Electricity part 7 AQA Triple Physics

Name: _____

Class: _____

Date: _____

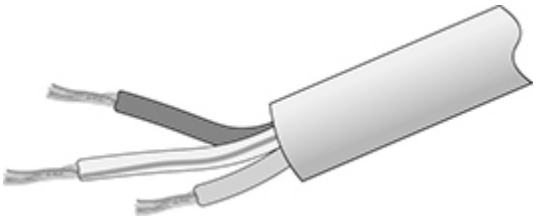
Time: **74 minutes**

Marks: **70 marks**

Comments:

1. An electrical appliance is connected to the mains electricity supply using a three-core cable.

The figure below shows a three-core cable.



(a) What colour is the insulation covering the live wire inside the cable?

Tick (✓) **one** box.

- Blue ☐
- Brown ☐
- Green and yellow ☐
- Orange ☐

(1)

(b) What colour is the insulation covering the neutral wire inside the cable?

Tick (✓) **one** box.

- Blue ☐
- Brown ☐
- Green and yellow ☐
- Orange ☐

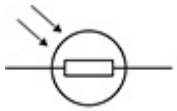
(1)

The plug connected to the cable contains a fuse.

A fuse contains a wire that is designed to melt when the current is too great.

(c) What is the circuit symbol for a fuse?

Tick (✓) **one** box.



☐

☐

☐

(1)

(d) The wire in the fuse melts when there is a charge flow of 2.0 C in a time of 0.40 s.

Calculate the current in the wire when it melts.

Use the equation:

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

Current = _____ A

(2)

(e) The mass of the wire is 0.016 g.

specific latent heat of fusion of the wire = 60 000 J/kg

Calculate the change in thermal energy needed to melt the wire.

Use the Physics Equations Sheet.

_____

_____

_____

_____

_____

Change in thermal energy = _____ J

(3)

(f) The fuse transfers some energy to the surroundings as it melts.

How does transferring energy to the surroundings affect the total energy needed to melt the fuse?

Tick (✓) **one** box.

The total energy will be smaller. ☐

The total energy will be the same. ☐

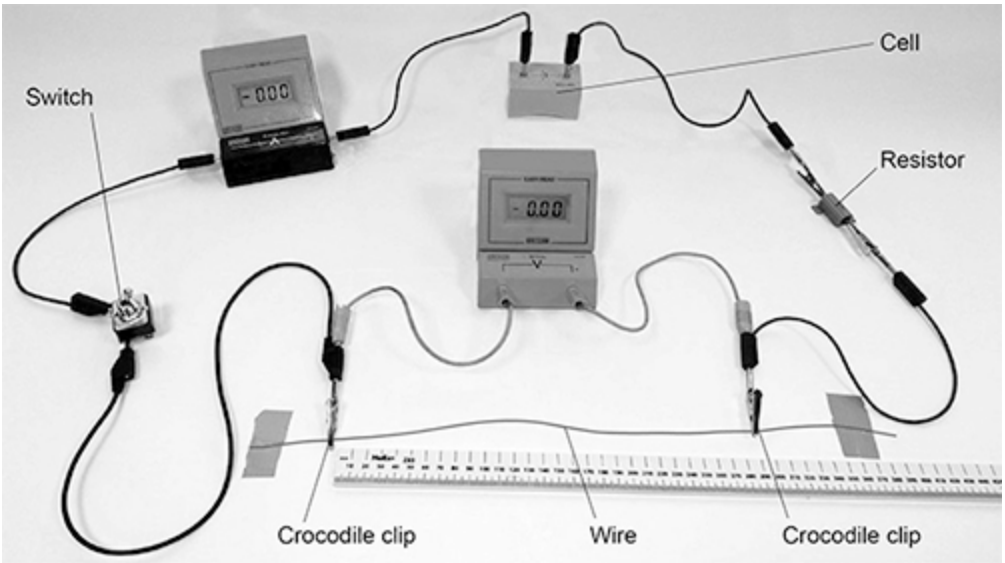
The total energy will be greater. ☐

(1)

(Total 9 marks)

2. A student investigated how the length of a wire affects the resistance of the wire at constant temperature.

The figure below shows the circuit used.



