AQA GCSE Physics | 8463

SPECIFICATION POINT 4.2.3.2

# Mains electricity

## Past-paper questions

| | |
|---|---|
| Tier | **Foundation** |
| Question groups | **46** |
| 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:** _____

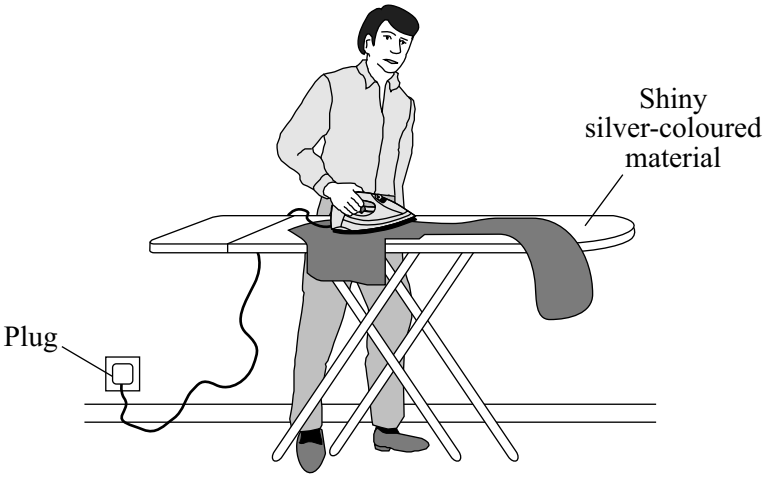
Whole questions are retained for context, so some parts assess other specification points. Current and legacy sources are labelled. Continue on extra paper if needed.

### 4.2.3.2 Mains electricity

**Question 01**

June 2003 | 3451F | Original Q13 | Legacy

**13** The drawing shows someone ironing a shirt. The top of the ironing board is covered in a shiny silver-coloured material.




(a) Explain why the shiny silver-coloured material helps to make ironing easier.

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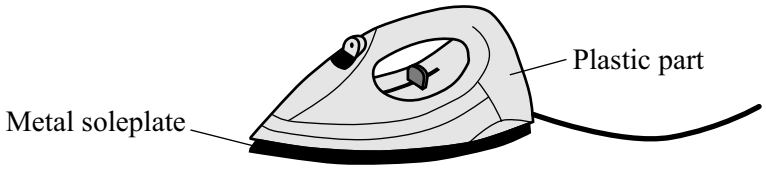
*(2 marks)*

(b) The iron must be earthed to make it safe. Which part of the iron is connected to the earth pin of the plug?




.....

*(1 mark)*

(c) Name a material that could be used to make the outside case of the plug.

.....

Give a reason for your choice.

.....

.....

*(2 marks)*

4.2.3.2 Mains electricity

Question 01 · continued





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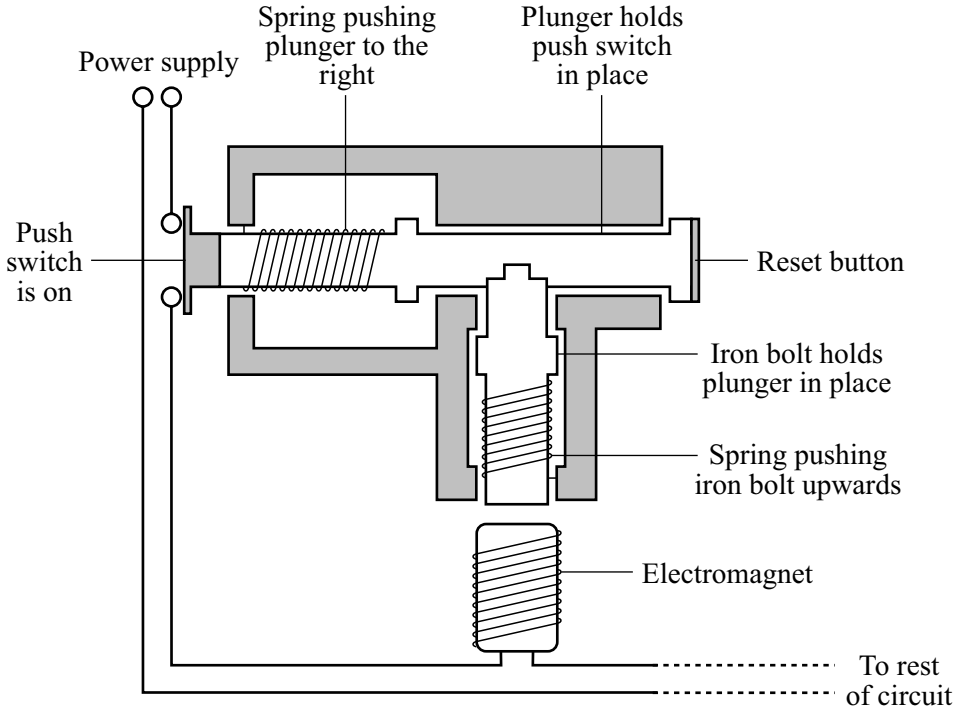
(d) *To gain full marks in this question you should write your ideas in good English. Put them into a sensible order and use the correct scientific words.*

Some electrical circuits are protected by a circuit breaker. These switch the circuit off if a fault causes a larger than normal current to flow. The diagram shows one type of circuit breaker. A normal current (15 A) is flowing.




*Source*: adapted from V. PRUDEN and K. HIRST, *AQA GCSE Science*
Reproduced by permission of Hodder and Stoughton Educational Ltd

Explain what happens when a current larger than 15 A flows. The answer has been started for you.

When the current goes above 15 A, the electromagnet becomes stronger and.....

.....

.....

.....

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.....

*(3 marks)*

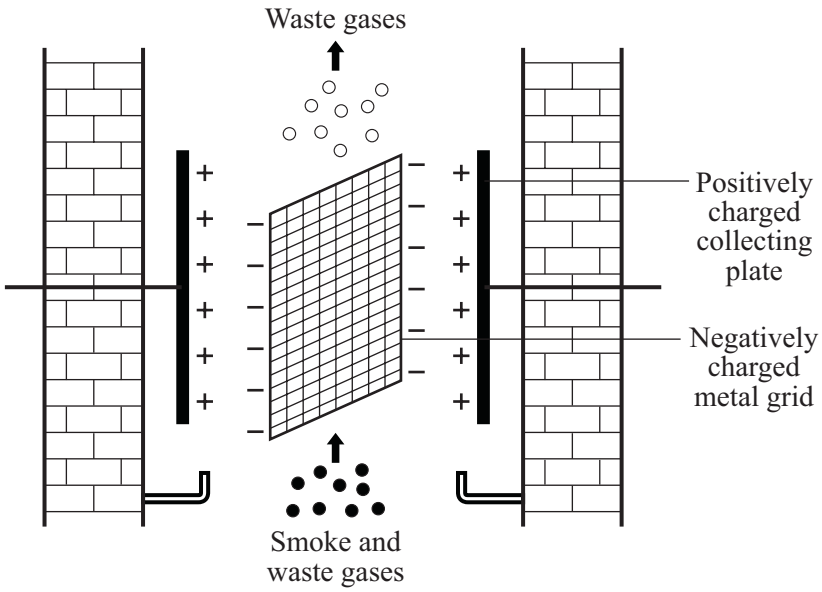
8

### 4.2.3.2 Mains electricity

**Question 02**

June 2004 | 3451F | Original Q4 | Legacy

**4** (a) Burning fuels produce smoke particles and waste gases. An electrostatic smoke precipitator can remove the smoke particles from the waste gases.




The following sentences **A** to **E** describe how an electrostatic smoke precipitator works. The sentences are in the wrong order.

**A** The smoke particles stick to the positively charged collecting plates.

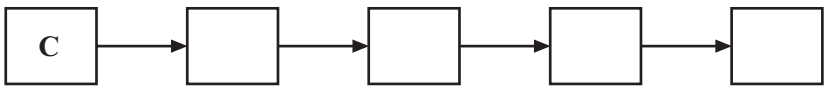
**B** The smoke particles are given a negative charge.

**C** The waste gases and smoke pass through a negatively charged metal grid.

**D** The collecting plates are knocked so the smoke particles fall and can be taken away.

**E** The smoke particles are repelled from the grid and attracted to the positively charged collecting plates.

Arrange the sentences in the right order. Start with sentence **C**.




*(3 marks)*

**4.2.3.2 Mains electricity**

**Question 02 · continued**



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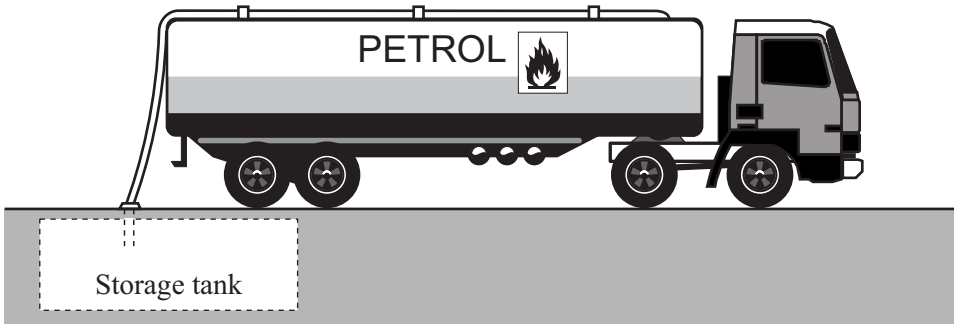
(b) The underground storage tanks at petrol stations are filled from tankers. A static electric charge can build up on the tanker as the petrol flows through the pipe to the storage tank. This could be dangerous.




Why is the static electric charge dangerous and what should be done to stop the charge building up?

.....

.....

.....

.....

*(2 marks)*

(c) A 3-pin plug should always be fitted with the correct value fuse for a particular electrical appliance. The fuse protects the appliance and wires from damage.

Explain how a fuse works.

*To gain full marks in this question you should write your ideas in good English. Put them into a sensible order and use the correct scientific words.*

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*(3 marks)*

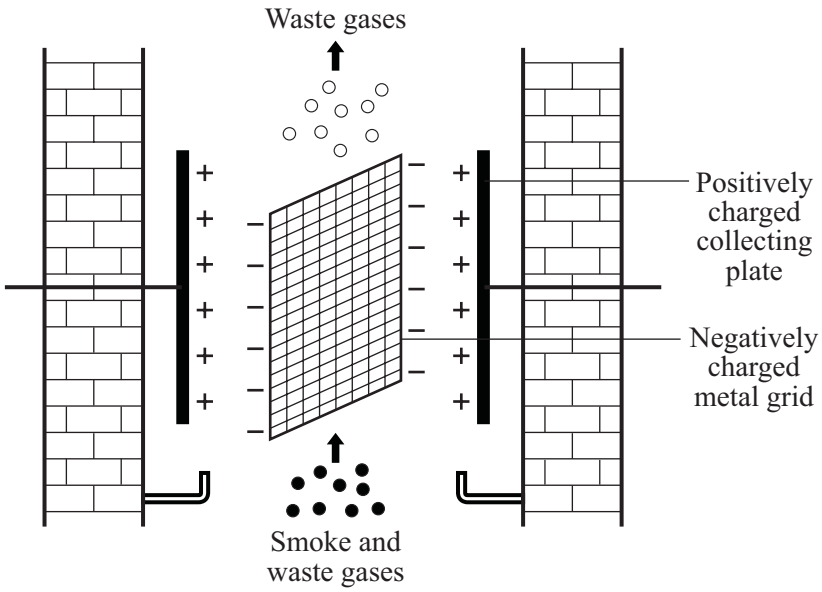
8

### 4.2.3.2 Mains electricity

**Question 03**

June 2004 | 3462F3 | Original Q4 | Legacy

**4** (a) Burning fuels produce smoke particles and waste gases. An electrostatic smoke precipitator can remove the smoke particles from the waste gases.

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**A** The smoke particles stick to the positively charged collecting plates.

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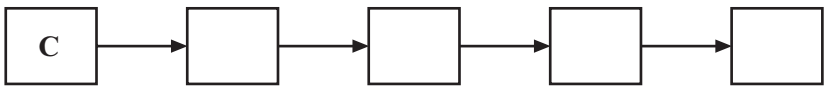
**C** The waste gases and smoke pass through a negatively charged metal grid.

**D** The collecting plates are knocked so the smoke particles fall and can be taken away.

**E** The smoke particles are repelled from the grid and attracted to the positively charged collecting plates.

Arrange the sentences in the right order. Start with sentence **C**.




*(3 marks)*

**4.2.3.2 Mains electricity**

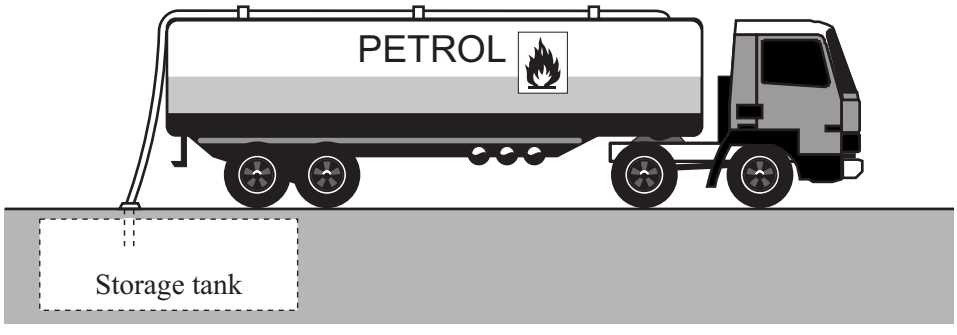
**Question 03 · continued**



/

MARGIN BLANK

(b) The underground storage tanks at petrol stations are filled from tankers. A static electric charge can build up on the tanker as the petrol flows through the pipe to the storage tank. This could be dangerous.




Why is the static electric charge dangerous and what should be done to stop the charge building up?

.....

.....

.....

.....

*(2 marks)*

(c) A 3-pin plug should always be fitted with the correct value fuse for a particular electrical appliance. The fuse protects the appliance and wires from damage.

Explain how a fuse works.

*To gain full marks in this question you should write your ideas in good English. Put them into a sensible order and use the correct scientific words.*

.....

.....

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.....

*(3 marks)*

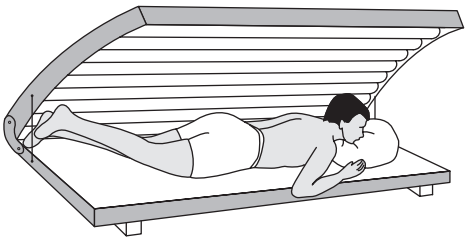
8

**4.2.3.2 Mains electricity**

**Question 04**

June 2006 | 3451 | Original Q2 | Legacy

**2** (a) The diagram shows a person using a sunbed.



(i) Which type of radiation is used in a sunbed to give a suntan?

Draw a ring around your answer.

**infra red** **light** **microwave** **ultraviolet**

*(1 mark)*

(ii) What can a high dose of radiation from a sunbed do to living cells?

.....

.....

*(1 mark)*

Question 04 · continued



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(b) The box contains the information shown on the side of a sunbed.

| | |
|---|---|
| **230 V** | **1.8 kW** |
| **50 Hz** | **7.8 A** |

(i) Which **one** of the following statements is true? Put a tick (✓) in the box next to your choice.

The sunbed uses an alternating current (a.c.) electricity supply. ☐

A 5 amp fuse should be used in the plug of the sunbed. ☐

The sunbed transfers 1.8 joules of energy every second. ☐

*(1 mark)*

(ii) In one week the sunbed is used for a total of 6 hours.

Use the following equation to calculate the number of units of energy transferred by the sunbed in 6 hours.

Show clearly how you work out your answer.

energy transferred (kilowatt-hour, kWh) = power (kilowatt, kW) × time (hour, h)

.....

.....

Energy transferred = ..... kWh

*(2 marks)*

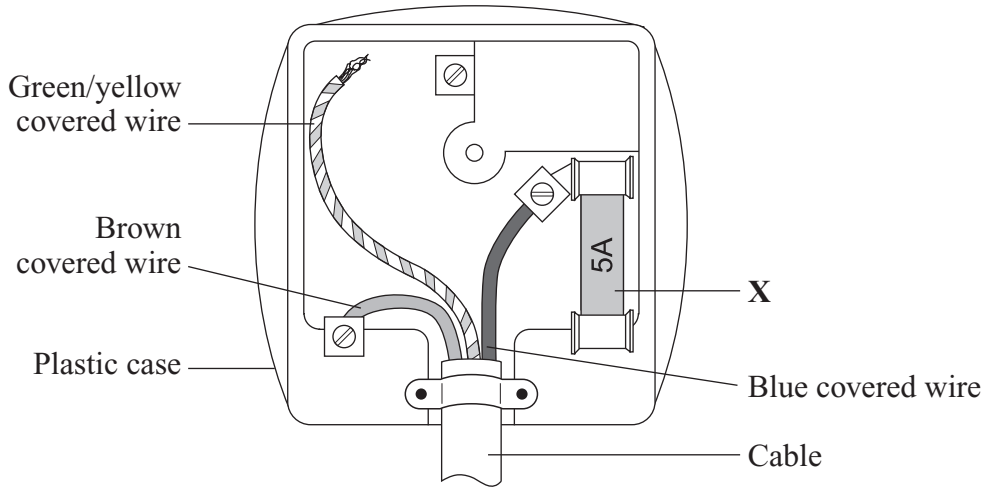
5

**4.2.3.2 Mains electricity**

**Question 05**

June 2006 | 3451 | Original Q5 | Legacy

**5** The diagram shows a badly wired mains electricity plug.




(a) Why is the outside case of the plug made from plastic?

