

Name: \_\_\_\_\_

# Electricity part 6 AQA Triple Physics

Date: \_\_\_\_\_

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Time: **73 minutes**

Marks: **68 marks**

Comments:

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1.

Figure 1 shows an electric kettle used to boil water.

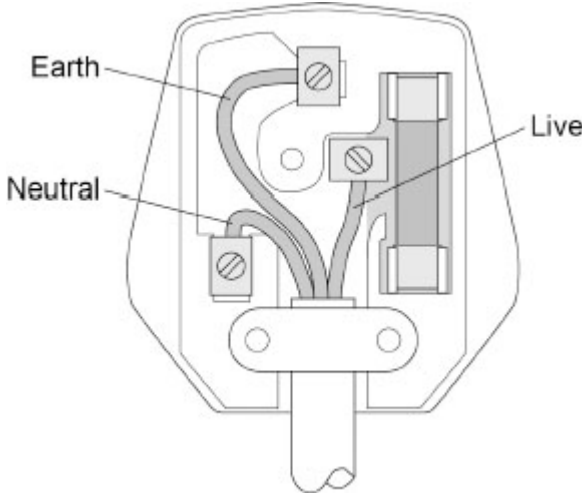
Figure 1



(a) The kettle is connected to the mains electricity supply by a three-core cable and plug.

Figure 2 shows the inside of the plug.

Figure 2



What are the colours of the insulation around the earth, live and neutral wires inside a plug?

Choose answers from the box.

blue	brown	green and yellow	red	yellow and brown
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Earth wire \_\_\_\_\_

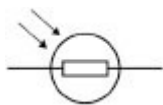
Live wire \_\_\_\_\_

Neutral wire \_\_\_\_\_

(b) The plug in **Figure 2** contains a fuse.

What is the circuit symbol for a fuse?

Tick (✓) **one** box.



(1)

(c) The electric kettle contains a heating element.

The power of the heating element is 2420 W.

The current in the heating element is 11.0 A.

Calculate the potential difference across the heating element.

Use the equation:

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

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Potential difference = \_\_\_\_\_ V

(2)

(d) The power of the heating element is 2420 W.

The current in the heating element is 11.0 A.

Calculate the resistance of the heating element.

Use the equation:

$$\text{resistance} = \frac{\text{power}}{(\text{current})^2}$$

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Resistance = \_\_\_\_\_  $\Omega$

(2)

(e) Kettle **A** and kettle **B** have the same total power input.

Kettle **A** has a greater efficiency than kettle **B**.

Which **two** of the following describe heating water in kettle **A** compared with kettle **B**?

Tick (✓) **two** boxes.

A greater percentage of energy is usefully transferred by kettle **A**.

Kettle **A** has a lower useful power output.

Kettle **A** takes less time to boil the same volume of water.

More energy is wasted by kettle **A** each second.

The temperature of the same volume of water increases more slowly in kettle **A**.

(2)

(Total 10 marks)

2.

A student built a circuit to investigate how the efficiency of a motor varies with the speed of the motor.


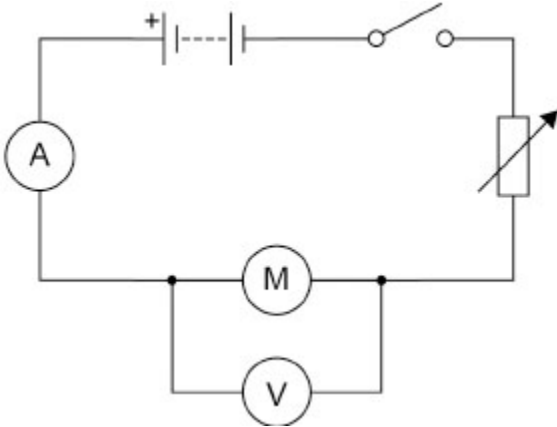
The symbol for a motor is 

Figure 1 shows the circuit.

Figure 1



The student used the motor to lift a mass through a height of 1.0 m.

(a) The motor took 12 seconds to lift the mass.

The charge flow through the circuit was 6.0 C.

Calculate the current in the circuit.

Use the equation:

$$\text{current} = \frac{\text{charge flow}}{\text{time}}$$

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Current = \_\_\_\_\_ A

(2)

(b) The potential difference across the motor was 8.0 V.

