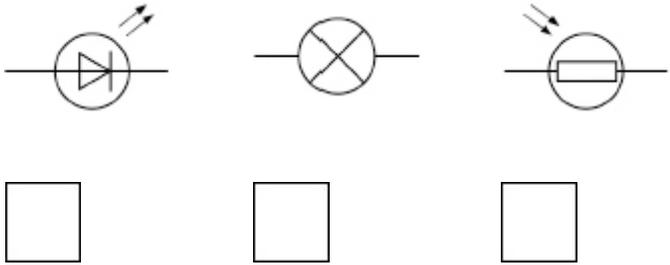


1.

A filament lamp breaks if the electric current in the filament becomes too big.

(a) What is the correct symbol for a filament lamp?

Tick (✓) **one** box.



(1)

(b) What is meant by an electric current?

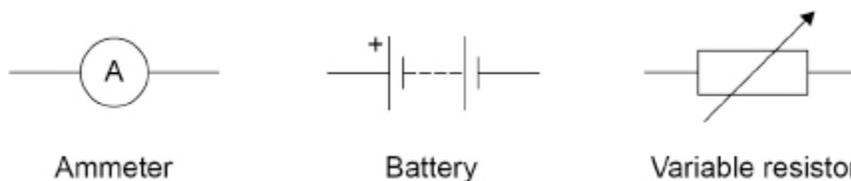
Tick (✓) **one** box.

- The energy carried by each unit of charge
- The flow of electrical charge
- The number of electrons in a circuit
- The speed at which charge moves

(1)

A manufacturer investigated the maximum current value of some filament lamps.

(c) The figure below shows the symbols for an ammeter, a battery and a variable resistor.



The manufacturer connected an ammeter, battery, filament lamp and variable resistor in series.

Draw a circuit diagram to show the manufacturer's circuit.

Include the symbol for a filament lamp from part (a)

(1)

(d) How could the manufacturer increase the current in the filament lamp?

Tick (✓) **one** box.

Add an extra ammeter to the circuit.

Decrease the resistance of the variable resistor.

Use a battery with a smaller potential difference.

(1)

(e) When the potential difference across a filament lamp was 0.75 V, the current in the filament lamp was 0.16 A.

Calculate the power of the filament lamp.

Use the equation:

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

$$\text{Power} = \text{_____ W}$$

(2)

(f) Write down the equation which links charge flow (Q), current (I) and time (t).

(1)

(g) The manufacturer increased the current in the filament lamp to 200 mA.

Calculate the charge flow through the filament lamp in 15 s.

Charge flow = _____ C

(3)

(h) The manufacturer increased the current in the filament lamp from 200 mA.

The filament in the lamp broke when the current reached 320 mA.

How many times greater than 200 mA was the current at which the filament broke?

_____ times greater

(1)

(i) The manufacturer tested lots of filament lamps.

The current at which the filament lamps broke was 320 ± 60 mA.

What is the range of currents at which the filament lamps broke?

Tick (✓) **one** box.

60 mA to 320 mA

260 mA to 320 mA

320 mA to 380 mA

260 mA to 380 mA

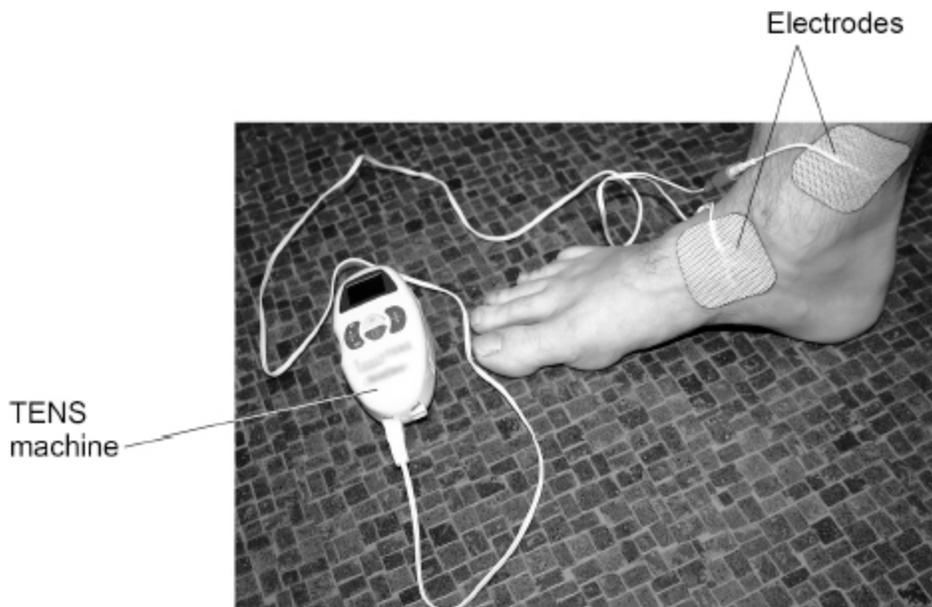
(1)

