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	

Do not write outside the box

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:

$$\underset{1.30\ g}{Zn(s)} + \underset{1.59\ g}{CuO(s)} \rightarrow \underset{1.62\ g}{ZnO(s)} + Cu(s)$$

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

Do not write outside the box

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.

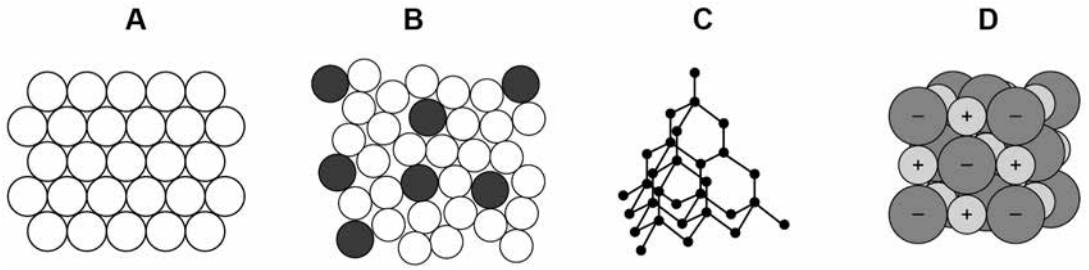
- Combustion ☐
- Crystallisation ☐
- Displacement ☐
- Neutralisation ☐

Question 1 continues on the next page

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]

Do not write outside the box

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

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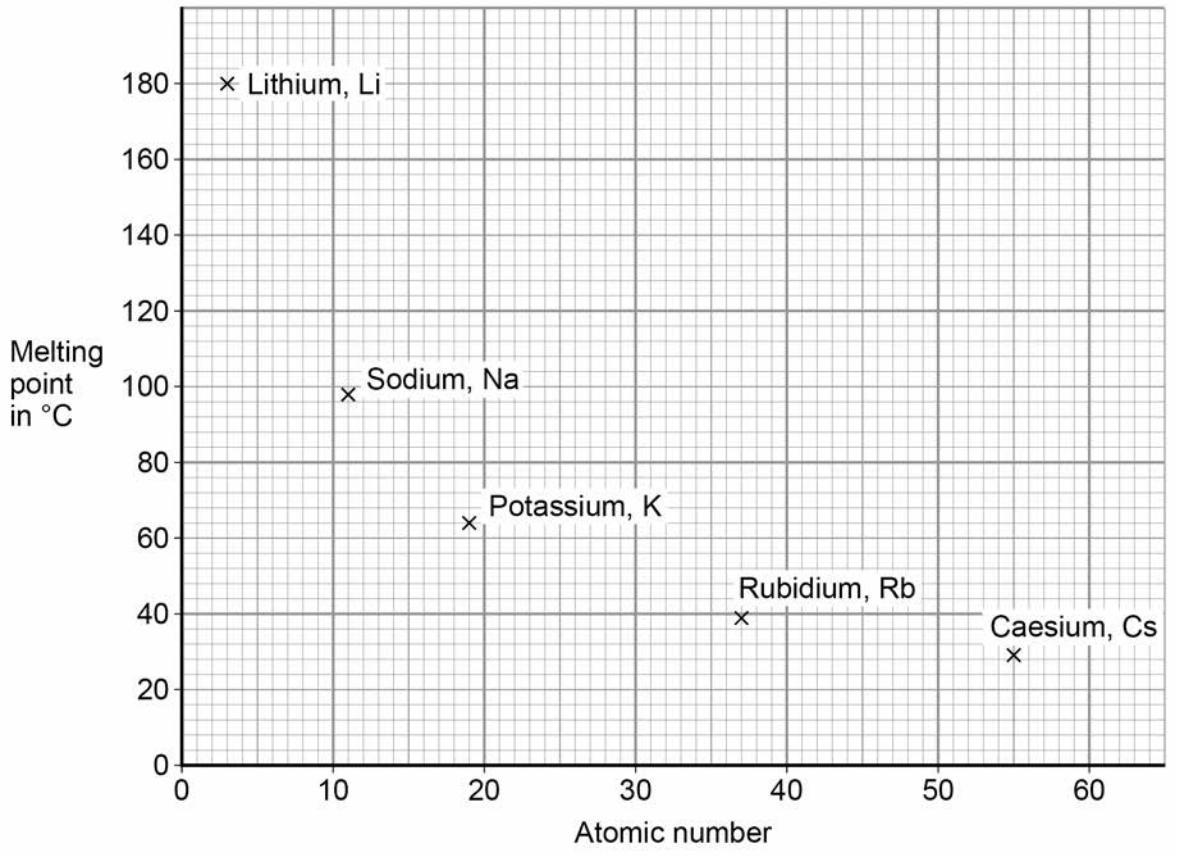
0 2 This question is about Group 1 metals.