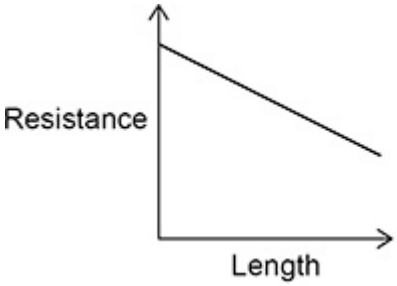
(a) The student plotted a graph of resistance against the length of wire.

Describe a method the student could have used to collect the data needed to plot the graph.

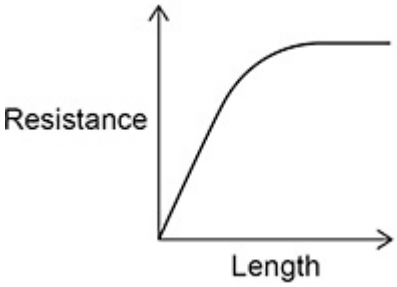
(6)

(b) Which graph shows the relationship between the resistance of a wire at constant temperature and its length?

Tick (✓) **one** box.



☐



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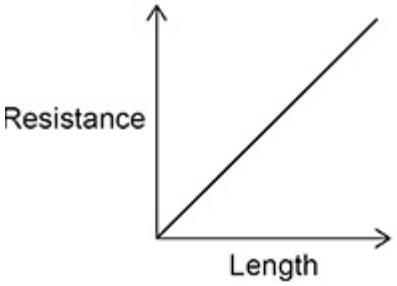


☐

(1)

(c) The student used a cell that had a potential difference of 1.50 V.

Explain why the cell was **not** an electrical hazard to the student in the investigation.

_____

_____

_____

_____

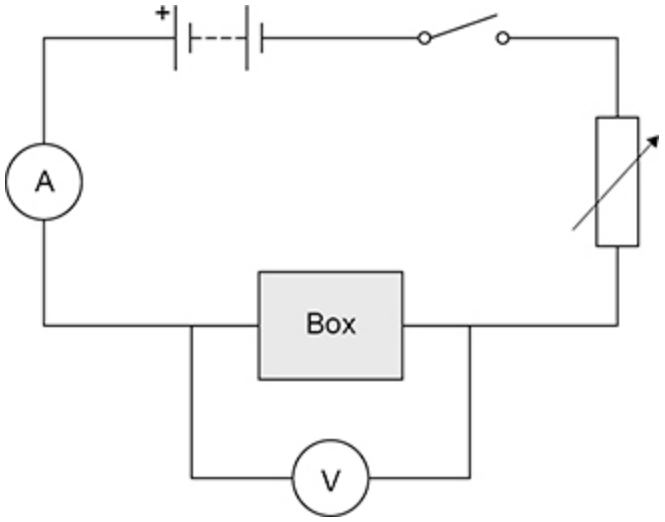
(2)

(Total 9 marks)

3. A student had an unknown electrical component inside a sealed box.

Figure 1 shows the circuit the student used to identify the component.

Figure 1



The student varied the potential difference across the component and measured the current in the component.

The table below shows the results when the potential difference across the component was 6.0 V.

Potential difference in volts	**Current in amps**			
	1st reading	2nd reading	3rd reading	**Mean**
6.0	0.26	0.21	0.25	**X**

(a) Calculate value **X** in above table.

