

Please write clearly in block capitals.

Centre number

Candidate number

Surname

Forename(s)

Candidate signature

GCSE COMBINED SCIENCE: SYNERGY

F

Foundation Tier Paper 3 Physical sciences

Monday 11 June 2018

Morning

Time allowed: 1 hour 45 minutes

Materials

For this paper you must have:

- a ruler
- a scientific calculator
- the periodic table (enclosed)
- the Physics Equations Sheet (enclosed).

Instructions

- Use black ink or black ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions in the spaces provided. Do not write outside the box around each page or on blank pages.
- Do all rough work in this book. Cross through any work you do not want to be marked.
- In all calculations, show clearly how you work out your answer.

Information

- The maximum mark for this paper is 100.
- 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.

For Examiner's Use	
Question	Mark
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
TOTAL	



0 1

A teacher extracted copper from copper oxide.

This is the method used.

1. Mix 1.30 g of zinc and 1.59 g of copper oxide.
2. Heat the mixture strongly.
3. When the mixture starts to glow, stop heating.
4. Let the glow spread through the mixture.
5. Leave the mixture to cool.

0 1 . 1

This reaction is exothermic.

Which part of the method shows the reaction is exothermic?

[1 mark]

Tick **one** box.

Mix zinc and copper oxide

☐

Heat the mixture

☐

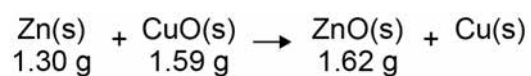
Let the glow spread

☐

Leave to cool

☐

The equation for the reaction between zinc and copper oxide is:



0 1 . 2

1.30 g of zinc fully reacted with 1.59 g of copper oxide to produce 1.62 g of zinc oxide.

What mass of copper was produced?

[1 mark]

Mass of copper produced = _____ g



0 1 . 3 What is the physical state of zinc oxide in the reaction?

[1 mark]

Tick **one** box.

Aqueous

☐

Gas

☐

Liquid

☐

Solid

☐

0 1 . 4 Which substance has been oxidised in the reaction?

[1 mark]

Tick **one** box.

Copper

☐

Copper oxide

☐

Zinc

☐

Zinc oxide

☐

0 1 . 5 What type of reaction takes place when zinc reacts with copper oxide?

[1 mark]

Tick **one** box.

Combustion

☐

Crystallisation

☐

Displacement

☐

Neutralisation

☐

Question 1 continues on the next page

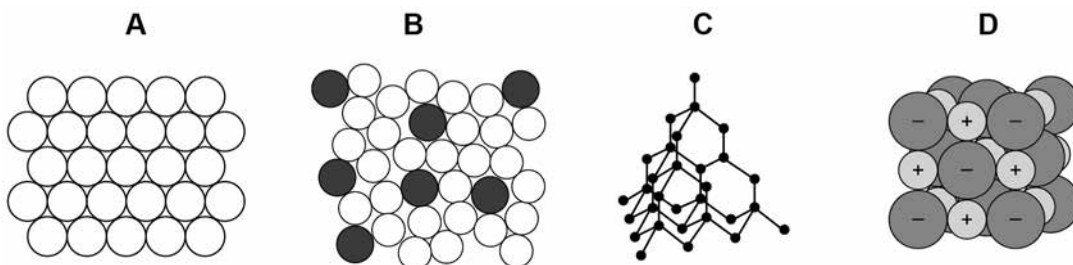
Turn over ►



Copper is a metal.

0 1 . 6 Which structure represents the arrangement of atoms in pure copper?

[1 mark]



Tick **one** box.

A	☐
B	☐
C	☐
D	☐

0 1 . 7 Copper is used in electrical wiring.

Give **one** reason why.

[1 mark]



0 1 . 8

In the UK, 40% of the copper we use is recycled copper.

The other 60% is copper obtained by mining.

What is the simplest ratio of recycled copper to copper obtained by mining?

[1 mark]

Tick **one** box.