.....

.....

*(1 mark)*

(b) What is the part labelled **X** called?

.....

*(1 mark)*

(c) Describe what must be done to correctly wire the plug.

.....

.....

.....

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*(2 marks)*

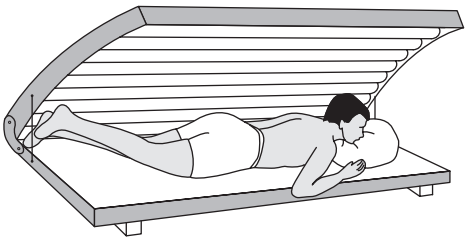
4

**4.2.3.2 Mains electricity**

**Question 06**

June 2006 | 3462 | Original Q2 | Legacy

**2** (a) The diagram shows a person using a sunbed.



(i) Which type of radiation is used in a sunbed to give a suntan?

Draw a ring around your answer.

**infra red** **light** **microwave** **ultraviolet**

*(1 mark)*

(ii) What can a high dose of radiation from a sunbed do to living cells?

.....

.....

*(1 mark)*

Question 06 · continued



*BLANK*

(b) The box contains the information shown on the side of a sunbed.

| | |
|---|---|
| **230 V** | **1.8 kW** |
| **50 Hz** | **7.8 A** |

(i) Which **one** of the following statements is true? Put a tick (✓) in the box next to your choice.

The sunbed uses an alternating current (a.c.) electricity supply. ☐

A 5 amp fuse should be used in the plug of the sunbed. ☐

The sunbed transfers 1.8 joules of energy every second. ☐

*(1 mark)*

(ii) In one week the sunbed is used for a total of 6 hours.

Use the following equation to calculate the number of units of energy transferred by the sunbed in 6 hours.

Show clearly how you work out your answer.

energy transferred (kilowatt-hour, kWh) = power (kilowatt, kW) × time (hour, h)

.....

.....

Energy transferred = ..... kWh

*(2 marks)*

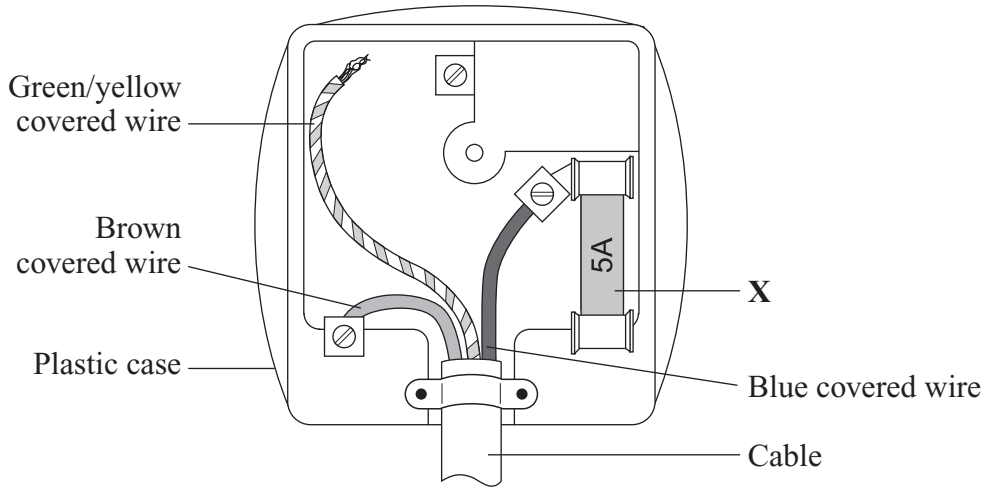
5

**4.2.3.2 Mains electricity**

**Question 07**

June 2006 | 3462 | Original Q5 | Legacy

**5** The diagram shows a badly wired mains electricity plug.




(a) Why is the outside case of the plug made from plastic?

.....

.....

*(1 mark)*

(b) What is the part labelled **X** called?

.....

*(1 mark)*

(c) Describe what must be done to correctly wire the plug.

.....

.....

.....

.....

*(2 marks)*

4

4.2.3.2 Mains electricity

Question 08

March 2007 | PHY1A | Original Q1 | Legacy

## QUESTION ONE

Energy is supplied to a microwave oven by mains electricity.

The oven transforms this energy in various ways.

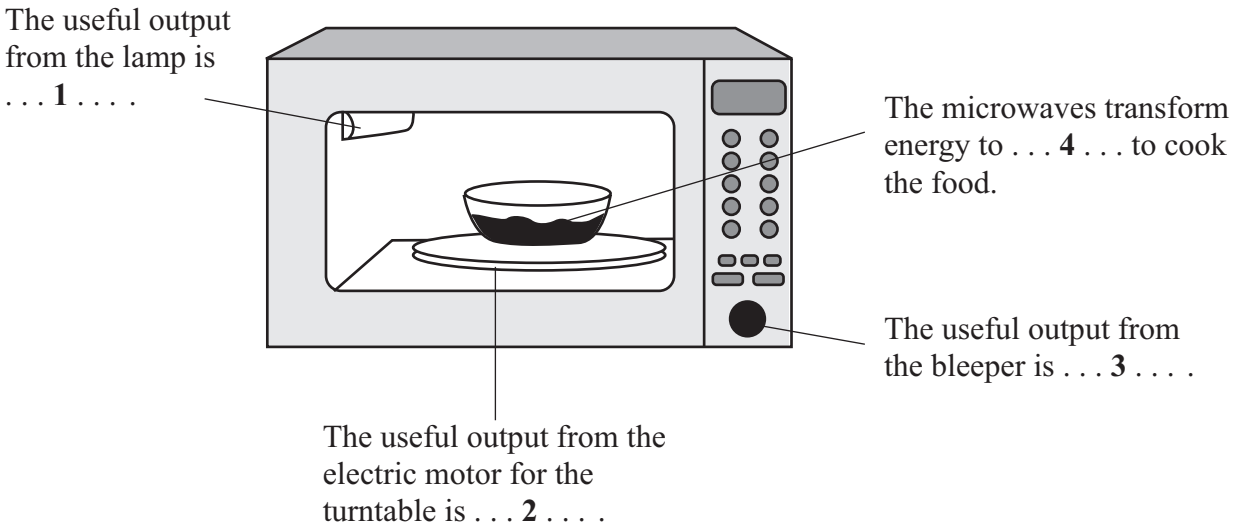
Match words, **A**, **B**, **C** and **D**, with the numbers **1–4** in the sentences.

**A** heat

**B** light

**C** movement

**D** sound



4.2.3.2 Mains electricity

Question 09

June 2007 | PHY1A | Original Q9 | Legacy

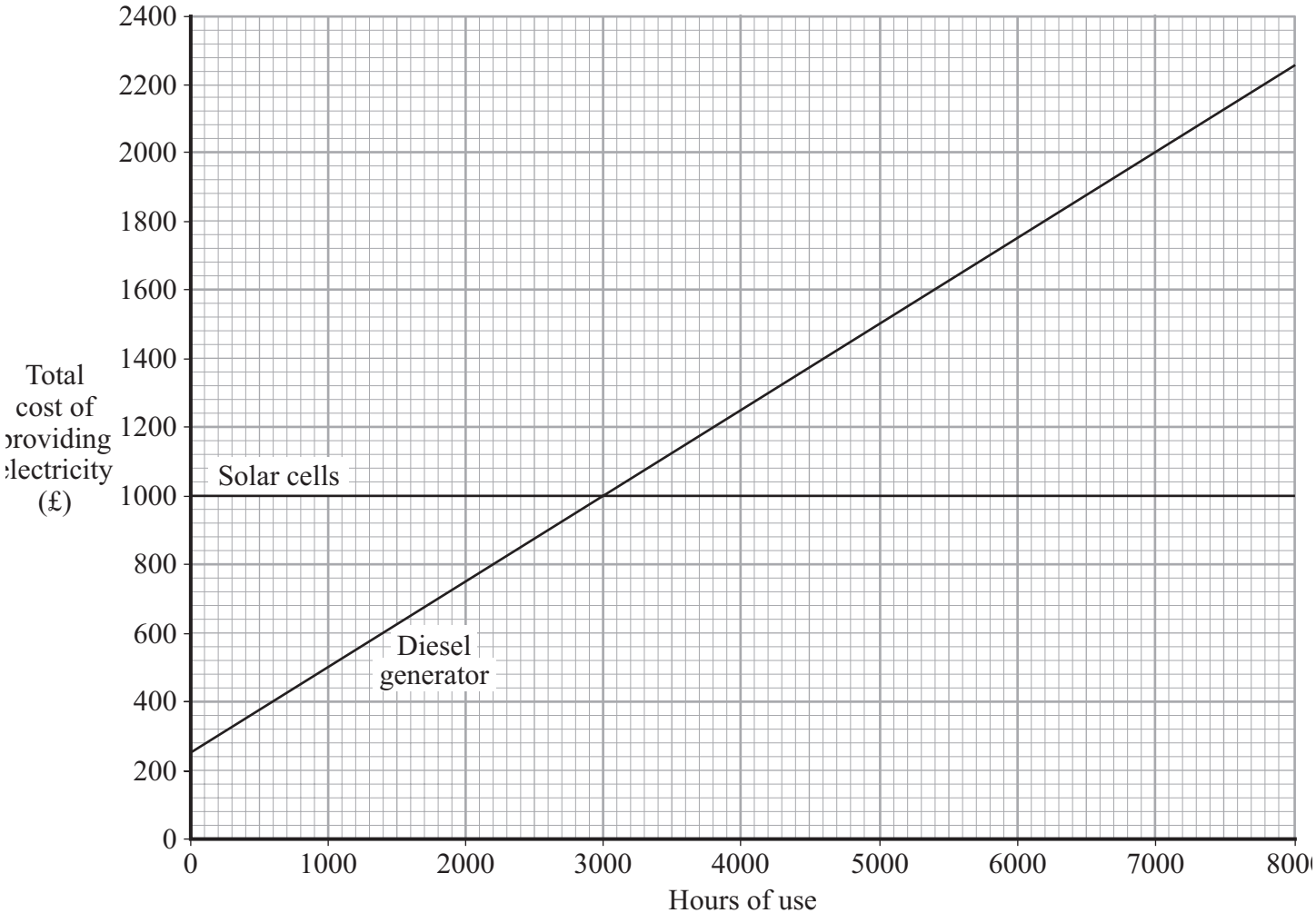
## QUESTION NINE

A remote village in South America is many kilometres from a mains electricity supply.

The villagers plan to pump water from the river and to use some of the water to irrigate fields.

They need an electricity supply to operate the pump.

The graph shows the total cost of two different ways of providing this electricity over time.




**9A** The graph shows that . . .

**1** there are fuel costs but no maintenance costs for the solar cells.

**2** there are maintenance costs but no fuel costs for the solar cells.

**3** there are no fuel costs and no maintenance costs for the solar cells.

**4** there are no fuel costs and no maintenance costs for the diesel generator.

4.2.3.2 Mains electricity



**9B** The price to buy the solar cells, compared with buying the diesel generator, is . . .

**1** twice as much.

**2** three times as much.

**3** four times as much.

**4** five times as much.

**9C** Providing electricity by diesel generator becomes more expensive than by solar cells after . . .

**1** 1000 hours of use.

**2** 2000 hours of use.

**3** 3000 hours of use.

**4** 4000 hours of use.

**9D** Maintenance of solar cells costs less than maintenance of the diesel generator mainly because . . .

**1** solar cells have no moving parts.

**2** solar cells do not produce exhaust gases.

**3** solar cells operate at lower temperatures than diesel generators.

**4** solar cells work only during the day.

**END OF TEST**

**4.2.3.2 Mains electricity**

**Question 10**

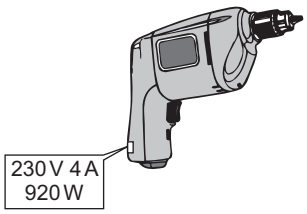


**4** (a) Look at this electrical safety information poster.

**Get it right!**
**Choose the right fuse.**

Most fuses are 3 A or 13 A.

To choose the right fuse you must know the power of the appliance.




Power is marked on the information plate.

| Power over 700 W use a 13 A fuse. | Power under 700 W use a 3 A fuse. |
|---|---|
| • Fan heaters<br>• Kettles<br>• Dishwashers<br>• Washing machines | • Radios<br>• Table lamps<br>• Portable TVs<br>• Electric blankets |

(i) Complete the table to show which size fuse, 3 A or 13 A, should be fitted to each of the appliances.

| Appliance | Power rating | Fuse |
|---|---|---|
| Hairdryer | 1600 W | |
| Electric saw | 350 W | |
| Food mixer | 1200 W | |

*(2 marks)*

(ii) The plug of an electric kettle has been wrongly fitted with a 3 A fuse.

What will happen to the fuse when the kettle is switched on?

.....

.....

*(1 mark)*

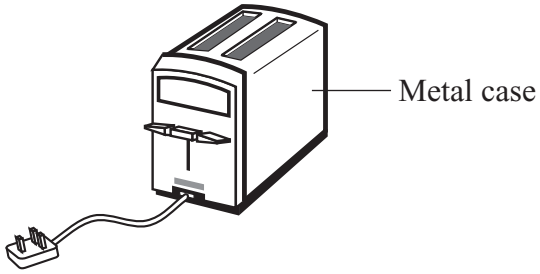
**4.2.3.2 Mains electricity**

**Question 10 · continued**



*BLANK*

(b) The drawing shows a toaster, which takes a current of 4 A from the 230 V mains electricity supply.




(i) Use the equation in the box to calculate the power of the toaster.

| Power (watt, W) | = | current (ampere, A) | × | potential difference (volt, V) |
|---|---|---|---|---|

Show clearly how you work out your answer.

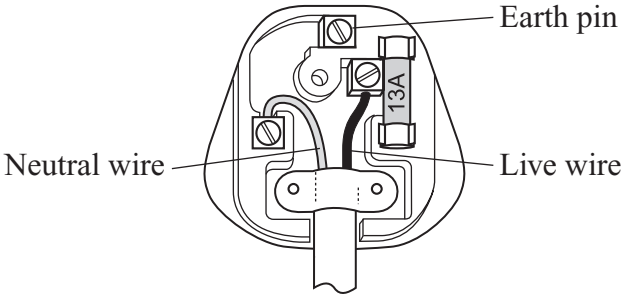
.....

.....

Power = ..... W

*(2 marks)*

(ii) A householder rewires the toaster with a new cable and plug. The diagram shows how the new cable has been connected to the plug.




Explain why the toaster may **not** be safe to use.

.....

.....

.....

.....

*(2 marks)*

**Question 4 continues on the next page**

**4.2.3.2 Mains electricity**

**Question 10 · continued**



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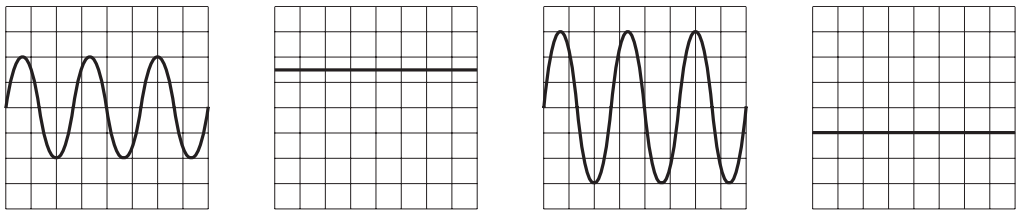
(c) The diagram shows the oscilloscope traces produced by four different electricity supplies. The settings on the oscilloscope are the same for each electricity supply.



**K** **L** **M** **N**

(i) Which **two** supplies give a direct current (d.c)?

..... and .....

*(1 mark)*

(ii) Supply **K** provides a peak potential difference of 6 V.

What is the peak potential difference provided by supply **M**?

.....

*(1 mark)*

9

**4.2.3.2 Mains electricity**

**Question 11**

June 2008 | PHY1AP | Original Q5 | Legacy

## QUESTION FIVE

Different energy sources are used to generate electricity. Each energy source has its own problems.

Match the ways of producing electricity, **A**, **B**, **C** and **D**, with the statements **1–4** in the table.

**A** power stations using fossil fuels

**B** power stations using nuclear fuels

**C** solar cells

**D** wind turbines

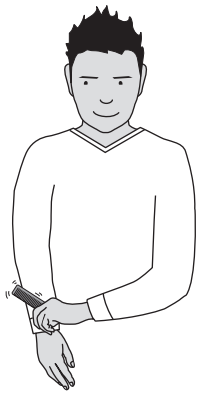
| | |
|---|---|
| **1** | give off polluting gases |
| **2** | useful for applications in remote regions or for small-scale uses |
| **3** | waste remains radioactive for a very long time |
| **4** | can be unsightly and cause noise pollution |

**4.2.3.2 Mains electricity**

**Question 12**

June 2008 | PHY2F | Original Q2 | Legacy

**2** (a) A student rubs a nylon comb on the sleeve of his jumper.



**2** (a) (i) Use words from the box to complete the following sentence.

| | | | |
|---|---|---|---|
| **electrons** | **hand** | **jumper** | **protons** |

The comb becomes negatively charged because ..... move

from the student's ..... to the comb.

