SPECIMEN MATERIAL

# GCSE
# COMBINED SCIENCE: SYNERGY

**F**

Foundation Tier Paper 4F

Specimen 2018 Time allowed: 1 hour 45 minutes

**Materials**

For this paper you must have:
- a ruler
- a calculator
- the periodic table (enclosed)
- the Physics equation sheet (enclosed).

**Instructions**
- Answer all questions in the spaces provided.
- Do all rough work in this book. Cross through any work you do not want to be marked.

**Information**
- There are 100 marks available on this paper.
- The marks for questions are shown in brackets.
- You are expected to use a calculator where appropriate.
- You are reminded of the need for good English and clear presentation in your answers.
- When answering questions 06.4 and 10.6 you need to make sure that your answer:
  - is clear, logical, sensibly structured
  - fully meets the requirements of the question
  - shows that each separate point or step supports the overall answer.

**Advice**
- In all calculations, show clearly how you work out your answer.

Please write clearly, in block capitals.

Centre number ☐☐☐☐☐ Candidate number ☐☐☐☐

Surname ☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐

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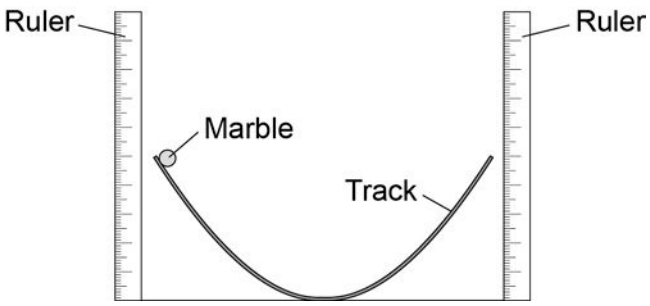
Candidate signature _____

**0 1** A student investigates rolling a marble down a track.

**Figure 1** shows how he sets up the investigation.

**Figure 1**




The student lets go of the marble from different heights.

He records:

- the height from which he drops the marble (the drop height)
- the height the marble rolls up the other side (the roll height).

**0 1 . 1** What force causes the marble to fall down the track?

**[1 mark]**

Tick **one** box.

- Air resistance ☐
- Friction ☐
- Gravity ☐
- Magnetism ☐

**0 1 . 2** What is one variable the student should control in the investigation?

**[1 mark]**

Tick **one** box.

- Length of ruler ☐
- Length of track ☐
- Mass of marble ☐
- Roll height ☐

**Question 1 continues on the next page**

**Table 1** shows the student's results.

**Table 1**

| Drop height in cm | Roll height in cm | | | |
|---|---|---|---|---|
| | **Test 1** | **Test 2** | **Test 3** | **Mean** |
| 20 | 15 | 14 | 14 | 14 |
| 40 | 29 | 33 | 32 | |
| 60 | 47 | 19 | 46 | 46 |
| 80 | 65 | 61 | 63 | 63 |

**0 1 . 3** What is the **independent** variable in the investigation?

**[1 mark]**

Tick **one** box.

- Drop height ☐
- Length of track ☐
- Mass of marble ☐
- Roll height ☐

**0 1 . 4** Calculate the mean roll height of the marble when it is dropped from 40 cm.

**[1 mark]**

Mean roll height = _____ cm

**0 1 . 5** The student calculated the mean roll height for a drop height of 60 cm.

He did not include the result for Test 2 in his calculation.

Why did the student leave out the result for Test 2?

**[1 mark]**

**0 1 . 6** Describe how the drop height of the marble affects the roll height.

**[1 mark]**

**0 1 . 7** Why does the marble never roll up to the same height the student drops it from?

**[1 mark]**

**Turn over for the next question**

**0 2** **Table 2** shows information about some elements.

**Table 2**

| Element | Melting point in ˚C | Boiling point in ˚C |
|---|---|---|
| Fluorine | –202 | –188 |
| Chlorine | –101 | –35 |
| Bromine | –7 | 59 |
| Iodine | 114 | 184 |
| Astatine | | |

**0 2 . 1** Look at **Table 2**.

Describe the trend in melting point from fluorine to astatine.

**[1 mark]**

**0 2 . 2** Estimate the boiling point of astatine.

Use **Table 2** to help you.

**[1 mark]**

Boiling point of astatine = _____ °C

**0 2 . 3** Room temperature is 20 °C.

Which element in **Table 2** is a liquid at room temperature?

**[1 mark]**

**0 2 . 4** To which group of the periodic table do the elements in **Table 2** belong?

**[1 mark]**

Tick **one** box.

Group 0 ☐

Group 1 ☐

Group 5 ☐

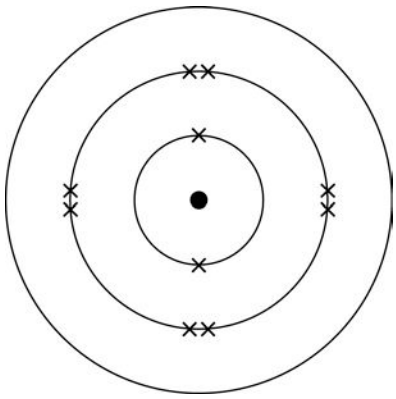
Group 7 ☐

**0 2 . 5** A chlorine atom has 17 electrons.

On **Figure 2**, use crosses to show the arrangement of electrons in the outer shell of a chlorine atom.