2 : 3

☐

2 : 5

☐

4 : 10

☐

6 : 4

☐

0 1 . 9

What are **two** advantages of recycling copper?

[2 marks]

Tick **two** boxes.

Conserves copper ores

☐

Increase in greenhouse gases

☐

Less energy used

☐

More jobs for miners

☐

More space used at landfill

☐

10

Turn over for the next question

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ANSWER IN THE SPACES PROVIDED**

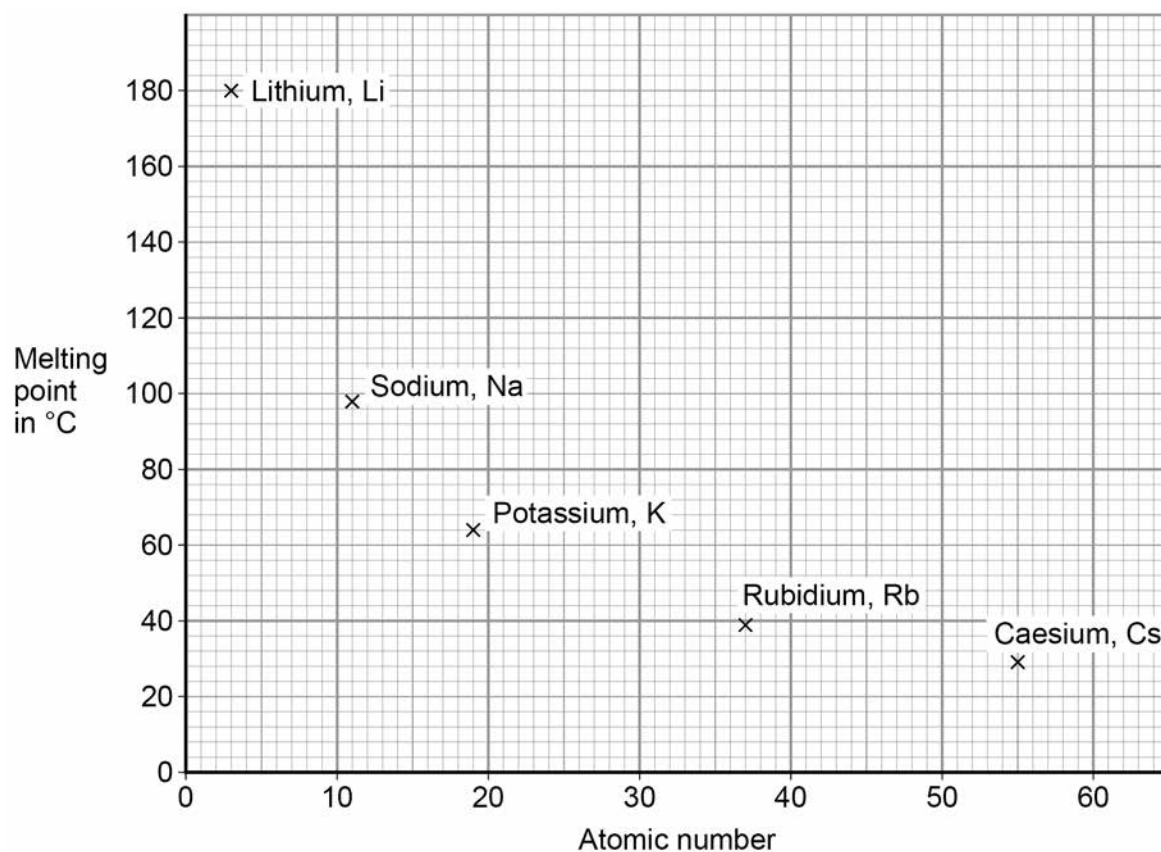


0 2

This question is about Group 1 metals.

Figure 1 shows the melting points of Group 1 metals plotted against their atomic number.

Figure 1



0 2 . 1

Describe the trend shown by the melting points of Group 1 metals as the atomic number increases.

[1 mark]

0 2 . 2

Determine the atomic number and melting point of caesium.

Use **Figure 1**.