The charge flow through the motor was 6.0 C.

Calculate the energy transferred to the motor.

Use the equation:

$$\text{energy transferred} = \text{charge flow} \times \text{potential difference}$$

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$$\text{Energy transferred} = \underline{\hspace{10em}} \text{ J}$$

(2)

Use the Physics Equations Sheet to answer parts (c) and (d).

(c) Which equation links efficiency, total input energy transfer and useful output energy transfer?

Tick (✓) **one** box.

efficiency = useful output energy transfer × total input energy transfer

$$\text{efficiency} = \frac{\text{total input energy transfer}}{\text{useful output energy transfer}}$$

$$\text{efficiency} = \frac{\text{useful output energy transfer}}{\text{total input energy transfer}}$$

(1)

(d) The efficiency of the motor was 0.70

The useful output energy transfer of the motor was 1.96 J.

Calculate the total input energy transfer to the motor.

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Total input energy transfer = \_\_\_\_\_ J

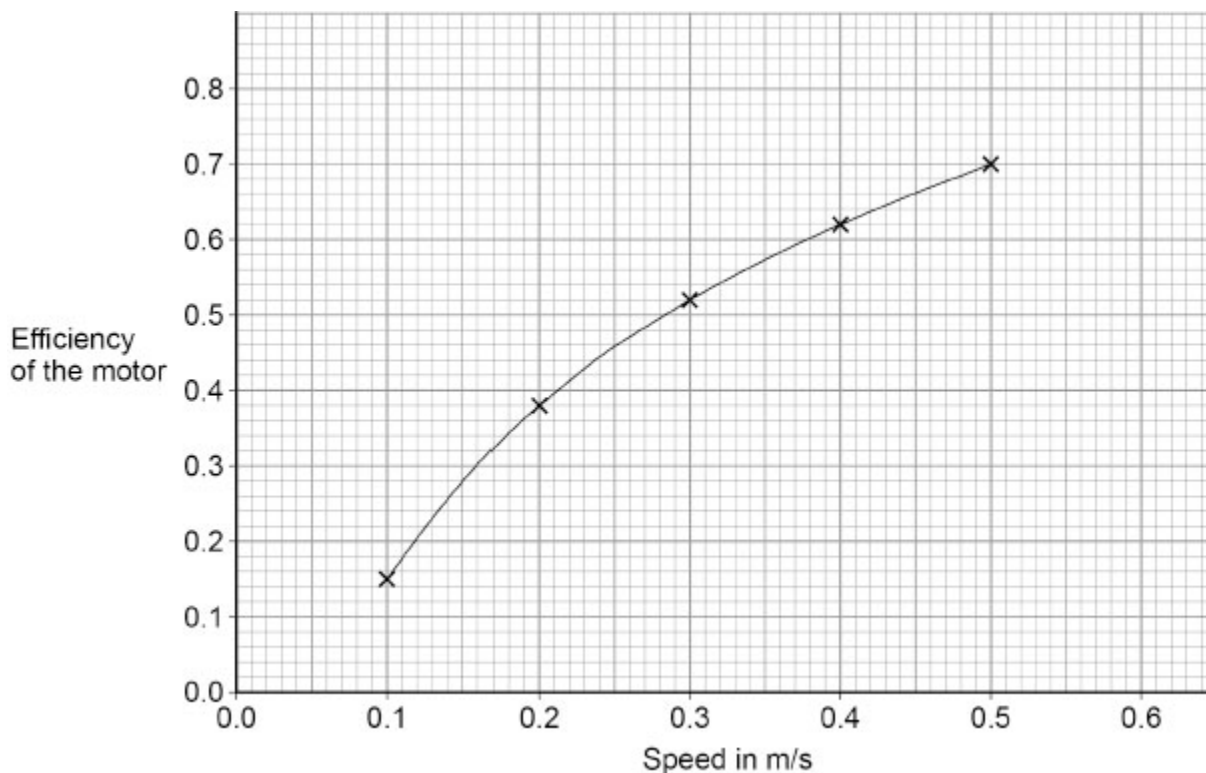
(3)

The student adjusted the speed at which the mass was lifted.

For each speed, the student determined the efficiency of the motor.

**Figure 2** shows the results.

**Figure 2**



(e) Use **Figure 2** to predict the efficiency of the motor when the speed is 0.6 m/s.