_____

_____

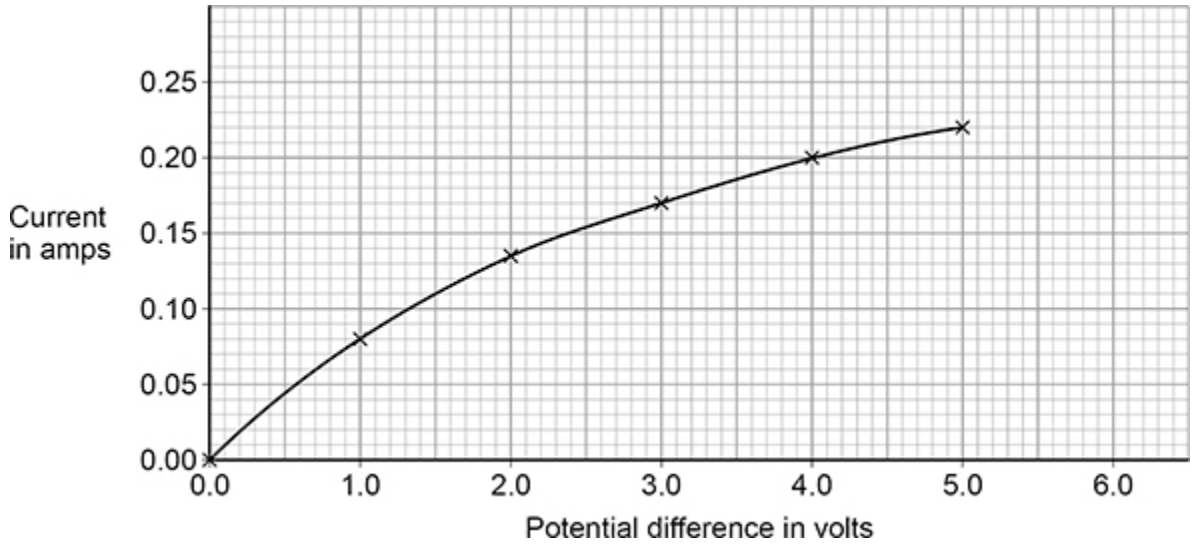
_____

X = _____ A

(2)

Figure 2 shows the results.

Figure 2



(b) Calculate the power of the component when the potential difference across the component is 3.0 V.

Use **Figure 2** and the equation:

power = potential difference × current

Power = _____ W

(3)

(c) Complete the sentence.

Choose the answer from the box.

decreases	**stays the same**	**increases**

As the potential difference across the component increases, the gradient of the graph _____.

(1)

(d) What is the component in the sealed box?

Tick (✓) **one** box.

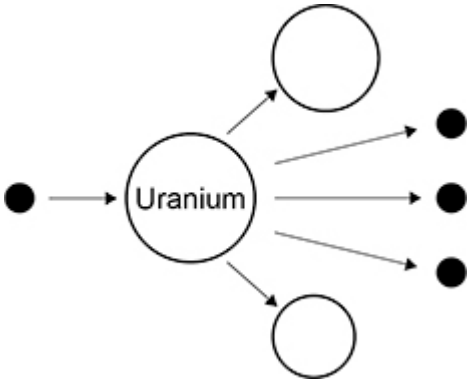
Diode	☐
Filament lamp	☐
Resistor at constant temperature	☐

(1)

(Total 7 marks)

4. The process of nuclear fission is used in nuclear power stations.

The figure below shows the process of nuclear fission.



(a) Complete the sentences.

Choose answers from the box.

electrons	**gamma rays**	**neutrons**	**nuclei**	**protons**

In nuclear power stations, energy is released from uranium

_____ .

The uranium in above figure splits into two parts and releases three

_____ .

The process of nuclear fission releases electromagnetic radiation in the form of

_____.

(3)

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

(b) Write down the equation which links energy (*E*), power (*P*) and time (*t*).

_____

(1)

(c) A nuclear power station has a power output of 500 MW.

Calculate the energy output in 3600 s.

Give your answer in J.

_____

_____

_____

_____

_____

Energy output = _____ J

(3)

(d) Radioactive waste produced by nuclear power stations has a long half-life.

Suggest **one** precaution taken to reduce the hazard caused by radioactive waste from power stations.

_____

_____

_____

(1)

(e) Nuclear power stations do **not** generate electricity every day of the year.

One nuclear power station generated electricity for 92% of a year.

one year = 365 days

Calculate the number of days during the year that the nuclear power station generated electricity.

_____

_____

_____

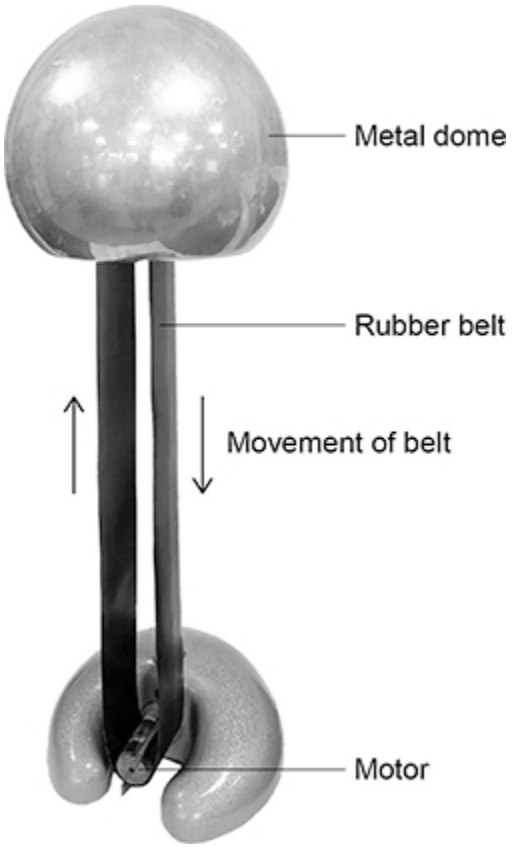
Number of days = _____

(2)

(Total 10 marks)

5. **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.

