

Please write clearly in block capitals.

Centre number

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Candidate number

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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.

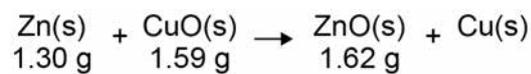
Mix zinc and copper oxide

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

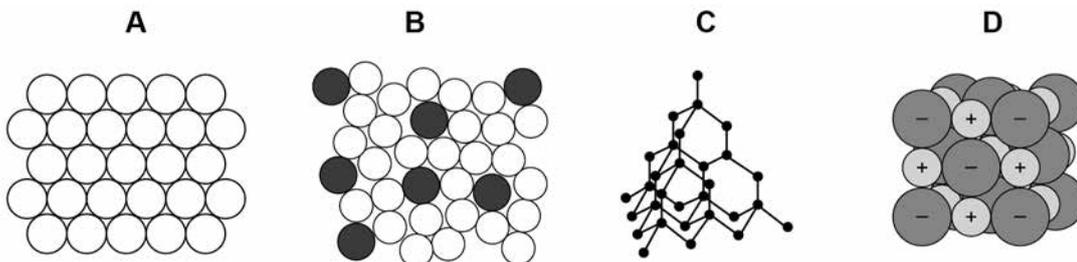
Turn over ►



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

Turn over ►



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ANSWER IN THE SPACES PROVIDED**