[1 mark]

Atomic number of caesium = _____

Melting point of caesium = _____ °C

Turn over ►



Lithium is a Group 1 metal.

0 2 . 3 A lithium atom can be shown as ${}^7_3\text{Li}$.

How many electrons does the **outer shell** of a lithium atom contain?

[1 mark]

Tick **one** box.

- | | |
|---|--------------------------|
| 1 | ☐ |
| 3 | ☐ |
| 4 | ☐ |
| 7 | ☐ |

0 2 . 4 Lithium reacts with oxygen to produce lithium oxide.

Draw **one** line from each substance to the correct description of the substance.

[2 marks]

Substance

Description

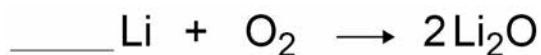
	compound
Lithium oxide	element
	metal
Oxygen	mixture
	polymer



0 2 . 5

Balance the equation for the reaction of lithium with oxygen.

[1 mark]



0 2 . 6

What type of bonding is present in lithium oxide?

[1 mark]

Tick **one** box.

Covalent

☐

Ionic

☐

Metallic

☐

0 2 . 7

Calculate the relative formula mass (M_r) of lithium oxide (Li_2O).Relative atomic masses (A_r): Li = 7 O = 16

[2 marks]

Relative formula mass =

9

Turn over for the next question

Turn over ►



0 3

The stopping distance of a car depends on the thinking distance and the braking distance.

0 3 . 1

Thinking distance depends on the driver's reaction time.

Give **two** factors that can affect reaction time.

[2 marks]

1 _____

2 _____

0 3 . 2

Give **one** factor that can affect the braking distance.

[1 mark]

0 3 . 3

The thinking distance is the distance travelled during the driver's reaction time.

A car was travelling at 13 m/s

The driver's reaction time was 0.6 s

Calculate the thinking distance.

Use the equation:

$$\text{distance travelled} = \text{speed} \times \text{time}$$

[2 marks]

Thinking distance = _____ m



0 3 . 4 The braking distance of the car was 14.0 m

What was the stopping distance of the car?

[1 mark]

Stopping distance = _____ m

0 3 . 5 What is the link between speed and braking distance?

Complete the sentence.

[1 mark]

The greater the speed, the _____

0 3 . 6 If a large braking force is applied, the car decelerates and stops in a very short distance.

Give **two** disadvantages of applying a large braking force.

[2 marks]

1 _____

2 _____

9

Turn over for the next question

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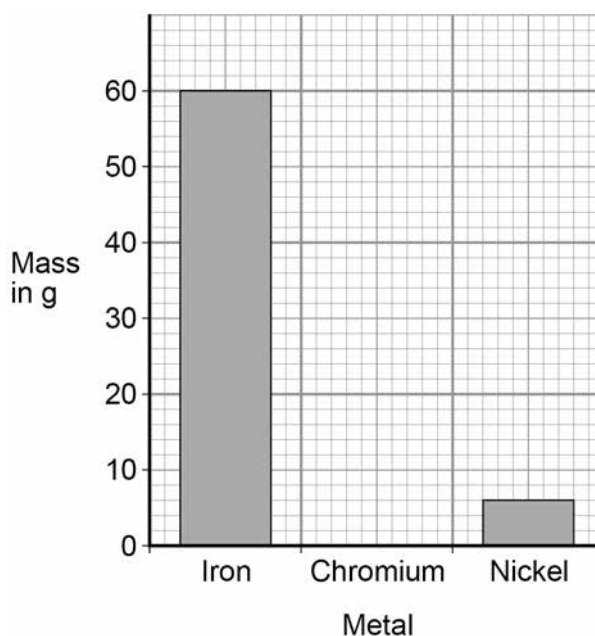


0 4

One alloy contains iron, chromium and nickel.

Figure 2 shows the mass of iron and the mass of nickel in 80 g of this alloy.

Figure 2



0 4

1

Determine the mass of iron and nickel in 80 g of the alloy.