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

The dome is negatively charged.

Figure 2

Explain why the student s hair stands up on end.

_____

_____

_____

_____

_____

_____

(3)

The charged metal dome creates an electric field.

(b) What is an electric field?

_____

_____

_____

(1)

(c) How does the electric field strength vary as the distance from the charged metal dome increases?

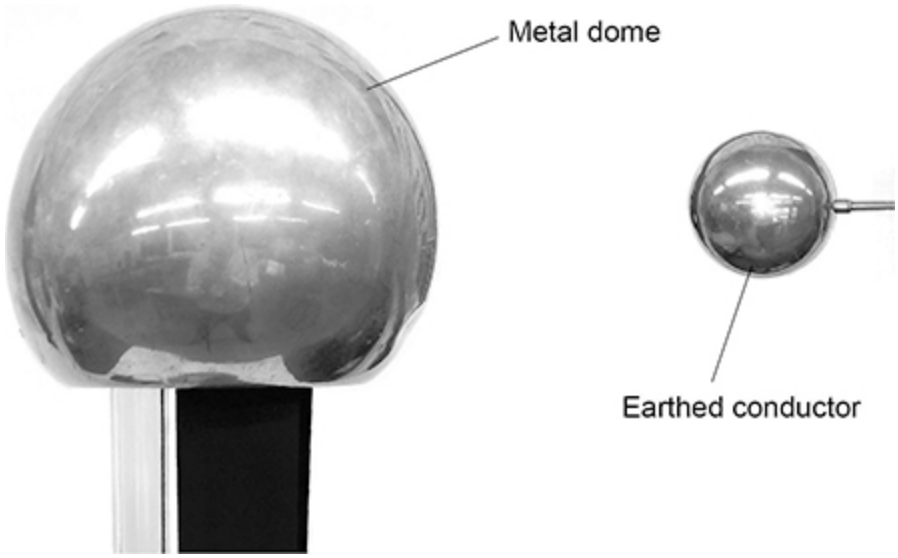
_____

_____

(1)

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

Figure 3



When the earthed conductor is moved towards the metal dome, there is a spark between the dome and the earthed conductor.

(d) The spark transfers 0.60 J of energy, and 2.0 μC of charge is transferred from the dome to the earthed conductor.

Calculate the potential difference between the metal dome and the earthed conductor.

Use the Physics Equations Sheet.

Potential difference = _____ V

(4)

(e) Which of the following changes would increase the distance a spark can jump between the dome and the earthed conductor?

Tick (✓) **one** box.

- Decreased charge on the metal dome ☐
- Decreased electric field strength ☐
- Decreased electrical resistance of air ☐
- Decreased potential difference ☐

(1)

(Total 10 marks)

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

Figure 1

(a) The vending machine is connected to the mains electricity supply.

What is the frequency and the potential difference of the mains electricity supply in the UK?

Frequency = _____ Hz

Potential difference = _____ V

(2)

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

(b) The power dissipated by the coin is 340 mW when the current in the coin is 0.75 A.

Calculate the resistance of the coin.

Use the Physics Equations Sheet.

_____

_____

_____

_____

_____

_____

Resistance = _____ Ω

(4)

(c) Coins that are dirty are **not** recognised by the vending machine.

Suggest **one** reason why.