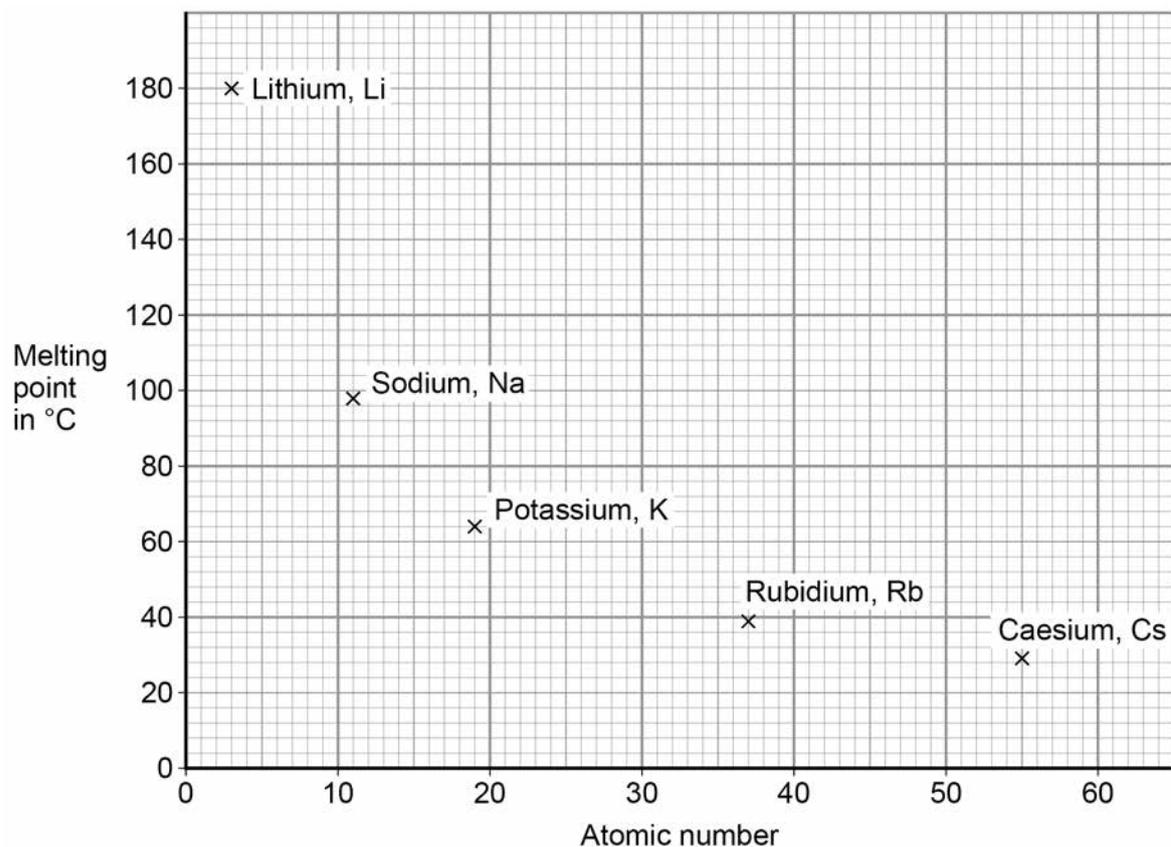


0 2

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.

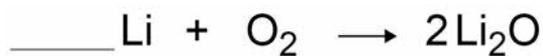
[2 marks]

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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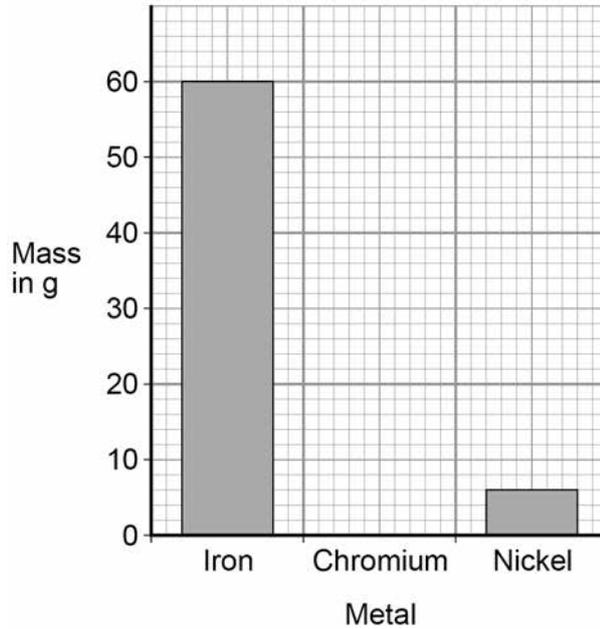


0 4

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

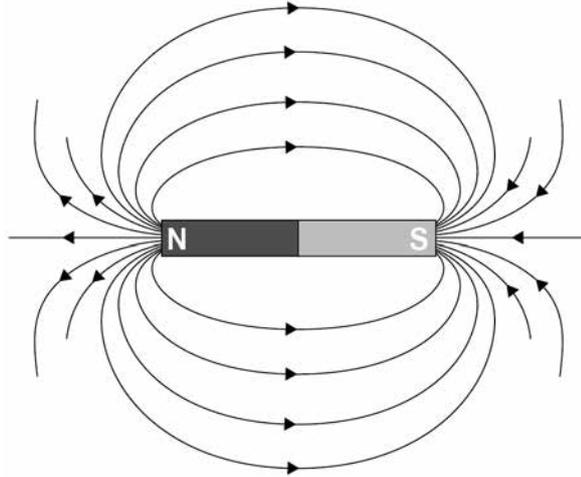
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A student plotted the magnetic field pattern around a bar magnet.

