

Electricity 2

Name: _____

Class: _____

Date: _____

Time: **88 minutes**

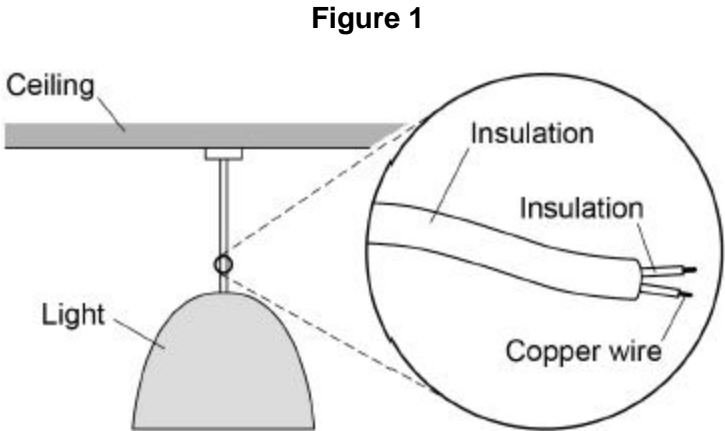
Marks: **83 marks**

Comments:

1.

Some ceiling lights in the home are connected to the mains by a two-core cable.

Figure 1 shows a ceiling light.



(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.

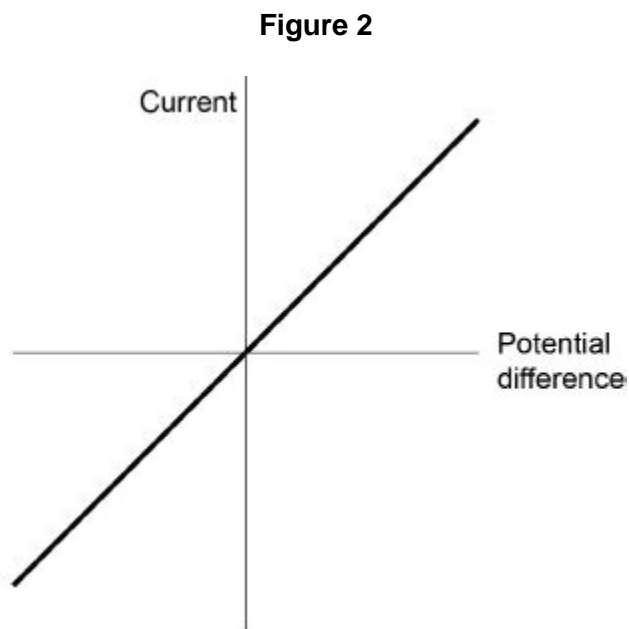
Calculate the charge flow through the wire.

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.



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)

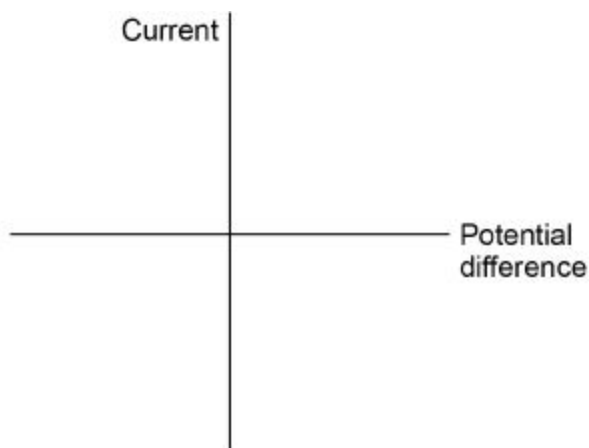
(Total 13 marks)

2.

A student built a circuit using filament lamps.

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

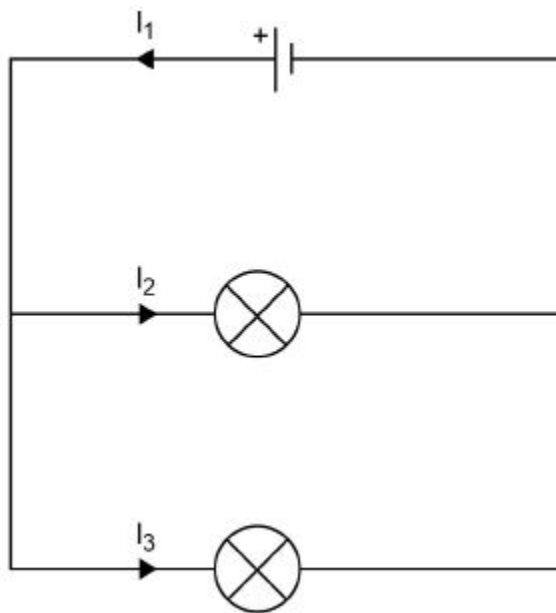
Figure 1



(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 = _____

(a) Which component is a variable resistor?