_____

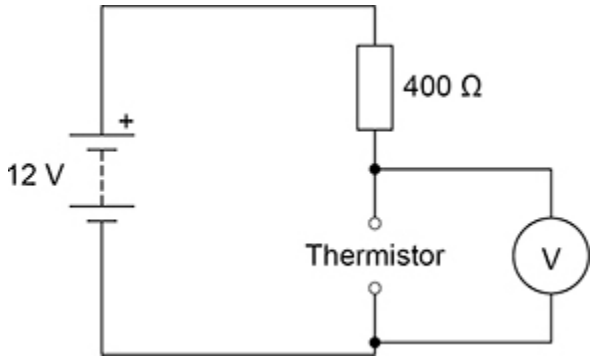
_____

_____

(1)

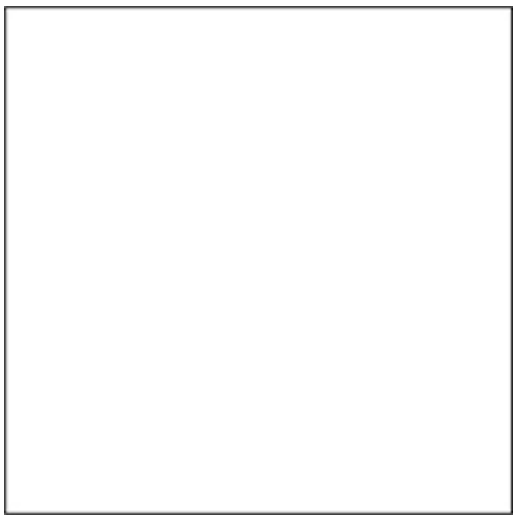
Figure 2 shows part of a different circuit that is used to monitor the temperature inside the vending machine.

Figure 2



(d) The circuit symbol for a thermistor has not been included.

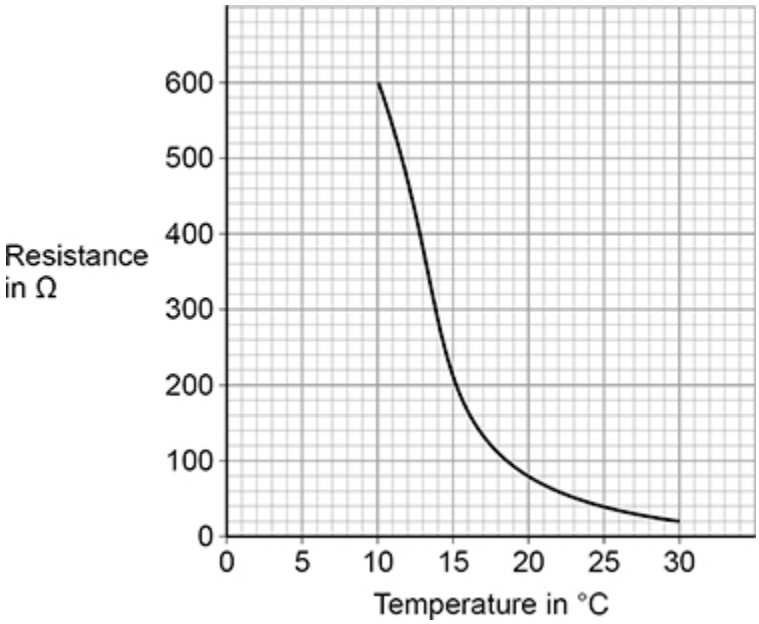
Draw the circuit symbol for a thermistor in the box below.



(1)

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

Figure 3



(e) The cooling system inside the vending machine turns on when the temperature of the thermistor is above 20 °C.

Determine the potential difference across the thermistor when the temperature is 20 °C.

Use the Physics Equations Sheet.

Potential difference = _____ V

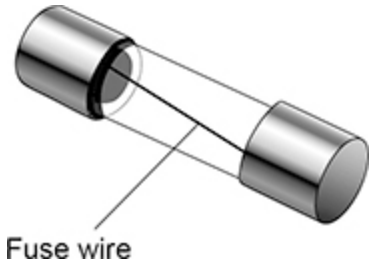
(5)

(Total 13 marks)

7. The live wire in a three-core cable is connected to a fuse inside a plug.

A fuse contains a wire that is designed to melt when the current gets too great.

The figure below shows a fuse.

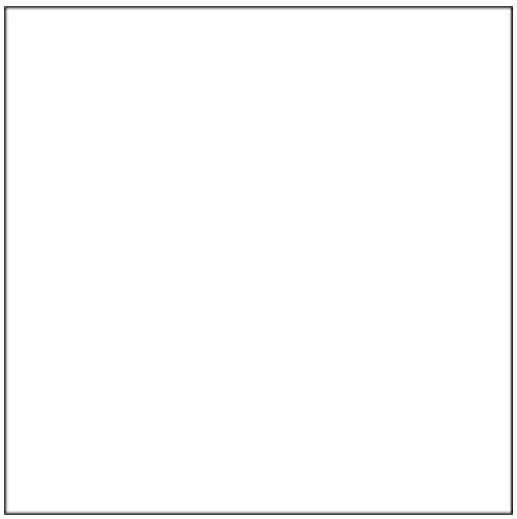


(a) What colour is the insulation covering the live wire in a three-core cable?