*(2 marks)*

**2** (a) (ii) What type of charge is left on the jumper?

.....

*(1 mark)*

**2** (a) (iii) The negatively charged comb is placed close to a charged plastic ruler. The comb and the ruler attract each other.

Complete the following sentence by drawing a ring around the correct line in the box.

The ruler is

| |
|---|
| negatively charged |
| positively charged |
| uncharged |

.

*(1 mark)*

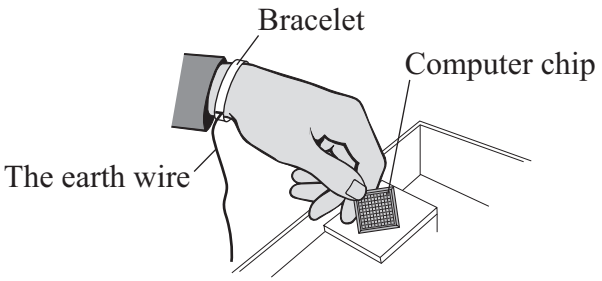
**4.2.3.2 Mains electricity**

**Question 12 · continued**



*for mark*

**2** (b) Electrostatic charge can damage computer chips. People working with computer chips may wear a special bracelet, with a wire joining the bracelet to earth (the earth wire). Any negative charge on the person will flow through the wire to earth.




**2** (b) (i) Which **one** of the following materials should the bracelet be made from?

Draw a ring around your answer.

**copper** **plastic** **rubber**

Give a reason for your answer.

.....

.....

*(2 marks)*

**2** (b) (ii) Which **one** of the following words is used to describe the rate of flow of charge through a wire?

Draw a ring around your answer.

**current** **resistance** **voltage**

*(1 mark)*

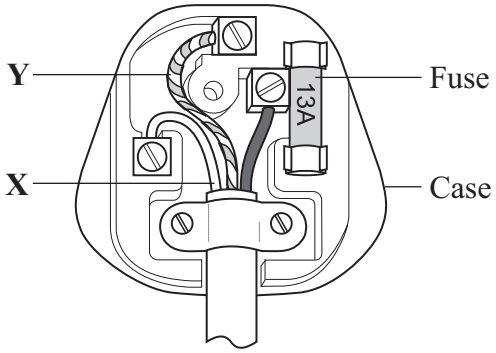
7

**4.2.3.2 Mains electricity**

**Question 13**

June 2008 | PHY2F | Original Q3 | Legacy

**3** (a) The diagram shows the inside of a correctly wired three-pin plug.




**3** (a) (i) What colour is the insulation on the wire labelled **X**?

Draw a ring around your answer.

**blue** **brown** **green/yellow**

*(1 mark)*

**3** (a) (ii) What name is given to the wire labelled **Y**?

Draw a ring around your answer.

**earth** **live** **neutral**

*(1 mark)*

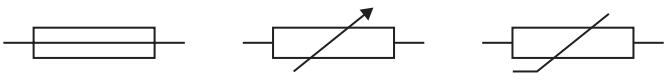
**3** (a) (iii) What material would be suitable for the case of the plug?

.....

*(1 mark)*

**3** (a) (iv) Which **one** of the following is the correct circuit symbol for a fuse?

Draw a ring around your answer.



*(1 mark)*

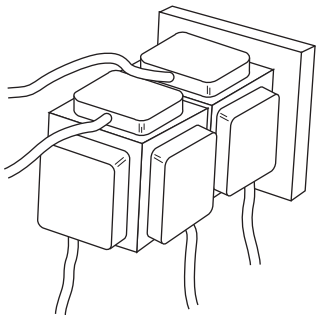
**4.2.3.2 Mains electricity**

**Question 13 · continued**



*for mark*

**3** (b) A householder does not have enough electric sockets in the kitchen. To overcome the problem, the householder uses two adaptors to plug five appliances into a single electric socket.



Explain why this is dangerous.

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.....

.....

*(2 marks)*

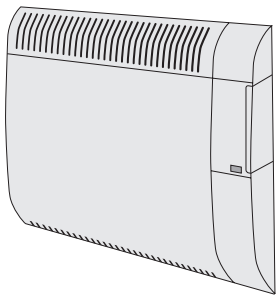
6

**4.2.3.2 Mains electricity**

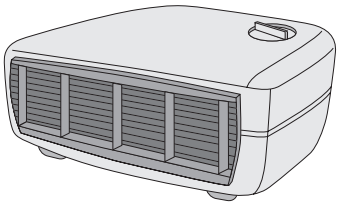
**Question 14**

January 2009 | PHY1F | Original Q7 | Legacy

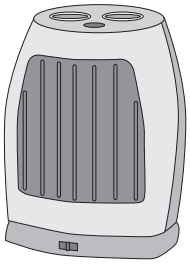
**7** The pictures show three different types of electric heater.



**400 W oil-filled panel heater (wall mounted)**
- 3 heat settings
- Efficient background heat
- Safety overheat cut-out



**3 kW fan heater**
- 2 heat settings
- Power indicator light
- Cool air fan setting



**1800 W ceramic heater**
- 2 heat settings
- 8 hour timer
- Power indicator light
- Safety overheat cut-out

**7** (a) The ceramic heater is run on full power for 5 hours.

Use the following equation to calculate, in kilowatt-hours, the amount of energy transferred from the mains to the heater.

energy transferred = power × time

Show clearly how you work out your answer.

.....

.....

Energy transferred = ..... kilowatt-hours

*(2 marks)*

**7** (b) Which heater will be the most expensive to run on its highest heat setting?

.....

*(1 mark)*

**4.2.3.2 Mains electricity**

**Question 14 · continued**



*for mark*

**7** (c) A heater is needed for a small office.

Comparing each type of heater with the other two, give **one** advantage of using each type of heater in the office.

oil-filled panel heater .....

.....

fan heater .....

.....

ceramic heater .....

.....

*(3 marks)*

**6**

**4.2.3.2 Mains electricity**

**Question 15**

January 2009 | PHY2F | Original Q2 | Legacy

**2** (a) Use numbers given in the box to complete the following sentences.

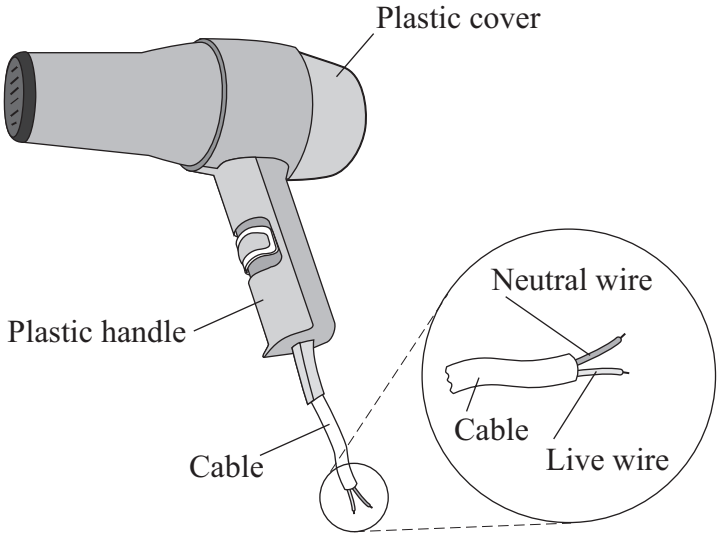
| | | | |
|---|---|---|---|
| **12** | **50** | **110** | **230** |

In the UK, the mains electricity supply is ..... volts.

The frequency of the UK mains electricity supply is ..... hertz.

*(2 marks)*

2 (b) The diagram shows a hairdryer designed to be used with the UK mains supply.
The cable connecting the hairdryer to the plug does not have an earth wire.




**2** (b) (i) Why does the hairdryer **not** need a cable with an earth wire?

.....

.....

*(1 mark)*

**2** (b) (ii) Which **one** of the following materials are the two wires inside the cable made from?

Draw a ring around your answer.

**aluminium** **copper** **steel**

*(1 mark)*

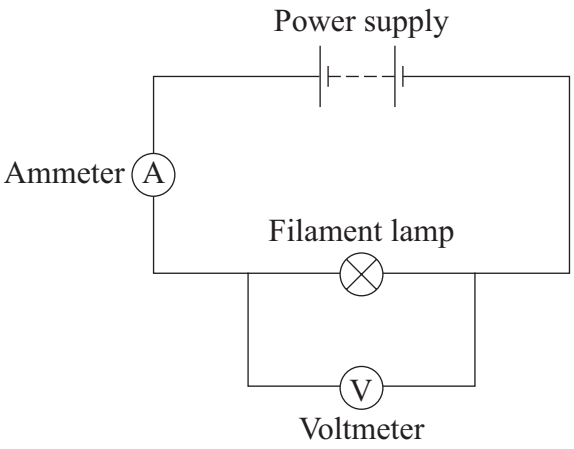
4

**4.2.3.2 Mains electricity**

**Question 16**

January 2009 | PHY2F | Original Q4 | Legacy

**4** (a) The diagram shows the circuit used by a student to measure the power of a filament lamp.




Name a component connected in parallel with the filament lamp.

.....

*(1 mark)*

**4** (b) By adding another component to the circuit, the student is able to obtain a range of ammeter and voltmeter readings.

| Ammeter reading in amps | Voltmeter reading in volts |
|---|---|
| 0.10 | 1.0 |
| 0.15 | 2.0 |
| 0.20 | 4.0 |
| 0.25 | 7.0 |
| 0.30 | 11.0 |

**4.2.3.2 Mains electricity**

**Question 16 · continued**



*for mark*

**4** (b) (i) Which **one** of the following components did the student add to the circuit?

Draw a ring around your answer.

**fuse** **switch** **variable resistor**

*(1 mark)*

**4** (b) (ii) What is the range of ammeter readings taken by the student?

from ..... amps to ..... amps

*(1 mark)*

**4** (b) (iii) Use the data in the table and the equation in the box to calculate the **maximum** power of the filament lamp.

| power (watt, W) | = | current (ampere, A) | × | potential difference (volt, V) |
|---|---|---|---|---|

Show clearly how you work out your answer.

.....

.....

Power = ..... W

*(3 marks)*

**4** (c) Complete the following sentence by drawing a ring around the correct line in the box.

As the temperature of a filament lamp increases, its resistance

| |
|---|
| increases |
| remains constant |
| decreases |

.

*(1 mark)*

7

**4.2.3.2 Mains electricity**

**Question 17**

June 2009 | PHY1F | Original Q6 | Legacy

**6** (a) The table lists the names of seven telescopes. Each one of the telescopes is designed to detect a different one of the seven types of electromagnetic wave.
The table is incomplete.

| Name of telescope | Type of wave detected |
|---|---|
| HESS | Gamma |
| XMM Newton | X-ray |
| FUSE | Ultraviolet |
| William Herschel | Visible light |
| Spitzer | |
| SPT | Microwave |
| Lovell | Radio |

**6** (a) (i) Which **one** of the telescopes is designed to detect the type of wave with the shortest wavelength?

.....

*(1 mark)*

**6** (a) (ii) What type of wave is the Spitzer telescope designed to detect?

.....

*(1 mark)*

**6** (b) The William Herschel telescope is on the Earth's surface. Another telescope, the Hubble telescope, which also detects visible light, orbits the Earth.

How is the image produced by the Hubble telescope better than the image produced by the William Herschel telescope?

.....

Give a reason for your answer.

.....

.....

*(2 marks)*

4.2.3.2 Mains electricity

Question 17 · continued



*for mark*

**6** (c) Some types of electromagnetic wave are absorbed by water.
The SPT telescope is located in the Antarctic, which is a dry environment.

Explain why it is better to have this type of telescope in a dry environment rather than in a wet, humid environment.

.....

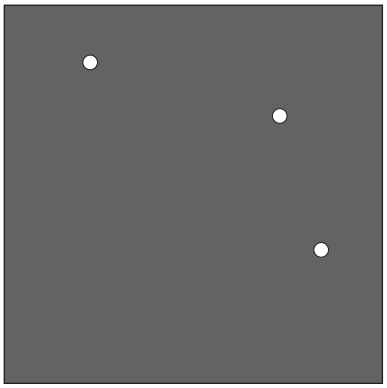
.....

.....

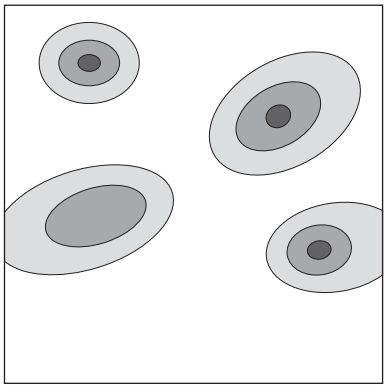
.....

*(2 marks)*

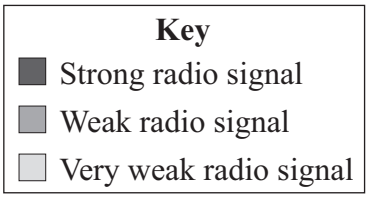
**6** (d) The pictures represent the images produced using a visible light telescope and a radio telescope. Both images are of the same part of the sky. The shading on the radio telescope image represents the strength of the radio signals.



Visible light image



Radio telescope image




Suggest what extra information can be gained from the radio telescope image compared with the visible light image.

.....

.....

*(1 mark)*

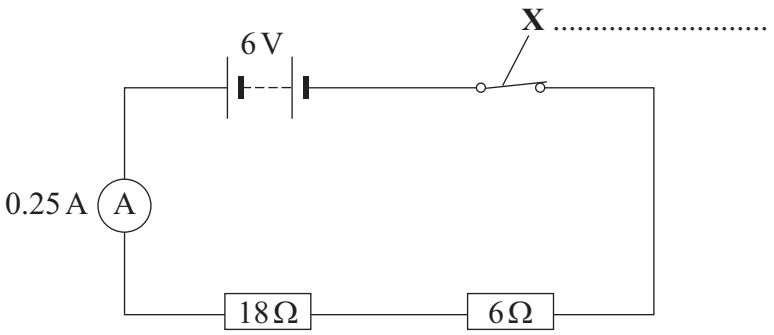
7

**4.2.3.2 Mains electricity**

**Question 18**



**1** A circuit diagram is shown below.




**1** (a) Use a word from the box to label component **X**.

| **fuse** | **switch** | **thermistor** |
|---|---|---|

*(1 mark)*

**1** (b) Calculate the total resistance of the two resistors in the circuit.

.....

Total resistance = ..... Ω

*(1 mark)*

**1** (c) The reading on the ammeter is 0.25 A.

The current through the 6 Ω resistor will be:

**bigger than 0.25 A** **equal to 0.25 A** **smaller than 0.25 A**

Draw a ring around your answer.

*(1 mark)*

**1** (d) The 6 V battery is made by correctly joining several 1.5 V cells in series.

Calculate the number of cells needed to make the battery.

.....

Number of cells = .....

*(1 mark)*

4

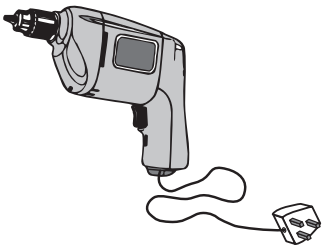
### 4.2.3.2 Mains electricity

**Question 19**

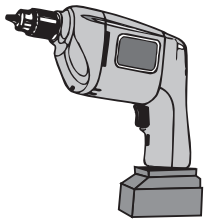
June 2010 | PHY1AP | Original Q1 | Legacy

**QUESTION ONE**

The diagrams show a mains electric drill and a cordless electric drill. The cordless drill has a rechargeable battery.



Mains electric drill



Cordless electric drill

Match types of energy, **A**, **B**, **C** and **D**, with the numbers **1–4** in the sentences.

**A** chemical energy

**B** electrical energy

**C** heat (thermal energy)

**D** kinetic energy

Drills are designed to produce . . . **1** . . . .

The drills also produce . . . **2** . . . and sound energy which are wasted.

Both drills use . . . **3** . . . to make their motors work.

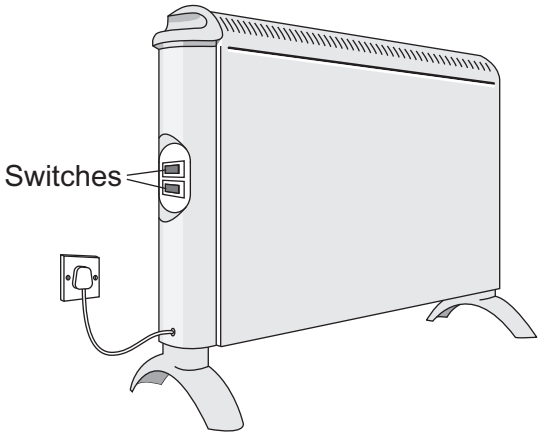
The cordless drill has a battery that stores . . . **4** . . . .

### 4.2.3.2 Mains electricity

**Question 20**

June 2010 | PHY1F | Original Q3 | Legacy

**3 (a)** The diagram shows two switches on a room heater. The heater has three power settings. The power produced by two of the settings is given in the table.




| Setting | Power in kW |
|---|---|
| Low | 0.5 |
| Medium | 1.5 |
| High | |

**3 (a) (i)** When both switches are on, the heater works at the high power setting.

What is the power of the heater when it is switched to the **high** power setting?

.....