Efficiency = \_\_\_\_\_

(1)

(f) How does **Figure 2** show that the efficiency of the motor is **not** directly proportional to the speed?

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(1)

(Total 10 marks)

**3.** A student investigated how the current in an LED varies with the potential difference across the LED.

**Figure 1** shows the circuit used.

**Figure 1**

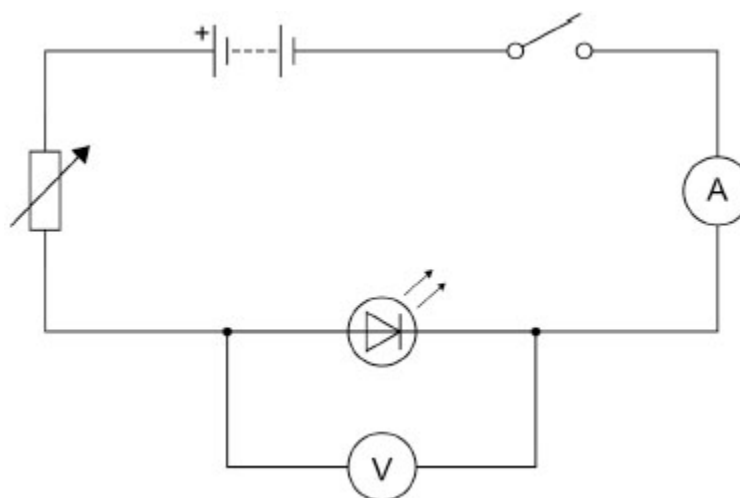
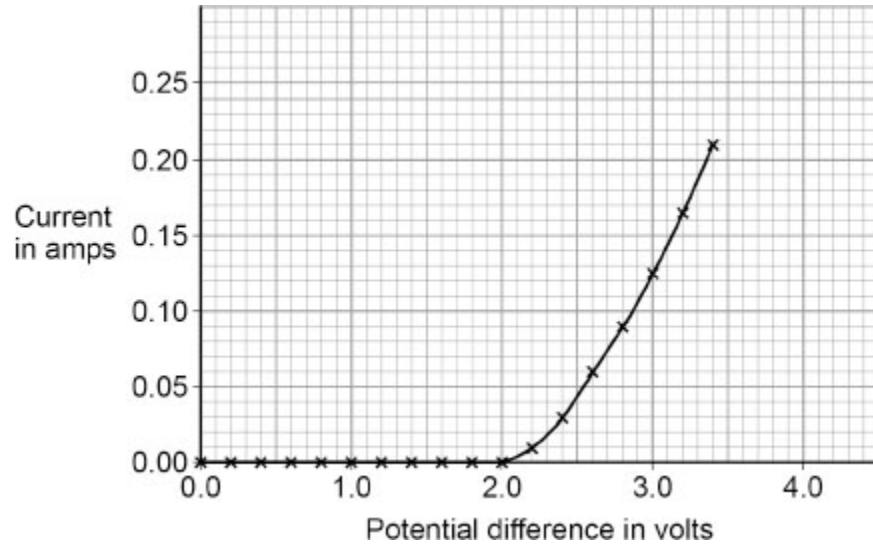


Figure 2 shows the results.

Figure 2



(a) Give **one** way the student could have varied the potential difference across the LED.

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(1)

Use the Physics Equations Sheet to answer parts (b) and (c).

(b) Which of the following equations links current ( $I$ ), potential difference ( $V$ ) and resistance ( $R$ )?

Tick (✓) **one** box.

$$V = I^2 \times R$$

$$V = I \times R$$

$$V = \frac{I}{R}$$

$$V = \frac{R}{I}$$

(1)

- (c) Determine the resistance of the LED when the potential difference across the LED was 3.0 V.

Use **Figure 2**.

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Resistance = \_\_\_\_\_  $\Omega$

**(4)**

- (d) The student reversed the connections to the power supply and varied the potential difference across the LED.

Explain why the ammeter displayed a value of 0.0 A for all the values of potential difference the student used.

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**(2)**

**(Total 8 marks)**

4.

**Figure 1** shows a battery-powered hand warmer that contains a heating pad. The battery transfers energy to increase the temperature of the heating pad.

**Figure 1**



(a) The heating pad has a mass of 0.20 kg.