**[1 mark]**

**Figure 2**



**Question 2 continues on the next page**

**0 2 . 6** Chlorine reacts with sodium bromide solution to produce bromine and sodium chloride solution.

Complete the symbol equation for the reaction.

**[2 marks]**

____ $Cl_2$ + ____ NaBr $\longrightarrow$ _____ + _____

**0 2 . 7** Which element in **Table 2** will react with sodium chloride solution?

Give a reason for your answer.

**[2 marks]**

**0 3** This question is about magnetism.

**0 3 . 1** Which two materials are magnetic?

**[2 marks]**

Tick **two** boxes.

- Carbon ☐
- Cobalt ☐
- Copper ☐
- Nickel ☐
- Sodium ☐

**0 3 . 2** Describe how you could find the magnetic field pattern of a permanent bar magnet.

**[3 marks]**

**Question 3 continues on the next page**

A student investigates how the number of turns of wire on a solenoid affects the strength of the solenoid.

To test the strength of the solenoid she looks at how many paper clips the solenoid could lift.

**Figure 6** shows how she sets up the equipment.

She keeps the current through the coil constant throughout the experiment.

**Figure 3**

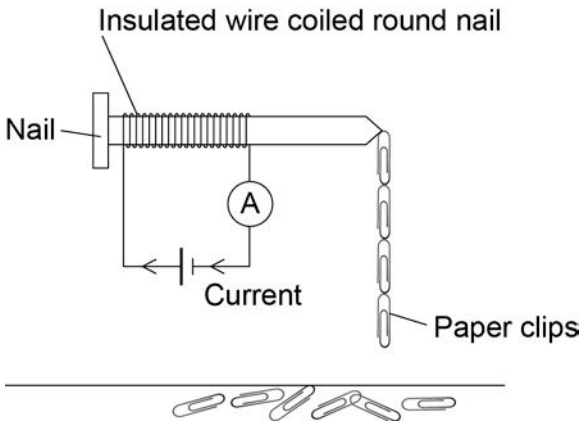



**Table 3** shows the student's results.

**Table 3**

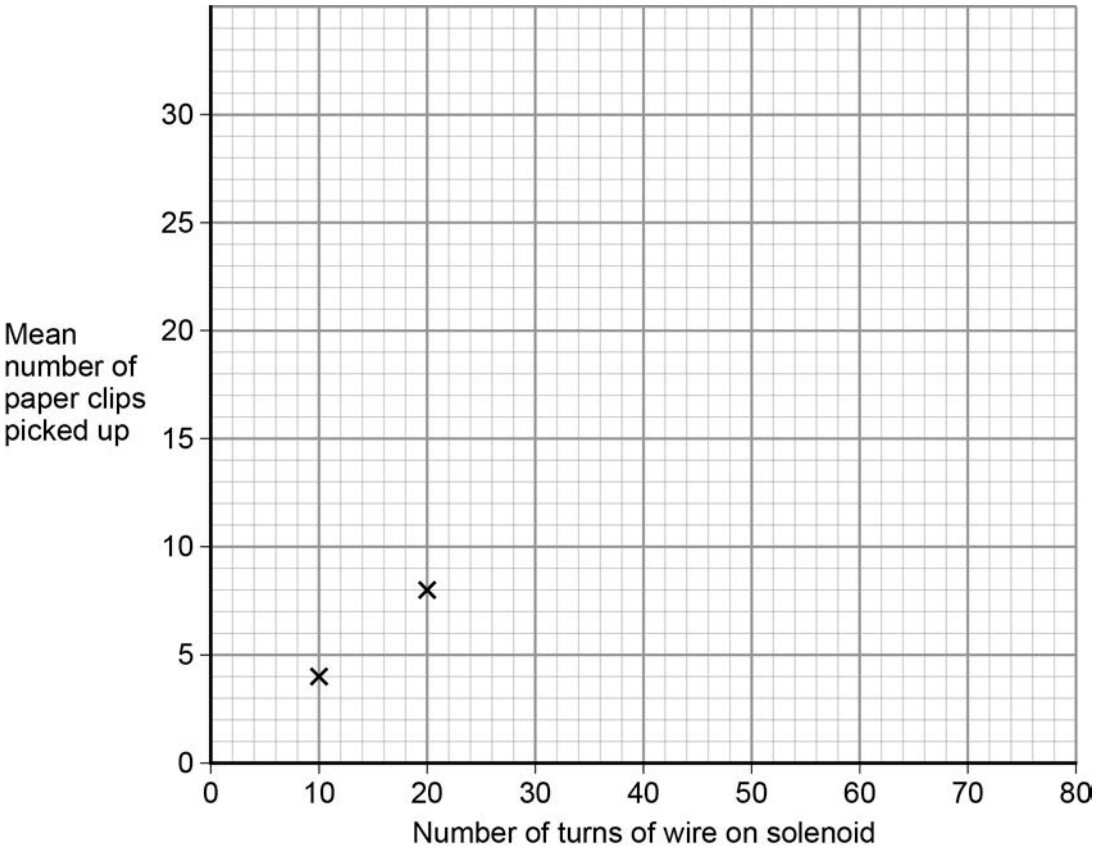
| Number of turns of wire on solenoid | Number of paper clips picked up by solenoid | | | |
|---|---|---|---|---|
| | Test 1 | Test 2 | Test 3 | Mean |
| 0 | 0 | 0 | 0 | 0 |
| 10 | 4 | 3 | 4 | 4 |
| 20 | 8 | 8 | 9 | 8 |
| 30 | 11 | 11 | 13 | 12 |
| 40 | 15 | 13 | 16 | 15 |
| 50 | 21 | 24 | 19 | 21 |
| 60 | 25 | 24 | 26 | 25 |