Use **Figure 2**.

[1 mark]

Mass of iron = _____ g

Mass of nickel = _____ g

0 4

2

Calculate the mass of chromium in 80 g of the alloy.

Draw a bar on **Figure 2** to show the mass of chromium in 80 g of the alloy.

[2 marks]

Mass of chromium = _____ g



0 4 . 3

What mass of iron is present in **0.80 kg** of the alloy?

Give your answer in grams.

[1 mark]

Mass of iron = _____ g

0 4 . 4

What is an alloy?

[1 mark]

0 4 . 5

Give **one** reason why alloys are used instead of pure metals.

[1 mark]

0 4 . 6

Iron and nickel are both magnetic metals.

Which is also a magnetic metal?

[1 mark]

Tick **one** box.

Cobalt

☐

Copper

☐

Sodium

☐

Zinc

☐

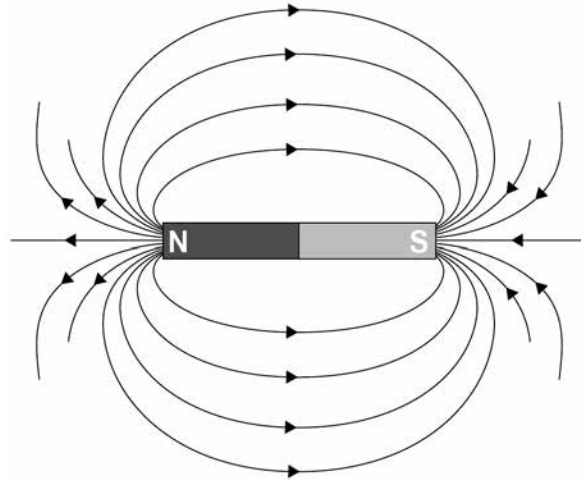
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A student plotted the magnetic field pattern around a bar magnet.

Figure 3 shows the magnetic field pattern.

Figure 3



0 4 . 7

Complete the sentence.

Choose the answer from the box.

[1 mark]

induced

permanent

temporary

Bar magnets produce their own magnetic fields.

Bar magnets are described as _____ magnets.

0 4 . 8

Which statement about the magnetic field around a bar magnet is correct?

[1 mark]

Tick **one** box.

The magnetic field is the same strength all around the magnet.

☐

The magnetic field is strongest at the poles of the magnet.

☐

The magnetic field is strongest near the middle of the magnet.

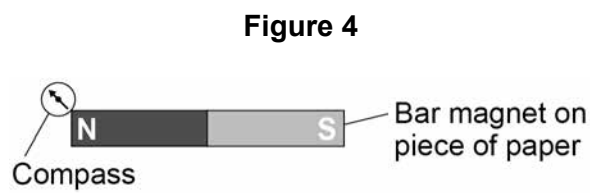
☐


0 4 . 9

This is the start of a method used to plot a magnetic field pattern around a bar magnet.

1. Place the magnet on a piece of paper.
2. Draw around the magnet.
3. Mark a dot by a pole of the magnet.
4. Place the compass on the dot.

Figure 4 shows the apparatus after steps 1–4.



Describe the rest of the method to plot the magnetic field pattern.

[4 marks]