When the hand warmer was switched on, the energy transferred to the heating pad was 8000 J.

specific heat capacity of heating pad = 1600 J/kg °C

Calculate the temperature increase of the heating pad.

Use the Physics Equations Sheet.

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Temperature increase = \_\_\_\_\_ °C

(3)

(b) The hand warmer was powered by a 5.0 V battery.

The battery transferred 180 kJ of energy to the heating pad.

Calculate the charge flow through the battery.

Use the Physics Equations Sheet.

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Charge flow = \_\_\_\_\_ C

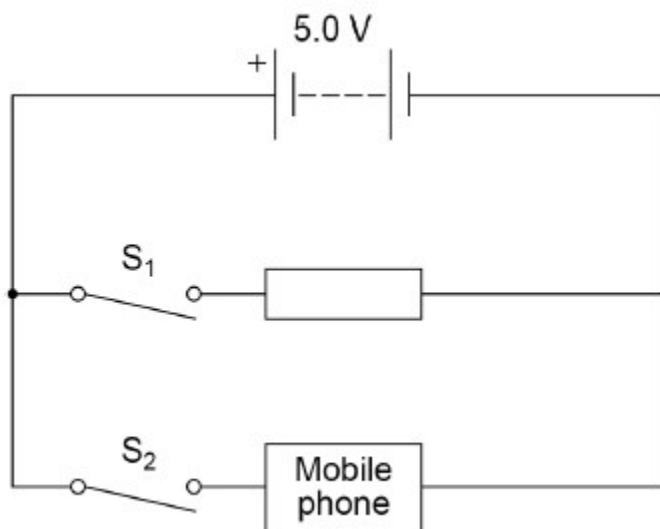
**(4)**

- (c) The circuit inside the hand warmer can be connected to a mobile phone to recharge the mobile phone.

**Figure 2** shows the circuit diagram when the hand warmer is connected to a mobile phone.

The heating pad of the hand warmer is represented by the resistor symbol.

**Figure 2**



Explain how closing both switches S<sub>1</sub> and S<sub>2</sub> affects the power output of the battery compared with only closing switch S<sub>1</sub>.

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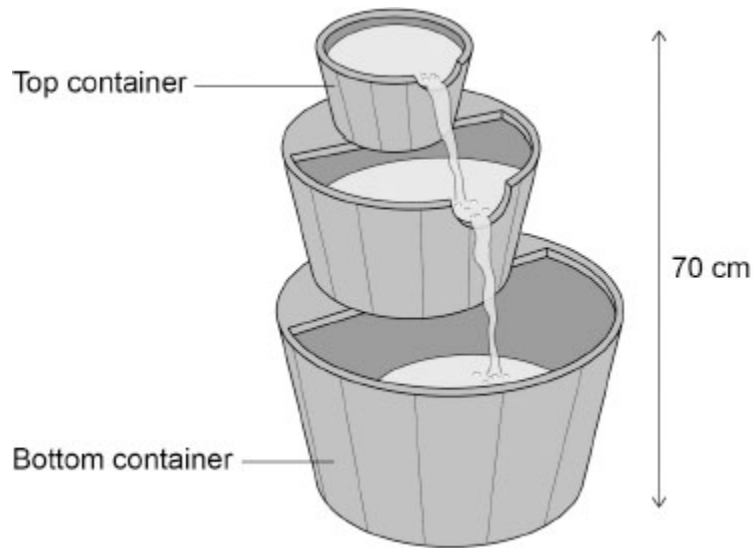
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(3)  
(Total 10 marks)

**5.** The figure below shows a garden water feature.



The water feature has an electric motor that pumps water from the bottom container to the top container.

(a) The pump transfers 0.343 J of gravitational potential energy to the water each second.

gravitational field strength = 9.8 N/kg

Determine the mass of water passing through the pump each second.

Use the Physics Equations Sheet.

