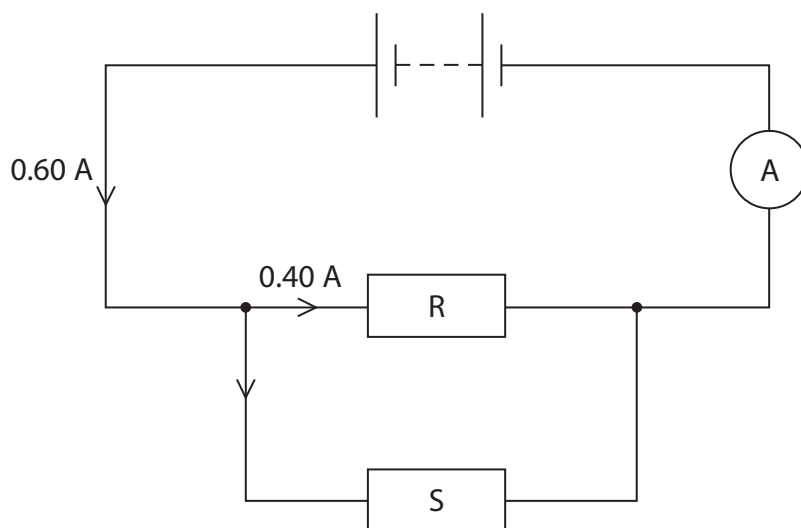
(i) R has a resistance of 11 ohms.

Calculate the potential difference across R.

(2)

potential difference = ... V

P41961A01420

(ii) Use information from the diagram to calculate the current in S.

(1)

current = ... A

(iii) Complete the sentence by putting a cross (☒) in the box next to your answer.

A student wants to measure the battery voltage with a voltmeter.

The voltmeter should be placed

(1)

☒ **A** in series with the battery

☒ **B** in parallel with the battery

☒ **C** in parallel with the ammeter

☒ **D** in series with either resistor R or S

(b) Explain why the temperature of a resistor increases when a current passes through it.

(2)

....

....

....

....

*(c) A resistor is a circuit component.

Two other circuit components are a light dependent resistor (LDR) and a thermistor.

Explain how LDRs and thermistors can be used to control the current in a circuit.

(6)

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(Total for Question 5 = 12 marks)

Light-dependent resistors

6 (a) A technician investigates a light-dependent resistor (LDR) connected in series with a 120 Ω resistor and a voltage source.

The technician measures the voltage across the LDR and also the current in the LDR.

(i) Which **one** of these circuits should the technician use?

Put a cross (☒) in the box next to your answer.

(1)
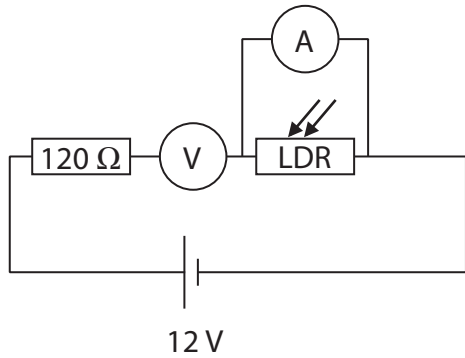
☒ **A**
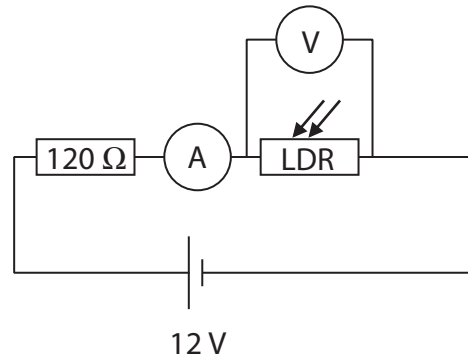
☒ **B**
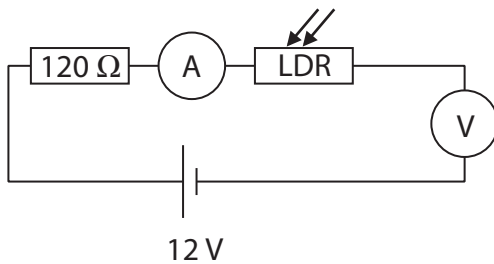
☒ **C**
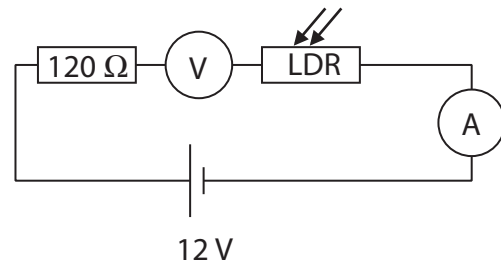
☒ **D**

(ii) When the LDR is in bright sunlight, its resistance is 185 Ω. The voltage across the LDR is then 7.2 V.

Show that the current in the LDR is about 0.039 A.

(2)

(iii) Complete the sentence by putting a cross (☒) in the box next to your answer.

The current in the 120 Ω resistor is

(1)

☒ **A** much more than the current in the LDR

☒ **B** much less than the current in the LDR

☒ **C** the same as the current in the LDR

☒ **D** the opposite of the current in the LDR

(iv) The technician repeats the readings with the LDR in different light conditions.

The table gives two of the readings.

light condition	current in LDR
bright sunlight	0.039 A
cloudy skies	0.028 A

Explain why the two current readings are different.

(2)

....

....

....

....

*(b) The photograph shows a temporary traffic sign.

The traffic sign uses many small lights all powered by a rechargeable battery. These lights need to be very bright during the day so that they can be seen clearly. They do not need to be as bright at night.

Explain how using a light-dependent resistor can make the energy stored in the battery last longer.

(6)

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(Total for Question 6 = 12 marks)

TOTAL FOR PAPER = 60 MARKS

P 4 4 8 0 4 A 0 2 0 2 4