Tick **one** box.

A B C

(1)

(b) Which component is a thermistor?

Tick **one** box.

A B C

(1)

(c) In which component will the resistance decrease when the temperature increases?

Tick **one** box.

A B C

(1)

(d) In which component will the resistance decrease when the light intensity increases?

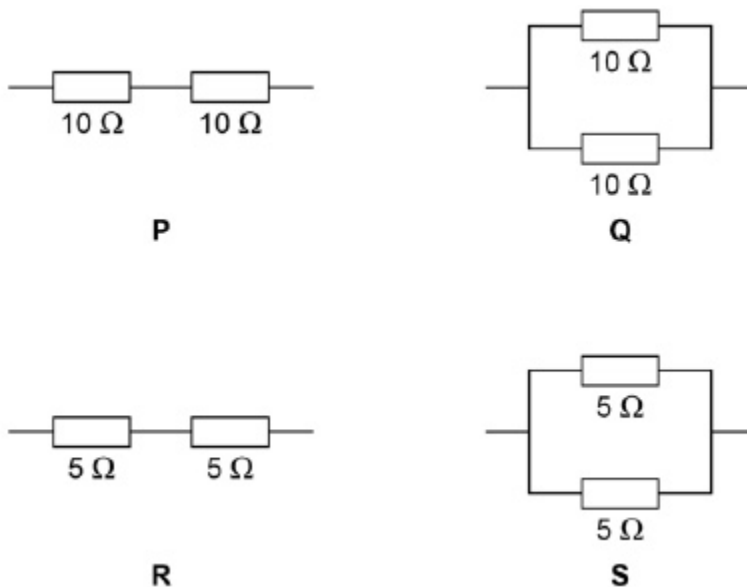
Tick **one** box.

A B C

(1)

Figure 2 shows four different arrangements of resistors.

Figure 2



(e) Two of the arrangements are in series and two are in parallel.

Describe the difference between a series and a parallel arrangement.

(2)

(f) Which arrangement has a resistance of $10\ \Omega$?

Tick **one** box.

P Q R S

(1)

(g) Which arrangement has the highest resistance?

Tick **one** box.

P Q R S

(1)

(h) A student connects a resistor to a cell for 60 seconds.

The current through the resistor is 0.97 A

Calculate the charge flow.

Use the equation:

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

Give your answer to 2 significant figures.

Charge flow = _____ C

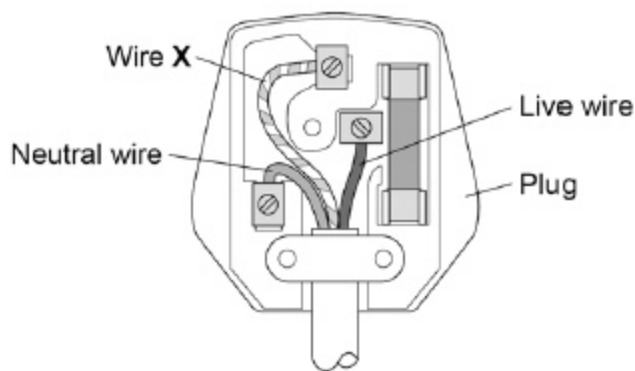
(3)

(Total 11 marks)

4.

Figure 1 shows a three pin plug connected to the cable of a metal toaster.

Figure 1



(a) Name wire X.

(1)

(b) What does wire **X** do?

Tick **one** box.

It provides extra energy to the toaster when needed.

It completes the circuit in the toaster.

It can prevent an electric shock from the toaster.

It supplies the current to the toaster.

(1)

(c) The toaster is plugged in to the mains electricity supply.

What is the potential difference between the live and neutral wires?

Tick **one** box.