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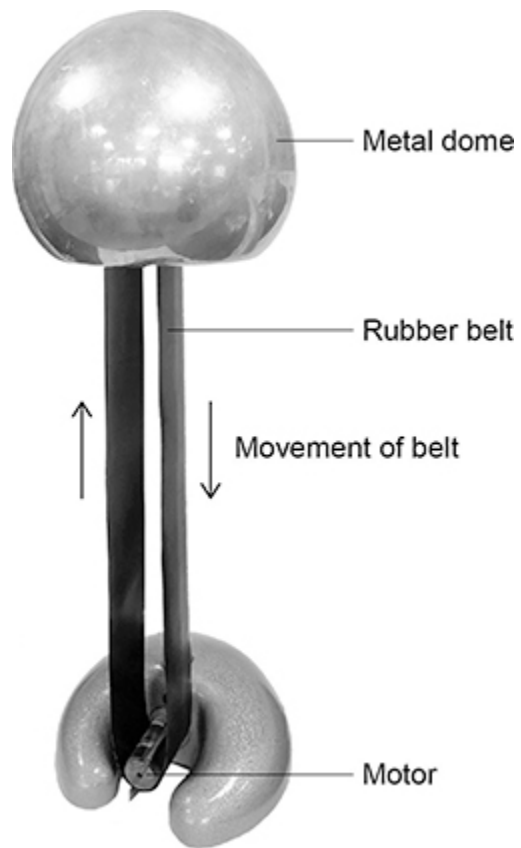
Mass = \_\_\_\_\_ kg

**(4)**



6. **Figure 1** shows a static electricity generator.

**Figure 1**



The rubber belt is turned by a motor.

As the rubber belt moves, charge is transferred from the rubber belt to the metal dome.

**Figure 2** shows a student touching the metal dome of the static electricity generator.

The dome is negatively charged.

**Figure 2**



(a) Complete the sentence.

Choose the answer from the box.

<b>negative</b>	<b>neutral</b>	<b>positive</b>
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When the student touches the negatively charged metal dome the student s hair gains a \_\_\_\_\_ charge.

**(1)**

(b) Complete the sentence.

Choose the answer from the box.

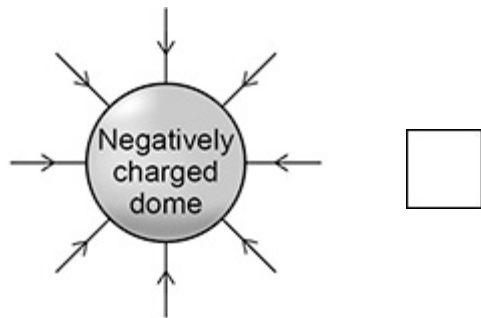
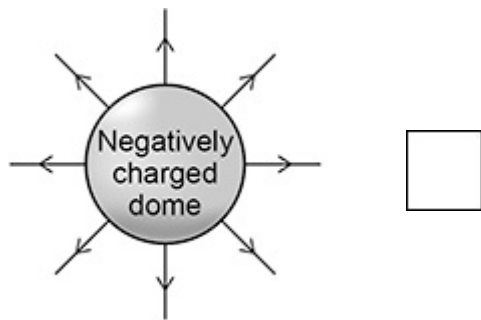
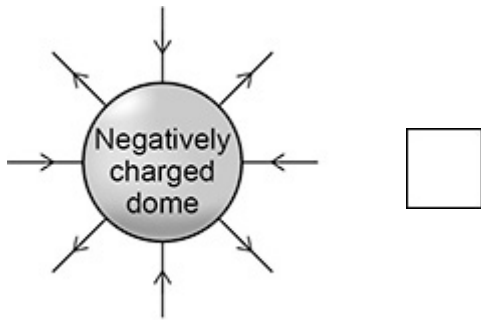
<b>attraction</b>	<b>gravity</b>	<b>repulsion</b>
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The hair on the student s head stands up because the strands of hair experience forces of \_\_\_\_\_ .

**(1)**

(c) Which of the following diagrams shows the electric field pattern around the negatively charged metal dome?