**0 3 . 3** Use the data from **Table 3** to complete the graph in **Figure 4**.

- The first two points have been plotted for you.
- Draw a line of best fit.

**[3 marks]**

**Figure 4**




**0 3 . 4** Describe the pattern shown in the graph.

**[2 marks]**

**0 3 . 5** Use your graph to predict how many paper clips the solenoid will pick up when 80 turns of wire are used.

**[1 mark]**

Number of paper clips picked up = _____

**There are no questions printed on this page**

**0 4** Forces can be classed as contact or non-contact forces.

**0 4 . 1** Look at **Table 4**.

Tick **one** box for each type of force to say whether it is a contact force or a non-contact force.

**[3 marks]**

**Table 4**

| Type of force | Contact force | Non-contact force |
|---|---|---|
| Electrostatic | | |
| Friction | | |
| Gravity | | |

**0 4 . 2** Force is a vector quantity.

What are two other vector quantities?

**[2 marks]**

Tick **two** boxes.

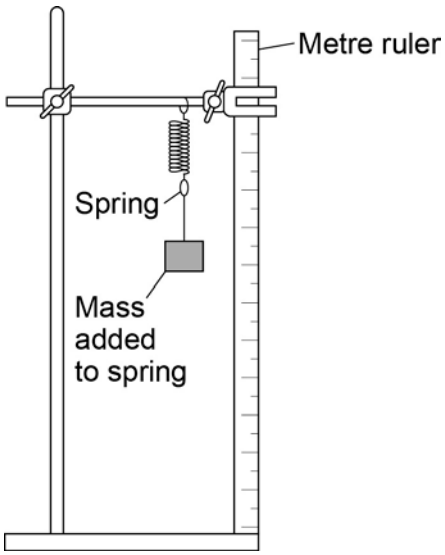
- Mass ☐
- Time ☐
- Velocity ☐
- Speed ☐
- Displacement ☐

**Question 4 continues on the next page**

A student does a practical to investigate the relationship between force and extension for a spring.

**Figure 5** shows how he set up his experiment.

**Figure 5**




**0 4 . 3** What could the student do to improve the accuracy of his investigation?

**[1 mark]**

Tick **one** box.

Use a longer ruler to measure the length ☐

Use a pointer from the spring to measure the length ☐

Use a new spring between each reading ☐

Use a stronger spring in the investigation ☐

**0 4 . 4** The weight on the spring is the force applied to the spring.

The student puts a mass of 25 g on the spring.

Gravitational field strength = 9.8 N/kg

Calculate the weight on the spring.

Use the equation:

weight = mass × gravitational field strength

**[3 marks]**

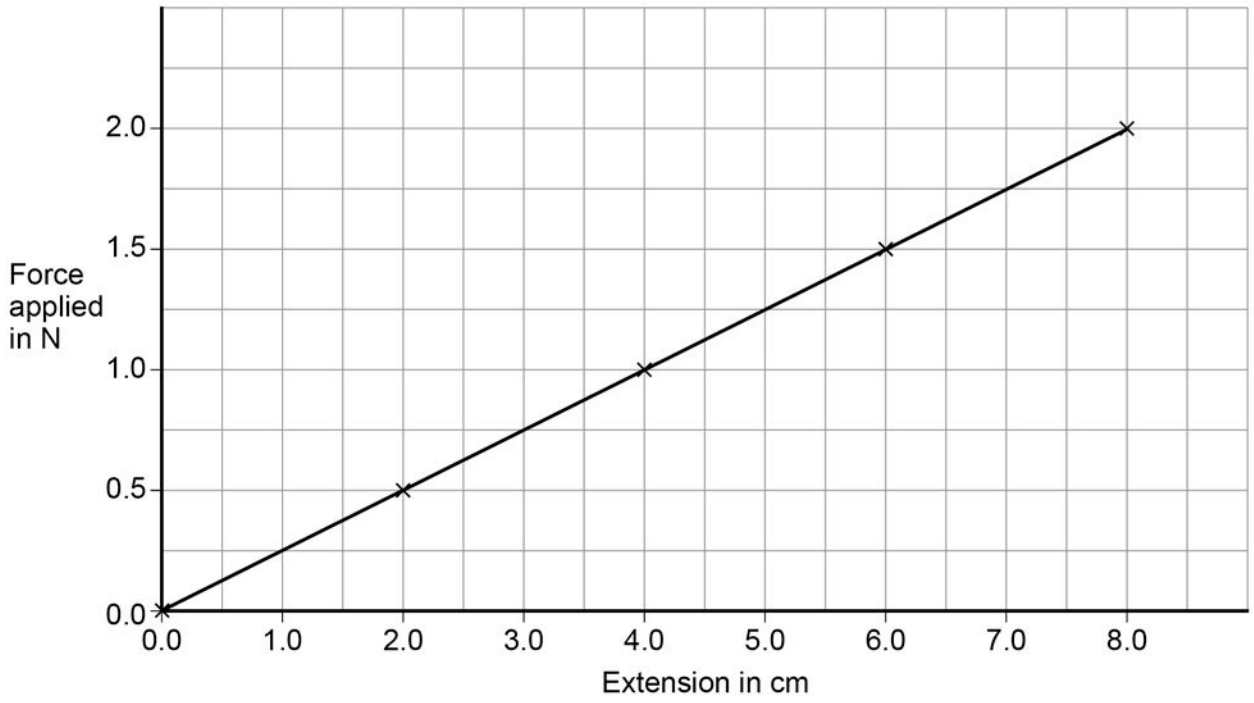
Weight on spring = _____ N

**Question 4 continues on the next page**

The student plotted a graph of force applied and extension of the spring.

**Figure 6** shows his graph.

**Figure 6**




**0 4 . 5** What is the relationship between force applied and extension?

**[1 mark]**

Tick **one** box.

- Extension is directly proportional to force ☐
- Extension increases by smaller values as force increases ☐
- Extension is inversely proportional to force ☐

**0 4 . 6** Use **Figure 6** to determine the force needed to give an extension of 4.5 cm.

**[1 mark]**

Force needed = _____ N

**0 4 . 7** A different spring has a spring constant of 13.5 N/m.

Calculate the elastic potential energy stored in the spring when its extension is 12 cm.

Use the correct equation from the Physics equation sheet.

**[2 marks]**

_____

_____

_____

Elastic potential energy = _____ J

**Turn over for the next question**

**0 5** We use mains electricity in our homes.

**0 5 . 1** What is the frequency of the UK mains electricity supply?

**[1 mark]**

Tick **one** box.

23 Hz ☐

50 Hz ☐

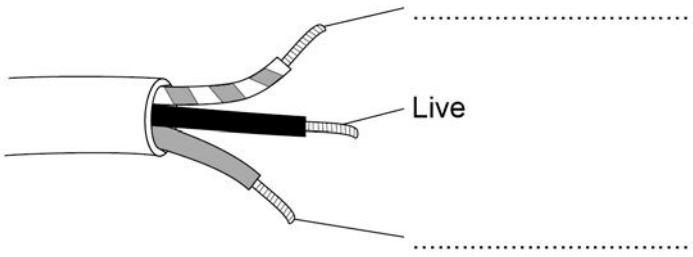
230 Hz ☐

500 Hz ☐

**0 5 . 2** Many appliances in the home use three-core electrical cable.

Look at **Figure 7**.

**Figure 7**




Label the wires in the cable in **Figure 7**.

Use words from the box.

**[2 marks]**

| | | | |
|---|---|---|---|
| **Earth** | **Negative** | **Neutral** | **Positive** |

**0 5 . 3** The sentences explain how touching the live wire in a cable can cause an electric shock.

Complete the sentences.

Use words from the box.

**[2 marks]**

| | | | |
|---|---|---|---|
| **current** | **force** | **resistance** | **potential difference** |

Touching the live wire causes a large _____

to exist across the body.

This causes a _____ through the body,

which results in an electric shock.

**0 5 . 4** A heater has a power rating of 2500 W.

The heater is turned on for 180 seconds.

Calculate the energy transferred by the heater.

Use the equation:

energy transferred = power × time

Give your answer in kilojoules (kJ).

**[3 marks]**

Energy transferred = _____ kJ

**Question 5 continues on the next page**

**0 5 . 5** Write down the equation that links charge flow, energy transferred and potential difference.

**[1 mark]**

**0 5 . 6** The mains electricity supply is at 230 V.

A different heater transfers 4200 J of energy.

Calculate the charge flow through the heater.

**[3 marks]**

Charge flow = _____ C

**0 6** Hydrocarbons are used to make useful products.

**0 6 . 1** What are the elements in hydrocarbons?

**[1 mark]**

Tick **one** box.

- Carbon and hydrogen only ☐
- Carbon, hydrogen and oxygen ☐
- Carbon and nitrogen only ☐
- Carbon, nitrogen and oxygen ☐

**Question 6 continues on the next page**

**0 6 . 2** **Table 5** gives some information about four hydrocarbons.

**Table 5**

| Hydrocarbon | Melting point in °C | Boiling point in °C |
|---|---|---|
| Methane | –183 | –162 |
| Ethene | –169 | –104 |
| Octane | –57 | +126 |
| Decane | –30 | +174 |

What are two correct statements about the four compounds?

**[2 marks]**

Tick **two** boxes.

- Methane has the lowest boiling point and decane has the highest melting point ☐
- Methane and decane are both gases at 20 °C ☐
- Ethene and octane are both alkanes ☐
- Decane and ethene are both liquids at 0 °C ☐
- Octane is liquid over a larger temperature range than methane ☐

**0 6 . 3** Ethene can be produced from long-chain hydrocarbons by cracking.

Give the conditions needed for cracking.