0 V

120 V

230 V

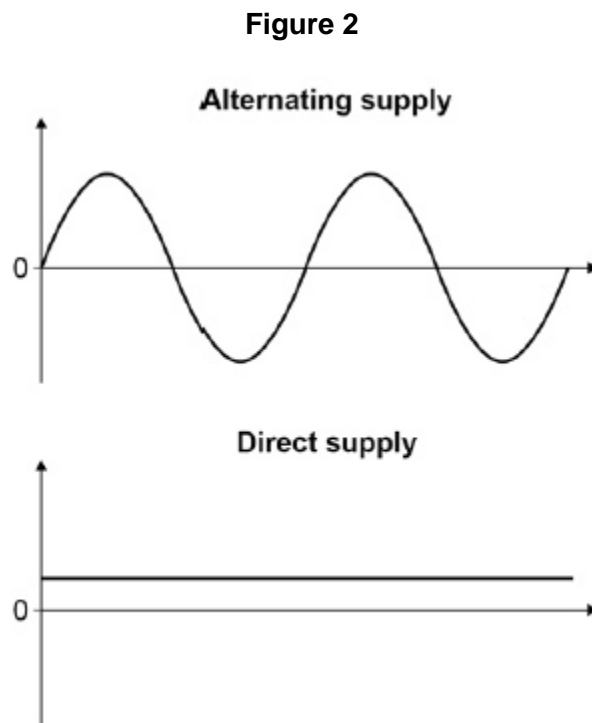
460 V

(1)

(d) Mains electricity is an alternating supply.

A battery is a direct supply.

Figure 2 shows an alternating supply and a direct supply.



Give **two** differences between the alternating supply and the direct supply.

1. _____

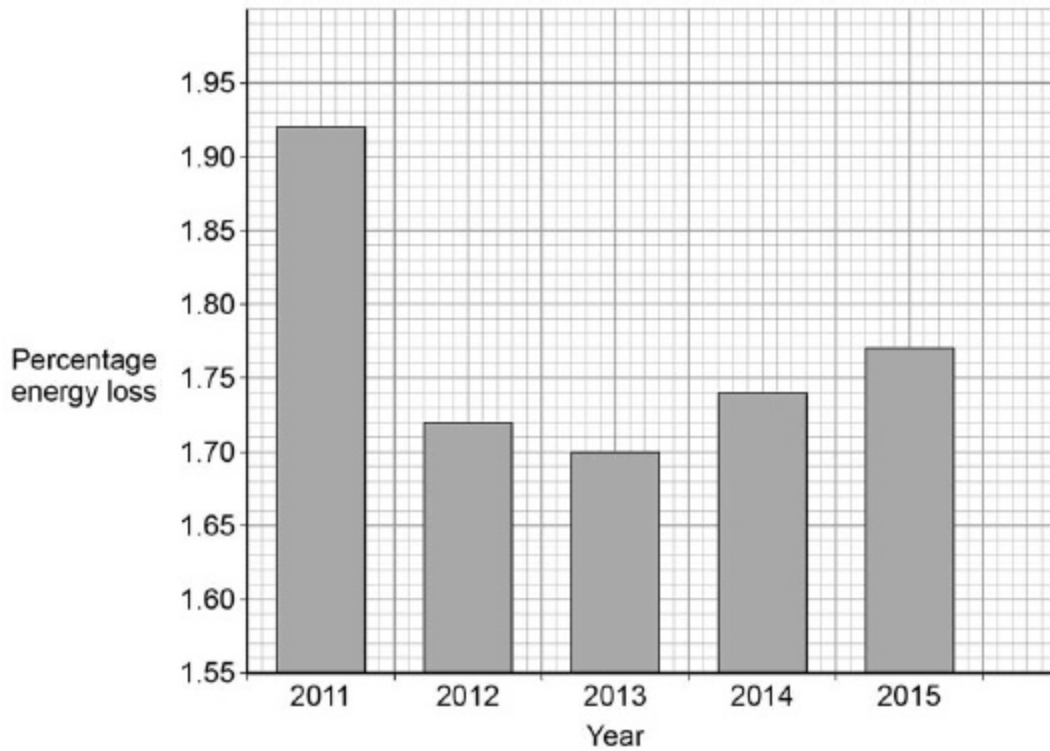
2. _____

(2)

Energy is transferred to homes by the National Grid.

Figure 3 shows the percentage energy losses over the National Grid for different years.