(Total 12 marks)

2. A TENS machine uses an electrical current to relieve pain.

Figure 1 shows the electrodes of a TENS machine connected across an ankle.

Figure 1



(a) The maximum power of the TENS machine is 240 mW.

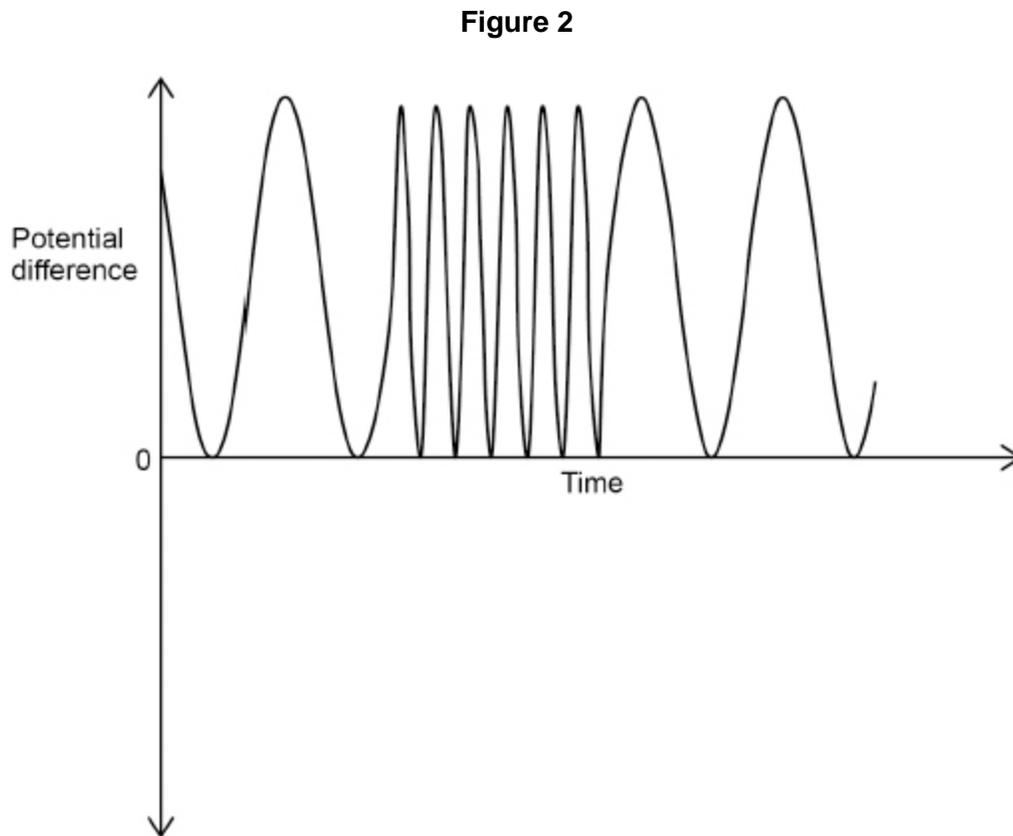
The potential difference across the battery in the TENS machine is 2.5 V.

Calculate the maximum current from the battery.

Maximum current = _____ A

(4)

- (b) **Figure 2** is a sketch graph showing how the potential difference across the electrodes varies with time.

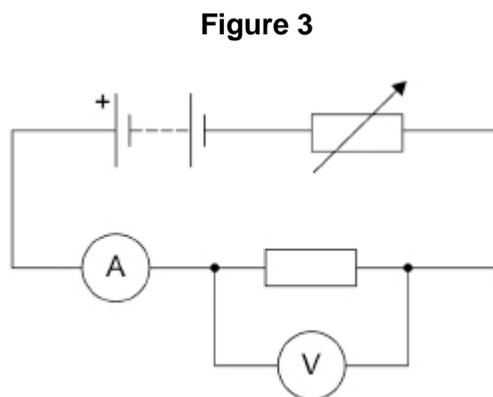


A student concluded that there was an alternating potential difference across the electrodes.