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 5

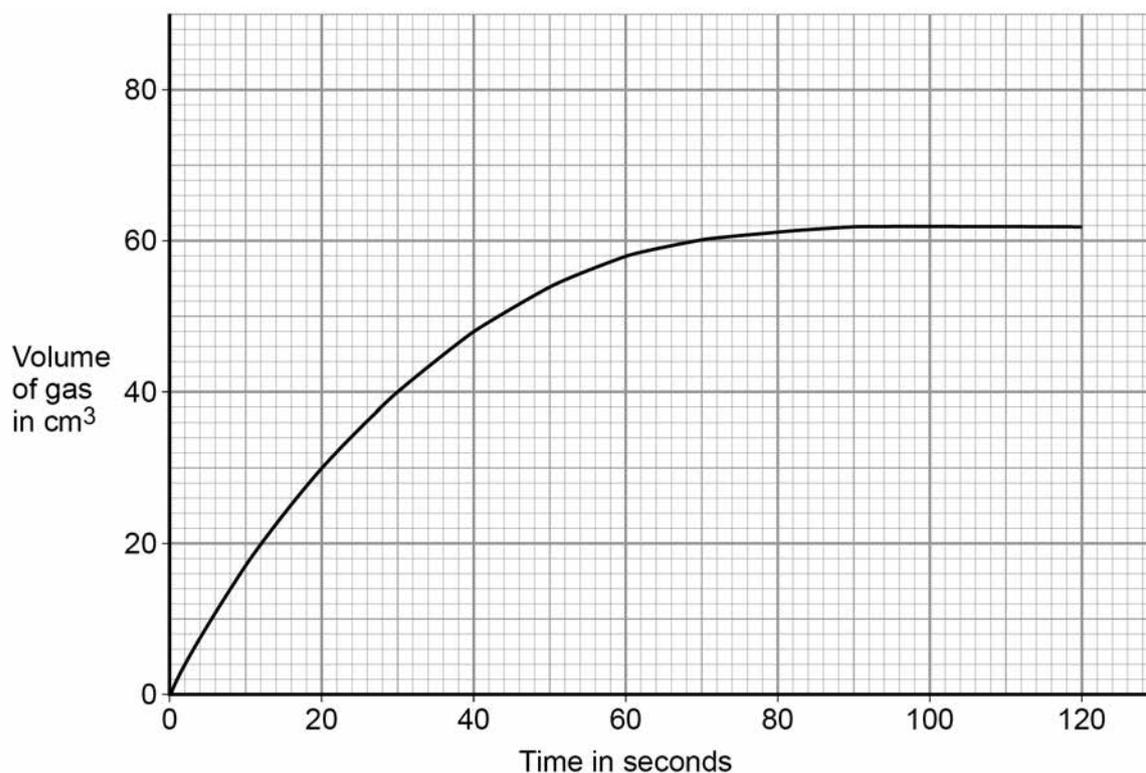
A student investigated the rate of reaction of magnesium with dilute hydrochloric acid.

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:

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

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.

cm³/s

g/s

s/cm³

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 cm³ of sodium hydroxide solution to a polystyrene cup.
2. Measure the temperature of the sodium hydroxide solution.
3. Add 25.0 cm³ 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