Power = ..... kW

*(1 mark)*

**3 (a) (ii)** The heater is used on the **medium** power setting. It is switched on for three hours.

Use the equation in the box to work out the energy transferred from the mains to the heater in three hours.

| energy transferred (kilowatt-hour, kWh) | = | power (kilowatt, kW) | × | time (hour, h) |
|---|---|---|---|---|

Show clearly how you work out your answer.

.....

.....

Energy transferred = ..... kWh

*(2 marks)*

4.2.3.2 Mains electricity

Question 20 · continued



**3 (a) (iii)** Electricity costs 12 pence per kilowatt-hour.

Use the equation in the box to calculate how much the heater costs to use on **medium** power for three hours.

| total cost = number of kilowatt-hours × cost per kilowatt-hour |
|---|

Show clearly how you work out your answer.

.....

.....

Total cost = ..... pence

*(2 marks)*

**Question 3 continues on the next page**

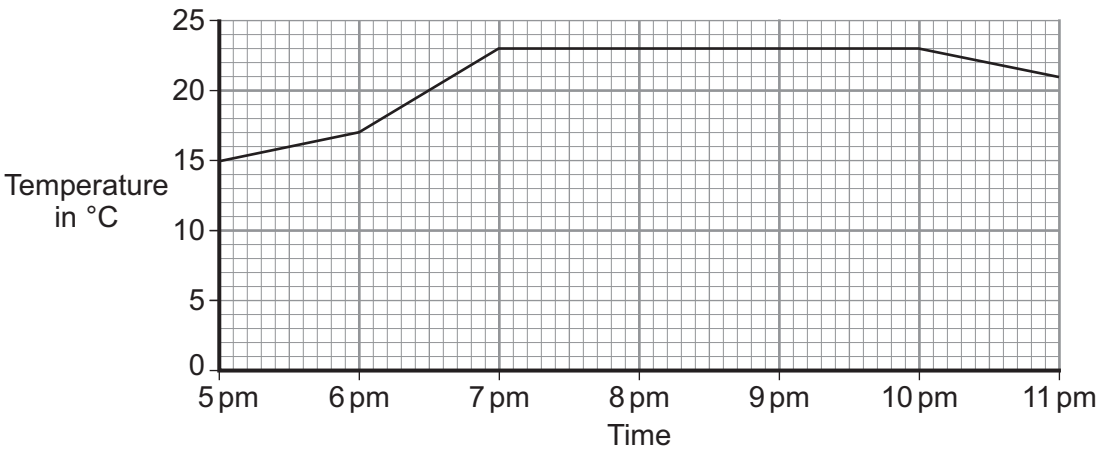
4.2.3.2 Mains electricity

Question 20 · continued



**3 (b)** The heater is used to warm a room.

The graph shows how the temperature of the room changes from the moment the heater is switched on.




The heater was first used on the medium setting.

**3 (b) (i)** At what time was the heater setting changed to the **high** setting?

.....

Give a reason for your answer.

.....

.....

.....

*(2 marks)*

**3 (b) (ii)** From 7 pm until 10 pm, the temperature of the room is **not** changing.

Which **one** of the following statements gives the reason why the temperature of the room is **not** changing?

Put a tick (✓) in the box next to your answer.

The room is losing energy slower than the heater supplies energy. ☐

The room is losing energy as fast as the heater supplies energy. ☐

The room is losing energy faster than the heater supplies energy. ☐

*(1 mark)*

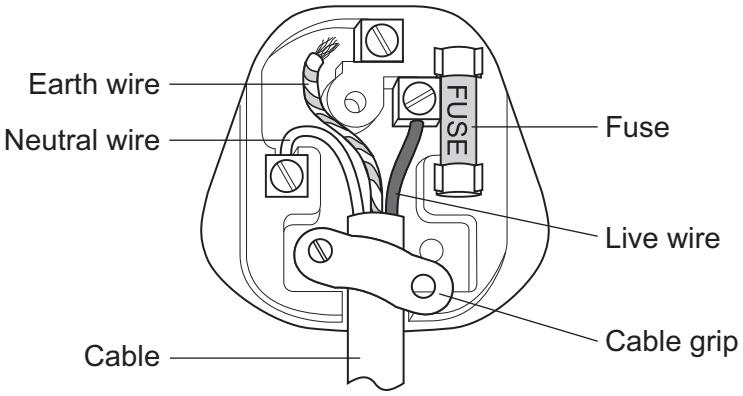
8

### 4.2.3.2 Mains electricity

**Question 21**

June 2010 | PHY2F | Original Q5 | Legacy

**5 (a)** The diagram shows the inside of an incorrectly wired three-pin plug.




**5 (a) (i)** What **two** changes need to be made so that the plug is wired correctly?

1 .....

.....

2 .....

.....

*(2 marks)*

**5 (a) (ii)** Which one of the wires inside a plug is there to make an appliance with a metal case safer to use?

.....

*(1 mark)*

**5 (a) (iii)** The fuse inside a plug is a safety device.

Explain what happens when too much current passes through a fuse.

.....

.....

.....

.....

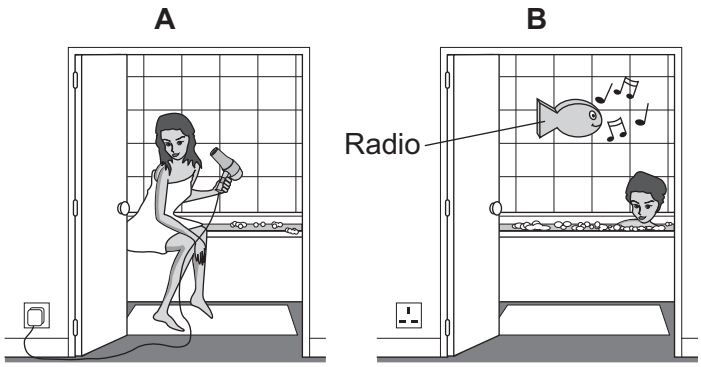
*(2 marks)*

### 4.2.3.2 Mains electricity

**Question 21 · continued**



**5 (b)** Each of these pictures shows an electrical appliance being used in a bathroom.




Using the hairdryer in picture **A** is dangerous. However, it is safe to use the battery-operated radio in picture **B**.

Explain why.

.....

.....

.....

.....

*(2 marks)*

7

### 4.2.3.2 Mains electricity

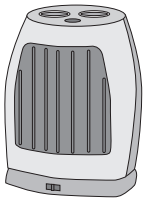
**Question 22**

November 2010 | PHY1AP | Original Q6 | Legacy

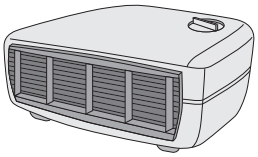
## QUESTION SIX

The pictures show four different types of electric heater.

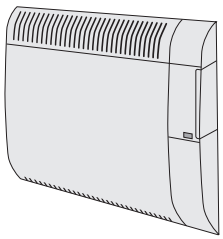
**1800 W ceramic heater**
- 2 heat settings
- 8 hour timer
- Power indicator light
- Safety overheat cut-out



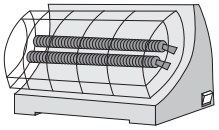
**3 kW fan heater**
- 2 heat settings
- Power indicator light
- Cool air fan setting



**400 W oil-filled panel heater**
- 3 heat settings
- Efficient background heat
- Safety overheat cut-out



**2 kW radiant heater**
- 2 heat settings



**6A** Which heater is the most powerful?

**1** the ceramic heater

**2** the fan heater

**3** the oil-filled panel heater

**4** the radiant heater

**6B** The fan heater is run on full power for 4 hours.

| energy transferred (kilowatt-hour, kWh) | = | power (kilowatt, kW) | × | time (hour, h) |
|---|---|---|---|---|

How much energy, in kWh, is transferred from the mains supply to the fan heater?

**1** 0.75

**2** 3.0

**3** 7.0

**4** 12.0

4.2.3.2 Mains electricity

Question 22 · continued



**6C** In one week, the oil-filled panel heater used 10 kWh of electrical energy.

| total cost = number of kilowatt-hours × cost per kilowatt-hour |
|---|

Electricity costs 14p per kWh

How much did it cost to run the oil-filled panel heater for the week?

**1** £0.14

**2** £1.40

**3** £14.00

**4** £140.00

**6D** Which of the following is an advantage of the fan heater compared with the other heaters?

**1** The fan heater can make a room feel cooler in summer.

**2** The fan heater has a power indicator light.

**3** The fan heater has a safety overheat cut-out.

**4** The fan heater has more than one heat setting.

### 4.2.3.2 Mains electricity

**Question 23**

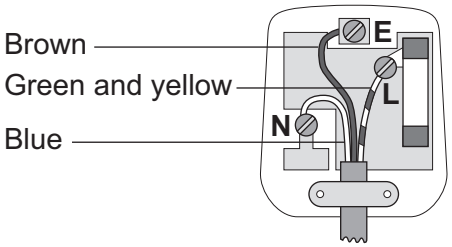


**4** The diagrams show the inside of a 13 amp plug.

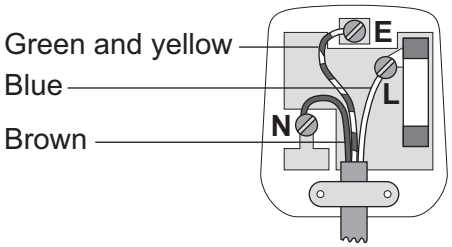
**4 (a) (i)** Which **one** of the plugs, **A**, **B**, **C** or **D**, is correctly wired?

Write your answer, **A**, **B**, **C** or **D**, in the box.

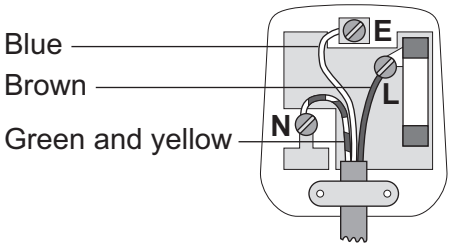
**A**



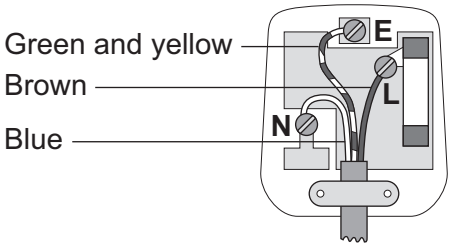

**B**




**C**




**D**




The plug that is correctly wired is ☐ .

*(1 mark)*

**4 (a) (ii)** What material is the outside casing of a plug made from?

.....

*(1 mark)*

**4 (b)** An electric drill draws a current of 2 amps from the 230 volt mains electricity supply.

Use the equation in the box to calculate the power of the drill.

power = current × potential difference

Show clearly how you work out your answer.

.....

.....

Power ..... watts

*(2 marks)*

4.2.3.2 Mains electricity

Question 23 · continued



**4 (c)** A householder needs to replace a damaged plug. Most replacement plugs are sold with a 13 amp fuse fitted inside. The householder thinks it would be better for shops to sell the plugs without a fuse. He could then buy either a 3 A, 5 A or 13 A fuse to fit inside the plug.

Explain an advantage of selling plugs without a fuse, rather than with a 13 amp fuse fitted.

.....

.....

.....

.....

*(2 marks)*

6

**Turn over for the next question**

4.2.3.2 Mains electricity

Question 24

June 2011 | PHY1AP | Original Q8 | Legacy

**QUESTION EIGHT**

Some dairy farmers have installed electrical generators that run on methane gas.

- Methane gas is produced from rotting vegetation and animal waste.
- On farms, the rotting process takes place in a digester.
- Methane produced in this way is a biofuel called biogas.
- Burning methane produces carbon dioxide and water.
- The electrical generators can be installed in a farm building.

**8A** Methane is called a biofuel because . . .

**1** it is a renewable fuel.

**2** it comes from living things.

**3** it produces carbon dioxide and water.

**4** it is made in a digester.

**8B** Farmers have been encouraged to install their own biogas generators because . . .

**1** this would reduce the amount of fuel used in power stations.

**2** this would reduce the amount of animal waste produced.

**3** biogas is a non-renewable fuel.

**4** this would use less electricity.

**8C** A farmer's weekly electricity bill using the mains supply is £290. The biogas generator costs £15 000 to install.

The biogas generator provides all of the farmer's electricity.

What is the pay-back time?

**1** 1.0 years

**2** 4.3 years

**3** 5.2 years

**4** 52 years

4.2.3.2 Mains electricity



**8D** It would have been cheaper for the farmer to install a wind turbine generator.

What is the advantage of the biogas generator over the wind turbine generator?

**1** It uses a renewable energy source.

**2** It produces water.

**3** It can work all the time.

**4** It does not require any space.

**Turn over for the next question**

4.2.3.2 Mains electricity

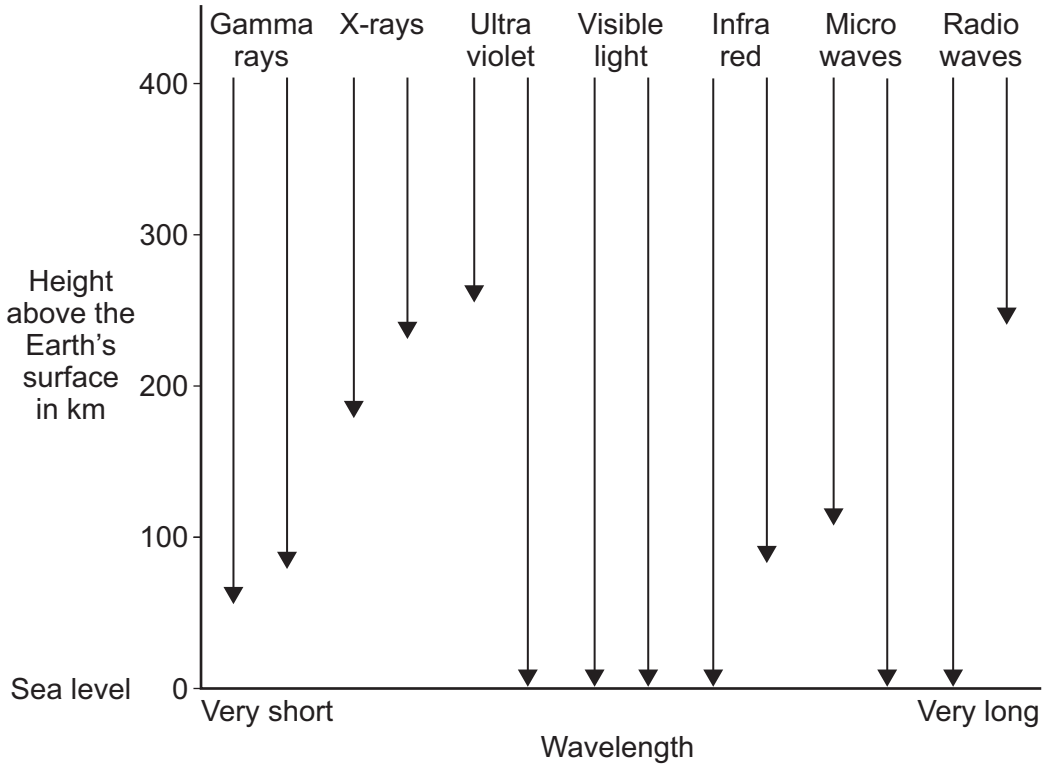
Question 25

June 2011 | PHY1BP | Original Q9 | Legacy

**QUESTION NINE**

Telescopes can be based on the Earth's surface or put into orbit in space.

The diagram shows how far electromagnetic waves penetrate the Earth's atmosphere. For some types of electromagnetic radiation, longer and shorter waves penetrate the atmosphere to different depths.




**9A** Telescopes on Earth detect **all** wavelengths of . . .

**1** radio waves only.

**2** visible light only.

**3** radio waves and visible light.

**4** visible light and X-rays.

**9B** Which of the following statements about the use of telescopes in space is true?

**1** The atmosphere distorts the image produced by the telescope.

**2** The telescopes are affected by light pollution from the Earth.

**3** The telescopes can detect electromagnetic waves that cannot reach the Earth's surface.

**4** The telescopes are easy to repair and maintain.

4.2.3.2 Mains electricity

Question 25 · continued



The table gives information about some space telescopes. Each telescope detects a different type of electromagnetic radiation.

| Telescope | Wavelength detected in nanometres |
|---|---|
| INTEGRAL | less than 0.01 |
| Chandra | 0.01 – 20 |
| FUSE | 20 – 400 |
| Hubble | 400 – 700 |
| Spitzer | 1000 – 1 000 000 |

**9C** The Hubble telescope detects visible light.

Which telescope detects infra red radiation?

**1** Chandra

**2** FUSE

**3** INTEGRAL

**4** Spitzer

**9D** Which telescope detects X-rays?

**1** Chandra

**2** FUSE

**3** INTEGRAL

**4** Spitzer

**END OF TEST**

### 4.2.3.2 Mains electricity

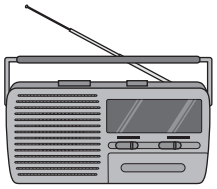
**Question 26**

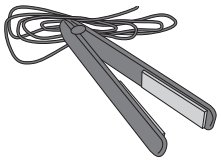
June 2011 | PHY1F | Original Q5 | Legacy

**5** The diagram shows four electrical appliances. Each appliance is designed to transform electrical energy into one form of output energy.


Kettle


Toaster


Radio


Hair straighteners

**5 (a)** Which **one** of the appliances is designed to give a different form of output energy from the other three appliances?