How does **Figure 2** show that the student was **not** correct?

(1)

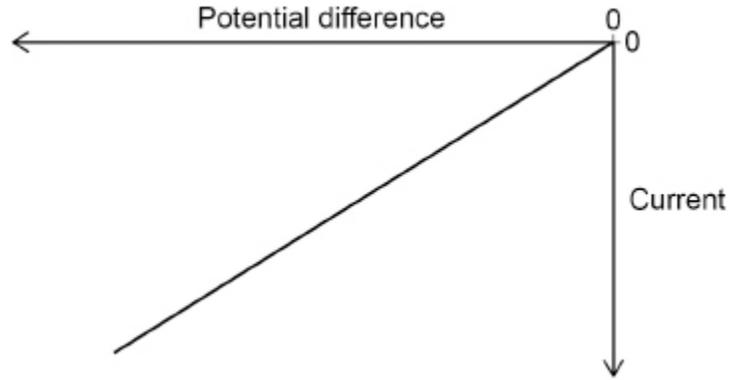
Figure 3 shows a circuit the student built using the battery from the TENS machine.



The student recorded how the current in the resistor varied with the potential difference across the resistor.

Figure 4 shows a sketch graph of the results.

Figure 4

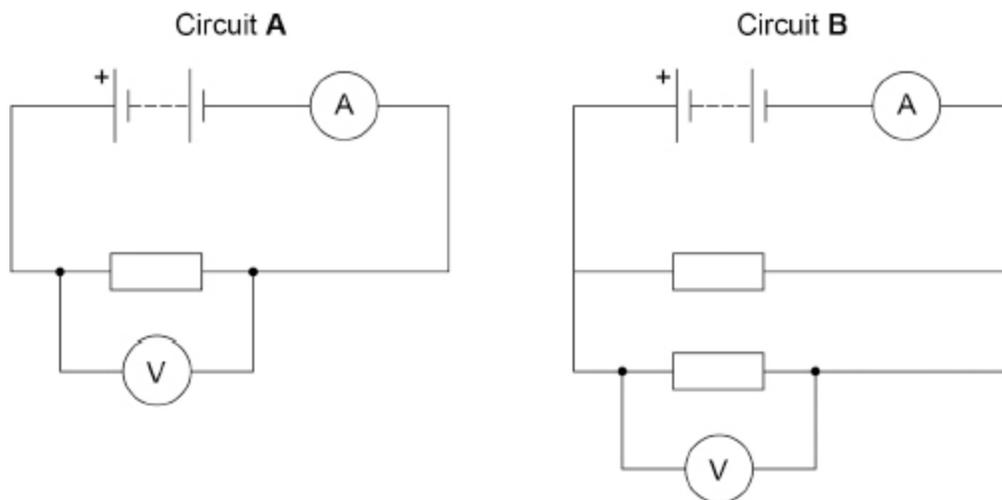


(c) What relationship does **Figure 4** show?

(1)

- (d) **Figure 5** shows two more circuits that the student built using the battery from the TENS machine.

Figure 5



The resistors all have the same resistance.

Compare the readings on the voltmeter and ammeter in circuit **A** and circuit **B**.

Voltmeter _____

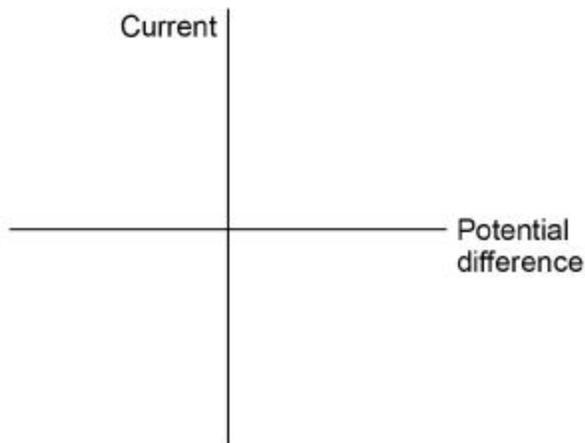
Ammeter _____

(3)
(Total 9 marks)

3. A student built a circuit using filament lamps.

(a) Sketch a current potential difference graph for a filament lamp on **Figure 1**