13

Turn over for the next question

Turn over ►



0 5

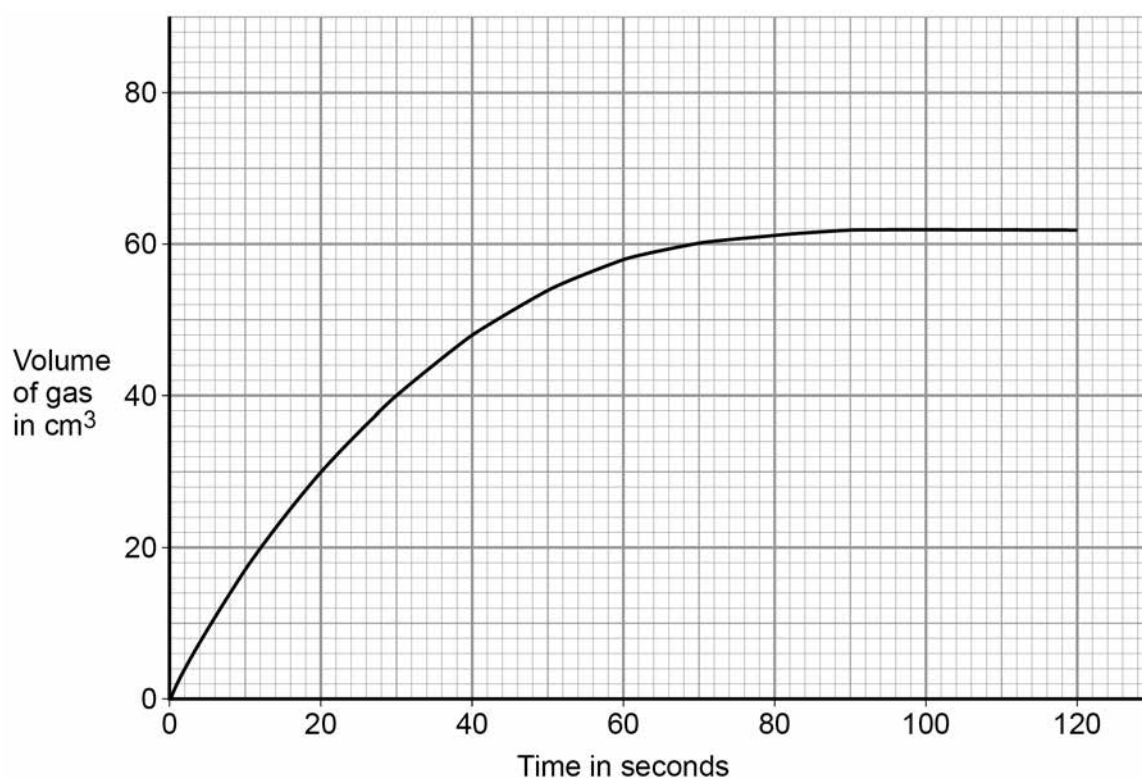
A student investigated the rate of reaction of magnesium with dilute hydrochloric acid.

This is the method used.

1. Add 50 cm³ of dilute hydrochloric acid to a conical flask.
2. Add 0.2 g of magnesium ribbon to the dilute hydrochloric acid in the conical flask.
3. Attach a gas syringe to the conical flask.
4. Record the volume of gas in the gas syringe every 10 seconds.

Figure 5 shows the student's results.

Figure 5

**0 5****1**

Calculate the mean rate of reaction in the first 10 seconds.

Use **Figure 5** and the equation:

$$\text{mean rate of reaction} = \frac{\text{volume of gas produced after 10 seconds}}{\text{time taken}} \quad \text{[2 marks]}$$

Mean rate of reaction = _____



0 5 . 2 What is the unit for the mean rate of the reaction calculated in Question **05.1**?

[1 mark]

Tick **one** box.

cm^3/s

☐

g/s

☐

s/cm^3

☐

s/g

☐

0 5 . 3 Give **two** conclusions you can make about the reaction from 90 s to 120 s

Use **Figure 5**.

[2 marks]

1 _____

2 _____

The student repeated the method using magnesium powder instead of magnesium ribbon. All other variables were kept the same.

0 5 . 4 What is the independent variable in the investigation?

[1 mark]

Tick **one** box.

Surface area of magnesium

☐

Temperature of reaction

☐

Volume of gas collected

☐

Volume of hydrochloric acid

☐

0 5 . 5 Sketch a line on **Figure 5** to show the expected results for the experiment using magnesium powder.

[2 marks]

8

Turn over ►



0 6

A teacher demonstrated the temperature change when hydrochloric acid is added to sodium hydroxide.

This is the method used.