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 $^{7}_{3}Li$.

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

Do not write outside the box

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

Do not write outside the box

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:

distance travelled = speed × time

[2 marks]

_____

_____

_____

Thinking distance = _____ m

Do not write outside the box

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

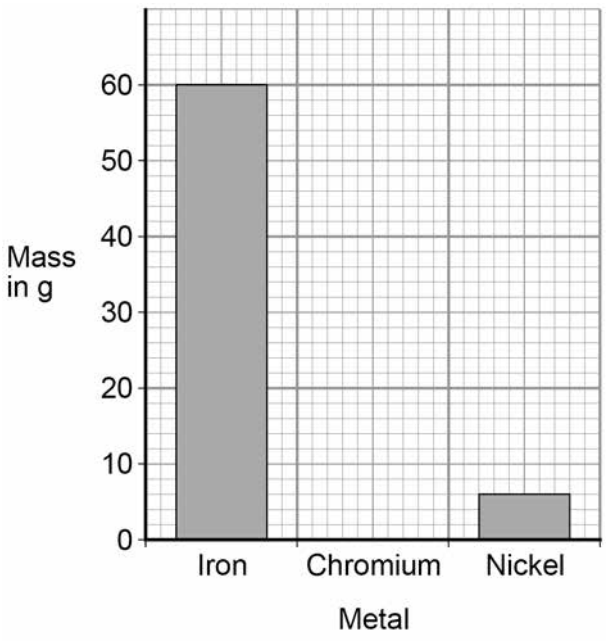
Turn over for the next question

Do not write outside the box

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

Do not write outside the box

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.

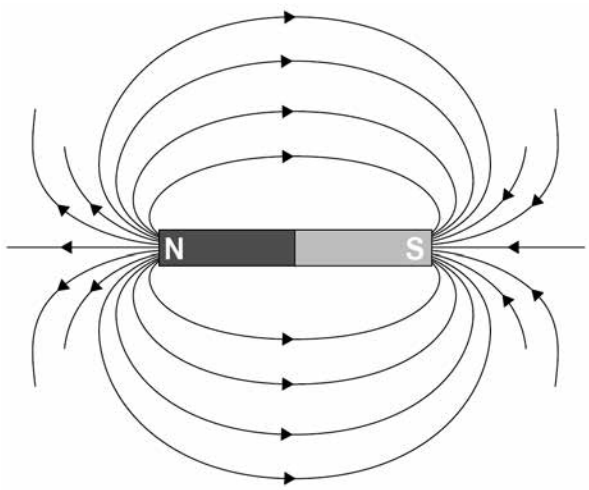
- Cobalt ☐
- Copper ☐
- Sodium ☐
- Zinc ☐

Do not write outside the box

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. ☐

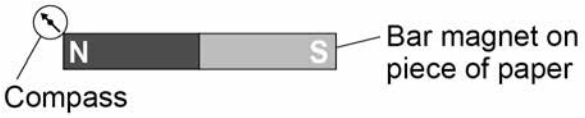
Do not write outside the box

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.

Figure 4



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

[4 marks]

