AQA GCSE Physics | 8463

SPECIFICATION POINT 4.2.1.2

Electrical charge and current

Past-paper questions

Tier	**Higher**
Question groups	**25**
Available paper years	**2003–2025**

Using this booklet

1. Answer the questions in order and show your working.
2. Original question numbers and marks are retained.
3. Print at actual size (100%) for measuring questions.
4. Use the companion answer booklet to check your work.

Name: _____ **Date:** _____

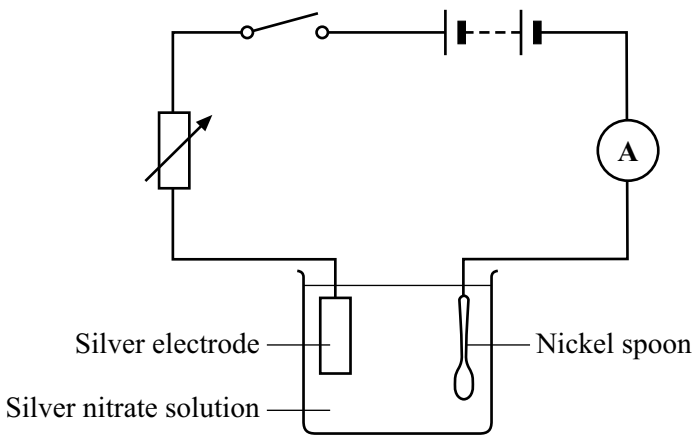
Whole questions are retained for context, so some parts assess other specification points. Current and legacy sources are labelled. Continue on extra paper if needed.

4.2.1.2 Electrical charge and current

Question 01

June 2003 | 3451H | Original Q12 | Legacy

12 The diagram shows a circuit which can be used to silver-plate a nickel spoon.



(a) Silver nitrate solution contains silver ions. When the switch is closed, the silver ions move towards the spoon. Are the silver ions negatively or positively charged? Give a reason for your answer.

.....

.....

(1 mark)

(b) With the switch closed, the ammeter reads 0.5 A. In 30 minutes, 1.0 g of silver is deposited on the spoon.

(i) Write down the equation which links charge, current and time.

.....

(1 mark)

(ii) Calculate the charge which flows in 30 minutes. Show clearly how you get your final answer and give the units.

.....

.....

Charge = ...

(3 marks)

(iii) What mass of silver would have been deposited if the current had been 1 A and the circuit switched on for 1 hour?

.....

Mass = ...g

(1 mark)

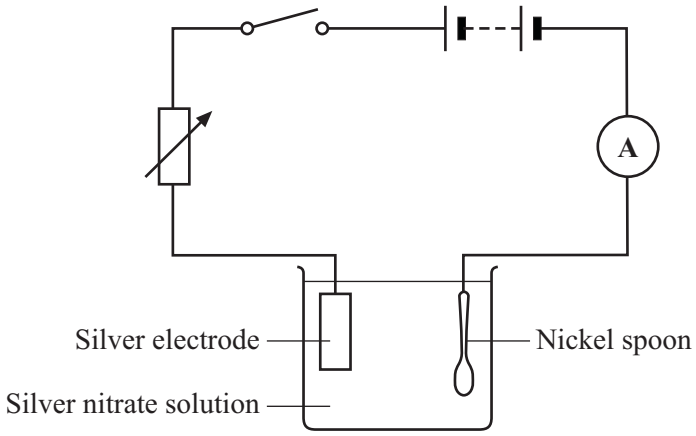
6

4.2.1.2 Electrical charge and current

Question 02

June 2003 | 3462H3 | Original Q10 | Legacy

10 The diagram shows a circuit which can be used to silver-plate a nickel spoon.



(a) Silver nitrate solution contains silver ions. When the switch is closed, the silver ions move towards the spoon. Are the silver ions negatively or positively charged? Give a reason for your answer.

.....

.....

(1 mark)

(b) With the switch closed, the ammeter reads 0.5 A. In 30 minutes, 1.0 g of silver is deposited on the spoon.

(i) Write down the equation which links charge, current and time.

.....

(1 mark)

(ii) Calculate the charge which flows in 30 minutes. Show clearly how you get your final answer and give the units.

.....

.....

Charge = ...

(3 marks)

(iii) What mass of silver would have been deposited if the current had been 1 A and the circuit switched on for 1 hour?

.....

Mass = ...g

(1 mark)

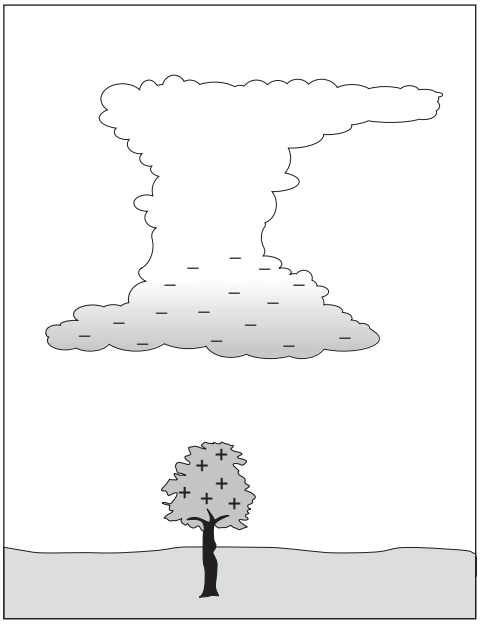
6

4.2.1.2 Electrical charge and current

Question 03

June 2005 | 3451 | Original Q11 | Legacy

11 The diagram shows a charged thundercloud.



(a) Why does the tree below the thundercloud become positively charged?

.....

.....

(1 mark)

(b) The base of the cloud has a negative charge of 18 coulombs.
The potential difference between the base of the cloud and the ground is 1 200 000 kilovolts.

(i) Write down the equation that links charge, energy transferred and potential difference.

.....

(1 mark)

(ii) Calculate the maximum energy that could be transferred to the ground by a lightning strike. Show clearly how you work out your answer.

.....

.....

Maximum energy transferred = ... joules

(2 marks)

4.2.1.2 Electrical charge and current

Question 03 · continued

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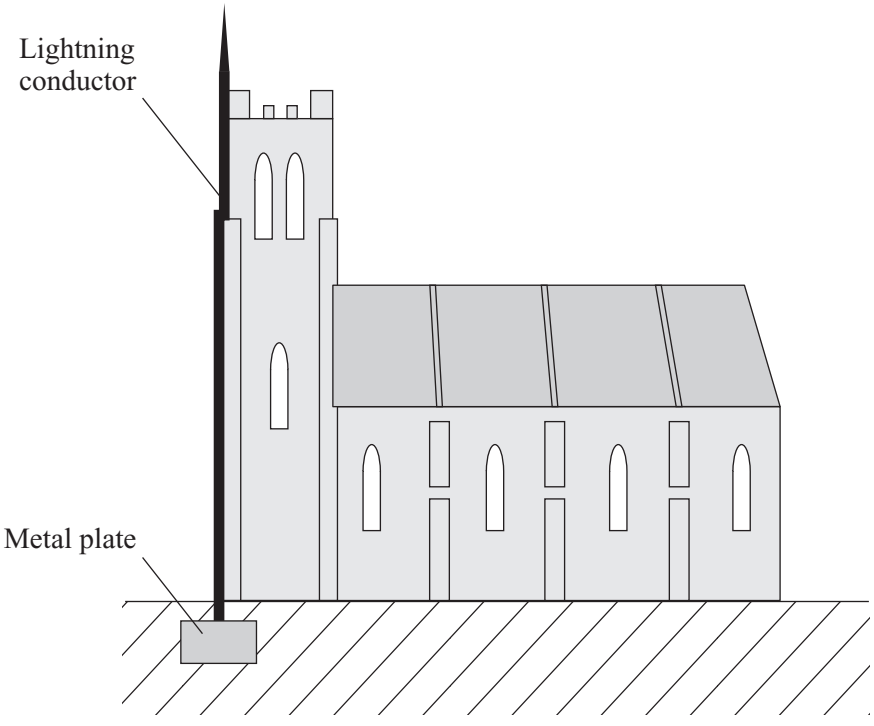
(c) A lightning conductor is usually attached to tall buildings. This reduces the risk of damage by a lightning strike.



Explain why the lightning conductor is made of copper.

.....

.....

.....

.....