1. Add 25.0 cm^3 of sodium hydroxide solution to a polystyrene cup.
2. Measure the temperature of the sodium hydroxide solution.
3. Add 25.0 cm^3 of hydrochloric acid to the sodium hydroxide solution.
4. Stir the solution.
5. Measure the maximum temperature of the solution.

0 6

1

Draw **one** line from each measurement to the most suitable piece of equipment to use to make the measurement.

[2 marks]

Measurement

Equipment

Temperature of solution

Volume of hydrochloric acid

balance

beaker

measuring cylinder

metre rule

thermometer



0 6 . 2 The teacher did the experiment four times.

Table 1 shows the teacher's results.

Table 1

Experiment	Maximum temperature rise in °C
1	6.1
2	7.8
3	6.1
4	6.4

Calculate the mean maximum temperature rise.

Do **not** use the anomalous result in your calculation.

[2 marks]

Mean maximum temperature rise = _____ °C

0 6 . 3 How could the accuracy of the experiment be improved?

[1 mark]

Tick **one** box.

Add 20.0 cm³ of hydrochloric acid

☐

Use a lid on the polystyrene cup

☐

Use a metal beaker

☐

Use a thermometer with a resolution of 1 °C

☐

Question 6 continues on the next page

Turn over ►



The reaction between hydrochloric acid and sodium hydroxide is a neutralisation reaction.

The reaction produces a salt and one other product.

0 6 . 4 Complete the word equation for the reaction.

[2 marks]

hydrochloric acid + sodium hydroxide $\rightarrow$ _____ + _____

0 6 . 5 Universal indicator is used to measure the pH of solutions.

Hydrochloric acid is pH 1

Sodium hydroxide is pH 13

Draw **one** line from the pH to the colour of universal indicator in a solution with that pH.

[2 marks]

pH	Colour of universal indicator
	green
1	orange
	purple
13	red
	yellow



0 7

An athlete trains to improve his fitness by walking, cycling and running.

0 7 . 1

What is a typical mean speed for a person walking?

[1 mark]Tick **one** box.

1.5 m/s

☐

3.0 m/s

☐

4.5 m/s

☐

6.0 m/s

☐**0 7 . 2**

What is a typical mean speed for a person cycling?

[1 mark]Tick **one** box.