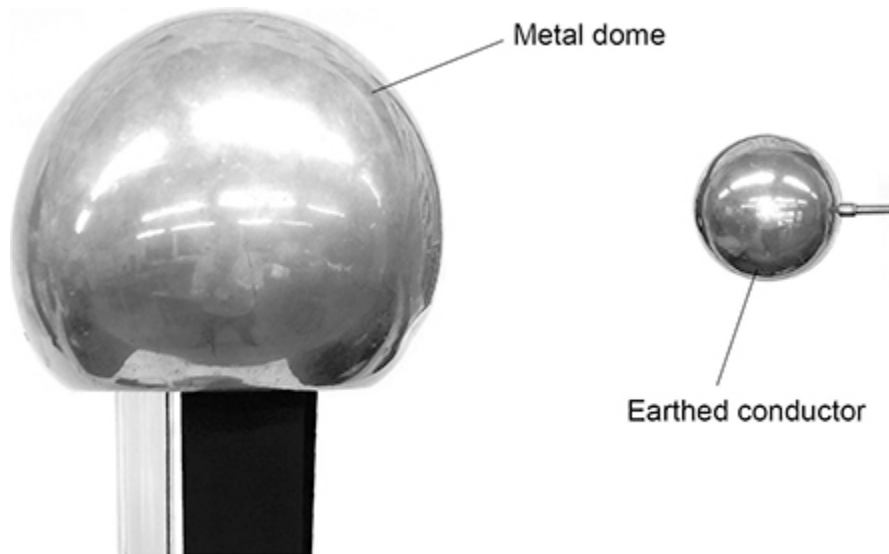
Tick (✓) **one** box.



(1)

Figure 3 shows the negatively charged metal dome and an earthed conductor.

Figure 3



(d) The air between the dome and the earthed conductor is an insulator.

Complete the sentence.

Choose the answer from the box.

<b>efficiency</b>	<b>resistance</b>	<b>temperature</b>
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The air between the dome and the earthed conductor has

a high \_\_\_\_\_.

(1)

The earthed conductor is moved closer to the metal dome.

A spark jumps from the dome to the earthed conductor.

(e) Complete the sentence.

Choose the answer from the box.

<b>earthed</b>	<b>ionised</b>	<b>neutral</b>
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The spark jumps because the air around the charged dome has

become \_\_\_\_\_.

(1)

- (f) Which particles are transferred when the spark jumps from the negatively charged metal dome to the earthed conductor?

Tick (✓) **one** box.

Electrons

Neutrons

Protons

(1)

- (g) The potential difference between the metal dome and earth is 300 000 V.

When the spark jumps there is a charge flow of 0.000 002 C.

Calculate the energy transferred by the spark.

Use the equation:

$$\text{energy transferred} = \text{charge flow} \times \text{potential difference}$$

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$$\text{Energy transferred} = \text{_____} \text{ J}$$

(2)

(Total 8 marks)

7.

Figure 1 shows a student putting a coin into a vending machine that sells food.

Figure 1



The vending machine is connected to the mains electricity supply.

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

Tick (✓) **one** box.

- 50 hertz
- 60 hertz
- 100 hertz

(1)

(b) What is the potential difference of the mains electricity supply in the UK?

Tick (✓) **one** box.

12 volts

230 volts

20 000 volts

(1)

The vending machine identifies the value of the coin by measuring the resistance of the coin.

(c) The machine applies a potential difference of 0.45 V across the coin.

The current in the coin is 0.75 A.

Calculate the resistance of the coin.

Use the equation:

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

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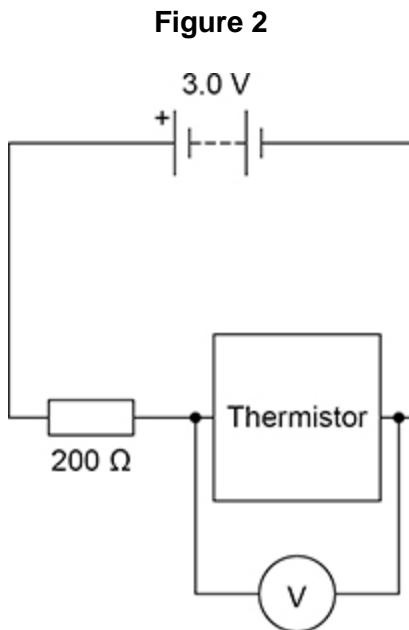
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Resistance = \_\_\_\_\_  $\Omega$

(2)

The temperature inside the vending machine is monitored using an electrical circuit.

Figure 2 shows part of the circuit.



(d) The circuit symbol for the thermistor is wrong.

What is the circuit symbol for a thermistor?

Tick (✓) **one** box.

	<input type="checkbox"/>
	<input type="checkbox"/>
	<input type="checkbox"/>

(1)

(e) How could the potential difference (pd) across the resistor be calculated?

Tick (✓) **one** box.

pd across battery – pd across thermistor

pd across battery + pd across thermistor

pd across battery  $\times$  pd across thermistor

pd across battery  $\div$  pd across thermistor

(1)

(f) At one temperature, the thermistor in **Figure 2** has a resistance of 200  $\Omega$ .