**[2 marks]**

**0 6 . 4** Poly(ethene) is a polymer made from ethene. Poly(ethene) is used to make plastic bags.

**Table 6** is from a life cycle assessment comparing paper bags and plastic bags.

**Table 6**

| | **Paper bag** | **Plastic bag** |
|---|---|---|
| Raw material | Wood (renewable) | Oil or gas (non-renewable) |
| Energy used to make in MJ | 1.7 | 1.5 |
| Solid waste produced in g | 50 | 14 |
| Carbon dioxide produced in kg | 0.23 | 0.53 |

Evaluate which type of bag is more environmentally friendly.

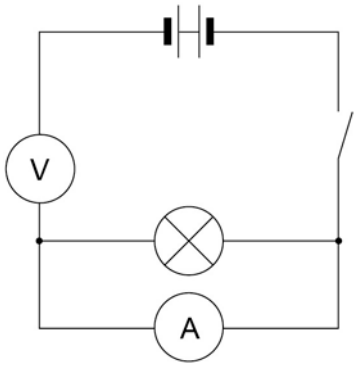
Use data from **Table 6** and your own knowledge to support your answer.

**[6 marks]**

**0 7** A student used electrical circuits to investigate the relationship between resistance, potential difference and current.

**Figure 8** shows how the student connects the first circuit he set up.

**Figure 8**




**0 7 . 1** The circuit does not work.

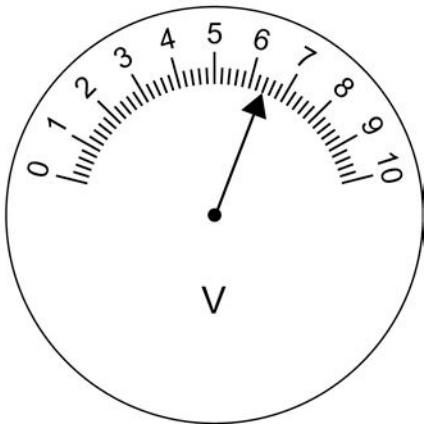
Draw the correct circuit.

**[2 marks]**

The student then sets up the circuit correctly.

Look at **Figure 9**.

**Figure 9**




**0 7 . 2** What is the reading on the voltmeter?

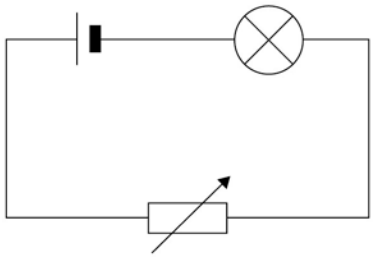
**[1 mark]**

**Question 7 continues on the next page**

The student then set up a circuit to investigate how resistance affects the brightness of a lamp.

**Figure 10** shows the circuit he set up.

**Figure 10**



**0 7 . 3** The student increases the resistance of the variable resistor.

What effect does this have on the brightness of the lamp?

Explain your answer.

**[2 marks]**

**0 7 . 4** Write down the equation that links current, potential difference and resistance.

**[1 mark]**

**0 7 . 5** When the potential difference across the lamp is 3.3 V the current is 0.15 A.

Calculate the resistance of the lamp in the student's experiment.

**[3 marks]**

Resistance = _____ Ω

**Turn over for the next question**

**0 8** A student investigates a potassium salt, **X**.

She finds that salt **X**:

- has a high melting point
- does not conduct electricity when it is solid
- dissolves in water and the solution does conduct electricity.

**0 8 . 1** What is the type of bonding in salt **X**?

**[1 mark]**

Tick **one** box.

Covalent ☐

Giant molecular ☐

Ionic ☐

Metallic ☐

**0 8 . 2** What is the name given to solutions that conduct electricity?

**[1 mark]**

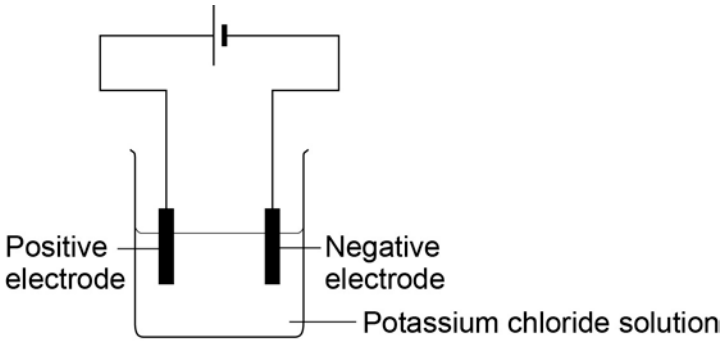
**0 8 . 3** Why does a solution of salt **X** in water conduct electricity?

**[1 mark]**

**0 8 . 4** The student electrolyses a solution of potassium chloride.

**Figure 11** shows the apparatus she uses.

**Figure 11**




When the current is switched on, bubbles of hydrogen gas are given off at the negative electrode.

Explain why hydrogen is produced and **not** potassium.