Figure 3



(e) Describe the changes in percentage energy loss.

(2)

(f) Calculate the mean percentage energy loss per year in **Figure 3**.

Mean energy loss per year = _____ %

(3)

(Total 10 marks)

5. The image shows a girl riding a self-balancing scooter.



(a) The scooter has an electric motor powered by a battery.

During the ride the battery transfers 15 000 C of charge.

The potential difference across the battery is 36 V

Calculate the energy transferred by the battery.

Use the equation:

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

Give your answer in kJ

Energy transferred = _____ kJ

(3)

The table gives data for two scooters with different motors.

Both motors have the same efficiency.

	Power of motor in W	Mass in kg
Scooter A	500	10.5
Scooter B	700	14.0

(b) Explain why scooter B has a higher maximum speed.

(2)

- (c) Both scooters can be ridden for 20 minutes before the battery needs recharging.
Compare the amount of chemical energy stored in the batteries of each scooter.

(1)

- (d) Write the equation that links energy transferred, power and time.

(1)

- (e) Calculate the energy transferred by the motor in scooter **B** in 20 minutes.

Energy transferred = _____ J

(3)

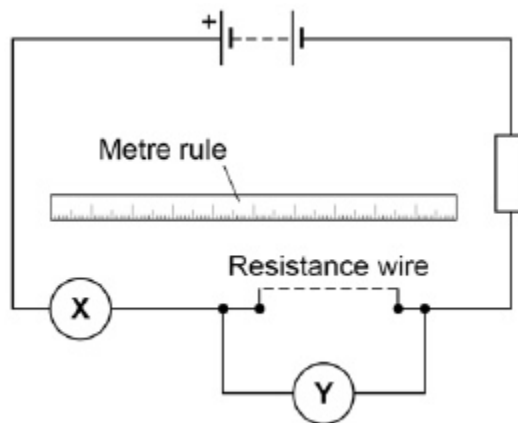
(Total 10 marks)

6.

A student investigated how length affects resistance of a wire.

Figure 1 shows the circuit the student used.

Figure 1



(a) The student took measurements using the meters **X** and **Y**.

Name meters **X** and **Y**.

Meter **X** _____

Meter **Y** _____

(2)

The table shows the results.

Length in m	Resistance in Ω			
	Test 1	Test 2	Test 3	Mean
0.100	0.66	0.67	0.74	0.69
0.200	1.36	1.40	1.34	1.37
0.300	2.02	2.02	2.03	2.02
0.400	2.77	2.72	2.68	2.72
0.500	3.37	3.35	3.40	3.37
0.600	4.03	4.02	3.96	4.00

(b) For which length of wire are the readings of resistance the most precise?

Give the reason for your answer.

Length = _____ m

Reason _____

(2)

(c) Why did the student do three tests and calculate a mean?

(1)

(d) Write the equation that links current, potential difference, and resistance.

(1)

(e) The potential difference across a piece of wire is 2.1 V

The current in the wire is 0.30 A

Calculate the resistance of the wire.