What is the potential difference across the thermistor at this temperature?

Give a reason for your answer.

Tick (✓) **one** box.

0.0 V

1.0 V

1.5 V

2.0 V

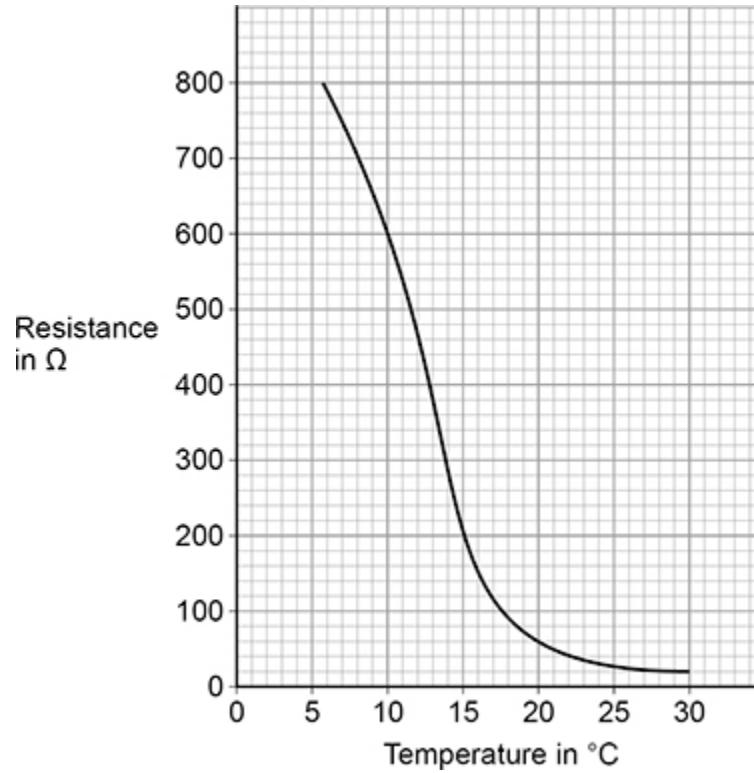
Reason \_\_\_\_\_

\_\_\_\_\_

(2)

Figure 3 shows how the resistance of the thermistor varies with temperature.

Figure 3



- (g) When the temperature of the thermistor is 10 °C, the resistance of the thermistor is 600 Ω.  
Calculate the change in resistance when the temperature increased from 10 °C to 15 °C.

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Change in resistance = \_\_\_\_\_ Ω

(2)

(Total 10 marks)

## Mark schemes

1.

(a) (earth wire) green and yellow

1

(live wire) brown

1

(neutral wire) blue

1

(b)



1

(c)

$$\text{potential difference} = \frac{2420}{11.0}$$

1

potential difference = 220 (V)

1

(d)

$$\text{resistance} = \frac{2420}{11^2}$$

1

resistance = 20 ( $\Omega$ )

1

(e) a greater percentage of energy is usefully transferred by kettle **A**

1

kettle **A** takes less time to boil the same volume of water

1

**[10]**

2.

(a)

$$\text{current} = \frac{6.0}{12}$$

1

current = 0.50 (A)

1

(b) energy transferred =  $6.0 \times 8.0$

1

energy transferred = 48 (J)

1

(c) 
$$\text{efficiency} = \frac{\text{useful output energy transfer}}{\text{total input energy transfer}}$$
 1

(d) 
$$0.70 = \frac{1.96}{\text{total input energy transfer}}$$
 1

$$\text{total input energy transfer} = \frac{1.96}{0.70}$$
 1

total input energy transfer = 2.8 (J) 1

(e) 0.74 to 0.78 inclusive 1

(f) the line is curved  
or  
the line does not pass through the origin  
*allow the line is not straight*  
*allow the line is not linear* 1

[10]

**3.** (a) any **one** from:

- change the resistance of the variable resistor
  - change the number of cells in the battery
  - change the potential difference of the power supply / pack
  - add additional resistors / components to the circuit
- allow use the variable resistor*  
*allow add another battery*  
*allow use a battery with a higher / lower potential difference*