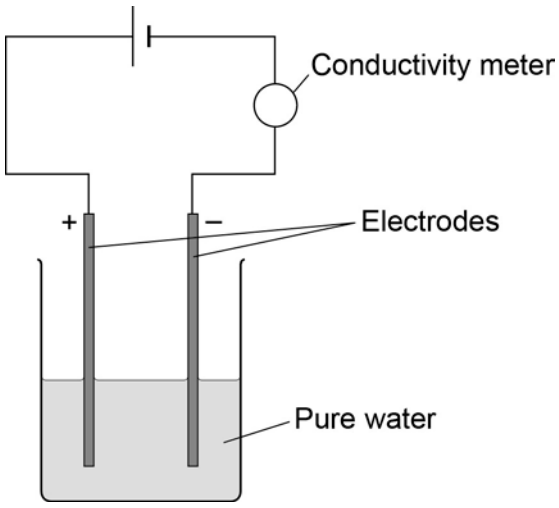
**[2 marks]**

**Question 8 continues on the next page**

The student then compares the relative conductivity of different concentrations of potassium chloride.

**Figure 12** shows the apparatus she uses.

**Figure 12**




This is the method used.

1. Add potassium chloride solution to the water one drop at a time.
2. Stir the mixture.
3. Record the reading on the conductivity meter.

**Table 7** shows the student's results.

**Table 7**

| Number of drops of potassium chloride solution | Relative conductivity of solution |
|---|---|
| 0 | 0 |
| 1 | 90 |
| 2 | 180 |
| 3 | 270 |
| 4 | 360 |
| 5 | 450 |
| 6 | 540 |

**0 8 . 5** When there is no potassium chloride in the beaker no electrical charge flows.

Suggest why pure water does **not** conduct electricity.

**[2 marks]**

**0 8 . 6** Describe the relationship shown in **Table 7**.

**[2 marks]**

**Turn over for the next question**

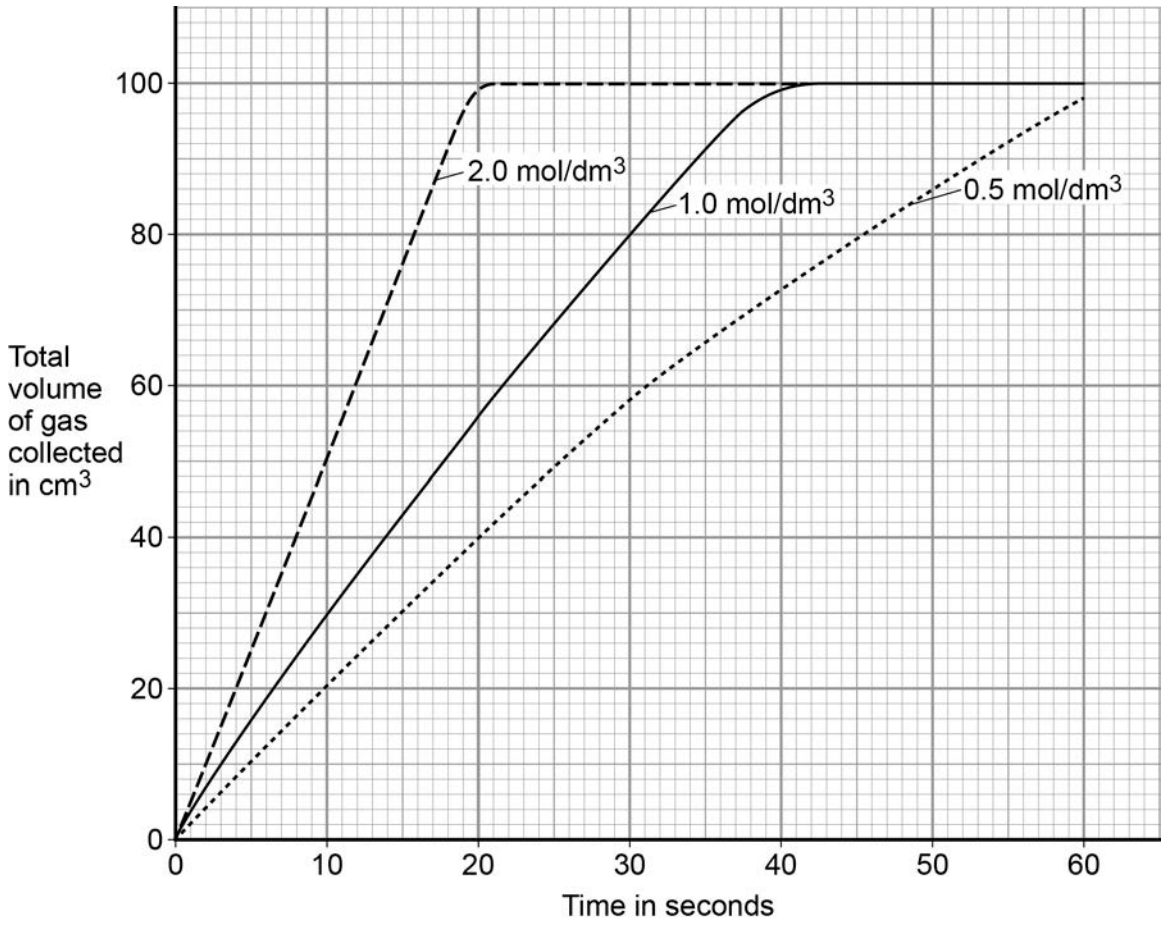
**0 9** A student investigates how the concentration of an acid affects the rate of a reaction.