.....

Give a reason for your answer.

.....

.....

*(2 marks)*

**5 (b)** The power of each appliance is given in the table.

| Appliance | Power |
|---|---|
| Kettle | 2.5 kW |
| Toaster | 920 W |
| Radio | 15 W |
| Hair straighteners | 75 W |

Each appliance is switched on for 5 minutes.

Which appliance transforms the most energy?

.....

*(1 mark)*

4.2.3.2 Mains electricity

Question 26 · continued



**5 (c)** The 75 watt hair straighteners are switched on for a few minutes each day.
In one year, the amount of energy transferred from the mains electricity supply to the hair straighteners is 4 kilowatt-hours.

Electricity costs 15 p per kilowatt-hour.

Use the equation in the box to calculate the yearly cost of using the hair straighteners.

| total cost = number of kilowatt-hours × cost per kilowatt-hour |
|---|

Show clearly how you work out your answer.

.....

.....

Total cost = ..... pence
*(2 marks)*

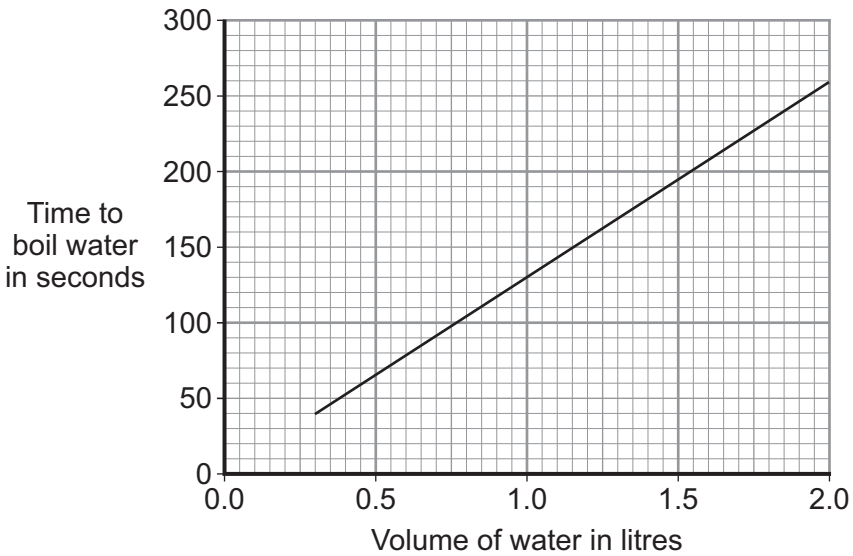
**Question 5 continues on the next page**

4.2.3.2 Mains electricity

Question 26 · continued



**5 (d)** The graph shows how the time to boil water in an electric kettle depends on the volume of water in the kettle.




A householder always fills the electric kettle to the top, even when only enough boiling water for one small cup of coffee is required.

Explain how the householder is wasting money.

.....

.....

.....

.....

.....

.....

*(3 marks)*

8

### 4.2.3.2 Mains electricity

**Question 27**

June 2011 | PHY2F | Original Q6 | Legacy

**6** **Diagram 1** shows a hairdryer.
**Diagram 2** shows how the heaters and fan of the hairdryer are connected to a 3-pin plug.
The hairdryer does not have an earth wire.

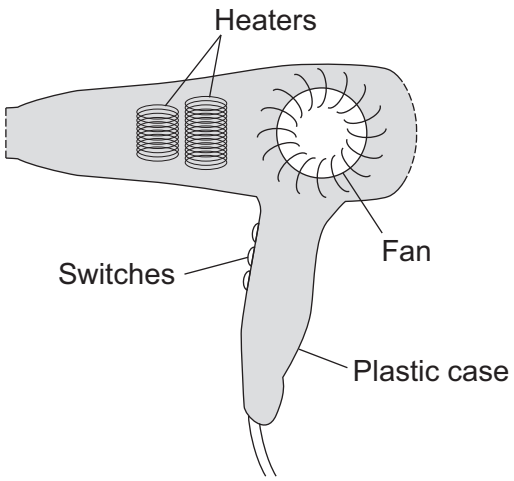



**Diagram 1**

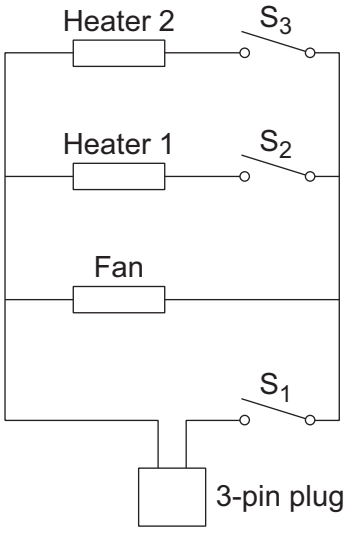



**Diagram 2**

**6 (a)** What colour is the insulation around the wire connected to the live pin inside the plug?

.....
*(1 mark)*

**6 (b)** Why does the hairdryer **not** need an earth wire?

.....

.....
*(1 mark)*

**6 (c)** All the switches are shown in the OFF position.

**6 (c) (i)** Which switch or switches have to be ON to make:

(1) only the fan work; .....

(2) heater 2 work? .....
*(2 marks)*

4.2.3.2 Mains electricity

Question 27 · continued



**6 (c) (ii)** The heaters can only be switched on when the fan is also switched on.

Explain why.

.....

.....

.....

.....

.....

*(2 marks)*

**6 (d)** The table shows the current drawn from the 230 volt mains electricity supply when different parts of the hairdryer are switched on.

| | **Current in amps** |
|---|---|
| Fan only | 1.0 |
| Fan and heater 1 | 4.4 |
| Fan and both heaters | 6.5 |

Use the equation in the box to calculate the maximum power of the hairdryer.

power = current × potential difference

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

.....

.....

Maximum power = .....

*(3 marks)*

9

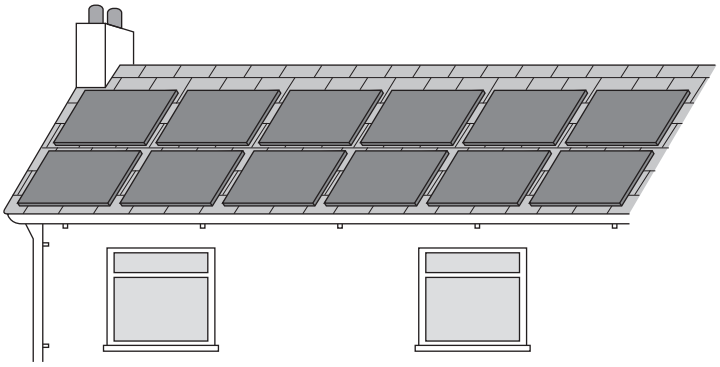
### 4.2.3.2 Mains electricity

**Question 28**

November 2011 | PHY1AP | Original Q6 | Legacy

**QUESTION SIX**

The diagram shows a group of solar cells on the roof of a building.



**6A** The energy transformation in a solar cell is . . .

**1** electrical to light.

**2** electrical to heat.

**3** heat to electrical.

**4** light to electrical.

**6B** There are twelve 180 watt solar cells on the roof.

The maximum power output of the group of solar cells is . . .

**1** 15 W

**2** 15 kW

**3** 2160 W

**4** 2160 kW

4.2.3.2 Mains electricity

Question 28 · continued



**6C** The solar cells will provide 1600 kilowatt-hours (kWh) of electrical energy per year.

| total cost | = | number of kilowatt-hours | × | cost per kilowatt-hour |
|---|---|---|---|---|

Electricity from the mains supply costs 15 p per kWh

How much money will be saved per year by using the solar cells rather than the mains supply?

**1** £2.40

**2** £24

**3** £240

**4** £24 000

**6D** Energy from the solar cells is cheaper than energy from the mains supply because there are no . . .

**1** fuel costs.

**2** habitats destroyed.

**3** polluting gases given off.

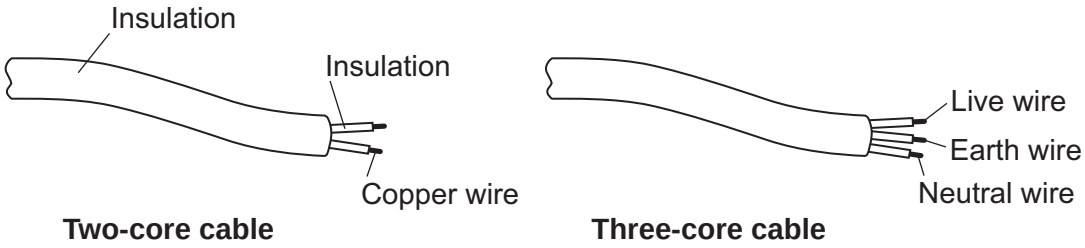
**4** radioactive waste products.

4.2.3.2 Mains electricity

Question 29

June 2012 | PH2FP | Original Q5 | Legacy

**5 (a)** The diagram shows a piece of two-core cable and a piece of three-core cable.




**Two-core cable** **Three-core cable**

**5 (a) (i)** Which **one** of the wires inside a three-core cable is missing from a two-core cable?

Draw a ring around your answer.

**earth wire** **live wire** **neutral wire**

*(1 mark)*

**5 (a) (ii)** Use a word from the box to complete the following sentence.

| | | |
|---|---|---|
| **double** | **extra** | **totally** |

A pottery table lamp fitted with a two-core cable is safe to use because it is

..... insulated.

*(1 mark)*

**5 (b)** The cables connecting the power sockets in a building contain wires 1.8 mm thick.
The maximum current that can safely pass through these wires is 20 amps.
A fuse is included in the circuit to protect the wiring.

Explain how a fuse protects the wiring of a circuit.

.....

.....

.....

.....

.....

.....

.....

*(3 marks)*

5

### 4.2.3.2 Mains electricity

**Question 30**

January 2013 | PH2FP | Original Q4 | Legacy

**4 (a)** The diagram shows the information plate on an electric kettle. The kettle is plugged into the a.c. mains electricity supply.

| | |
|---|---|
| **230 V** | **2760 W** |
| **50 Hz** | |

Use the information from the plate to answer the following questions.

**4 (a) (i)** What is the frequency of the a.c. mains electricity supply?

.....

*(1 mark)*

**4 (a) (ii)** What is the power of the electric kettle?

.....

*(1 mark)*

**4 (b)** To boil the water in the kettle, 2400 coulombs of charge pass through the heating element in 200 seconds.

Calculate the current flowing through the heating element and give the unit.

Use the correct equation from the Physics Equations Sheet.

Choose the unit from the list below.

**amps** **volts** **watts**

.....

.....

.....

Current = .....

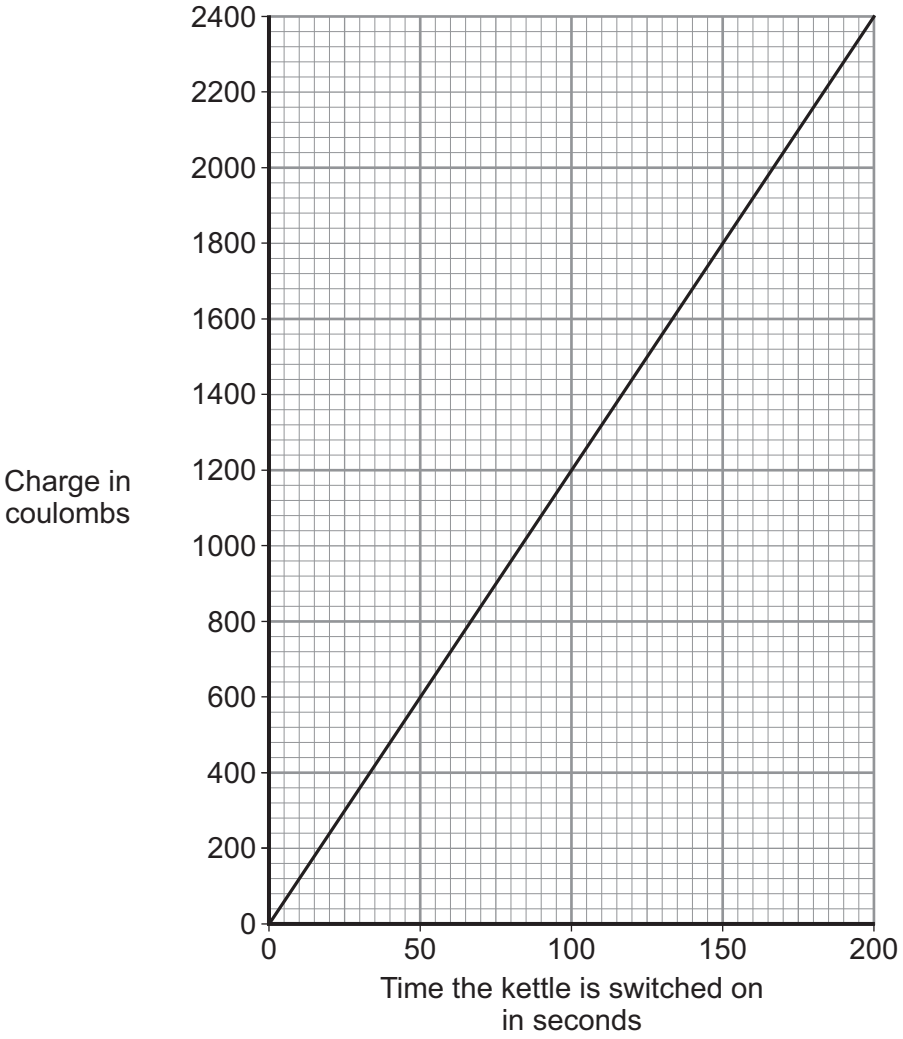
*(3 marks)*

4.2.3.2 Mains electricity

Question 30 · continued



**4 (c)** The amount of charge passing through the heating element of an electric kettle depends on the time the kettle is switched on.




What pattern links the amount of charge passing through the heating element and the time the kettle is switched on?

.....

.....

*(2 marks)*

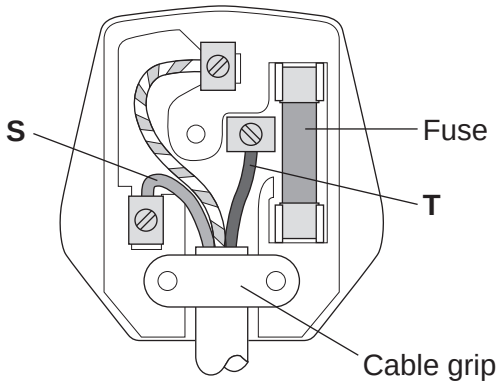
7

### 4.2.3.2 Mains electricity

**Question 31**

June 2013 | PH2FP | Original Q3 | Legacy

**3 (a)** The diagram shows the inside of a three-pin plug.




**3 (a) (i)** What name is given to the wire labelled **S**?

Draw a ring around the correct answer.

**earth** **live** **neutral**

*(1 mark)*

**3 (a) (ii)** What is the colour of the insulation around the wire labelled **T**?

Draw a ring around the correct answer.

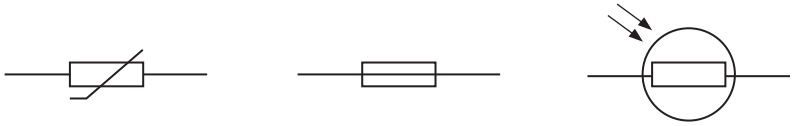
**blue** **brown** **green and yellow**

*(1 mark)*

**3 (b)** The plug contains a 13 amp fuse.

**3 (b) (i)** Which **one** of the following is the correct circuit symbol for a fuse?

Draw a ring around the correct answer.



*(1 mark)*

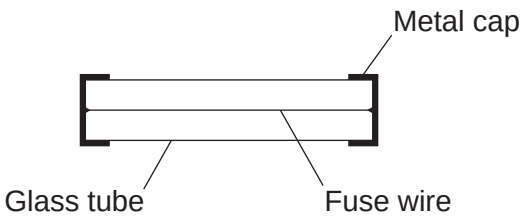
**Question 3 continues on the next page**

4.2.3.2 Mains electricity

Question 31 · continued



**3 (b) (ii)** The diagram shows the parts of the fuse.




What would happen if a current of 20 amps passed through the 13 amp fuse?

.....

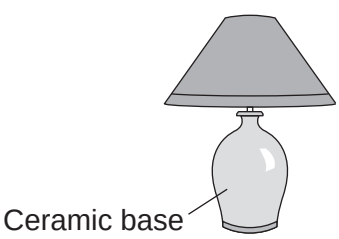
.....

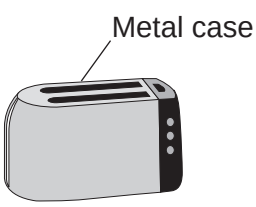
*(1 mark)*

**3 (c)** Not all electrical appliances are earthed.

**3 (c) (i)** Which **one** of the following appliances must be earthed?

Tick (✓) **one** box.



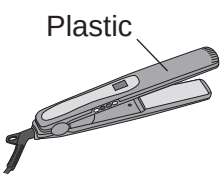




Table lamp ☐ Toaster ☐ Hair straighteners ☐

Give a reason for your answer.

.....

.....

*(2 marks)*

**3 (c) (ii)** Earthing an appliance helps to protect a person against a possible risk.

What is the risk?

.....