(2 marks)

6

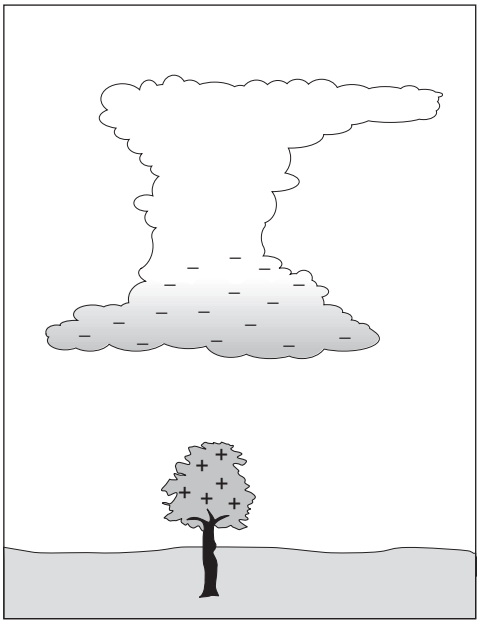
TURN OVER FOR THE NEXT QUESTION

4.2.1.2 Electrical charge and current

Question 04

June 2005 | 3462 | Original Q9 | Legacy

9 The diagram shows a charged thundercloud.



(a) Why does the tree below the thundercloud become positively charged?

.....

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(1 mark)

(b) The base of the cloud has a negative charge of 18 coulombs.
The potential difference between the base of the cloud and the ground is 1 200 000 kilovolts.

(i) Write down the equation that links charge, energy transferred and potential difference.

.....

(1 mark)

(ii) Calculate the maximum energy that could be transferred to the ground by a lightning strike. Show clearly how you work out your answer.

.....

.....

Maximum energy transferred = ... joules

(2 marks)

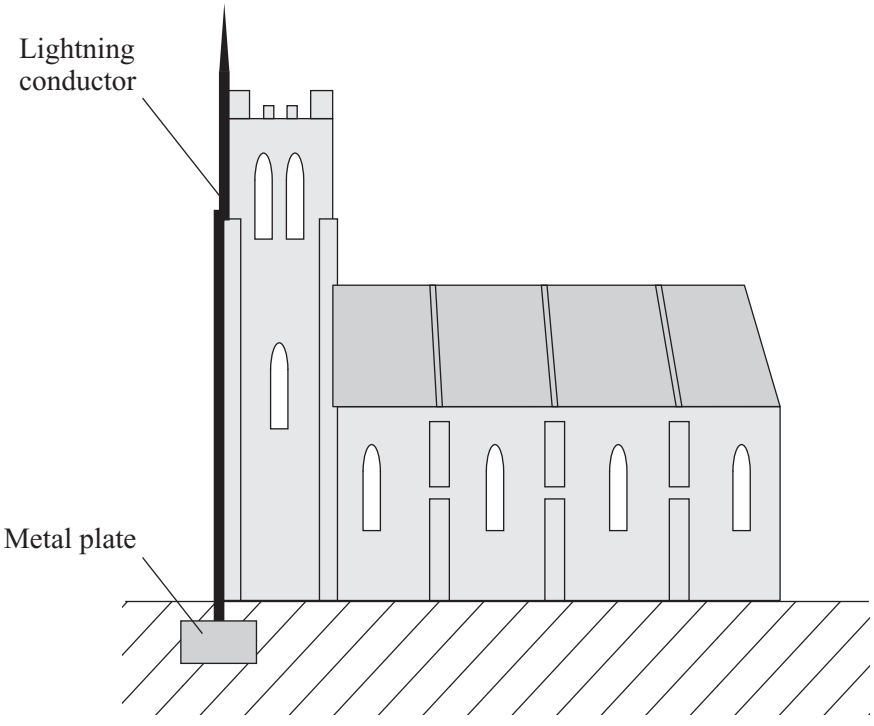
4.2.1.2 Electrical charge and current

Question 04 · continued

1 /

MARGIN BLANK

(c) A lightning conductor is usually attached to tall buildings. This reduces the risk of damage by a lightning strike.



Explain why the lightning conductor is made of copper.

.....

.....

.....

.....

(2 marks)

6

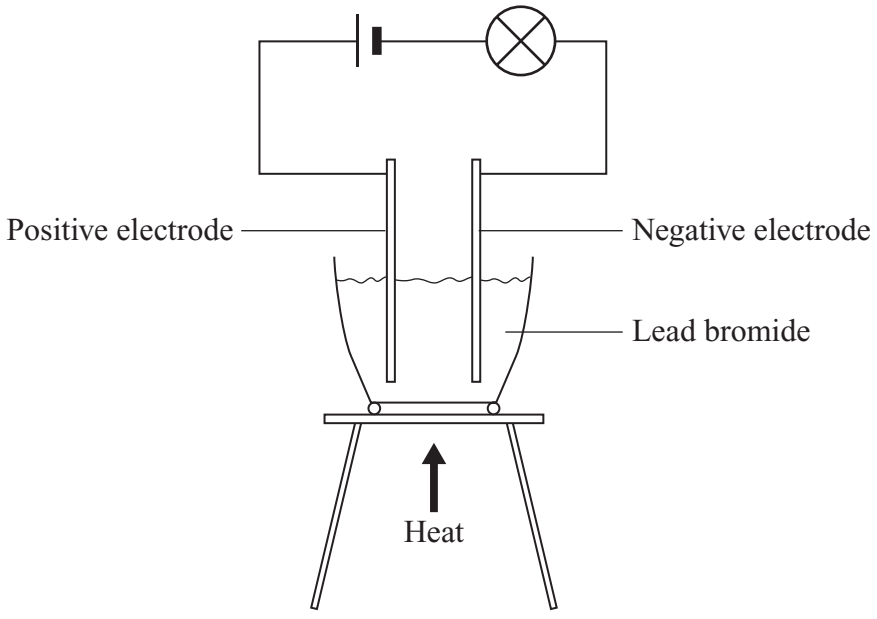
TURN OVER FOR THE NEXT QUESTION

4.2.1.2 Electrical charge and current

Question 05

June 2006 | 3451 | Original Q15 | Legacy

15 (a) The diagram shows the apparatus used to find out what happens when an electric current is passed through lead bromide.



The following observations were made.

	Light bulb	Change at negative electrode	Change at positive electrode
Solid lead bromide	OFF	None	None
Molten lead bromide	ON	Lead forms	Gas given off

(i) Why does molten lead bromide conduct electricity?

.....

.....

(1 mark)

(ii) The experiment shows that the electric current splits up the lead bromide.

What name is given to this process?

.....

(1 mark)

Question 05 · continued

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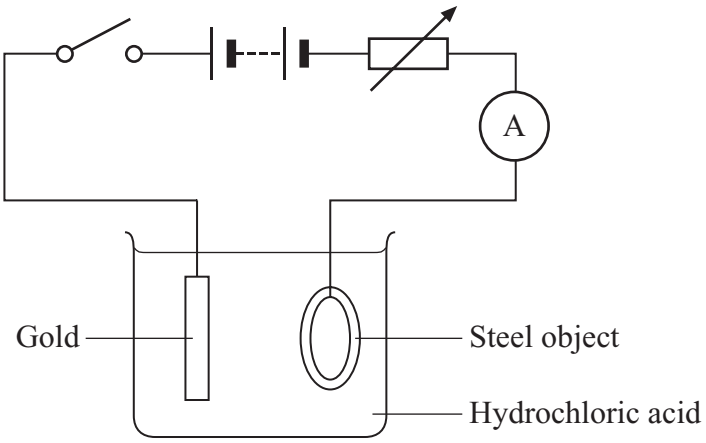
(b) The diagram shows the circuit used to electroplate a steel object with a thin coat of gold.



For each 1500 coulombs of charge flowing in the circuit, 1g of gold is deposited on the steel object.

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

.....

(1 mark)

(ii) Calculate the mass of gold deposited when a current of 2.5 A flows for 40 minutes.

Show clearly how you work out your answer.

.....

.....

.....

Mass deposited = ... g

(2 marks)

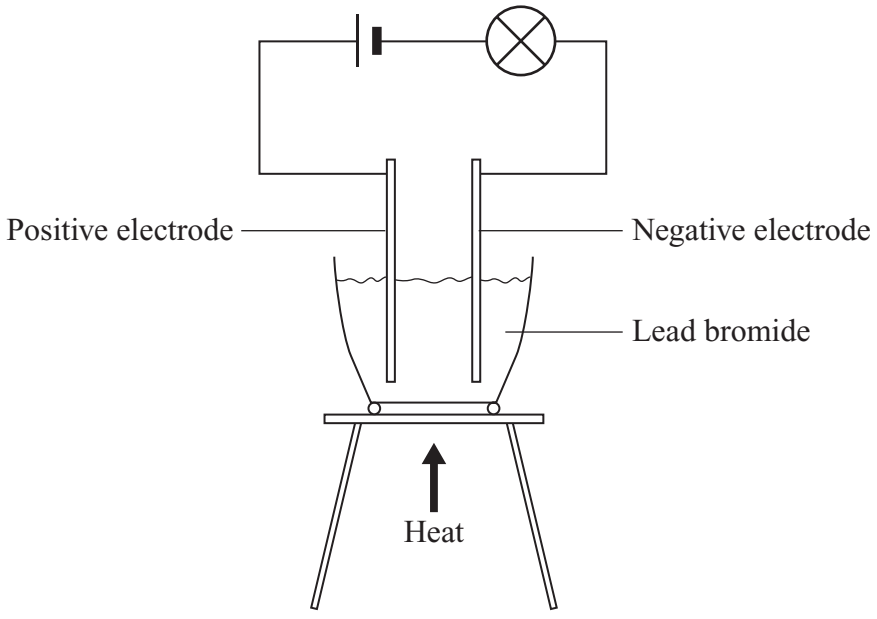
5

4.2.1.2 Electrical charge and current

Question 06

June 2006 | 3462 | Original Q13 | Legacy

13 (a) The diagram shows the apparatus used to find out what happens when an electric current is passed through lead bromide.