1.5 m/s

☐

3.0 m/s

☐

4.5 m/s

☐

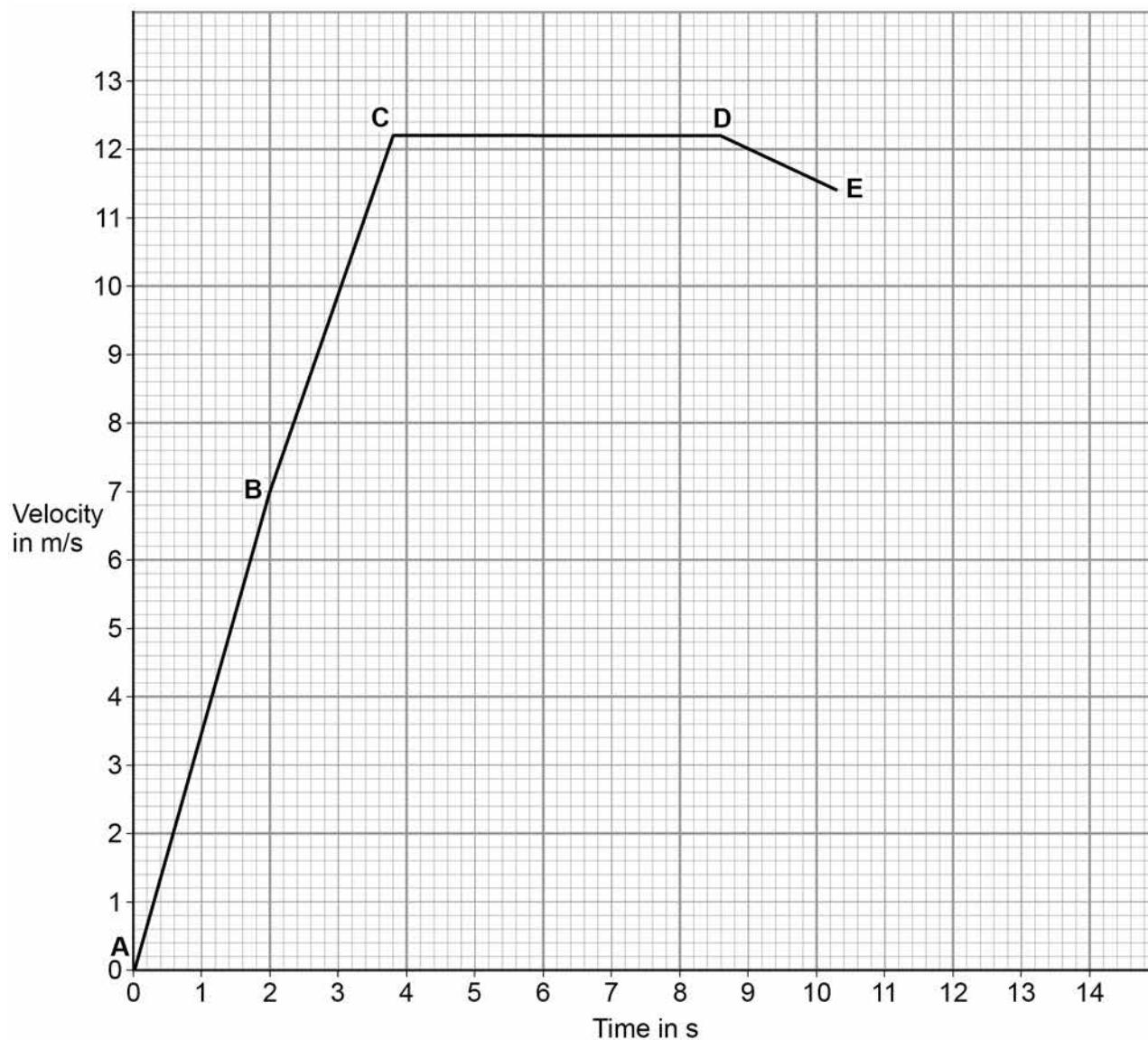
6.0 m/s

☐**Question 7 continues on the next page****Turn over ►**

The athlete takes part in a race on a straight, horizontal running track.

Figure 6 shows the velocity-time graph for the athlete. **A**, **B**, **C**, **D** and **E** represent points in the race.

Figure 6



0 7 . 3

Determine the time taken for the athlete to move between points **C** and **D**.

[2 marks]

Time at **C** = _____ s

Time at **D** = _____ s

Time taken between points **C** and **D** = _____ s



0 7 . 4 Point **E** represents the end of the race.

After point **E**, the athlete has a constant deceleration.

The athlete stops 14 seconds after the start of the race.

Complete **Figure 6** to show the motion of the athlete after point **E**.

[2 marks]

0 7 . 5 Which section of the graph in **Figure 6** shows the athlete moving at constant velocity?
[1 mark]

Tick **one** box.

A–B ☐

B–C ☐

C–D ☐

D–E ☐

0 7 . 6 Which section of the graph in **Figure 6** represents a part of the race where the resultant force on the athlete is zero?

[1 mark]

Tick **one** box.

A–B ☐

B–C ☐

C–D ☐

D–E ☐

Question 7 continues on the next page

Turn over ►



07.7

What does the area under a velocity-time graph represent?

[1 mark]

Tick **one** box.

Acceleration

☐

Distance travelled

☐

Energy

☐

Speed

☐

07.8

Write the equation which links acceleration, mass and resultant force.

[1 mark]

07.9

In another race, the athlete had a constant acceleration during the first 3.2 seconds. His velocity increased from 0 m/s to 11.6 m/s

Calculate the acceleration of the athlete.