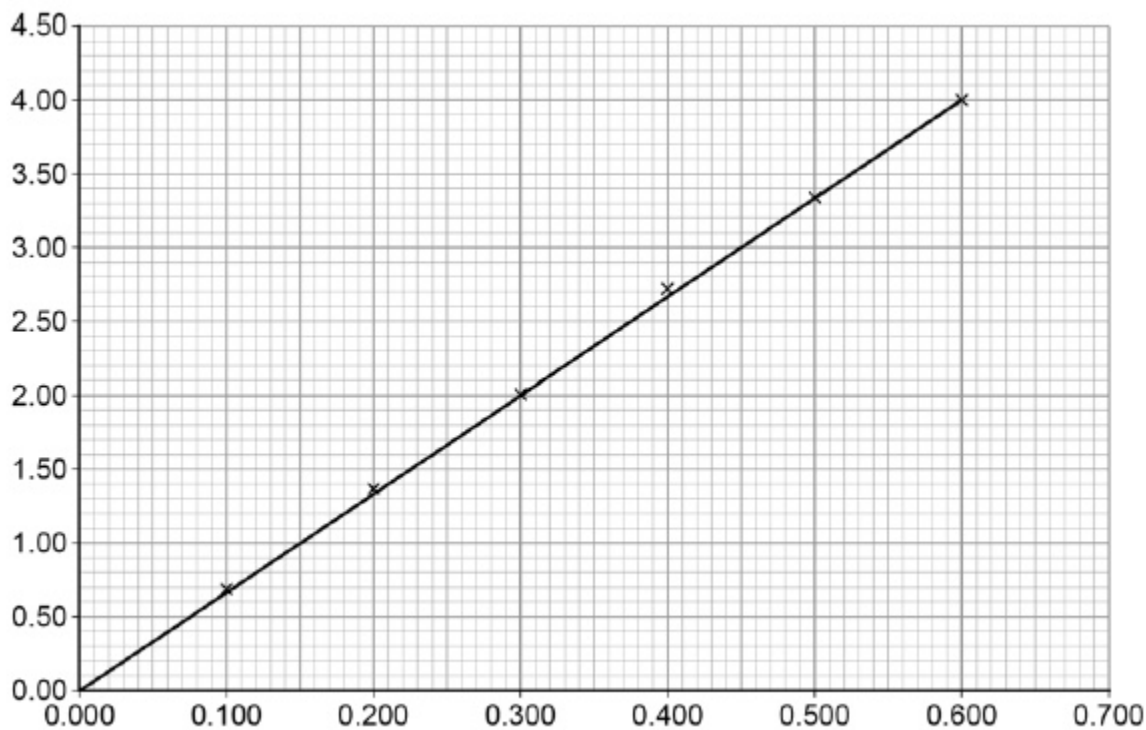
Write any equation that you use.

Resistance = _____ Ω

(3)

Figure 2 shows a graph of the results.

Figure 2



(f) What is the label for each axis of the graph?

x-axis _____

y-axis _____

(2)

(g) What conclusion can be made from the graph in **Figure 2**?

(1)

(Total 12 marks)

7.

Most electrical appliances are connected to the mains electricity using three-core cables.

(a) What is the approximate value of the potential difference of the UK mains electricity supply?

Tick **one** box.

23 V

230 V

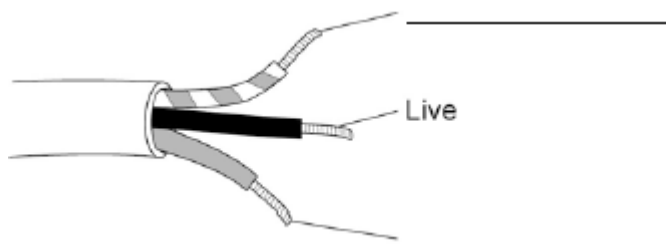
300 V

350 V

(1)

(b) **Figure 1** shows a three-core cable.

Figure 1



Use answers from the box to label the wires and complete **Figure 1**.

Earth	Negative	Neutral
-------	----------	---------

(2)

(c) In the UK the three wires in a three-core cable are always the same colours.

Why are the wires always the same colours?

Tick **one** box.

Each wire is made by a different company.

It is easy to identify each wire.

They are cheaper to manufacture.

(1)

(d) Touching the live wire is dangerous.

Use answers from the box to complete the sentences.

current	resistance	shock	force	voltage
----------------	-------------------	--------------	--------------	----------------

Touching the live wire causes a large potential difference to exist across the body.

This causes a _____ through the body, which results in an electric _____

(2)

(e) What is the approximate frequency of the UK mains electricity supply?

Tick **one** answer.

50 Hz

75 Hz

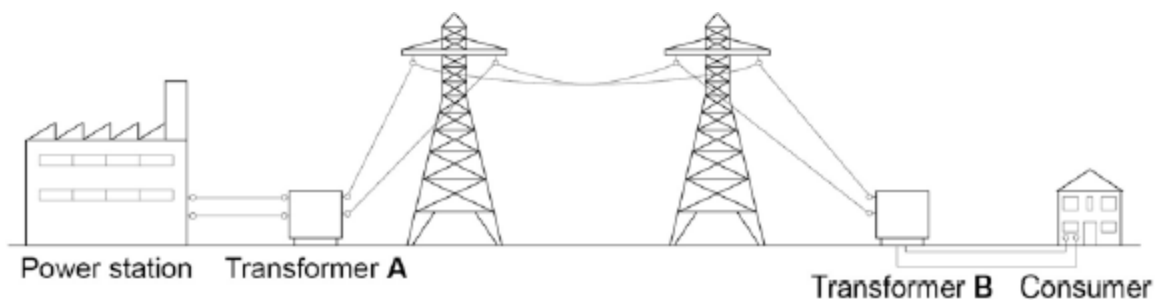
100 Hz

150 Hz

(1)

- (f) **Figure 2** shows how power stations transfer electrical power to consumers using the National Grid.