The following observations were made.

	Light bulb	Change at negative electrode	Change at positive electrode
Solid lead bromide	OFF	None	None
Molten lead bromide	ON	Lead forms	Gas given off

(i) Why does molten lead bromide conduct electricity?

.....

.....

(1 mark)

(ii) The experiment shows that the electric current splits up the lead bromide.

What name is given to this process?

.....

(1 mark)

Question 06 · continued

June 2006 | 3462 | Original Q13 | Legacy

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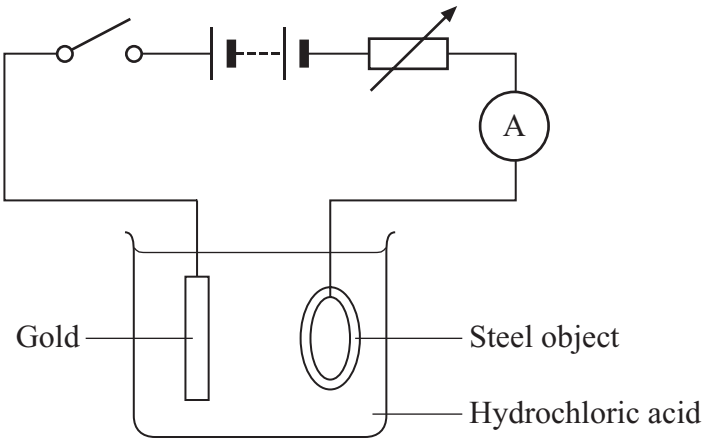
(b) The diagram shows the circuit used to electroplate a steel object with a thin coat of gold.



For each 1500 coulombs of charge flowing in the circuit, 1g of gold is deposited on the steel object.

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

.....

(1 mark)

(ii) Calculate the mass of gold deposited when a current of 2.5 A flows for 40 minutes.

Show clearly how you work out your answer.

.....

.....

.....

Mass deposited = ... g

(2 marks)

5

4.2.1.2 Electrical charge and current

Question 07

January 2008 | PHY2H | Original Q2 | Legacy

2 During car journeys, the driver will often become electrostatically charged. This is more noticeable on dry days than on damp, humid days.

(a) Explain what happens to cause the driver to become charged.

.....

.....

.....

.....

(2 marks)

(b) Scientists were asked to find out if the build up of charge on the driver depends on the type of material the driver's clothes are made from. The results of the investigation are given in the table.

Material	Humidity	Temperature in °C	Charge on the driver in millicoulombs
Nylon	48 %	18	3.0 to 3.2
Wool	48 %	18	2.4 to 2.5
Cotton	48 %	18	1.4 to 1.7

Humidity is a measure of how much water vapour the air can hold.

(i) Why was it important that the scientists controlled the humidity?

.....

.....

(1 mark)

(ii) Does the data in the table show that the charge on the driver would always be less if they were to wear cotton clothing?

Give a reason for your answer.

.....

.....

(1 mark)

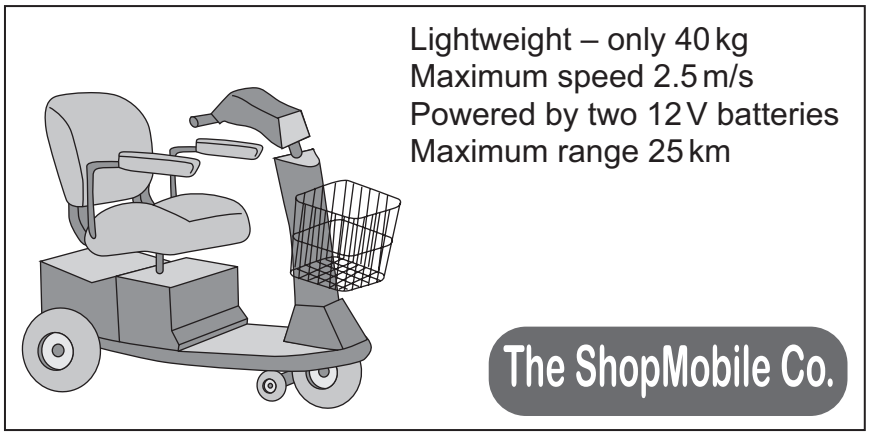
4

4.2.1.2 Electrical charge and current

Question 08

January 2008 | PHY2H | Original Q3 | Legacy

3 The picture shows an advert for an electric mobility scooter.



(a) The batteries are joined in series.

(i) What is the potential difference provided by the batteries to the motor?

.....

(1 mark)

(ii) The batteries supply a *direct current (d.c.)*.

What is a *direct current (d.c.)*?

.....

.....

(1 mark)

(b) At 2.5 m/s on flat ground, the motor takes a current of 3.0 A from the batteries.

(i) Explain why a bigger current is taken from the batteries when the scooter is going uphill at 2.5 m/s.

.....

.....

.....

.....

(2 marks)

Question 08 · continued

BLANK

(ii) What effect does travelling uphill have on the range of the scooter?

.....

(1 mark)

(c) The mass of the scooter driver is 80 kg.

Use the equation in the box to calculate the kinetic energy of the scooter **and** driver when they are travelling at maximum speed.

$$\text{kinetic energy} = \frac{1}{2} \times \text{mass} \times \text{speed}^2$$

Show clearly how you work out your answer.

.....

.....

Kinetic energy = ... J

(2 marks)

(d) A battery which has run down is recharged in 8 hours. The average current delivered by the battery charger is 1.5 A.

Use the equation in the box to calculate the maximum charge stored by **both** batteries.

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

Show clearly how you work out your answer and give the unit.

.....

.....

Charge stored = ...

(3 marks)

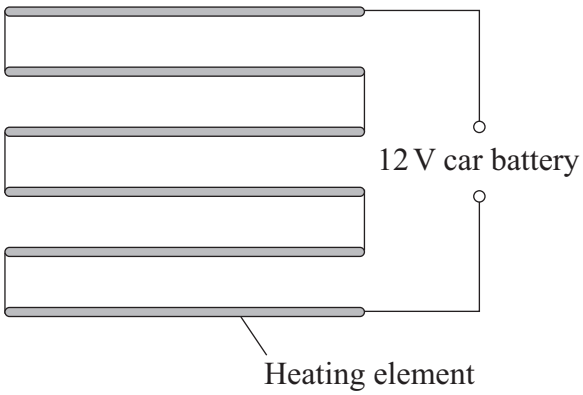
10

4.2.1.2 Electrical charge and current

Question 09

January 2009 | PHY2H | Original Q3 | Legacy

3 The diagram shows a simple type of car rear window heater. The six heating elements are exactly the same.



3 (a) Each heating element has a resistance of 5 Ω. The current passing through each element is 0.4 A.

3 (a) (i) Calculate the total resistance of the six heating elements.

Show clearly how you work out your answer.

.....

.....

Total resistance = ... ohms

(2 marks)

3 (a) (ii) Why is the current passing through each element the same?

.....

.....

(1 mark)

3 (a) (iii) What is the total current passing through the whole circuit?

.....

(1 mark)

3 (a) (iv) How is the 12 volt potential difference of the car battery shared between the six heating elements?

.....

.....

(1 mark)

4.2.1.2 Electrical charge and current

Question 09 · continued

for mark

3 (b) It takes the heater two minutes to demist the car window.

Use the equation in the box to calculate how much charge flows through the heater in this time.

charge = current × time

Show clearly how you work out your answer and give the unit.

.....

.....

Charge = ...

(3 marks)

8

Turn over for the next question

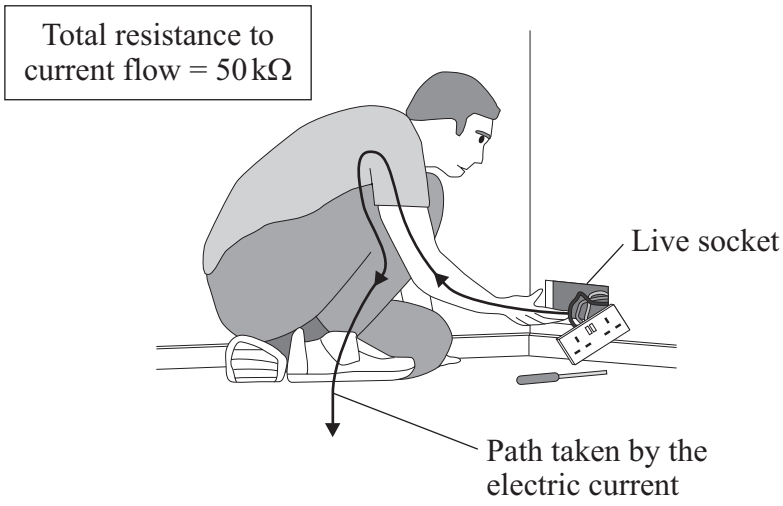
4.2.1.2 Electrical charge and current

Question 10

June 2009 | PHY2H | Original Q6 | Legacy

6 The diagram shows someone accidentally touching the live wire inside a dismantled 230 volt mains electricity socket.

A current flows through the person giving him an electric shock.