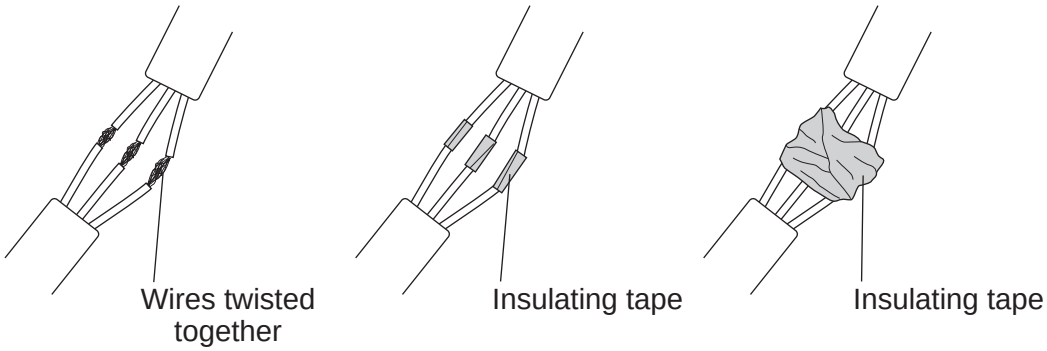
*(1 mark)*

4.2.3.2 Mains electricity

Question 31 · continued



**3 (d)** The diagrams show how two lengths of mains electrical cable were joined. The individual wires have been twisted together and covered with insulating tape. This is not a safe way to join the cables.



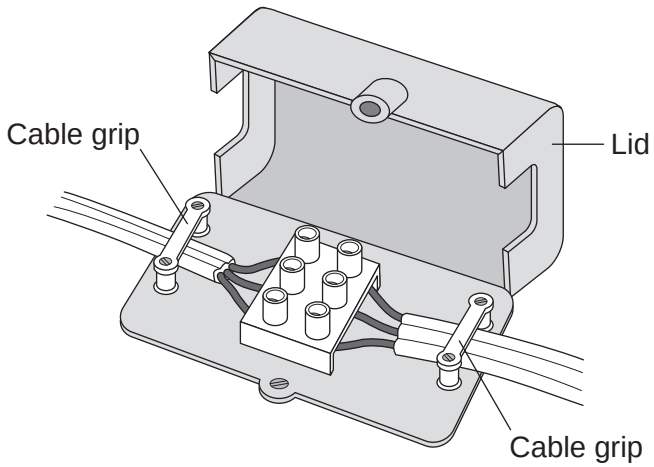

What is the possible risk from joining the two lengths of mains electrical cable in this way?

.....

.....

*(1 mark)*

**3 (e)** The diagram below shows a connecting box being used to join two lengths of electrical cable. This is a safe way to join the cables.




The cable grips are important parts of the connecting box.

Explain why.

.....

.....

.....

.....

*(2 marks)*

10

### 4.2.3.2 Mains electricity

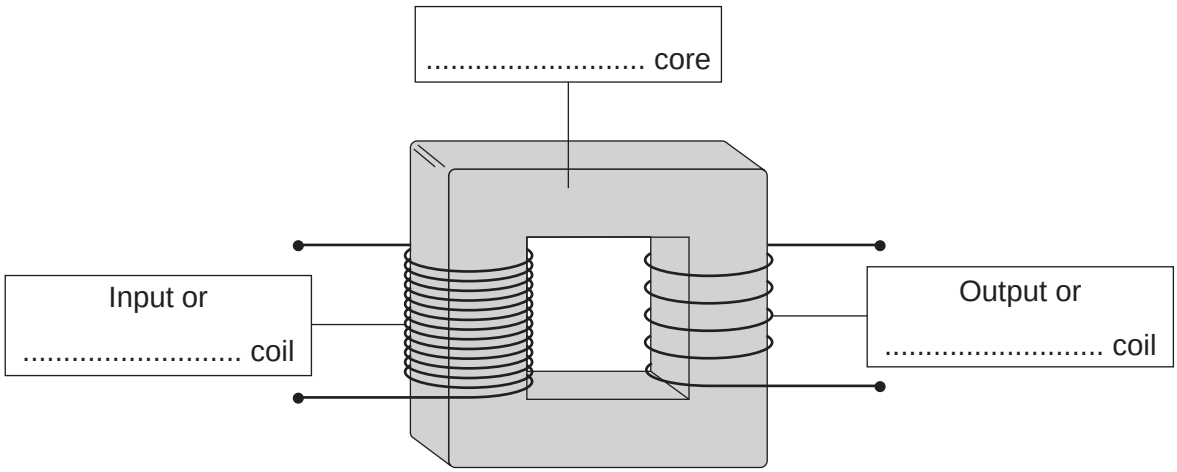
**Question 32**

June 2013 | PH3FP | Original Q2 | Legacy

**2 (a)** The diagram shows the structure of a traditional transformer.

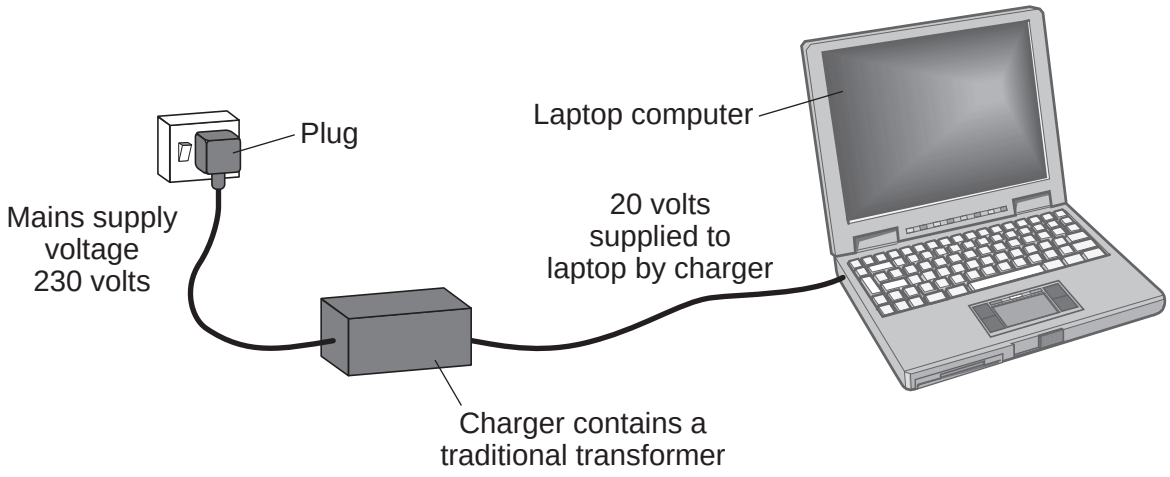
Use words from the box to label the diagram.

| | | | | | |
|---|---|---|---|---|---|
| **aluminium** | **brass** | **iron** | **large** | **primary** | **secondary** |




*(3 marks)*

**2 (b)** Batteries inside laptop computers are charged using laptop chargers. The laptop charger contains a traditional transformer.



4.2.3.2 Mains electricity

Question 32 · continued



The laptop charger contains a step-down transformer.

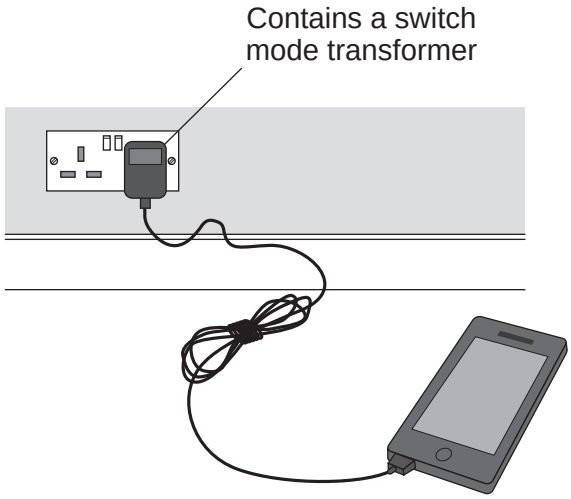
What does a step-down transformer do?

.....

.....

*(1 mark)*

**2 (c)** The transformer used in a modern mobile phone charger is a switch mode transformer. This is different to the traditional transformer used in the laptop charger.




Give **one** advantage of using a switch mode transformer, rather than a traditional transformer.

.....

.....

*(1 mark)*

**2 (d)** Laptop batteries and mobile phone batteries can only be recharged a limited number of times. When a battery cannot be recharged, it is better to recycle the battery than to throw it away.

Draw a ring around the correct answer to complete the sentence.

The batteries are recycled mainly due to

| |
|---|
| an environmental |
| a political |
| a social |

consideration.

*(1 mark)*

6

### 4.2.3.2 Mains electricity

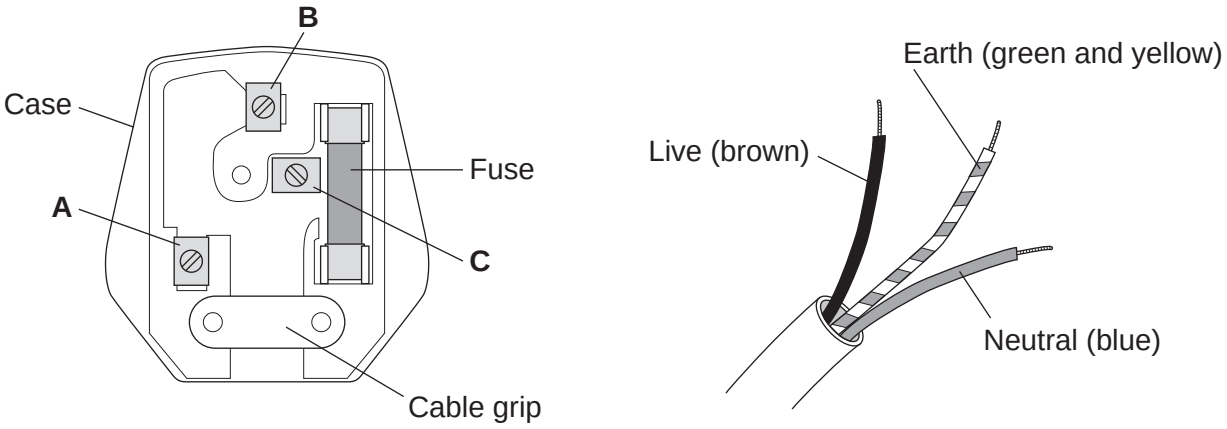
**Question 33**

June 2014 | PH2FP | Original Q6 | Legacy

**6 (a)** **Figure 10** shows the inside of a three-pin plug and a length of three-core cable.

The cable is to be connected to the plug.

**Figure 10**




**6 (a) (i)** Complete **Table 1** to show which plug terminal, **A**, **B** or **C**, connects to each of the wires inside the cable.

**[2 marks]**

**Table 1**

| Wire | Plug terminal |
|---|---|
| Live | |
| Neutral | |
| Earth | |

**6 (a) (ii)** Name a material that could be used to make the case of the plug.

**[1 mark]**

.....

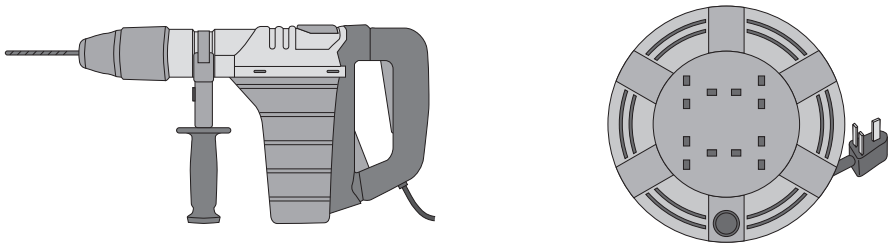
4.2.3.2 Mains electricity

Question 33 · continued



**6 (b)** **Figure 11** shows an electric drill and an extension lead. The drill is used with the extension lead.

**Figure 11**



Electric drill

Extension lead

**6 (b) (i)** The drill is used for 50 seconds.

In this time, 30 000 joules of energy are transferred from the mains electricity supply to the drill.

Calculate the power of the drill.

Use the correct equation from the Physics Equations Sheet.

**[2 marks]**

.....

.....

.....

Power = ..... W

**Question 6 continues on the next page**

4.2.3.2 Mains electricity

Question 33 · continued



**6 (b) (ii)** A second drill is used with the extension lead. The power of this drill is 1200 W.

The instructions for using the extension lead include the following information.

**When in use the lead may get hot:**

**DO NOT go over the maximum power**

- lead wound inside the case: 820 watts
- lead fully unwound outside the case: 3100 watts

It would **not** be safe to use this drill with the extension lead if the lead was left wound inside the plastic case.

Explain why.

**[3 marks]**

.....

.....

.....

.....

.....

.....

4.2.3.2 Mains electricity

Question 33 · continued



**6 (c)** **Table 2** gives information about three different electric drills.

**Table 2**

| Drill | Power input in watts | Power output in watts |
|---|---|---|
| **X** | 640 | 500 |
| **Y** | 710 | 500 |
| **Z** | 800 | 500 |

A person is going to buy **one** of the drills, **X**, **Y** or **Z**. The drills cost the same to buy.

Use only the information in the table to decide which **one** of the drills, **X**, **Y** or **Z**, the person should buy.

Write your answer in the box. ☐

Give a reason for your answer.

**[1 mark]**

.....

.....

.....

9

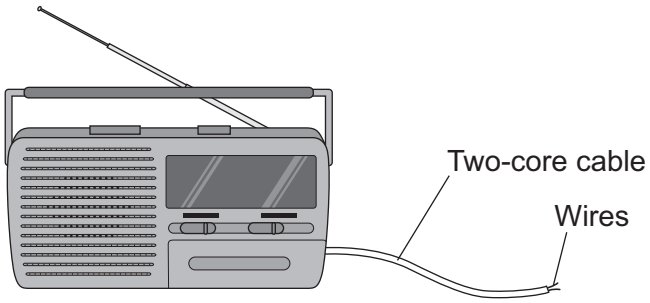
### 4.2.3.2 Mains electricity

**Question 34**

June 2015 | PH2FP | Original Q4 | Legacy

**4** **Figure 5** shows a radio. The radio can be powered by connecting the two-core cable to the mains electricity supply.

**Figure 5**




**4 (a) (i)** What must be fitted to the cable before it can be connected to the mains electricity supply?

**[1 mark]**

.....

**4 (a) (ii)** There are only two wires inside the cable.
What are the names of the two wires inside the cable?

**[1 mark]**

Tick (✓) **one** box.

Earth and live ☐

Earth and neutral ☐

Live and neutral ☐

**4 (a) (iii)** Use the correct answer from the box to complete the sentence.

**[1 mark]**

| | | |
|---|---|---|
| **double** | **extra** | **fully** |

It is safe to connect the radio to the mains electricity supply using a two-core cable because the radio is ..... insulated.

4.2.3.2 Mains electricity

Question 34 · continued



**4 (b)** The radio can also be powered by a battery.

What type of current does a battery supply?

**[1 mark]**

Tick (✓) **one** box.

Alternating current (a.c.) only ☐

Direct current (d.c.) only ☐

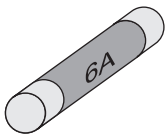
Both a.c. and d.c. ☐

**4 (c)** **Figure 6** shows a fuse and a circuit breaker.

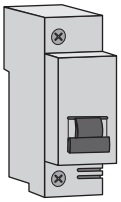
Fuses and circuit breakers are able to disconnect and switch off circuits.

**Figure 6**

**Fuse**




**Circuit breaker**



**4 (c) (i)** Use the correct answer from the box to complete the sentence.

**[1 mark]**

| | | |
|---|---|---|
| **earth** | **live** | **neutral** |

A fuse or a circuit breaker is connected to the ..... wire in a circuit.

**4 (c) (ii)** What happens to cause a fuse or circuit breaker to disconnect a circuit?

**[1 mark]**

.....

.....

**Question 4 continues on the next page**

### 4.2.3.2 Mains electricity

**Question 34 · continued**



**4 (c) (iii)** Suggest **two** advantages of using a circuit breaker to disconnect a circuit compared with using a fuse.

**[2 marks]**

1 .....

.....

2 .....

.....

8

### 4.2.3.2 Mains electricity

**Question 35**

June 2016 | PH1FP | Original Q2 | Legacy

**2** The electric kettle shown in **Figure 2** is used to boil water.

**Figure 2**



**2 (a)** After the water has boiled, the temperature of the water decreases by 22 °C.
The mass of water in the kettle is 0.50 kg.
The specific heat capacity of water is 4200 J/kg °C.

Calculate the energy transferred to the surroundings from the water.

Use the correct equation from the Physics Equations Sheet.

**[2 marks]**

_____

_____

_____

Energy = _____ joules

**2 (b)** Why is the total energy input to the kettle higher than the energy used to heat the water?

**[1 mark]**

Tick (✓) **one** box.

| | **Tick (✓)** |
|---|---|
| Energy is absorbed from the surroundings. | |
| Energy is used to heat the kettle. | |
| The kettle is more than 100% efficient. | |

4.2.3.2 Mains electricity

Question 35 · continued



**2 (c)** In one day, 0.6 kWh of energy is transferred from the mains electricity supply to the kettle.

The energy costs 15 pence per kWh.