Figure 2



The power station generates electricity at a voltage of 25 kV.

Transformer **A** increases the voltage by a factor of 16.

What is the voltage output of transformer **A**?

Output voltage = _____ kV

(2)

- (g) Why is the voltage increased by transformer **A**?

Tick **one** box.

To reduce the energy lost due to heating

To increase the power

To increase the current

(1)

(h) Why is it important that the voltage is decreased by transformer **B**?

Tick **one** box.

Less energy is used by consumers

It is safer for consumers

It reduces consumers' electricity bills

(1)
(Total 11 marks)

Mark schemes

1.

- (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

$$Q = 177 \text{ (C)}$$

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

[13]

2.

(a) a curve in the first and third quadrants only, passing through origin

1

decreasing gradient

1

(b) any **two** from:

- $l_1 = l_2 + l_3$
- $l_2 = l_3$
- $l_1 = 2l_2$
- $l_1 = 2l_3$

allow 1 mark for each correct description given in words

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]

3.	(a) A	1
	(b) C	1
	(c) C	1
	(d) B	1
	(e) a series circuit has only one path/loop/branch	1
	a parallel circuit has a branch(es) to provide more than one path / loop <i>allow answers that describe the difference in terms of potential difference, current or resistance</i>	1
	(f) R	1

- (g) P 1
- (h) $Q = 0.97 \times 60$ 1
- $Q = 58.2$ (C) 1
- $Q = 58$ (C) 1
- an answer of 58 (C) scores 3 marks* 1

[11]

- 4.** (a) earth 1
- (b) it can prevent an electric shock from the toaster 1
- (c) 230 V 1
- (d) (the potential difference) for the alternating supply changes direction
allow current 1
- (the potential difference) for the alternating supply changes magnitude
allow current
allow converse
allow potential difference of alternating supply is greater 1
- (e) there is an overall decrease
allow there is an decrease in percentage energy loss until 2013 1
- but there is a (small) increase since 2013 1
- (f) 1.92, 1.72, 1.70, 1.74, 1.77 1
- $(1.92 + 1.72 + 1.70 + 1.74 + 1.77)/5$ 1
- 1.77(%)
an answer of 1.77(%) scores 3 marks 1

[10]

5.	(a) $E = 15\,000 \times 36$	1
	$E = 540\,000$	1
	$E = 540$ (kJ)	
	<i>an answer of 540 (kJ) scores 3 marks</i>	1
	(b) (the motor in) scooter B has a higher power	1
	therefore	
	(because both motors have the same efficiency) scooter B will have a greater kinetic energy	1
	(c) the battery in scooter B has a greater store of chemical energy	1
	(d) energy transferred = power \times time	
	<i>allow $E = P \times t$</i>	1
	(e) 20×60	1
	$E = 1\,200 \times 700$	1
	$E = 840\,000$ (J)	
	<i>an answer of 840 000 (J) scores 3 marks</i>	1
		[10]
6.	(a) ammeter	1
	voltmeter	
	<i>must be in the correct order</i>	1
	(b) 0.300 (m)	1
	there is the smallest spread about the mean	1
	(c) to reduce the effect of random errors	1
	(d) potential difference = current \times resistance	
	<i>allow $V = I \times R$</i>	1

(e) $R = V / I$ 1

$R = 2.1 / 0.30$ 1

$R = 7.0 \Omega$

an answer of 7.0 Ω scores 3 marks

(f) length in m 1

resistance in Ω

must be in the correct order

allow other correct labelling eg

length / m

length (m)

allow 1 mark if units are omitted

1

(g) resistance is directly proportional to length 1

[12]

7.

(a) 230 V 1

(b) Earth

must be in the correct order

1

Neutral 1

(c) It is easy to identify each wire. 1

(d) current

must be in the correct order

1

shock 1

(e) 50 Hz 1

(f) output = 25×16 1

400 (kV) 1

allow 400 (kV) with no working shown for 2 marks

(g) It reduces the energy lost due to heating

1

(h) It is safer for consumers

1

[11]