6 (a) (i) Use the equation in the box to calculate the current that will flow through the person.

potential difference = current × resistance

Show clearly how you work out your answer.

.....

.....

Current = ... A

(2 marks)

6 (a) (ii) Rubber is a good insulator.

Explain why it is a good idea for electricians to wear rubber soled boots when working.

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.....

(2 marks)

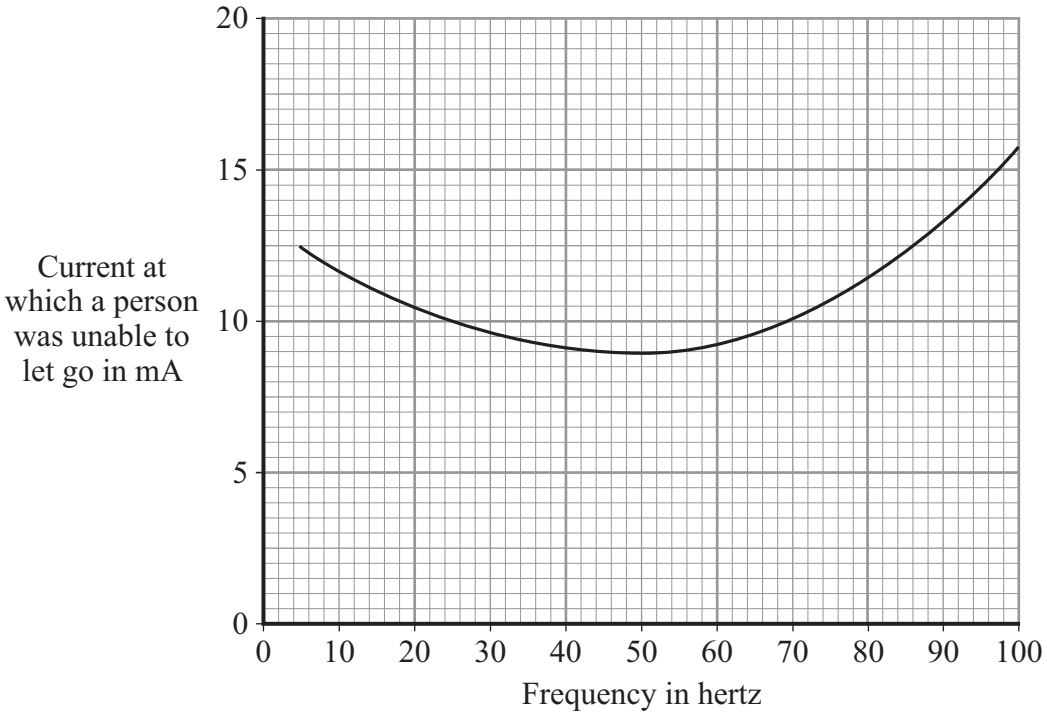
Question 10 · continued

for mark

6 (b) If the current flowing through a person is too high, the person cannot let go of the electrical source.

Different people were tested to see whether the ability to let go of an electrical source depended on the frequency of the current.

The results of the test are shown in the graph.



6 (b) (i) What is the frequency of the mains electricity supply in the UK?

.....

(1 mark)

6 (b) (ii) From a safety point of view, is the frequency of the UK mains electricity supply suitable?

Give a reason for your answer.

.....

.....

(1 mark)

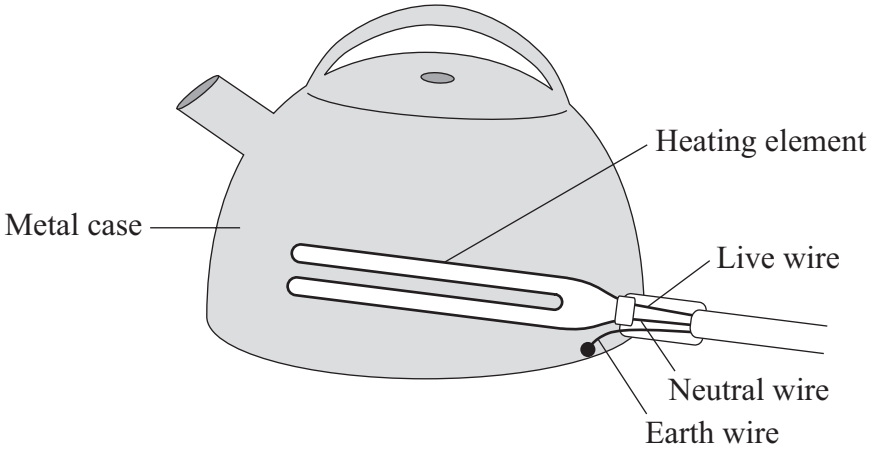
Question 6 continues on the next page

4.2.1.2 Electrical charge and current

Question 10 · continued

for mark

6 (c) The diagram shows how the electric supply cable is connected to an electric kettle. The earth wire is connected to the metal case of the kettle.



If a fault makes the metal case live, the earth wire and the fuse inside the plug protect anyone using the kettle from an electric shock.

Explain how.

.....

.....

.....

.....

(2 marks)

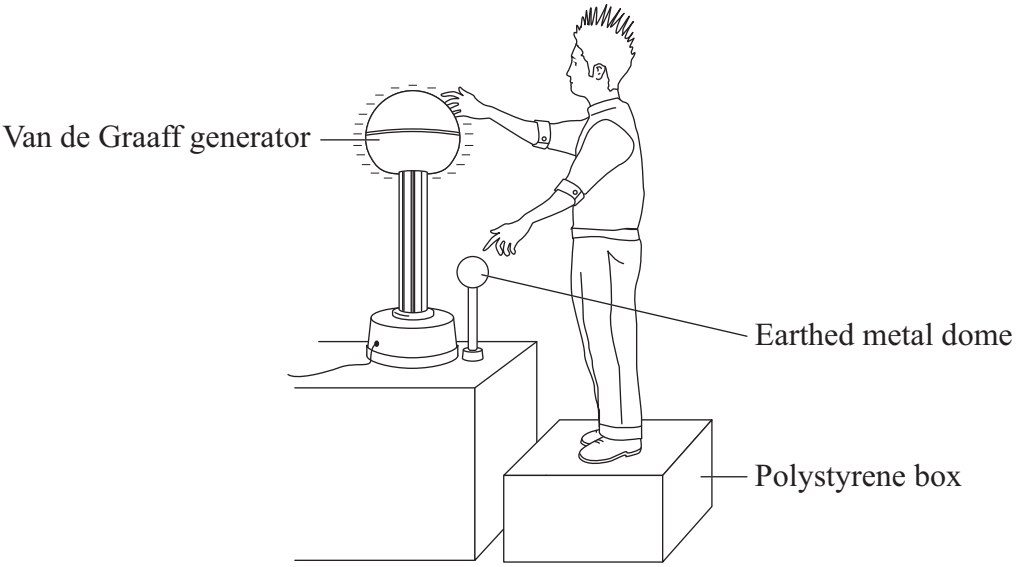
8

4.2.1.2 Electrical charge and current

Question 11

January 2010 | PHY2H | Original Q5 | Legacy

5 (a) The diagram shows a student touching the metal dome of a Van de Graaff generator. When the generator is switched on, the metal dome becomes negatively charged.



Explain why the student's hair stands on end when the generator is switched on.

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.....

.....

(2 marks)

5 (b) When the potential difference between the student and a nearby earthed metal dome reached 15 kV, a spark jumped between the student and the earthed dome. The spark transformed 30 mJ of energy into heat, light and sound. (1 mJ = 0.001 J)

Use the equation in the box to calculate the charge carried by the spark.

energy transformed = potential difference × charge

.....

.....

Charge transferred = ... coulombs

(2 marks)

5 (c) What name is given to the rate of flow of charge?

.....