1

(b)  $V = I \times R$  1

(c)  $I = 0.125 \text{ (A)}$

*allow a value in the range 0.12 (A) to 0.13 (A)*

1

$$3.0 = 0.125 \times R$$

*allow a correct substitution using a value of current in the range 0.10 (A) to 0.15 (A)*

1

$$R = \frac{3.0}{0.125}$$

*allow a correct rearrangement using a value of current in the range 0.10 (A) to 0.15 (A)*

1

$$R = 24 \text{ (}\Omega\text{)}$$

*allow a correct calculation using a value of current in the range 0.10 (A) to 0.15 (A)*

1

(d) (the LED / circuit has a) large resistance

1

in the reverse direction

*MP2 dependent on MP1*

*if no other marks scored allow 1 mark for: LEDs only allow current in one direction*

1

**[8]**

**4.**

(a)  $8000 = 0.20 \times 1600 \times \Delta\theta$

1

$$\Delta\theta = \frac{8000}{(0.20 \times 1600)}$$

1

$$\Delta\theta = 25 \text{ (}^\circ\text{C)}$$

1

(b)  $E = 180\,000 \text{ (J)}$

*all subsequent marks can score using an incorrectly / not converted value of E*

1

$$180\,000 = Q \times 5.0$$

1

$$Q = \frac{180\,000}{5.0}$$

1

$$Q = 36\,000 \text{ (C)}$$

1

(c) (when both switches are closed) the resistance of the circuit decreases

1

(so) current increases

*MP2 dependent on MP1*

1

(so) power output is greater as potential difference across the battery remains the same and  $P = IV$

*ignore reference to  $P = I^2R$  unless a quantitative comparison is included*

1

[10]

5.

(a)  $h = 0.70$  (m)

*all subsequent marks can score using an incorrectly / not converted value of  $h$*

1

$$0.343 = m \times 9.8 \times 0.70$$

1

$$m = \frac{0.343}{9.8 \times 0.70}$$

1

$$m = 0.050 \text{ (kg)}$$

1

(b)  $4.86 = I^2 \times 6.0$

1

$$I^2 = \frac{4.86}{6.0}$$

1

$$I = 0.90 \text{ (A)}$$

1

$$t = 1800 \text{ (s)}$$

*all subsequent marks can score using an incorrectly / not converted value of  $t$*

1

$$Q = 0.90 \times 1800$$

*allow a correct substitution using their value of current*

1

$$Q = 1620 \text{ (C)}$$

*allow a correct calculation using their value of current  
allow an answer of 1600 (C)*

1

(c) greater mass / volume of water each second

*allow water flow will increase*

*ignore increased water speed*

1

(because) smaller proportion / percentage of energy is wasted

*allow greater (useful) power output*

*allow less energy / power wasted*

1

[12]

6.

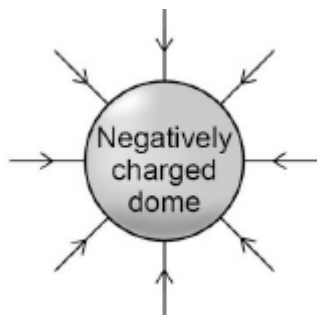
(a) negative

1

(b) repulsion

1

(c)



1

(d) resistance

1

(e) ionised

1

(f) electrons

1

(g) energy transferred =  $0.000\ 002 \times 300\ 000$

1

energy transferred = 0.6 (J)

1

[8]

7.

(a) 50 hertz

1

(b) 230 volts

1

(c)

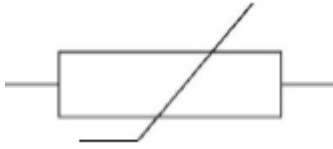
$$\text{resistance} = \frac{0.45}{0.75}$$

1

$$\text{resistance} = 0.60 \text{ } (\Omega)$$

1

(d)



1

(e) pd across battery - pd across thermistor

1

(f) 1.5 V

1

(thermistor has the) same resistance as resistor

**or**

both (components) have a resistance of 200 ( $\Omega$ )

*MP2 dependent on scoring MP1*

*allow pd shared equally (between components of equal resistance)*

*allow pd will be half (of the total pd)*

1

(g) resistance at 15 °C = 200 ( $\Omega$ )

1

change in resistance = 400 ( $\Omega$ )

*allow a correct change in resistance from a misread resistance  
within the range 180 to 220  $\Omega$*

1

**[10]**