13

Turn over for the next question

Do not write outside the box

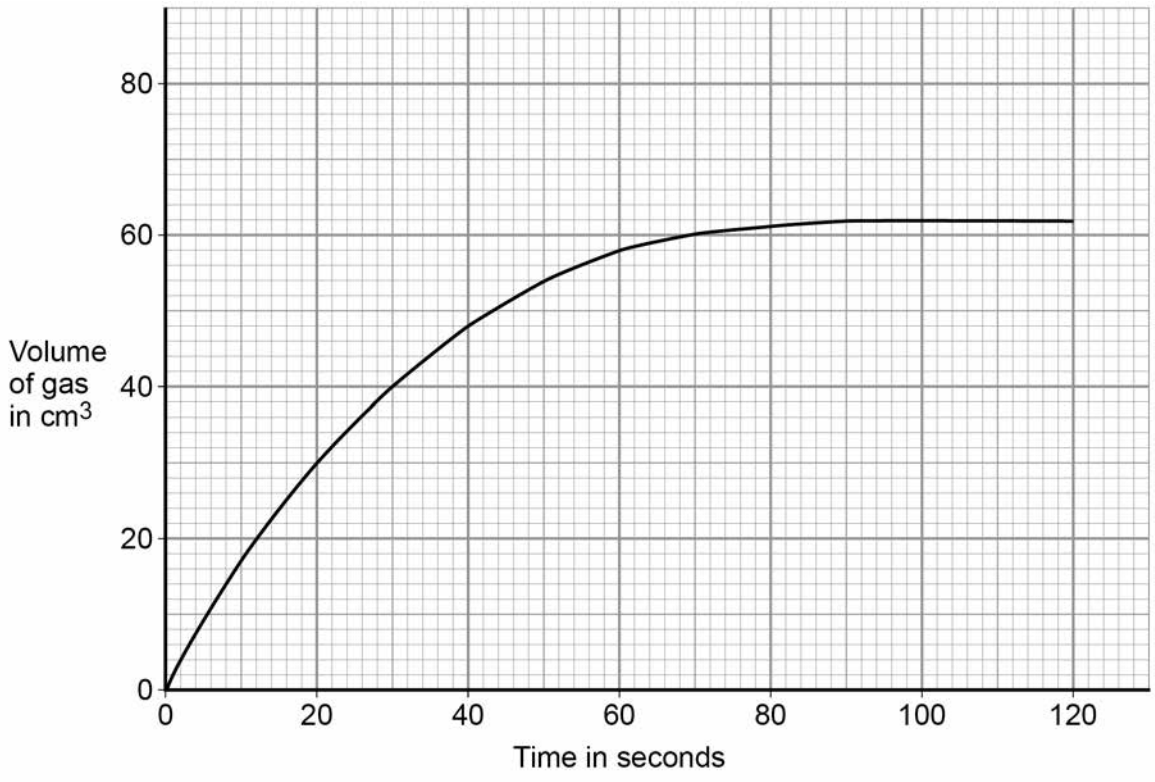
0 5 A student investigated the rate of reaction of magnesium with dilute hydrochloric acid.

This is the method used.

1. Add 50 cm^3 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:

$$\text{mean rate of reaction} = \frac{\text{volume of gas produced after 10 seconds}}{\text{time taken}}$$

[2 marks]

Mean rate of reaction = _____

Do not write outside the box

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 ►

Do not write outside the box

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
	balance
Temperature of solution	beaker
	measuring cylinder
Volume of hydrochloric acid	metre rule
	thermometer

Do not write outside the box

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 cm^3 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