(1 mark)

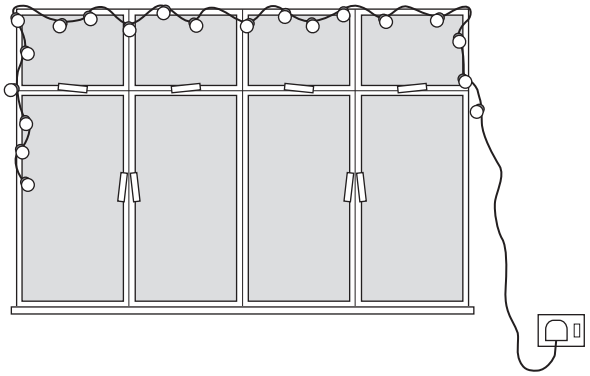
5

4.2.1.2 Electrical charge and current

Question 12

January 2011 | PHY2H | Original Q6 | Legacy

6 A set of lights consists of 20 lamps connected in series to the 230 V mains electricity supply.



6 (a) When the lights are switched on and working correctly, the current through each lamp is 0.25 A.

6 (a) (i) What is the total current drawn from the mains supply?

.....

(1 mark)

6 (a) (ii) Use the equation in the box to calculate the charge passing through **one** of the lamps in 5 minutes.

charge = current × time

Show clearly how you work out your answer and give the unit.

.....

.....

.....

.....

Total charge = ...

(3 marks)

4.2.1.2 Electrical charge and current

Question 12 · continued

6 (b) One of the lamps in the set is a fuse lamp. This contains a filament which melts if a fault occurs. A short time after the lights are switched on, a fault causes the filament inside the fuse lamp to melt and all the lamps go out.

The householder cannot find another fuse lamp so connects a piece of aluminium foil across the contacts inside the fuse lamp holder.
When switched on, the nineteen remaining lamps work.
What the householder has done is dangerous.

Explain why.

.....

.....

.....

.....

(2 marks)

6

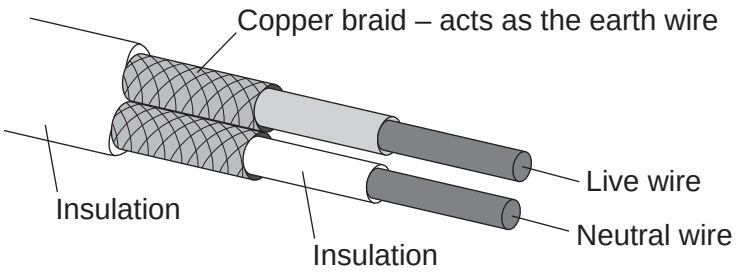
Turn over for the next question

4.2.1.2 Electrical charge and current

Question 13

January 2013 | PH2HP | Original Q6 | Legacy

6 The diagram shows the structure of a cable. The cable is part of an undersoil heating circuit inside a large greenhouse.



6 (a) The cable is connected to the mains electricity supply through a residual current circuit breaker (RCCB). If the cable is accidentally cut the RCCB automatically switches the circuit off.

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

.....

(1 mark)

6 (a) (ii) What happens, as the cable is cut, to cause the RCCB to switch the circuit off?

.....

.....

.....

.....

(2 marks)

6 (a) (iii) A circuit can also be switched off by the action of a fuse.

Give **one** advantage of using a RCCB to switch off a circuit rather than a fuse.

.....

.....

(1 mark)

4.2.1.2 Electrical charge and current

Question 13 · continued

6 (b) The 230 volt mains electricity supply causes a current of 11 amps to flow through the cable.

6 (b) (i) Calculate the amount of charge that flows through the cable when the cable is switched on for 2 hours and give the unit.

Use the correct equation from the Physics Equations Sheet.

.....

.....

.....

Charge = ...

(3 marks)

6 (b) (ii) Calculate the energy transferred from the cable to the soil in 2 hours.

Use the correct equation from the Physics Equations Sheet.

.....

.....

Energy transferred =..... J

(2 marks)

6 (c) The heating circuit includes a thermistor. The thermistor is buried in the soil and acts as a thermostat to control the increase in the temperature of the soil.

Describe how an **increase** in the temperature of the soil affects the thermistor.

.....

.....

.....

.....

(2 marks)

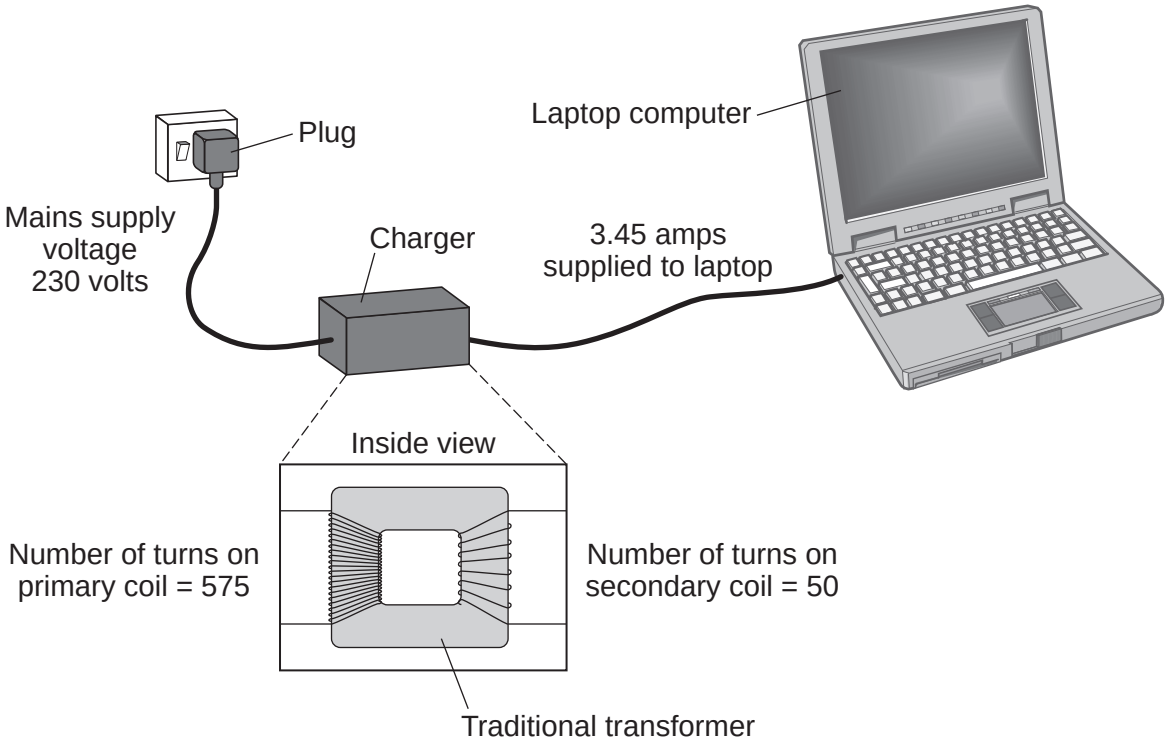
11

4.2.1.2 Electrical charge and current

Question 14

June 2013 | PH3HP | Original Q7 | Legacy

7 Batteries inside laptop computers are charged using laptop chargers. The laptop charger contains a traditional transformer.



7 (a) The alternating current flowing through the primary coil of the transformer creates an alternating current in the secondary coil.

Explain how.

.....

.....

.....

.....

.....

.....

.....

.....

(3 marks)

4.2.1.2 Electrical charge and current

Question 14 · continued

7 (b) (i) Use information from the diagram to calculate the potential difference the charger supplies to the laptop.

Use the correct equation from the Physics Equations Sheet.

.....

.....

.....

.....

Potential difference = ... V

(2 marks)

7 (b) (ii) Calculate the current in the primary coil of the transformer when the laptop is being charged.

Assume the transformer is 100% efficient.

Use the correct equation from the Physics Equations Sheet.

.....

.....

.....

.....

Current = ... A

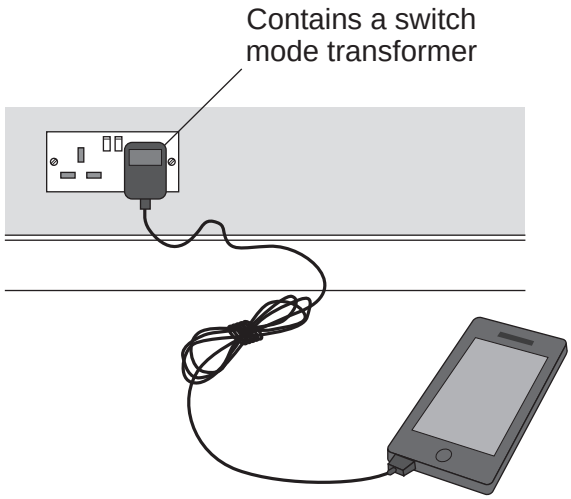
(2 marks)

Question 7 continues on the next page

4.2.1.2 Electrical charge and current

Question 14 · continued

7 (c) Switch mode transformers can be used in mobile phone chargers.



Switch mode transformers and traditional transformers can both use the UK mains supply.

The switch mode transformer is smaller and lighter than the traditional transformer used in the laptop charger.

Give **one** other advantage of the switch mode transformer.

.....

.....