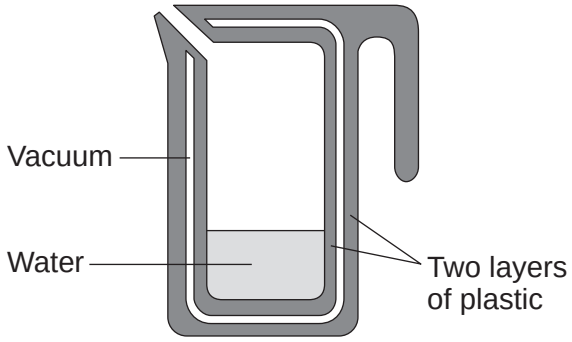
Calculate the cost of using the kettle for one day.

**[2 marks]**

Cost = _____ pence

**2 (d)** A new type of electric kettle is made from two layers of plastic separated by a vacuum. After the water in the kettle has boiled, the water stays hot for at least 2 hours. The new kettle is shown in **Figure 3**.

**Figure 3**




**2 (d) (i)** Which energy transfers does a vacuum reduce?

**[1 mark]**

Tick (✓) **one** box.

| | Tick (✓) |
|---|---|
| conduction and radiation | |
| conduction and convection | |
| convection and radiation | |

**2 (d) (ii)** Using the new kettle may reduce the householder's energy bill. Suggest **one** reason why.

**[1 mark]**

7

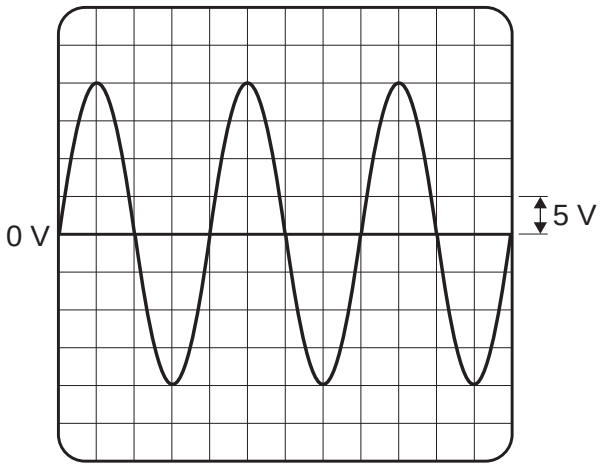
### 4.2.3.2 Mains electricity

**Question 36**

June 2016 | PH2FP | Original Q2 | Legacy

**2 (a)** **Figure 2** shows the oscilloscope trace an alternating current (a.c.) electricity supply produces.

**Figure 2**




One vertical division on the oscilloscope screen represents 5 volts.

Calculate the peak potential difference of the electricity supply.

**[1 mark]**

Peak potential difference = _____ V

**2 (b)** Use the correct answer from the box to complete the sentence.

**[1 mark]**

| | | |
|---|---|---|
| **40** | **50** | **60** |

In the UK, the frequency of the a.c. mains electricity supply is _____ hertz.

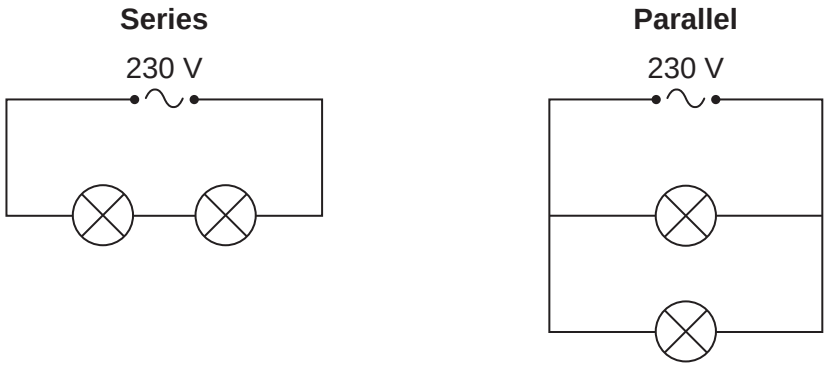
4.2.3.2 Mains electricity

Question 36 · continued



**2 (c)** **Figure 3** shows how two lamps may be connected in series or in parallel to the 230 volt mains electricity supply.

**Figure 3**




**2 (c) (i)** Calculate the potential difference across each lamp when the lamps are connected in **series**.
The lamps are identical.

**[1 mark]**

Potential difference when in series = _____ V

**2 (c) (ii)** What is the potential difference across each lamp when the lamps are connected in **parallel**?

**[1 mark]**

Tick (✓) **one** box.

115 V ☐ 230 V ☐ 460 V ☐

**2 (c) (iii)** Give **one** advantage of connecting the lamps in parallel instead of in series.

**[1 mark]**

**Question 2 continues on the next page**

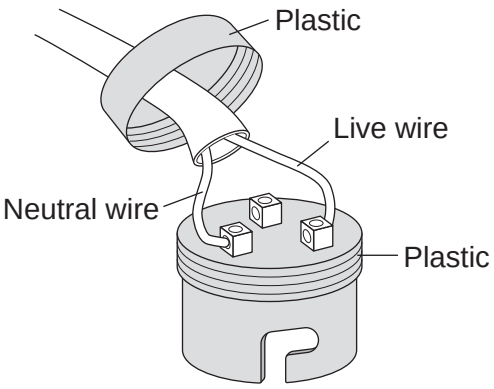
4.2.3.2 Mains electricity

Question 36 · continued



**2 (d)** **Figure 4** shows the light fitting used to connect a filament light bulb to the mains electricity supply.

**Figure 4**




The light fitting does **not** have an earth wire connected.

Explain why the light fitting is safe to use.

**[2 marks]**

**2 (e)** A fuse can be used to protect an electrical circuit.

Name a different device that can also be used to protect an electrical circuit.

**[1 mark]**

8

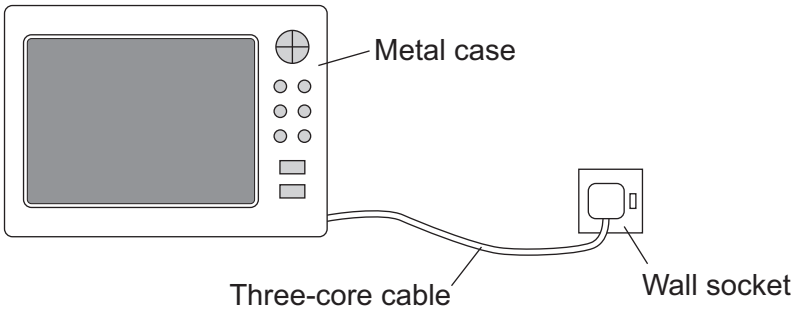
4.2.3.2 Mains electricity

Question 37

June 2017 | PH2FP | Original Q5 | Legacy

**5** **Figure 10** shows a microwave oven.

**Figure 10**




**5 (a)** The microwave oven is connected to the mains electricity supply using a three-core cable and plug.

Explain why a three-core cable must be used and not a two-core cable.

**[2 marks]**

**5 (b) (i)** The microwave oven draws a current of 3.3 amps from the mains electricity supply.

Which one of the following fuses should be used inside the plug?

**[2 marks]**

Tick (✓) **one** box.

**1 A** ☐ **3 A** ☐ **13 A** ☐

Give the reason for your answer.

**Question 5 continues on the next page**

4.2.3.2 Mains electricity

Question 37 · continued



**5 (b) (ii)** The microwave oven is used to cook a meal.
The microwave oven is switched on for 300 seconds.

During this time 225 000 joules of energy are transferred from the mains electricity supply to the oven.

Calculate the power of the microwave oven.

Use the correct equation from the Physics Equations Sheet.

**[2 marks]**

_____

_____

_____

Power = _____ W

6

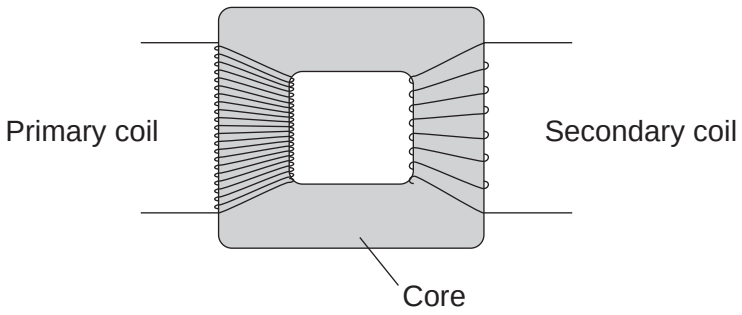
4.2.3.2 Mains electricity

Question 38

June 2017 | PH3FP | Original Q2 | Legacy

**2** **Figure 3** shows a traditional transformer.

**Figure 3**




**2 (a) (i)** Use the correct answer from the box to complete the sentence.

**[1 mark]**

| | | |
|---|---|---|
| **greater than** | **equal to** | **less than** |

The potential difference across the secondary coil is _____

the potential difference across the primary coil.

**2 (a) (ii)** Give a reason for your answer to part **2 (a) (i)**.

**[1 mark]**

_____

_____

**2 (b)** What is the core of the transformer made from?

**[1 mark]**

_____

4.2.3.2 Mains electricity

Question 38 · continued



**2 (c)** What happens as the magnetic field in the core of the transformer changes?

**[1 mark]**

Tick (✓) **one** box.

The mass of the core increases. ☐

A potential difference is induced across the secondary coil. ☐

The temperature of the core decreases. ☐

**2 (d)** The power supply to the transformer is connected to the mains electricity supply.

What is the frequency of the mains electricity supply?

**[1 mark]**

Tick (✓) **one** box.

25 hertz ☐

50 hertz ☐

100 hertz ☐

**2 (e)** The power input of the transformer is 2 W. The transformer is 100% efficient.

State the power output of the transformer.

**[1 mark]**

_____

6

4.2.3.2 Mains electricity

Question 39

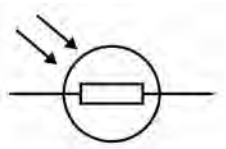
June 2018 | 8463/1F | Original Q7

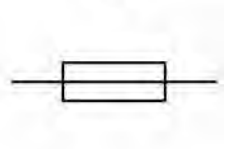
**0 7** The plug of an electrical appliance contains a fuse.

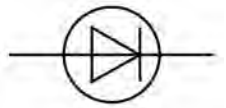
**0 7 . 1** What is the correct circuit symbol for a fuse?

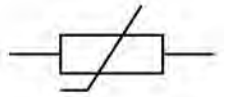
Tick **one** box.

**[1 mark]**


☐


☐


☐


☐

**0 7 . 2** The appliance is connected to the mains electrical supply. The mains potential difference is 230 V.

Calculate the energy transferred when 13 C of charge flows through the appliance.

Use the equation:

energy transferred = charge flow × potential difference

**[2 marks]**

Energy transferred = _____ J

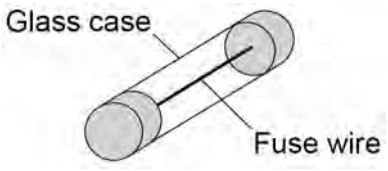
4.2.3.2 Mains electricity

Question 39 · continued



**Figure 9** shows the structure of a fuse.

**Figure 9**




**0 7 . 3** Write down the equation that links charge flow, current and time.

**[1 mark]**

**0 7 . 4** The fuse wire melts when 1.52 coulombs of charge flows through the fuse in 0.40 seconds.

Calculate the current at which the fuse wire melts.

**[3 marks]**

Current = _____ A

**0 7 . 5** The mass of the fuse wire is 0.00175 kg. The specific latent heat of fusion of the fuse wire is 205 000 J/kg.

Calculate the energy needed to melt the fuse wire.

Use the Physics Equations Sheet.

**[2 marks]**

Energy = _____ J

9

4.2.3.2 Mains electricity

Question 40

June 2019 | 8463/1F | Original Q9

**0 9** Light bulbs are labelled with a power input.

**0 9 . 1** What does power input mean?

**[1 mark]**

Tick (✓) **one** box.

- The charge transferred each second by the bulb. ☐
- The current through the bulb. ☐
- The energy transferred each second to the bulb. ☐
- The potential difference across the bulb. ☐

**0 9 . 2** Write down the equation which links current, potential difference and power.

**[1 mark]**

_____

**0 9 . 3** A light bulb has a power input of 40 W

The mains potential difference is 230 V

Calculate the current in the light bulb.

**[3 marks]**

_____

_____

_____

Current = _____ A

4.2.3.2 Mains electricity

Question 40 · continued



**Table 3** shows information about three different light bulbs.

**Table 3**

| Light bulb | Total power input in watts | Useful power output in watts | Efficiency |
|---|---|---|---|
| P | 6.0 | 5.4 | 0.90 |
| Q | 40 | 2.0 | 0.05 |
| R | 9.0 | **X** | 0.30 |

**0 9 . 4** Write down the equation which links efficiency, total power input and useful power output.

**[1 mark]**

**0 9 . 5** Calculate the value of **X** in **Table 3**.

**[3 marks]**

**X** = _____ W

**0 9 . 6** In addition to power input, light bulbs should also be labelled with the rate at which they emit visible light.

Suggest why.

**[2 marks]**

1

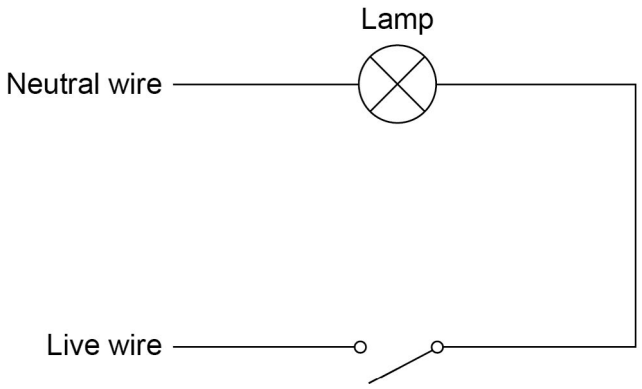
4.2.3.2 Mains electricity

Question 41

November 2020 | 8463/1F | Original Q3

**0 3** **Figure 5** shows part of a lighting circuit in a house.

**Figure 5**




**0 3 . 1** What is the frequency of the ac mains electricity supply in the UK?

**[1 mark]**

Tick (✓) **one** box.

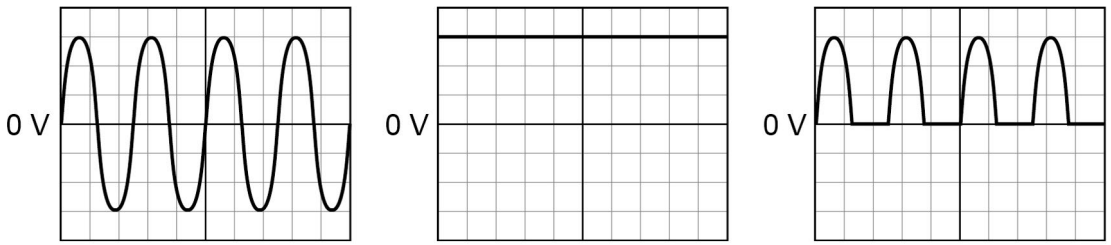
20 Hz ☐ 50 Hz ☐ 60 Hz ☐ 100 Hz ☐

**0 3 . 2** The mains electricity supply has an alternating potential difference.

Which diagram shows an alternating potential difference?

**[1 mark]**

Tick (✓) **one** box.




☐ ☐ ☐

4.2.3.2 Mains electricity

Question 41 · continued



**0 3 . 3** The potential difference across the lamp is 230 V.

The current in the lamp is 0.020 A.

Calculate the power output of the lamp.

Use the equation:

power = potential difference × current

**[2 marks]**

Power = _____ W

**0 3 . 4** The potential difference across the lamp is 230 V.

Calculate the energy transferred by the lamp when 180 C of charge flows through the lamp.

Use the equation:

energy transferred = charge flow × potential difference

**[2 marks]**

Energy transferred = _____ J

**0 3 . 5** An electrician needs to replace the light switch in **Figure 5**.

Describe the possible hazard and the risk to the electrician of changing the light switch.

**[2 marks]**

Hazard _____

Risk _____

8

4.2.3.2 Mains electricity

Question 42

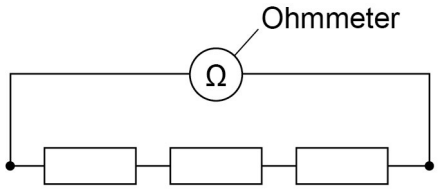


**0 4** A student investigated how the total resistance of identical resistors connected in series varied with the number of resistors.

The student used an ohmmeter to measure the total resistance of the resistors.

**Figure 6** shows the student's circuit with 3 resistors.

**Figure 6**




The student repeated each reading of resistance three times.

**Table 1** shows the student's results for 3 resistors in series.

**Table 1**

| Number of resistors | Total resistance in Ω | | | |
|---|---|---|---|---|
| | Reading 1 | Reading 2 | Reading 3 | Mean |
| 3 | 35.9 | 36.0 | 36.1 | 36.0 |

**0 4 . 1** Calculate the mean resistance of 1 resistor.

**[2 marks]**

Resistance = _____ Ω

**0 4 . 2** What was the resolution of the ohmmeter the student used?

Tick (✓) **one** box.

**[1 mark]**

0.1 Ω ☐ 0.2 Ω ☐ 1.1 Ω ☐ 36.0 Ω ☐

4.2.3.2 Mains electricity

Question 42 · continued



**0 4 . 3** How do the results show that the student's measurements were precise?

**[1 mark]**

Tick (✓) **one** box.