_____

(1)

(b) Draw the circuit symbol for a fuse in the box below.



(1)

(c) The fuse wire melts when there is a charge flow of 2.0 C for 400 ms.

Calculate the current in the fuse wire.

Use the Physics Equations Sheet.

Current = _____ A

(4)

(d) When the fuse wire is at its melting point, the additional energy needed to melt the wire is 1.02 J.

specific latent heat of fuse wire = 60 kJ/kg

Calculate the mass of the fuse wire.

Use the Physics Equations Sheet.

Mass = _____ kg

(4)

(e) The calculation in part (d) assumes there is no energy transferred to the surroundings.

How would the time taken for the wire to melt be affected if some energy was transferred to the surroundings?

Give a reason for your answer.

Tick (✓) **one** box.

Time taken would decrease	☐
Time taken would stay the same	☐
Time taken would increase	☐

Reason _____

_____

_____

(2)

(Total 12 marks)

1.

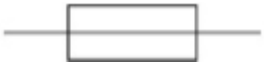
(a) brown

1

(b) blue

1

(c)



1

(d)

$$\text{current} = \frac{2.0}{0.40}$$

1

current = 5.0 (A)

1

(e) m = 0.000016 (kg)
or
$m = 1.6 \times 10^{-5}$ (kg)

1

E = 0.000016 × 60 000

allow a correct substitution using an incorrectly / not converted value of m

1

E = 0.96 (J)

allow an answer consistent with an incorrectly / not converted value of m

1

(f) the total energy will be greater

1

[9]

2.

(a) **Level 3**: The method would lead to the production of a valid outcome. The key steps are identified and logically sequenced.

5–6

Level 2: The method would not necessarily lead to a valid outcome. Most steps are identified, but the method is not fully logically sequenced.

3–4

Level 1: The method would not lead to a valid outcome. Some relevant steps are identified, but links are not made clear.

1–2

No relevant content

0

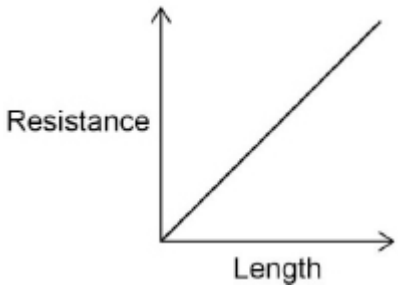
Indicative content

- measure the length of the wire (between the crocodile clips) using the ruler
- length varied by moving crocodile clips
- current measured with ammeter
- potential difference measured with voltmeter
- calculate resistance for each length
- use $V = IR$ to calculate resistance
- record current and pd for different lengths

- repeat readings of current and pd for each length and mean values calculated
- remove any anomalous readings
- ensure values of current are low to minimise heating of wire
- ensure circuit is disconnected between readings

Level 2:
Varying the length of the wire. Measurements / equipment needed for pd and current.

(b)



1

(c) potential difference is (very) low

1

(so) no risk of electric shock
or
(so) no risk of electrocution

allow less risk of electric shock
allow so wire won't melt
allow so wire won't get hot

1

[9]

3. (a)

$$\mathbf{X} = \frac{0.26 + 0.21 + 0.25}{3}$$

1

X = 0.24 (A)

allow $\mathbf{X} = \frac{0.26 + 0.25}{2} = 0.255$

for 2 marks

1

(b) current = 0.17 (A)

1

power = 3.0 × 0.17

allow a correct substitution using a value of I in the range 0.16 to 0.18 A

1

power = 0.51 (W)

allow an answer consistent using a value of I in the range 0.16 to 0.18 A

*answers of 0.456, 5.1 or 51 score **2** marks*

1

(c) decreases

1

(d) filament lamp

1

[7]

4. (a) nuclei

1

neutrons

1

gamma rays

this order only

1

(b) energy = power × time
or
$E = P \times t$

1

(c) P = 500 000 000 (W)