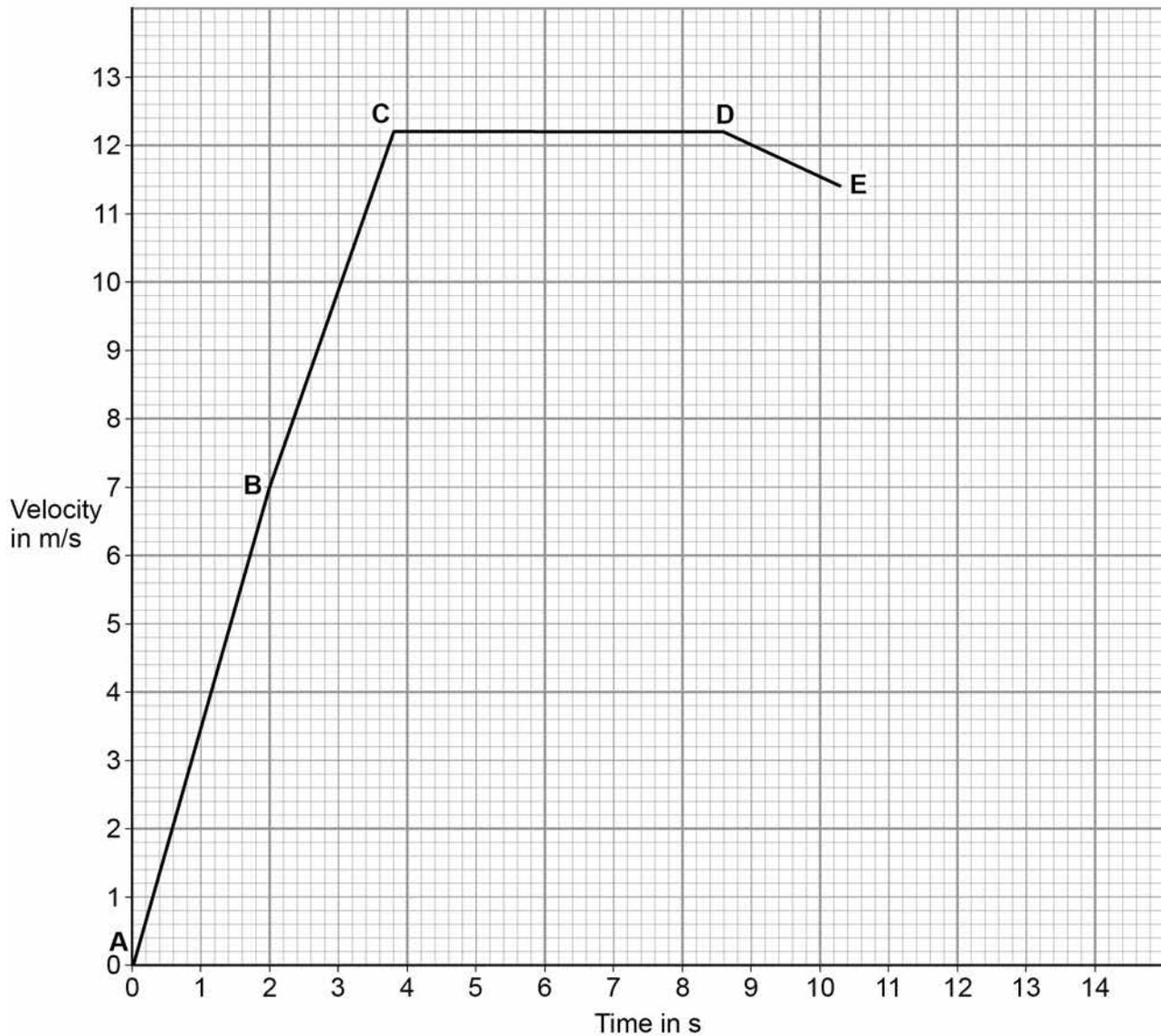
6.0 m/s

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



07.3

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 ►



0 7 . 7 What does the area under a velocity-time graph represent?

[1 mark]

Tick **one** box.

Acceleration

Distance travelled

Energy

Speed

0 7 . 8 Write the equation which links acceleration, mass and resultant force.

[1 mark]

0 7 . 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

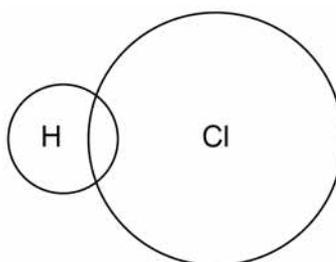
This question is about hydrogen chloride.

0 8 . 1

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

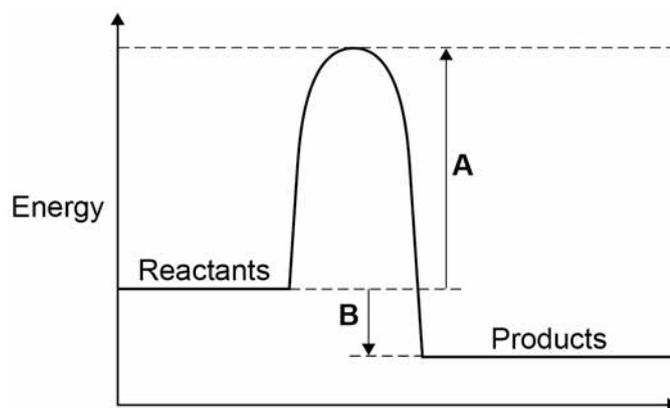
Complete **Figure 7** to show a dot and cross diagram for a hydrogen chloride molecule.

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

Turn over for the next question

Turn over ►



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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]

8**Turn over ►**

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



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