This is the method used.

1. Put a 3 cm piece of magnesium ribbon into a conical flask.
2. Add 50 $cm^3$ of 0.5 $mol/dm^3$ hydrochloric acid to the flask.
3. Collect and measure the volume of gas produced at 10 second intervals.
4. Repeat with different concentrations of hydrochloric acid using the same length of magnesium ribbon and volume of acid.

The student's results are shown in **Figure 13**.

**Figure 13**



**0 9 . 1** How do the results show that increasing the concentration of acid increases the rate of reaction?

You **must** use data from the graph in your answer.

**[2 marks]**

**0 9 . 2** Explain why the rate of reaction changes as the concentration of the acid increases.

You should answer in terms of particles.

**[3 marks]**

**Question 9 continues on the next page**

**0 9 . 3** Student **A** said that the final volume of gas collected was lower for a concentration of 0.5 mol $dm^3$ because the reaction had not finished.

Student **B** said it was because all the acid had reacted.

Describe further experimental work the students could do to find out which student was correct.

**[2 marks]**

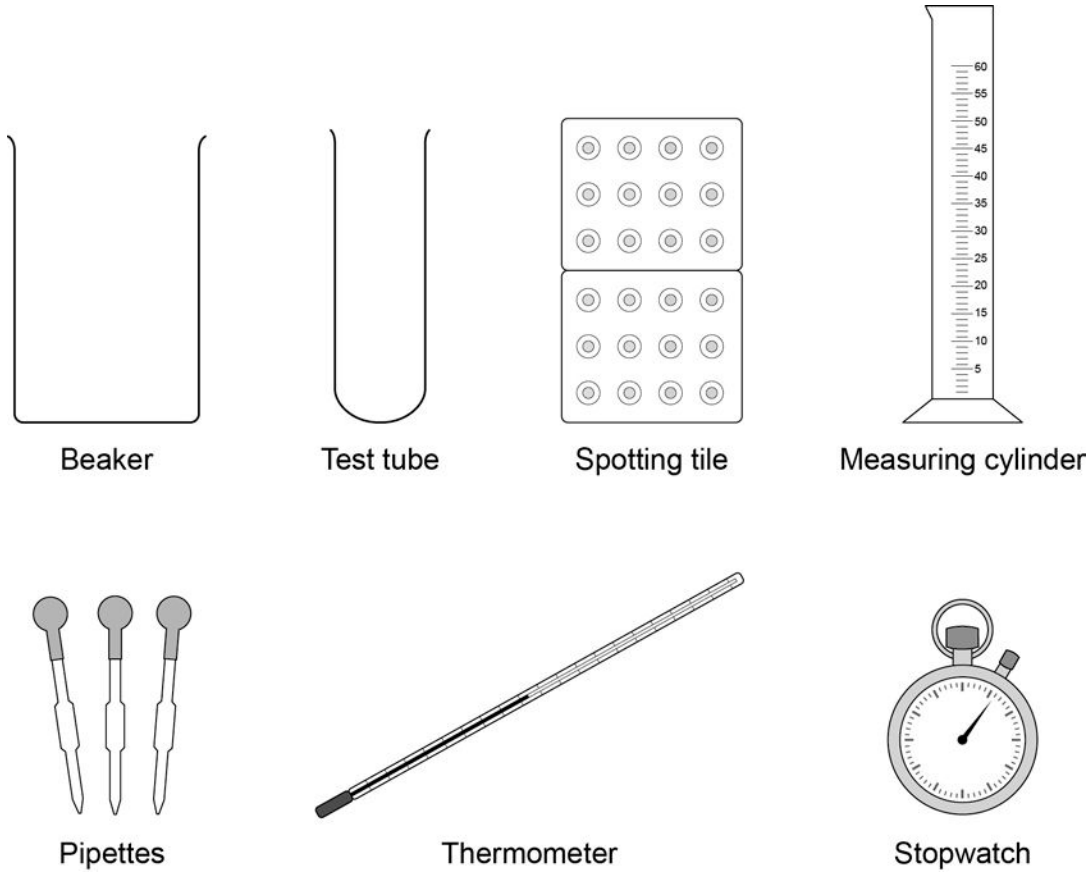
**Turn over for the next question**

**1 0** Amylase catalyses the breakdown of starch into sugars.

A student investigated the effect of amylase on the reaction at different temperatures.

**Figure 14** shows the apparatus the student used.

**Figure 14**




This is the method used.

1. Put starch suspension into a test tube.
2. Add amylase solution.
3. Put the test tube in a beaker of water at 15 °C.
4. Remove a small sample of the mixture every 30 seconds and put in a spotting tile.
5. Test the sample for starch.
6. Time how long it takes to break down all of the starch in the mixture.
7. Repeat steps 1–5 at 20 °C, 25 °C and 30 °C.
8. Repeat for each temperature twice more.