(1 mark)

7 (d) Laptop batteries and mobile phone batteries can only be recharged a limited number of times. After this, the batteries cannot store enough charge to be useful. Scientists are developing new batteries that can be recharged many more times than existing batteries.

Suggest **one** other advantage of developing these new batteries.

.....

.....

.....

(1 mark)

9

4.2.1.2 Electrical charge and current

Question 15

June 2017 | PH2HP | Original Q6 | Legacy

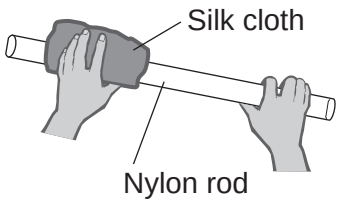
6 When two different materials listed in **Table 2** are rubbed together they become electrostatically charged. The polarity of the material that is higher in **Table 2** would become positive.

Table 2

glass
nylon
wool
silk
polyester
PVC

6 (a) **Figure 7** shows a nylon rod being rubbed with a silk cloth.

Figure 7



6 (a) (i) Explain why both materials become electrostatically charged.
Include in your answer the polarity of each material.

[3 marks]

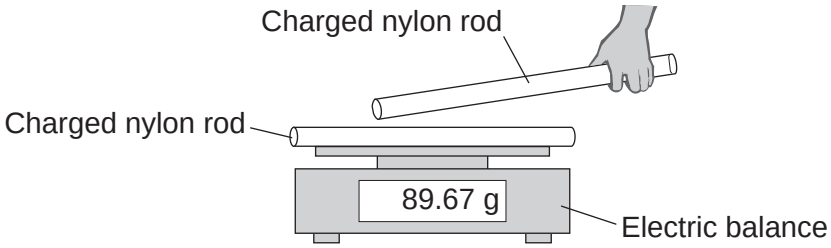
Question 15 · continued

6 (a) (ii) What difference would it have made if a PVC rod had been rubbed with the silk cloth rather than a nylon rod?

[1 mark]

6 (b) The charged nylon rod is put onto an electric balance.

Figure 8



A second identically charged nylon rod is moved towards the rod on the balance, as shown in **Figure 8**.

What will happen to the reading on the balance as the two rods get closer to each other?

The rods do not touch or discharge.

[3 marks]

Tick (✓) **one** box.

The reading will decrease. ☐

The reading will not change. ☐

The reading will increase. ☐

Explain the reason for your answer.

Question 6 continues on the next page

Question 15 · continued

6 (c) A driver often becomes electrostatically charged when in a car. This happens because the driver's clothing rubs against the car seat.

6 (c) (i) The charge on a driver who has just got out of his car is 3.0×10^{-3} coulombs. When the driver starts to close the car door a spark jumps across the air gap between the driver and the door. The spark transfers 27 joules of energy.

Calculate the potential difference between the driver and the car as the driver starts to close the door.

Use the correct equation from the Physics Equations Sheet.

[2 marks]

Potential difference = _____ volts

6 (c) (ii) A scientist investigated how the charge on a driver changed when the driver wore clothes made from different materials. The results from the investigation are given in **Table 3**.

Table 3

Type of material	Charge on the driver $\times 10^{-3}$ coulombs
cotton	1.4 to 1.7
wool	2.4 to 2.5
polyester	3.5 to 3.8

A student looked at the data in **Table 3** and concluded:

'The charge on a driver will always be less if the driver wears clothes made from cotton rather than any other type of material.'

Suggest **two** reasons why this may **not** be a valid conclusion.

[2 marks]

1 _____

2 _____

11

4.2.1.2 Electrical charge and current

Question 16

June 2018 | 8463/1H | Original Q5

0 5 . 1 Complete the sentence. Choose answers from the box.

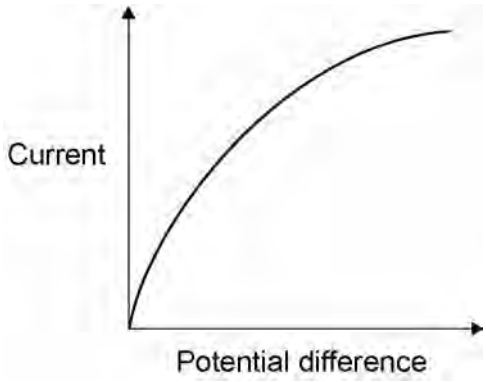
[2 marks]

charge	**potential difference**	**power**	**temperature**	**time**

The current through an ohmic conductor is directly proportional to the _____ across the component, provided that the _____ remains constant.

0 5 . 2 **Figure 7** shows a current – potential difference graph for a filament lamp.

Figure 7



Explain how the resistance of a filament lamp changes as the potential difference across it increases.

[3 marks]

4.2.1.2 Electrical charge and current

Question 16 · continued

0 5 . 3 Many householders are replacing their filament lamps with LED lamps which are more energy efficient.

What does more energy efficient mean?

[1 mark]

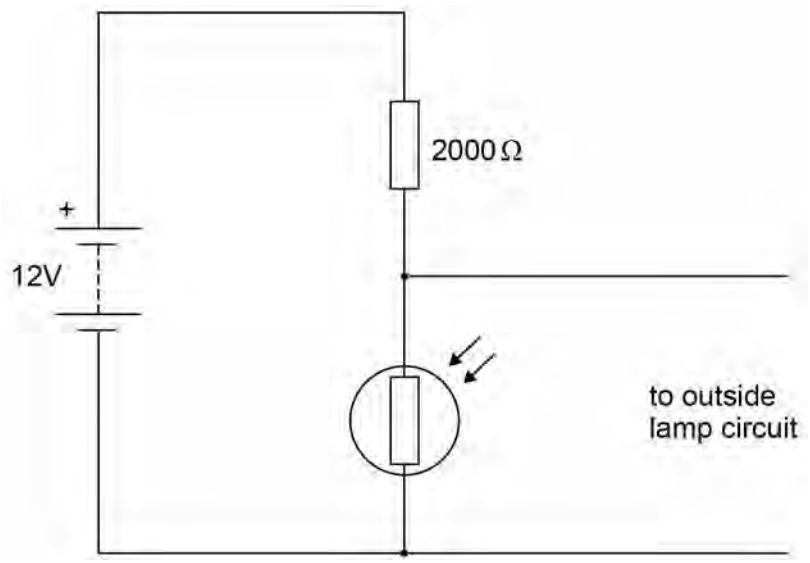
Question 5 continues on the next page

Question 16 · continued

A Light Dependent Resistor (LDR) is used to turn on an outside lamp when it gets dark.

Part of the circuit is shown in **Figure 8**.

Figure 8



0 5 . 4 The light intensity decreases.

What happens to the potential difference across the LDR and the current in the LDR?

[2 marks]

Potential difference _____

Current _____

0 5 . 5 What is the resistance of the LDR when the potential difference across it is 4 V?

Give a reason for your answer.

[2 marks]

Resistance = _____ Ω

Reason _____

_____

_____

4.2.1.2 Electrical charge and current

Question 16 · continued

0 5 . 6 Calculate the current through the LDR when the resistance of the LDR is 5000 Ω.

Give your answer to 2 significant figures.

[4 marks]

Current = _____ A

14

Turn over for the next question

4.2.1.2 Electrical charge and current

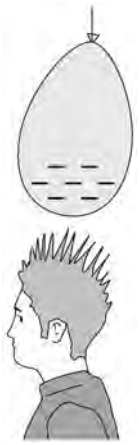
Question 17

June 2019 | 8463/1H | Original Q10

1 0 **Figure 12** shows a student after rubbing a balloon on his hair.

The balloon and hair have become charged.

Figure 12



1 0 . 1 Describe the force that acts on the student's hair in **Figure 12**.

[2 marks]

1 0 . 2 An earthed conductor was brought near the charged student.
A spark jumped between the conductor and the student.

The potential difference between the conductor and the student was 2.5 kV
The energy transferred by the spark was 0.0050 J

Calculate the charge transferred by the spark.

[3 marks]

Charge = _____ C

4.2.1.2 Electrical charge and current

Question 17 · continued

1 0 . 3 A defibrillator can transfer a charge to regulate a person's heartbeat.

Figure 13 shows a defibrillator.

Figure 13



When the defibrillator is in use, a potential difference of 4800 V is applied across the person's chest.

A charge of 0.16 coulombs passes through the person's chest in 4.0 ms

Calculate the resistance of the person's chest.

[5 marks]

Resistance = _____ Ω

10

4.2.1.2 Electrical charge and current

Question 18

November 2020 | 8463/1H | Original Q2

0 2 **Figure 3** shows an LED torch.

Figure 3

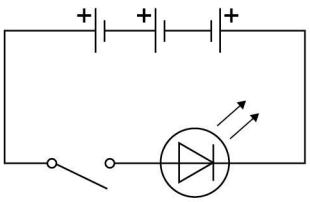


0 2 . 1 The torch contains one LED, one switch and three cells.

Which diagram shows the correct circuit for the torch?

[1 mark]

Tick (✓) **one** box.



