A

AQA

Surname

Other Names

Centre Number

Candidate Number

Candidate Signature

GCSE
COMBINED SCIENCE: SYNERGY

H

Higher Tier   Paper 3 Physical sciences

8465/3H

Monday 11 June 2018   **Morning**

Time allowed: 1 hour 45 minutes

For this paper you must have:
- **a ruler**
- **a scientific calculator**
- **the periodic table (enclosed)**
- **the Physics Equations Sheet (enclosed).**

At the top of the page, write your surname and other names, your centre number, your candidate number and add your signature.

[Turn over]

JUN1884653H01

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3

INSTRUCTIONS

- **Use black ink or black ball-point pen.**

- **Answer ALL questions in the spaces provided. Do not write 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.**

DO NOT TURN OVER UNTIL TOLD TO DO SO

03

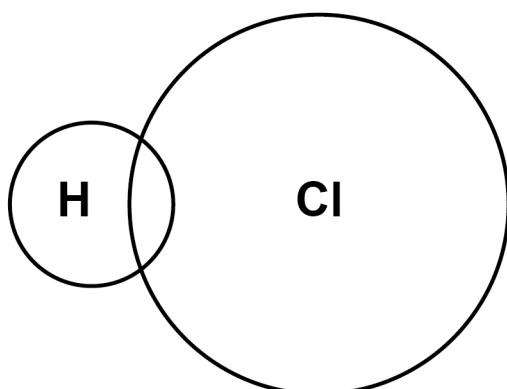**0 1**   **This question is about hydrogen chloride.**

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

Complete FIGURE 1 to show a dot and cross diagram for a hydrogen chloride molecule.

Show the outer electrons only.   **[2 marks]**

FIGURE 1

Hydrogen gas (H_2) reacts with chlorine gas to produce hydrogen chloride.

0 1 . 2   **Complete the balanced chemical equation for the reaction between hydrogen and chlorine. [2 marks]**
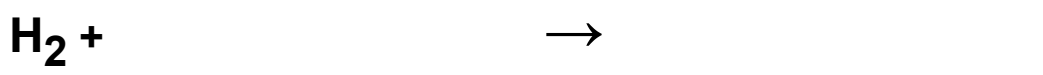
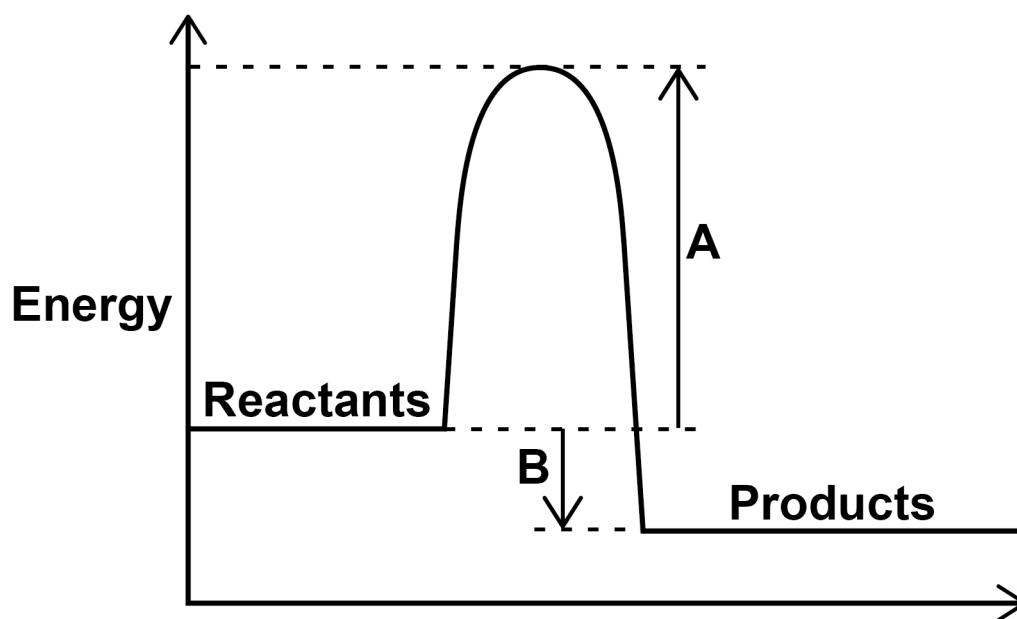$H_2 +$ _____ $\rightarrow$ _____

FIGURE 2 shows the reaction profile diagram for the reaction between hydrogen and chlorine.