The measurements are accurate. ☐

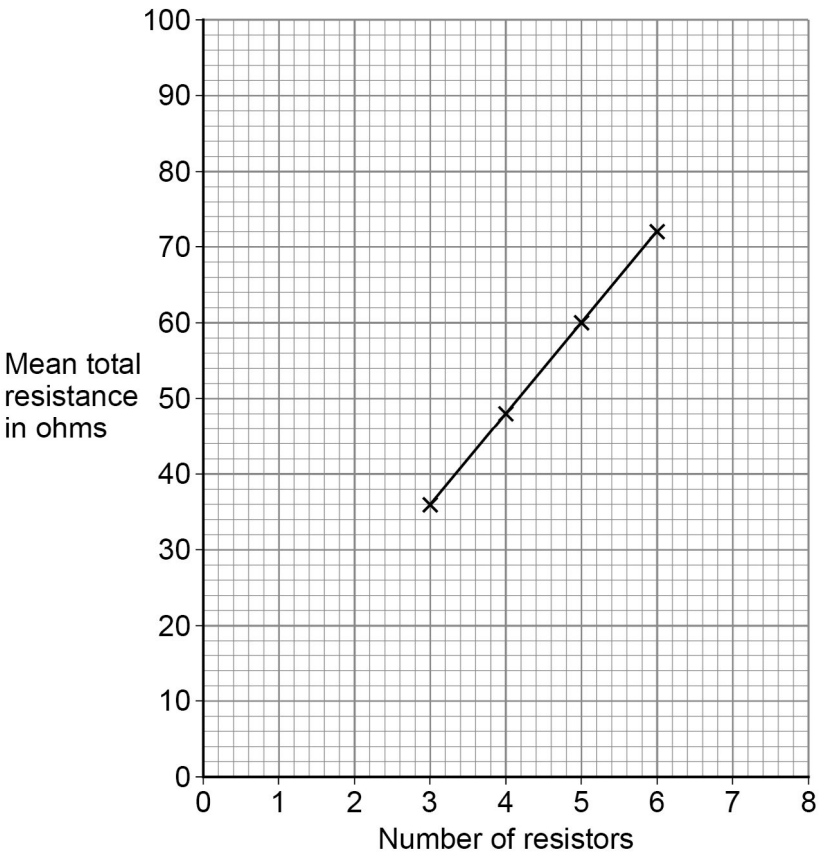
The measurements are grouped closely together. ☐

The measurements are reproducible. ☐

**Question 4 continues on the next page**

**Figure 7** shows the results.

**Figure 7**




**0 4 . 4** How do the results show that the total resistance is directly proportional to the number of resistors?

**[1 mark]**

Tick (✓) **one** box.

The results give a line with a positive gradient. ☐

The results give a straight line that would go through the origin. ☐

The results show a linear relationship. ☐

4.2.3.2 Mains electricity

Question 42 · continued



**0 4 . 5** Predict the mean total resistance of 7 resistors.

Use **Figure 7**.

**[1 mark]**

Mean total resistance of 7 resistors = _____ Ω

**0 4 . 6** Some resistors are connected in series with a battery.

When more resistors are added in series, the total resistance increases.

Complete the sentences.

Choose answers from the box.

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

**[2 marks]**

| | | |
|---|---|---|
| **decreases** | **increases** | **remains the same** |

When the number of resistors increases, the potential difference across each resistor _____ .

When the number of resistors increases, the current in the circuit _____ .

8

### 4.2.3.2 Mains electricity

**Question 43**

June 2022 | 8463/2F | Original Q1

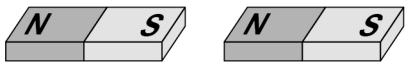
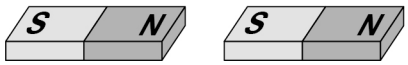
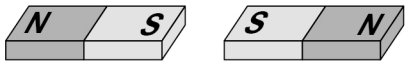
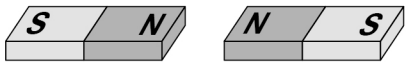
**0 1** When two magnets are close together they exert a force on each other.

**0 1 . 1** Complete **Table 1** to show if the magnets would attract or repel.

**[2 marks]**

Tick (✓) **one** box in **each** row.

**Table 1**

| | Attract | Repel |
|---|---|---|
|  | | |
|  | | |
|  | | |
|  | | |

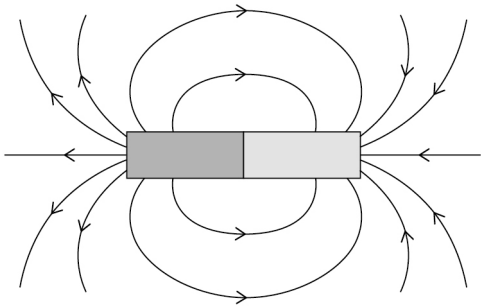
4.2.3.2 Mains electricity

Question 43 · continued



**0 1 . 2** **Figure 1** shows the magnetic field around a bar magnet.

**Figure 1**



Which statements are true for the magnetic field shown in **Figure 1**?

**[2 marks]**

Tick (✓) **two** boxes.

- The magnetic field gets weaker further from the magnet. ☐
- The magnetic field is strongest at the poles. ☐
- The magnetic field is uniform away from the poles. ☐
- The magnetic field lines all meet at a single point. ☐
- The magnetic field lines point from south to north. ☐

**Question 1 continues on the next page**

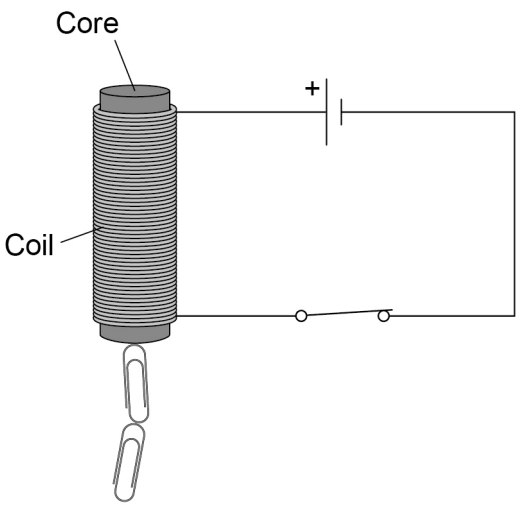
4.2.3.2 Mains electricity

Question 43 · continued



**Figure 2** includes an electromagnet.

**Figure 2**




**0 1 . 3** Which metal is used to make the core of the electromagnet?

**[1 mark]**

Tick (✓) **one** box.

- Aluminium ☐
- Copper ☐
- Iron ☐
- Magnesium ☐

**0 1 . 4** Complete the sentence.

Choose the answer from the box.

**[1 mark]**

| coil | metal core | paper clip |
|---|---|---|

The switch is closed. There is a current in the _____.

4.2.3.2 Mains electricity

Question 43 · continued



**0 1 . 5** The number of turns on the coil is increased. The current remains the same.

How does this affect the strength of the magnetic field around the electromagnet?

**[1 mark]**

Tick (✓) **one** box.

The magnetic field would be stronger. ☐

The magnetic field would stay the same. ☐

The magnetic field would be weaker. ☐

**0 1 . 6** The metal core was removed. The current remains the same.

How does this affect the strength of the magnetic field around the electromagnet?

**[1 mark]**

Tick (✓) **one** box.

The magnetic field would be stronger. ☐

The magnetic field would stay the same. ☐

The magnetic field would be weaker. ☐

**8**

### 4.2.3.2 Mains electricity

**Question 44**

June 2024 | 8463/1F | Original Q2

**0 2** **Figure 4** shows a student putting a coin into a vending machine that sells food.

**Figure 4**




The vending machine is connected to the mains electricity supply.

**0 2 . 1** What is the frequency of the mains electricity supply in the UK?

**[1 mark]**

Tick (✓) **one** box.

50 hertz ☐

60 hertz ☐

100 hertz ☐

4.2.3.2 Mains electricity

Question 44 · continued



**0 2 . 2** What is the potential difference of the mains electricity supply in the UK?

**[1 mark]**

Tick (✓) **one** box.

12 volts ☐

230 volts ☐

20 000 volts ☐

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

**0 2 . 3** 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:

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

**[2 marks]**

Resistance = _____ Ω

4.2.3.2 Mains electricity

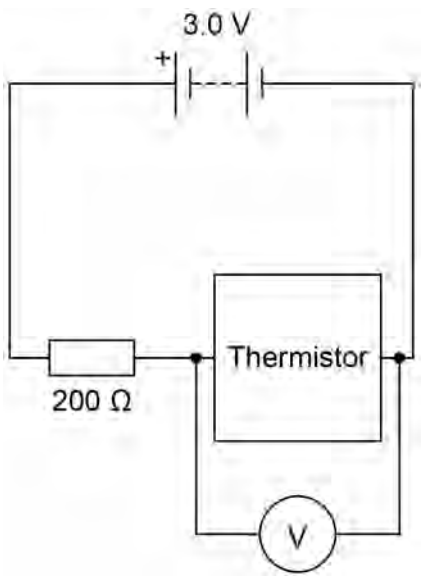
Question 44 · continued



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

**Figure 5** shows part of the circuit.

**Figure 5**

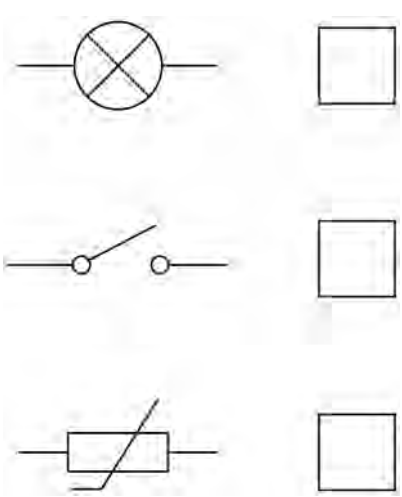



**0 2 . 4** The circuit symbol for the thermistor is wrong.

What is the circuit symbol for a thermistor?

**[1 mark]**

Tick (✓) **one** box.



4.2.3.2 Mains electricity

Question 44 · continued



**0 2 . 5** How could the potential difference (pd) across the resistor be calculated?

**[1 mark]**

Tick (✓) **one** box.

pd across battery – pd across thermistor ☐

pd across battery + pd across thermistor ☐

pd across battery × pd across thermistor ☐

pd across battery ÷ pd across thermistor ☐

**0 2 . 6** At one temperature, the thermistor in **Figure 5** has a resistance of 200 Ω.

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

Give a reason for your answer.

**[2 marks]**

Tick (✓) **one** box.

0.0 V ☐

1.0 V ☐

1.5 V ☐

2.0 V ☐

Reason _____

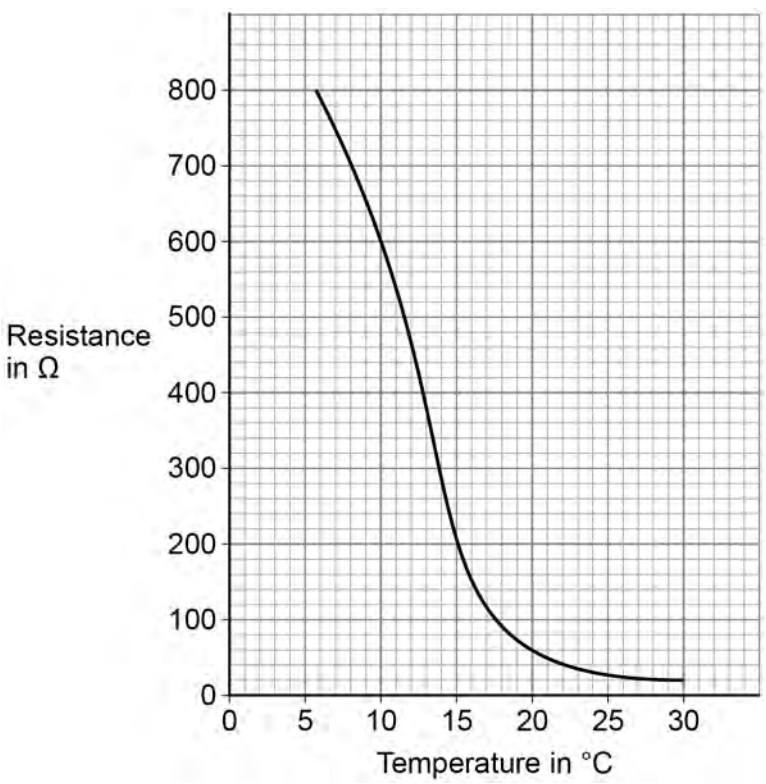
_____

Question 44 · continued



**Figure 6** shows how the resistance of the thermistor varies with temperature.

**Figure 6**




**0 2 . 7** 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.

**[2 marks]**

Change in resistance = _____ Ω

10

4.2.3.2 Mains electricity

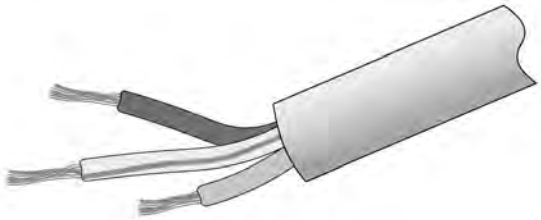
Question 45

June 2024 | 8463/1F | Original Q7

**0 7** An electrical appliance is connected to the mains electricity supply using a three-core cable.

**Figure 13** shows a three-core cable.

**Figure 13**



**0 7 . 1** What colour is the insulation covering the live wire inside the cable?

**[1 mark]**

Tick (✓) **one** box.

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

**0 7 . 2** What colour is the insulation covering the neutral wire inside the cable?

**[1 mark]**

Tick (✓) **one** box.

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

Question 45 · continued



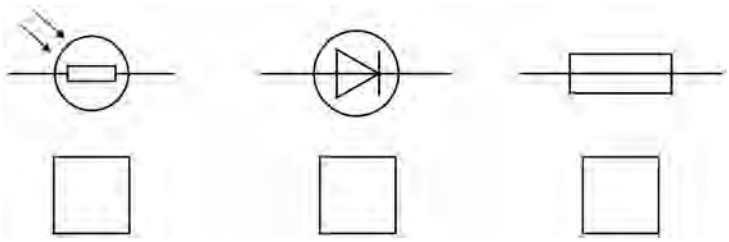
The plug connected to the cable contains a fuse.

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

**0 7 . 3** What is the circuit symbol for a fuse?

**[1 mark]**

Tick (✓) **one** box.



**0 7 . 4** 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:

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

**[2 marks]**

Current = _____ A

**Question 7 continues on the next page**

Question 45 · continued



**0 7 . 5** 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.

**[3 marks]**

Change in thermal energy = _____ J

**0 7 . 6** 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?

**[1 mark]**

Tick (✓) **one** box.

The total energy will be smaller. ☐

The total energy will be the same. ☐

The total energy will be greater. ☐

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### 4.2.3.2 Mains electricity

**Question 46**

June 2025 | 8463/1F | Original Q5

**0 5** **Figure 8** shows an electric kettle used to boil water.

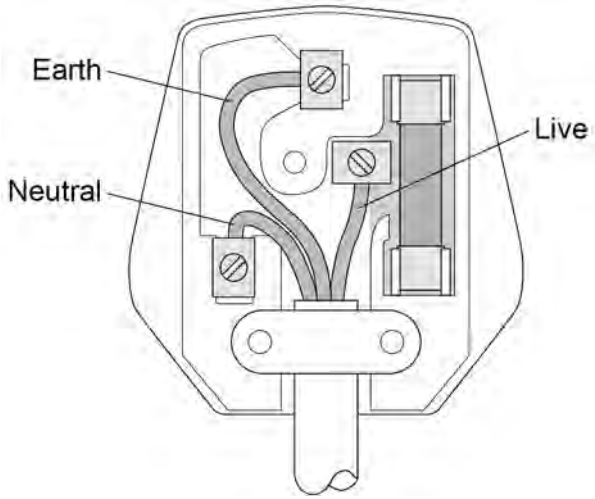
**Figure 8**



**0 5 . 1** The kettle is connected to the mains electricity supply by a three-core cable and plug.

**Figure 9** shows the inside of the plug.

**Figure 9**




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

**[3 marks]**

Choose answers from the box.

| | | | | |
|---|---|---|---|---|
| **blue** | **brown** | **green and yellow** | **red** | **yellow and brown** |

Earth wire _____

Live wire _____

Neutral wire _____

**Question 5 continues on the next page**

4.2.3.2 Mains electricity

Question 46 · continued

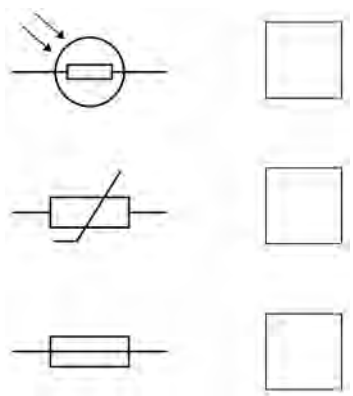


**0 5 . 2** The plug in **Figure 9** contains a fuse.

What is the circuit symbol for a fuse?

**[1 mark]**

Tick (✓) **one** box.



**0 5 . 3** 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:

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

**[2 marks]**

Potential difference = _____ V

Question 46 · continued



**0 5 . 4** 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:

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

**[2 marks]**

Resistance = _____ Ω

**0 5 . 5** 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**?

**[2 marks]**

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**. ☐

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