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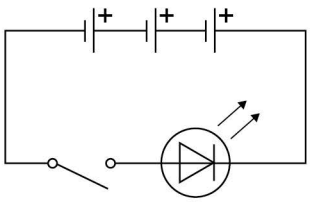

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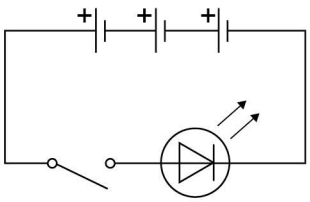


☐

4.2.1.2 Electrical charge and current

Question 18 · continued

0 2 . 2 Write down the equation which links charge flow (Q), current (I) and time (t).

[1 mark]

0 2 . 3 The torch worked for 14 400 seconds before the cells needed replacing.

The current in the LED was 50 mA.

Calculate the total charge flow through the cells.

[3 marks]

Total charge flow = _____ C

0 2 . 4 When replaced, the cells were put into the torch the wrong way around.

Explain why the torch did not work.

[2 marks]

Question 2 continues on the next page

4.2.1.2 Electrical charge and current

Question 18 · continued

0 2 . 5 Write down the equation which links efficiency, total power input and useful power output.

[1 mark]

0 2 . 6 The total power input to the LED was 0.24 W.

The efficiency of the LED was 0.75

Calculate the useful power output of the LED.

[3 marks]

Useful power output = _____ W

11

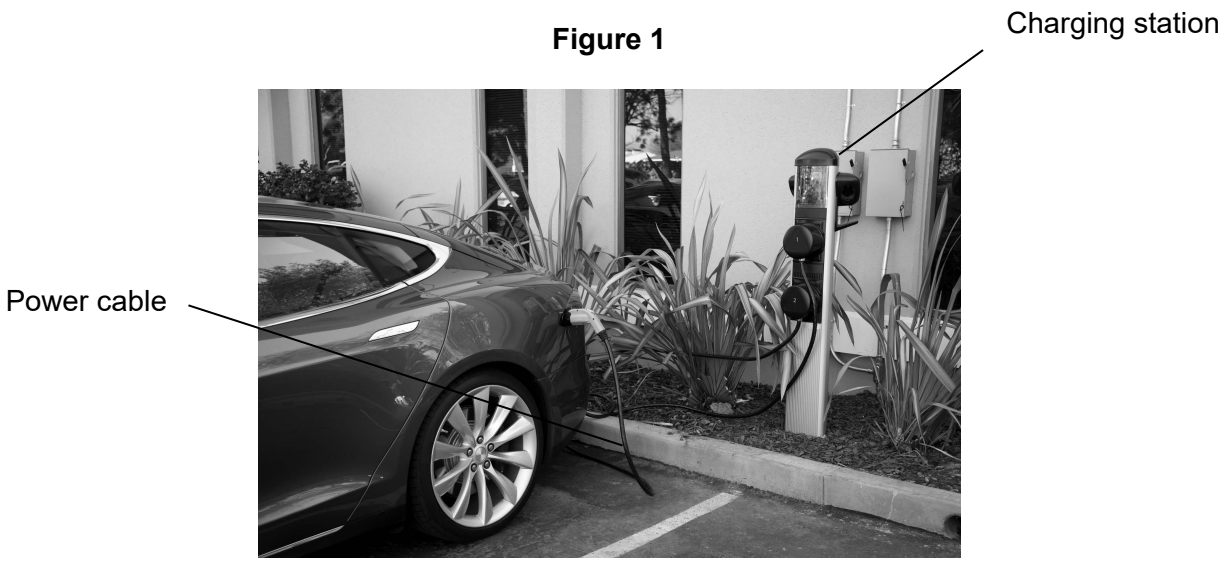
4.2.1.2 Electrical charge and current

Question 19

November 2021 | 8463/1H | Original Q1

0 1 **Figure 1** shows an electric car being recharged.

Figure 1



0 1 . 1 The charging station applies a direct potential difference across the battery of the car.

What does 'direct potential difference' mean?

[1 mark]

Question 1 continues on the next page

4.2.1.2 Electrical charge and current

Question 19 · continued

0 1 . 2 Which equation links energy transferred (E), power (P) and time (t)?

[1 mark]

Tick (✓) **one** box.

energy transferred = $\frac{\text{power}}{\text{time}}$ ☐

energy transferred = $\frac{\text{time}}{\text{power}}$ ☐

energy transferred = power × time ☐

energy transferred = power^2 × time ☐

0 1 . 3 The battery in the electric car can store 162 000 000 J of energy.

The charging station has a power output of 7200 W.

Calculate the time taken to fully recharge the battery from zero.

[3 marks]

Time taken = _____ s

4.2.1.2 Electrical charge and current

Question 19 · continued

0 1 . 4 Which equation links current (I), potential difference (V) and resistance (R)?

[1 mark]

Tick (✓) **one** box.

$I = V \times R$ ☐

$I = V^2 \times R$ ☐

$R = I \times V$ ☐

$V = I \times R$ ☐

0 1 . 5 The potential difference across the battery is 480 V.

There is a current of 15 A in the circuit connecting the battery to the motor of the electric car.

Calculate the resistance of the motor.

[3 marks]

Resistance = _____ Ω

Question 1 continues on the next page

4.2.1.2 Electrical charge and current

Question 19 · continued

0 1 . 6 Different charging systems use different electrical currents.

- Charging system **A** has a current of 13 A.
- Charging system **B** has a current of 26 A.
- The potential difference of both charging systems is 230 V.

How does the time taken to recharge a battery using charging system **A** compare with the time taken using charging system **B**?

[1 mark]

Tick (✓) **one** box.

Time taken using system **A** is half the time of system **B** ☐

Time taken using system **A** is the same as system **B** ☐

Time taken using system **A** is double the time of system **B** ☐

10

4.2.1.2 Electrical charge and current

Question 20

November 2021 | 8463/1H | Original Q5

0 5 . 1 During one year, 1.25×10^{18} J of energy was transferred from the National Grid.

number of seconds in 1 year = 3.16×10^{7}

Calculate the mean energy transferred from the National Grid each second.

Give your answer to 3 significant figures.

[2 marks]

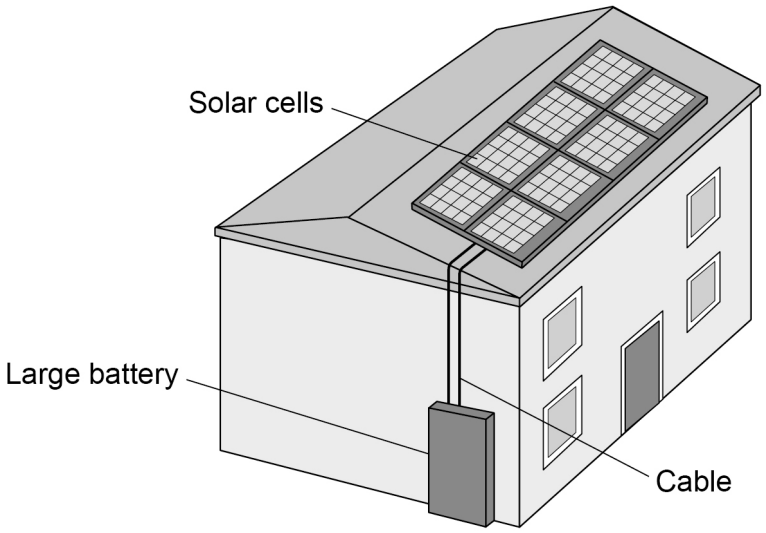
Energy each second (3 significant figures) = _____ J

Figure 5 shows a house with a solar power system.

The solar cells generate electricity.

When the electricity generated by the solar cells is not needed, the energy is stored in a large battery.

Figure 5



4.2.1.2 Electrical charge and current

Question 20 · continued

0 5 . 2 The charge flow through the cable between the solar cells and the battery in 24 hours was 27 000 coulombs.

Calculate the mean current in the cable.

[4 marks]

Mean current = _____ A

0 5 . 3 At one time, the total power input to the solar cells was 7.8 kW.

The efficiency of the solar cells was 0.15

Calculate the useful power output of the solar cells.

[3 marks]

Useful power output = _____ W

Question 5 continues on the next page

4.2.1.2 Electrical charge and current

Question 20 · continued

November 2021 | 8463/1H | Original Q5

0 5 . 4 It is unlikely that **all** of the electricity that the UK needs can be generated by solar power systems.

Explain why.