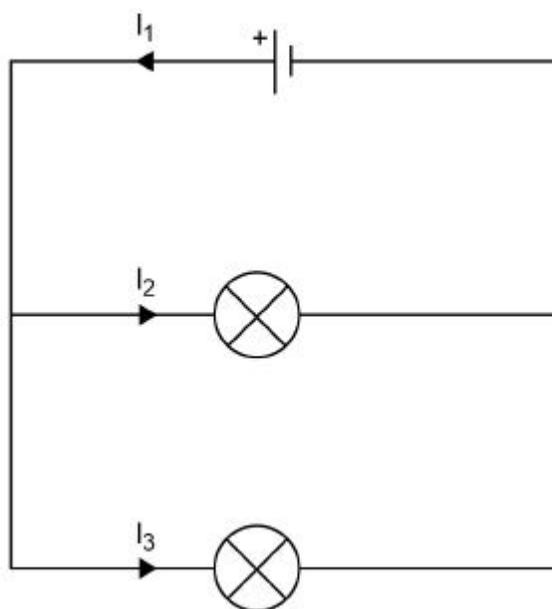
Figure 1



(2)

Figure 2 shows the circuit with two identical filament lamps.

Figure 2



(b) Compare the currents I_1 , I_2 and I_3

(2)

(c) Calculate the charge that flows through the cell in 1 minute.

Each filament lamp has a power of 3 W and a resistance of 12 Ω

Write any equations that you use.

Give the unit.

Charge = _____

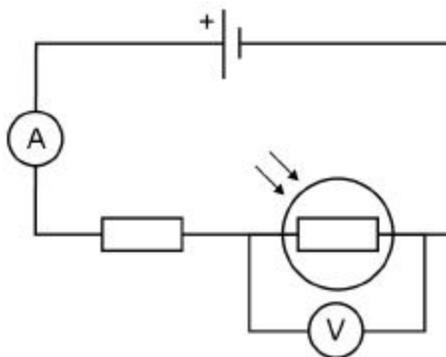
Unit = _____

(6)

(d) The student builds a different circuit.

Figure 3 shows the circuit.

Figure 3



(a) Suggest why some ceiling lights do **not** have an earth wire.

(2)

(b) Write down the equation that links charge flow, current and time.

(1)

(c) There is a current of 2.95 A in one of the copper wires for 60 seconds.

Calculate the charge flow through the wire.

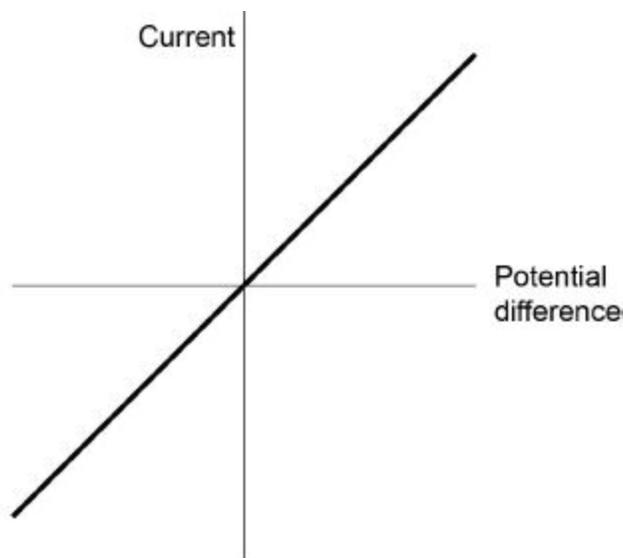
Use your equation from part **(b)**

Charge flow = _____ C

(2)

(d) **Figure 2** shows a current potential difference graph for a piece of copper wire.

Figure 2



Draw another line on **Figure 2** for a wire with a different resistance.

(2)

Some fuses have a thin piece of copper that melts if the current is too large.

(e) Draw the circuit symbol for a fuse.

(1)

(f) Describe how the movement of the copper particles in the wire changes when copper melts.

(2)

(g) Old copper wires are melted when they are recycled.

Calculate the energy needed to melt 500 kg of copper at its melting point.

Specific latent heat of fusion of copper = 200 kJ/kg

Use the Physics Equations Sheet.

Energy = _____ J

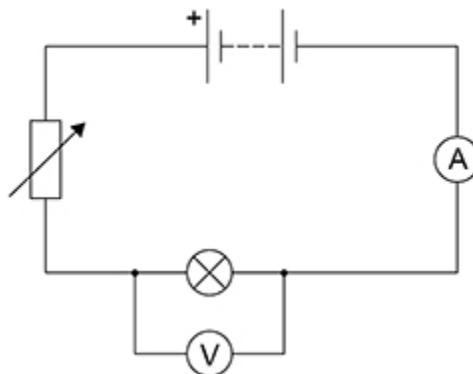
(3)

(Total 13 marks)

5. A student investigated how the potential difference across a filament lamp affects the current in the lamp.

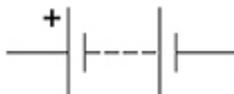
Figure 1 shows the circuit the student used.