1

E = 500 000 000 × 3600

allow a correct substitution of an incorrectly / not converted value of P

1

E = 1 800 000 000 000 (J)
or
$E = 1.8 \times 10^{12}$ (J)

allow an answer consistent with an incorrectly / not converted value of P

1

(d) any **one** from:

- bury the radioactive waste
- put the radioactive waste in cooling ponds

  allow store it for (at least) one half-life
- transport the radioactive waste in secure vessels
- store the radioactive waste in metal containers
- cover the radioactive waste in concrete

  ignore references to high / medium / low level waste

  ignore label the waste as hazardous

1

(e)

number of days = $\frac{92}{100} \times 365$

1

number of days = 335.8

allow answers of 335 and 336 days

allow an answer of 29.2 (days) for 1 mark

1

[10]

5. (a) <u>electrons</u> are transferred to the student

1

(so) her hair is negatively charged

allow each hair has the same (negative) charge

1

(and) like charges repel

do not accept student being positively charged for MP1 and MP2

1

(b) the region (around a charged object) where another charged object experiences a force

allow space / area for region

allow particle for object

1

(c) (electric field strength) decreases

1

(d) $Q = 2 \times 10^{-6}$ (C)

1

$0.6 = 2 \times 10^{-6} \times V$

allow a correct substitution of an incorrectly / not converted value of Q

1

$V = \frac{0.6}{2 \times 10^{-6}}$

allow a correct rearrangement of an incorrectly / not converted value of Q

1

V = 300 000 (V)

allow an answer consistent with an incorrectly / not converted value of Q

1

(e) decreased electrical resistance of air

1

[10]

6. (a) 50 (Hz)

1

230 (V)

this order only

1

(b) 340 mW = 0.34 W

1

$0.34 = 0.75^2 \times R$

allow a correct substitution of an incorrectly / not converted value of P

1

$R = \frac{0.34}{0.75^2}$

allow a correct rearrangement of an incorrectly / not converted value of P

1

R = 0.60 (Ω)

allow an answer consistent with an incorrectly / not converted value of P

allow a correct answer given to more than 2 sf

1

(c) the dirt changes the (measured) resistance of the coin

or

the (measured) resistance is different from the expected resistance (of the coin)

allow the measured resistance does not match the resistance of a known coin

allow dirt stops charge flow (through the coin)

allow dirt stops the current (in the coin)

1

(d)

1

(e) R_{Total} = 400 + 80 (= 480 Ω)

1

12 = I × 480

or

$I = \frac{12}{480}$

allow a correct substitution / rearrangement with R_{Total} in range 470 - 490 Ω

1

I = 0.025 (A)

allow a correct calculation using R_{Total} in range 470 - 490 Ω

1

V = 0.025 × 80

allow a correct substitution using their calculated value of I (using V = IR) and R_{Th} in range 70 - 90 Ω

1

V = 2.0 (V)

allow a correct calculation using their calculated value of I (using V = IR) and R_{Th} in range 70 - 90 Ω

OR

total R = 400 + 80 (= 480) (1)

ratio (Th:R) = 80:480 (1)

ratio = 1:6 (1)

$V = \frac{1}{6} \times 12$ (1)

V = 2.0 (V) (1)

allow a range of R_{Th} between 70 and 90 Ω

allow a correct ratio using a value of R_{Th} between 70 and 90 Ω

allow a correct substitution using a value of R_{Th} between 70 and 90 Ω

allow an answer in the range 1.8 (V) to 2.2 (V)

1

[13]

7. (a) brown

1

(b)

1

(c) t = 0.400 (s)

1

2.0 = I × 0.400

allow a correct substitution of an incorrectly / not converted value of t

1

$$I = \frac{2.0}{0.400}$$

allow a correct rearrangement using an incorrectly / not converted value of t

1

I = 5.0 (A)

allow an answer consistent with an incorrectly / not converted value of t

1

(d) L = 60 000 (J/kg)

allow full credit for a correct method using E = 0.00102 (kJ)

1

1.02 = m × 60 000

allow a correct substitution of an incorrectly / not converted value of L

1

$$m = \frac{1.02}{60\,000}$$

allow a correct rearrangement using an incorrectly / not converted value of L

1

$m = 1.7 \times 10^{-5}$ (kg)

allow an answer consistent with an incorrectly / not converted value of L

1

(e) time taken would increase

1

more energy would need to be transferred (in total)

MP2 dependent on scoring MP1

1

[12]