[2 marks]

11

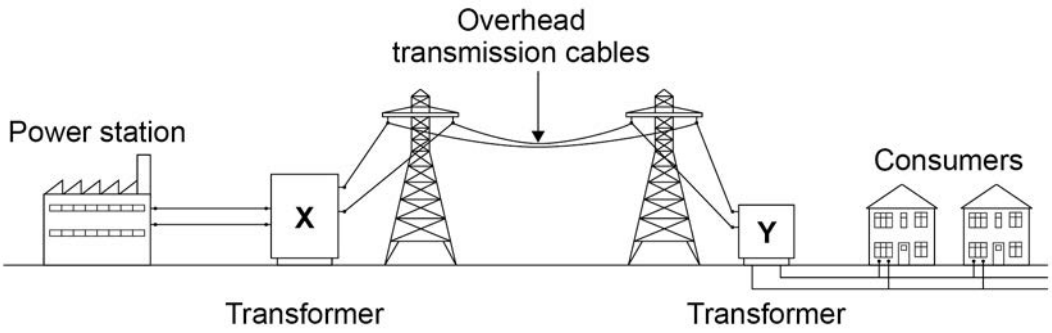
4.2.1.2 Electrical charge and current

Question 21

June 2022 | 8463/1H | Original Q6

0 6 **Figure 8** shows how electricity is supplied to consumers by the National Grid.

Figure 8



0 6 . 1 Explain why transformer **X** is used in the National Grid.

[4 marks]

0 6 . 2 Explain why transformer **Y** is used in the National Grid.

[2 marks]

4.2.1.2 Electrical charge and current

Question 21 · continued

0 6 . 3 The town of Hornsdale in Australia has electricity supplied by a huge battery.

On one day the battery transferred 3.24×10^{11} J of energy to the town.

The potential difference of the town's electricity supply is 230 V.

Calculate the charge flow to the town on this day.

Use the Physics Equations Sheet.

Give your answer to **3** significant figures.

[4 marks]

Charge flow (3 significant figures) = _____ C

10

4.2.1.2 Electrical charge and current

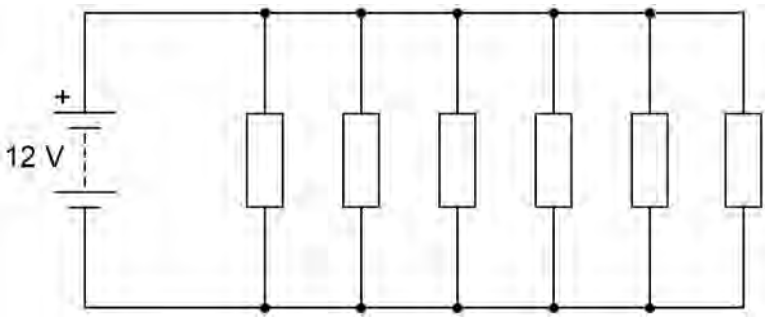
Question 22

June 2023 | 8463/1H | Original Q3

0 3 **Figure 4** shows an electrical circuit used to heat the windscreen of a car.

Each resistor in the circuit represents a heating element.

Figure 4



0 3 . 1 The 12 V battery supplies direct potential difference.

What is meant by 'direct potential difference'?

[1 mark]

Use the Physics Equations Sheet to answer questions **03.2** and **03.3**.

0 3 . 2 Which equation links charge flow (Q), energy (E) and potential difference (V)?

[1 mark]

Tick (✓) **one** box.

$E = \frac{V}{Q}$ ☐

$E = QV$ ☐

$E = \frac{Q}{V}$ ☐

$E = \frac{V^2}{Q}$ ☐

4.2.1.2 Electrical charge and current

Question 22 · continued

0 3 . 3 Calculate the charge flow through the 12 V battery when the battery transfers 5010 J of energy.

[3 marks]

Charge flow = _____ C

0 3 . 4 Ice forms on the windscreen at a temperature of 0 °C.

The electrical circuit transfers 5010 J of energy to the ice.

A mass of 0.015 kg of ice melts.

Calculate the specific latent heat of fusion of water.

Use the Physics Equations Sheet.

[3 marks]

Specific latent heat of fusion of water = _____ J/kg

4.2.1.2 Electrical charge and current

Question 22 · continued

0 3 . 5 The electrical circuit was left switched on while the ice changed from a solid to a liquid and increased in temperature to 5 °C.

Explain the changes in the arrangement **and** movement of the particles as the ice melted and the temperature increased to 5 °C.

[6 marks]

14

4.2.1.2 Electrical charge and current

Question 23

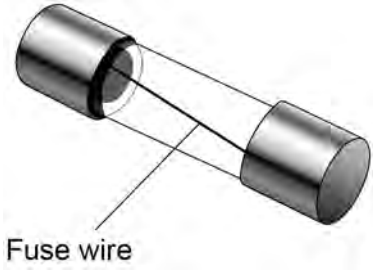
June 2024 | 8463/1H | Original Q10

1 0 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.

Figure 17 shows a fuse.

Figure 17



1 0 . 1 What colour is the insulation covering the live wire in a three-core cable?

[1 mark]

1 0 . 2 Draw the circuit symbol for a fuse in the box below.

[1 mark]

Question 23 · continued

1 0 . 3 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.

[4 marks]

Current = _____ A

1 0 . 4 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.

[4 marks]

Mass = _____ kg

Question 10 continues on the next page

4.2.1.2 Electrical charge and current

Question 23 · continued

1 0 . 5 The calculation in Question **10.4** 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.

[2 marks]

Tick (✓) **one** box.

Time taken would decrease ☐

Time taken would stay the same ☐

Time taken would increase ☐

Reason _____

_____

_____

12

4.2.1.2 Electrical charge and current

Question 24

June 2025 | 8463/1H | Original Q6

0 6 **Figure 8** shows a battery-powered hand warmer that contains a heating pad.

The battery transfers energy to increase the temperature of the heating pad.

Figure 8



0 6 . 1 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.

[3 marks]

Temperature increase = _____ °C

4.2.1.2 Electrical charge and current

Question 24 · continued

0 6 . 2 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.

[4 marks]

Charge flow = _____ C

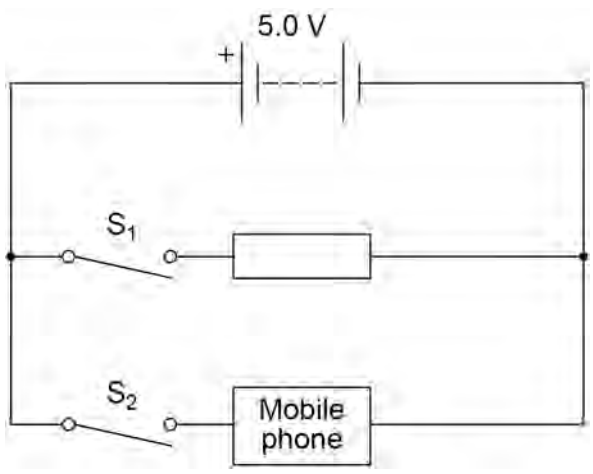
Question 6 continues on the next page

0 6 . 3 The circuit inside the hand warmer can be connected to a mobile phone to recharge the mobile phone.

Figure 9 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 9



Explain how closing both switches S_1 and S_2 affects the power output of the battery compared with only closing switch S_1.

[3 marks]

10

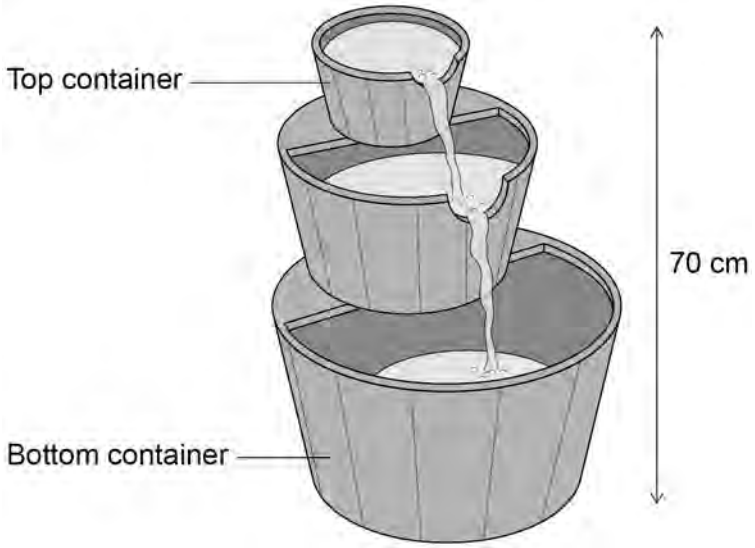
4.2.1.2 Electrical charge and current

Question 25

June 2025 | 8463/1H | Original Q9

0 9 **Figure 11** shows a garden water feature.

Figure 11



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

0 9 . 1 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.

[4 marks]

Mass = _____ kg

Question 25 · continued

0 9 . 2 The power of the pump motor is 4.86 W.

The resistance of the pump motor is 6.0 Ω.

Calculate the charge flow through the motor in 30 minutes.

Use the Physics Equations Sheet.

[6 marks]

Charge flow = _____ C

0 9 . 3 The pump motor breaks and is replaced with a new motor.

The new pump motor has the same power input, but has a greater efficiency.

Explain how the new pump motor would affect the flow of water in the water feature.

[2 marks]

12