Figure 1



- (a) **Figure 2** shows a circuit symbol.

Figure 2



What component does the symbol represent?

Tick (✓) **one** box.

Ammeter

Battery

Lamp

Variable resistor

(1)

- (b) Which component from **Figure 1** did the student use to adjust the potential difference across the lamp?

(1)

- (c) When the voltmeter was **not** connected to the circuit it gave a reading of 0.4 volts.

How can the student correct all the readings taken from the voltmeter?

Tick (✓) **one** box.

Add 0.4 volts to each reading

Divide each reading by 0.4 volts

Multiply each reading by 0.4 volts

Subtract 0.4 volts from each reading

(1)

(d) The student recorded three values of current for each potential difference.

The table below shows the results for 2.5 volts.

Potential difference in volts	Current in amps		
	1	2	3
2.5	0.54	0.58	0.53

Calculate the mean current in the lamp.

Mean current = _____ A

(2)

(e) Calculate the power of the lamp when the potential difference across the lamp was 4.8 V

The current in the lamp was 0.75 A

Use the equation:

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

Power = _____ W

(2)

- (f) Calculate the resistance of the lamp when the potential difference across the lamp was 4.8 V

The current in the lamp was 0.75 A

Use the equation:

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

Resistance = _____ Ω

(2)

- (g) Complete the sentence.

Choose answers from the box.

Each answer may be used once, more than once or not at all.

decrease	increase	stay the same
-----------------	-----------------	----------------------

Increasing the current in a filament lamp makes the temperature

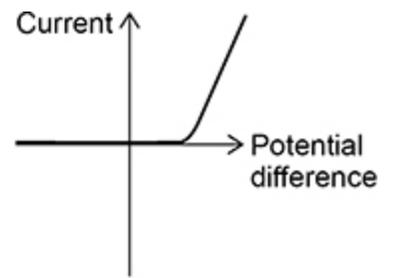
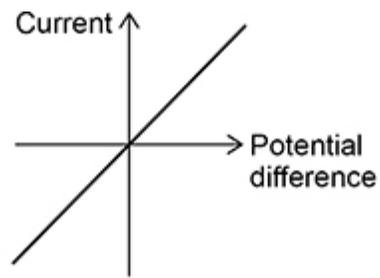
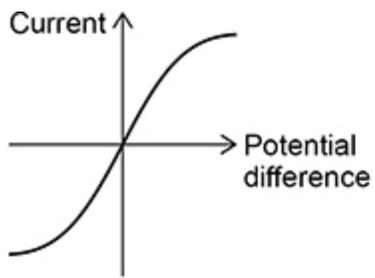
of the lamp _____ and the

resistance of the lamp _____.

(2)

- (h) Which graph shows the relationship between potential difference and current for a filament lamp?

Tick (✓) **one** box.



(1)
(Total 12 marks)

Mark schemes

1. (a)  1
- (b) the flow of electrical charge 1
- (c) all 4 components connected in a series circuit
allow a cell instead of a battery
allow an LED or LDR symbol instead of a lamp
ignore the + sign on the battery symbol 1
- (d) decrease the resistance of the variable resistor 1
- (e) $P = 0.75 \times 0.16$ 1
 $P = 0.12 \text{ (W)}$ 1
- (f) charge flow = current \times time
 $Q = It$ 1
- (g) $200 \text{ mA} = 0.2 \text{ A}$ 1
charge flow = 0.2×15
allow a correct substitution using an incorrectly/not converted value for current 1
charge flow = 3.0 (C)
allow a correct calculation using an incorrectly/not converted value for current 1
- (h) 1.6 1
- (i) 260 mA to 380 mA 1

[12]