Use the equation:

$$\text{acceleration} = \frac{\text{change in velocity}}{\text{time taken}}$$

[2 marks]

Acceleration = _____ m/s²

12



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0 8

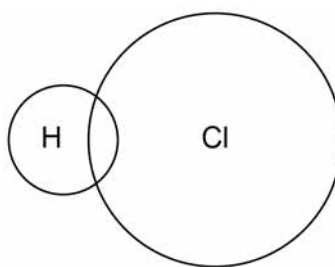
This question is about hydrogen chloride.

0 8 . 1

A hydrogen atom contains 1 electron and a chlorine atom contains 17 electrons.

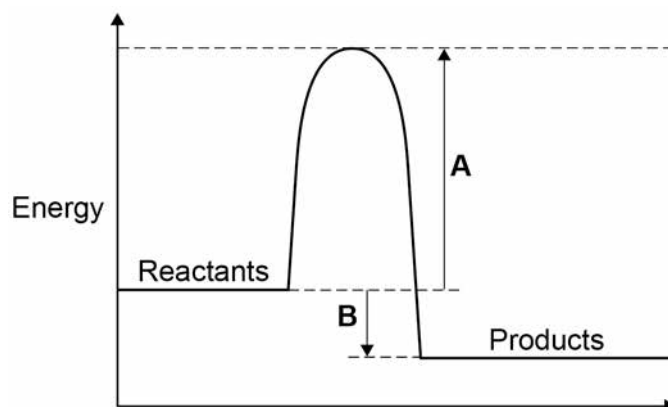
Complete **Figure 7** to show a dot and cross diagram for a hydrogen chloride molecule.

Show the outer electrons only.

[2 marks]**Figure 7**Hydrogen gas (H_2) reacts with chlorine gas to produce hydrogen chloride.

0 8 . 2

Complete the balanced chemical equation for the reaction between hydrogen and chlorine.

[2 marks]**Figure 8** shows the reaction profile diagram for the reaction between hydrogen and chlorine.**Figure 8**

0 8 . 3 What do **A** and **B** represent on **Figure 8**?

[2 marks]

A _____

B _____

0 8 . 4 How does the reaction profile diagram show that the reaction is exothermic?

[1 mark]

0 8 . 5 Hydrogen chloride gas dissolves in water to form hydrochloric acid.

Hydrochloric acid contains hydrogen ions and chloride ions.

Explain why hydrogen chloride gas does **not** conduct electricity but hydrochloric acid is able to conduct electricity.

[3 marks]

10

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0	9
---	---

When a metal carbonate reacts with an acid, a salt, carbon dioxide and water are produced.

0	9	.	1
---	---	---	---

Describe how you would test for carbon dioxide gas.

Give the result of the test.

[2 marks]

Test _____

Result _____

0	9	.	2
---	---	---	---

Describe how to make pure dry crystals of magnesium chloride from magnesium carbonate and a dilute acid.

In your method you should name the apparatus and reagents you plan to use.

[6 marks]



1 0

An energy input of 1.3×10^{18} J is supplied each year by power stations to the National Grid.

Not all of this energy is supplied to consumers. Some of the energy is wasted in the distribution process.

1 0**1**

Write the equation which links efficiency, total input energy transfer and useful output energy transfer.

[1 mark]

1 0**2**

The energy supplied each year to consumers is 1.2×10^{18} J

Calculate the efficiency of the distribution process.

[2 marks]

Efficiency = _____

1 0**3**

How is electrical power transmitted across the National Grid to make the process as efficient as possible?

[1 mark]

Tick **one** box.

At a high potential difference and a high current

☐

At a high potential difference and a low current

☐

At a low potential difference and a high current

☐

At a low potential difference and a low current

☐


1 0 . 4

Write the equation which links energy transferred, power and time.

[1 mark]

1 0 . 5

A wind turbine supplies a power output of 8000 kW for 1200 seconds.

Calculate the energy transferred by the wind turbine in kJ

[3 marks]

Energy transferred = _____ kJ

1 0 . 6

Describe the environmental advantages and disadvantages of using wind turbines to generate electricity in the UK.

[4 marks]

END OF QUESTIONS

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