**Table 8** shows the student's results.

**Table 8**

| | Time taken until there was no starch in the sample in minutes | | | |
|---|---|---|---|---|
| **Temperature in °C** | **Test 1** | **Test 2** | **Test 3** | **Mean** |
| 15 | 6.1 | 9.4 | 10.0 | 8.5 |
| 20 | 4.8 | 5.0 | 4.6 | 4.8 |
| 25 | 3.0 | 2.5 | 3.0 | 3.2 |
| 30 | 1.5 | 2.0 | 2.0 | |

**1 0 . 1** One of the results in **Table 8** is anomalous.

Draw a ring around the anomalous result.

**[1 mark]**

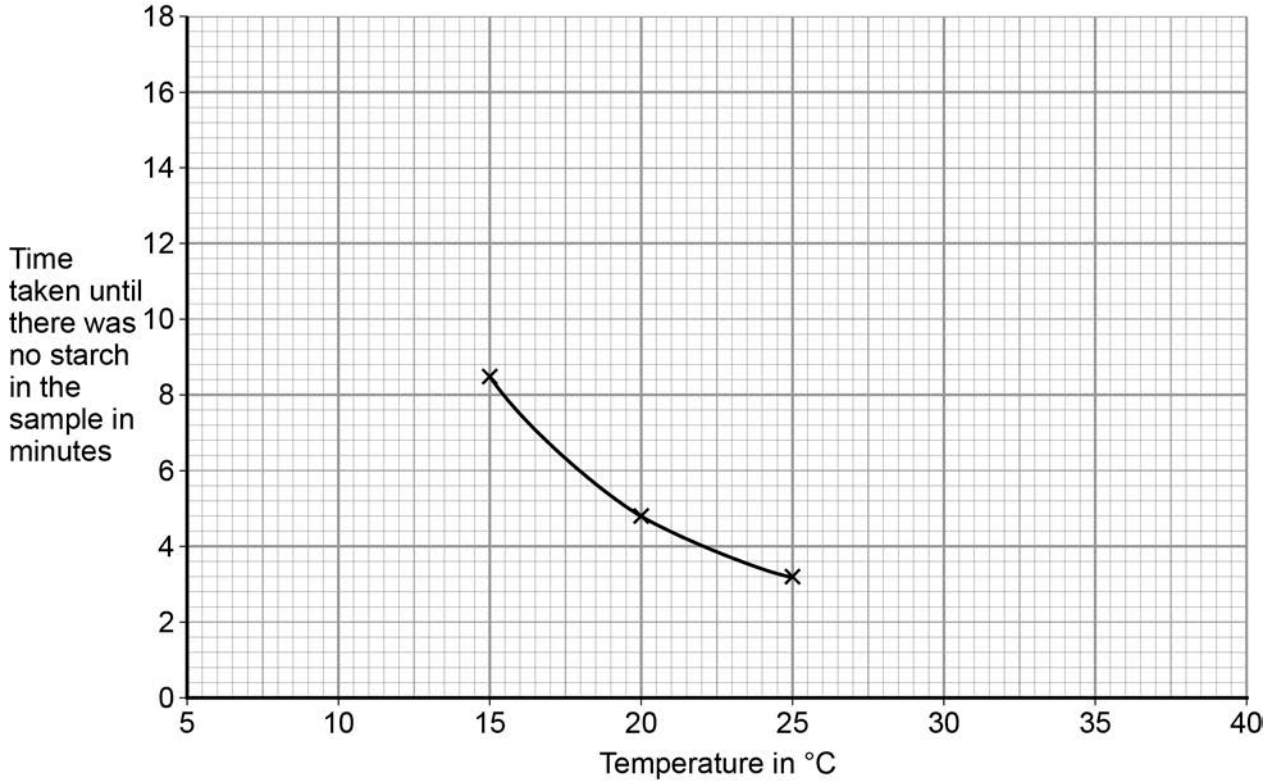
**1 0 . 2** Calculate the mean for 30 °C.

**[1 mark]**

**Question 10 continues on the next page**

**Figure 15** shows a graph of the student's results.

**Figure 15**




**1 0 . 3** Use the graph to predict how long it would take to break down all of the starch at 10 °C.

**[1 mark]**

Time = _____ minutes

**1 0 . 4** The student tested samples of the mixture for starch every 30 seconds.

In each test she added one drop of iodine to the sample in the spotting tile.

Predict the colour of the samples from the 20 °C test at 4.0 minutes and 7.0 minutes.

**[2 marks]**

Colour at 4.0 minutes _____

Colour at 7.0 minutes _____

**1 0 . 5** The student did a fourth test at 30 °C.

In this test the starch did not break down, even after 45 minutes.

Why did the amylase not break down the starch in this test?

**[1 mark]**

Tick **one** box.

- The amylase solution and the starch suspension were mixed before the start of the experiment. ☐
- The amylase solution had been prepared with water at 95 °C. ☐
- The amylase solution had been prepared with water at 20 °C. ☐
- The amylase solution had been stored in the fridge. ☐

**Question 10 continues on the next page**

**1 0 . 6** The student made the following conclusion about the optimum temperature for amylase to work at.

'Amylase works fastest at 40 °C'

Her teacher said that this is **not** a valid conclusion from her results.

Describe how the student could change her method to give results that would improve the validity of her conclusion.

**[6 marks]**

## END OF QUESTIONS