Do not write outside the box

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 ⟶ _____ + _____

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

9

Do not write outside the box

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 ☐

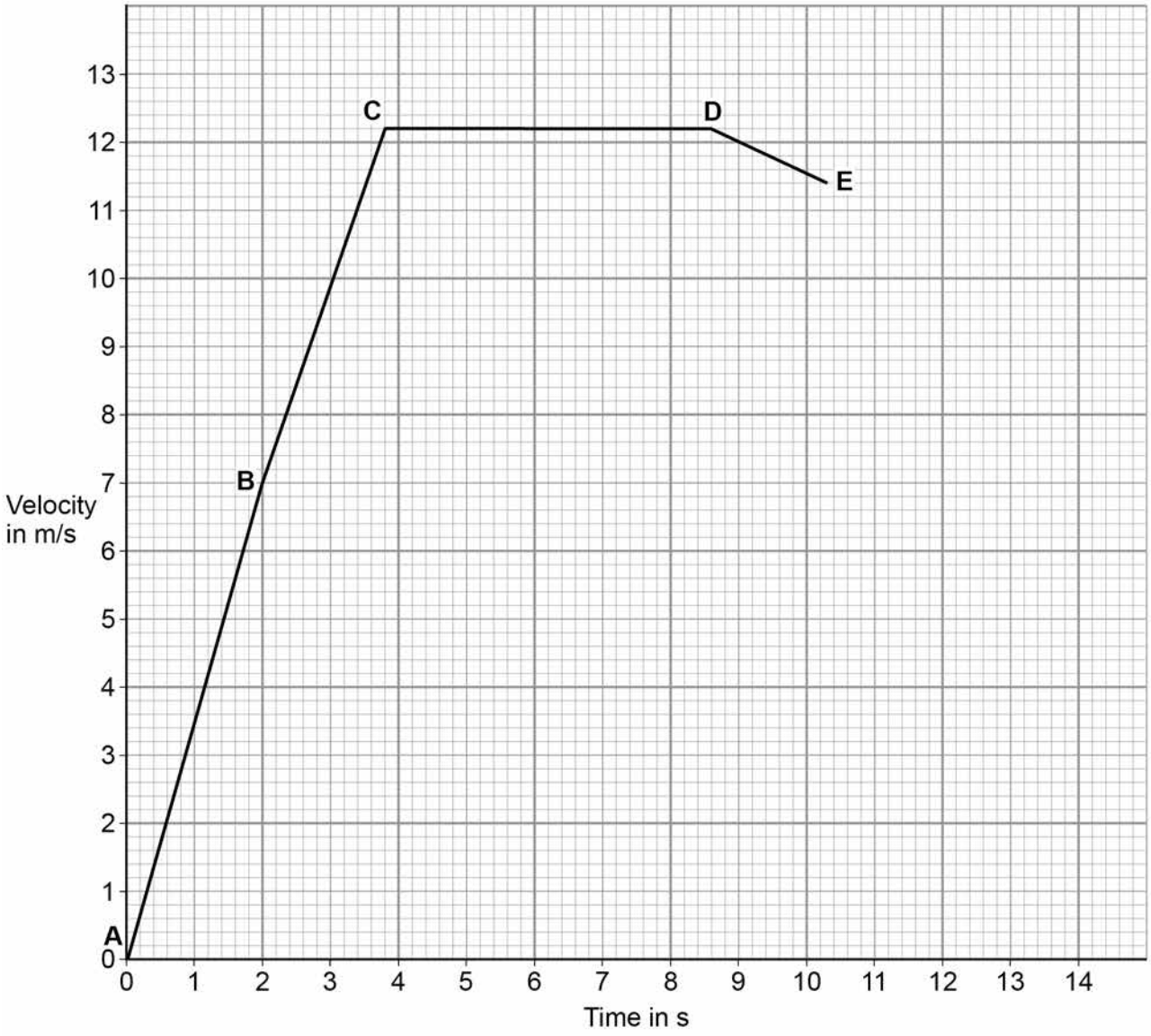
Question 7 continues on the next page

Do not write outside the box

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

Do not write outside the box

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

Do not write outside the box

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/s^2

12

Do not write outside the box

Turn over for the next question

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Do not write outside the box

0 8 This question is about hydrogen chloride.

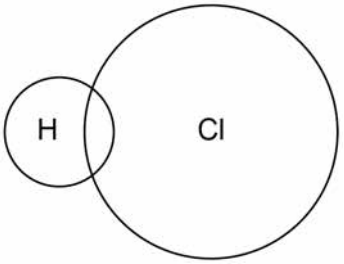
0 8 . 1 A hydrogen atom contains 1 electron and a chlorine atom contains 17 electrons.

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.

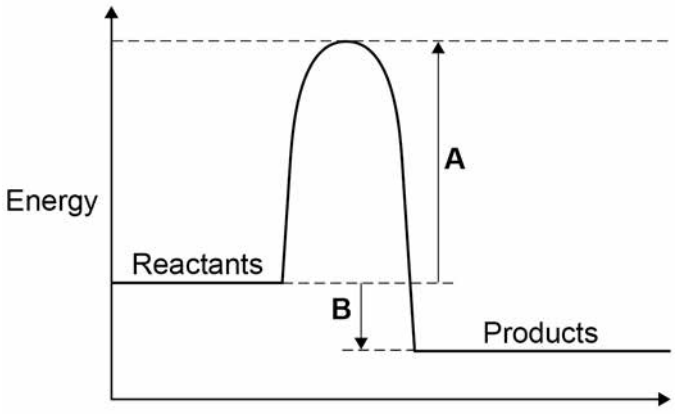
0 8 . 2 Complete the balanced chemical equation for the reaction between hydrogen and chlorine.

[2 marks]

$$H_2 + \_\_\_\_\_ \rightarrow \_\_\_\_\_$$

Figure 8 shows the reaction profile diagram for the reaction between hydrogen and chlorine.

Figure 8



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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

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ANSWER IN THE SPACES PROVIDED

Do not write outside the box

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]

_____

_____

_____

_____

_____

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_____

_____

_____

_____

_____

_____

8

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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 ☐

Do not write outside the box

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]

12

END OF QUESTIONS

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