2.	(a) 240 mW = 0.24 W	1
	0.24 = 2.5 × I <i>allow a correct substitution using an incorrectly/not converted value of power</i>	1
	$I = \frac{0.24}{2.5}$ <i>allow a correct re-arrangement using an incorrectly/not converted value of power</i>	1
	I = 0.096 (A) <i>allow a correct calculation using an incorrectly/not converted value of power</i>	1
	(b) because the potential difference is always positive <i>allow because potential difference does not change direction</i>	1
	(c) potential difference is (directly) proportional to current	1
	(d) voltmeter: the reading is the same in both circuits	1
	ammeter: the reading in circuit B is twice the reading of circuit A <i>allow 1 mark for the reading in circuit B is bigger than circuit A</i>	2
		[9]
3.	(a) a curve in the first and third quadrants only, passing through origin	1
	decreasing gradient	1
	(b) any two from: <ul style="list-style-type: none"> • $I_1 = I_2 + I_3$ • $I_2 = I_3$ • $I_1 = 2I_2$ • $I_1 = 2I_3$ <i>allow 1 mark for each correct description given in words</i>	2

(c) $3 = I^2 \times 12$

1

$$I = \sqrt{\left(\frac{3}{12}\right)}$$

1

$I = 0.5 \text{ (A)}$

1

$Q = 0.5 \times 60 = 30$

*allow Q =
their calculated I × 60*

1

$Q_{\text{total}} = 60$

*allow an answer that is consistent with their calculated
value of I*

1

or

$3 = I^2 \times 12 \text{ (1)}$

$$I = \sqrt{\left(\frac{3}{12}\right)}$$

$I = 0.5 \text{ (A) (1)}$

$I_{\text{total}} = 1.0 \text{ (A) (1)}$

allow $I_{\text{total}} = \text{their } I \times 2$

$Q = 1.0 \times 60 = 60 \text{ (1)}$

*allow an answer that is consistent with their calculated
value of I*

coulombs **or** C

1

an answer of 60 scores 5 calculation marks

(d) **Level 3:** Relevant points (reasons / causes) are identified, given in detail and logically linked to form a clear account.

5–6

Level 2: Relevant points (reasons / causes) are identified, and there are attempts at logically linking. The resulting account is not fully clear.

3–4

Level 1: Points are identified and stated simply, but their relevance is not clear and there is no attempt at logical linking.

1–2

No relevant content

0

Indicative content

- resistance of LDR changes when light intensity changes
- when light intensity increase resistance of LDR decreases

- overall resistance of circuit decreases
- potential difference across total resistance remains unchanged
- current in ammeter increases

- potential difference across fixed resistor increases
- potential difference across LDR decreases
- reading on the voltmeter decreases

- potential difference is shared between the components in series
- the lower the resistance of the LDR the smaller the share of the potential difference
- reading on the voltmeter decreases

[16]

4.

(a) (casing is) not made of metal

allow (casing is) made of plastic
allow they are double insulated

1

little / no chance of electric shock

1

(b) charge flow = current × time

allow the equation given in symbols

1

(c) $Q = 2.95 \times 60$

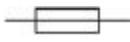
an answer of 177 scores 2 marks

1

$Q = 177$ (C)

allow 180 (C)

1

- (d) straight line with a different positive gradient
must go through the first and third quadrant 1
- straight line with positive gradient through the origin 1
- (e)  1
- (f) the particles vibrate about a fixed position regular arrangement
allow the particles are in a regular arrangement 1
- (the particles change) to being free to move around
allow correct description of translational kinetic energy 1
- (g) $L = 200\,000 \text{ (J/kg)}$ 1
- $E = 500 \times 200\,000$
allow $1 \times 10^8 \text{ (J)}$ 1
- $E = 100\,000\,000 \text{ (J)}$
allow correct calculation for incorrect conversion or no conversion of L for 2 marks 1
- an answer of 100 000 000 scores 3 marks* 1

[13]

5.

- (a) battery 1
- (b) variable resistor
allow resistor / battery
allow correct circuit symbol 1
- (c) subtract 0.4 volts from each reading 1
- (d) mean = $\frac{0.54+0.58+0.53}{3}$ 1
- mean = 0.55 (A) 1

(e) power = 4.8×0.75

1

power = 3.6 (W)

1

(f) resistance = $4.8 / 0.75$

1

resistance = 6.4 (Ω)

1

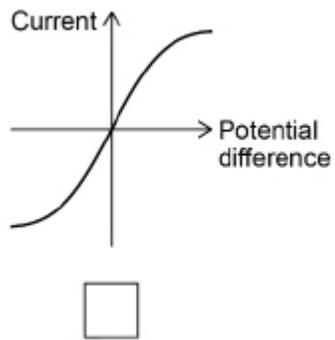
(g) increase

1

increase

1

(h)



1

[12]