FIGURE 2

0 1 . 3 **What do A and B represent on FIGURE 2?**
[2 marks]

A _____

_____

B _____

_____

[Turn over]

0 1 . 4 **How does the reaction profile diagram show that the reaction is exothermic? [1 mark]**

_____

_____

_____

0 1 . 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]

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[Turn over]

10

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0 2 When a metal carbonate reacts with an acid,
a salt, carbon dioxide and water are produced.

0 2 . 1 Describe how you would test for
carbon dioxide gas.

Give the result of the test. [2 marks]

Test _____

_____

_____

Result _____

_____

_____

[Turn over]

0 2 . 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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[Turn over]

8

0 3 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.

0 3 . 1 Write the equation which links efficiency, total input energy transfer and useful output energy transfer. [1 mark]

_____

_____

_____

0 3 . 2 **The energy supplied each year to consumers is 1.2 × 10^{18} J**

Calculate the efficiency of the distribution process. [2 marks]

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_____

_____

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_____

_____

Efficiency = _____

[Turn over]

0 3 . 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**

0 3 . 4 **Write the equation which links energy transferred, power and time. [1 mark]**

_____

_____

_____

0 3 . 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]

_____

_____

_____

_____

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Energy transferred = _____ kJ

[Turn over]

0 3 . 6 **Describe the environmental advantages and disadvantages of using wind turbines to generate electricity in the UK. [4 marks]**

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[Turn over]

| 12 |

| 0 | 4 |

FIGURE 3 shows a bar magnet.

| 0 | 4 | . | 1 |

Complete the diagram to show the magnetic field lines around a bar magnet. [2 marks]

FIGURE 3

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│ N            │            S │
└──────────────┴──────────────┘
```

| 0 | 4 | . | 2 |

Describe a method using a compass to plot the magnetic field lines around a bar magnet. [4 marks]

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[Turn over]

0 4 . 3 **Explain why a compass needle moves when placed near the bar magnet. [2 marks]**

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2 0

0 4 . 4 **Iron is a magnetic element.**

Which of the following is also a magnetic ELEMENT? **[1 mark]**

Tick ONE box.

☐ **Cobalt**

☐ **Copper**

☐ **Steel**

☐ **Zinc**

[Turn over]

| 0 | 4 |.| 5 |

Give TWO pieces of evidence that show the Earth's magnetic field is changing. [2 marks]

1 _____

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2 _____

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| 0 | 4 | . | 6 | **Describe the most likely cause of the changes in the Earth's magnetic field. [2 marks]**

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[Turn over]

| |
| **13** |

0 5   A teacher demonstrated the extraction of 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.

6. Add hydrochloric acid to the cooled mixture.

7. Filter the mixture obtained in step 6.

0 5 . 1 **A student concluded that an exothermic reaction had taken place.**

Explain how an observation made during the demonstration shows this. [2 marks]

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[Turn over]

| 0 | 5 | . | 2 | The equation for the reaction between zinc and copper oxide is:

$$Zn + CuO \longrightarrow ZnO + Cu$$
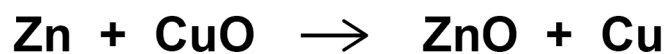
1.59 g of copper oxide reacted.

Calculate the mass of copper produced.

Relative atomic masses (A_r):
Cu = 63.5   O = 16   Zn = 65
[3 marks]

_____

_____

_____

_____

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_____

Mass of copper produced =

_____ **g**

0 5 . 3 **Explain why steps 6 and 7 result in only copper being obtained as the residue.**
[4 marks]

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[Turn over]

| 0 | 5 | . | 4 | **The ionic equation for the reaction is:**

$$Zn + Cu^{2+} \longrightarrow Zn^{2+} + Cu$$
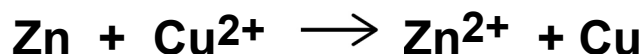
Which statement about the reaction between zinc and copper ions is correct? [1 mark]

Tick ONE box.

☐   **Copper ions have been oxidised because the copper ions have gained electrons.**

☐   **Copper ions have been oxidised because the copper ions have lost electrons.**

☐   **Zinc has been oxidised because the zinc atoms have gained electrons.**

☐   **Zinc has been oxidised because the zinc atoms have lost electrons.**

| **10** |

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[Turn over]

0 6 Copper can be extracted using biological methods.

0 6 . 1 Name TWO biological methods used to extract copper from copper ores.

For each method, name the type of organism used in the process. **[4 marks]**

Method 1 _____

_____

Type of organism _____

_____

Method 2 _____

_____

Type of organism _____

_____

0 6 . 2 **Give THREE reasons why biological methods are being introduced to extract copper.**
[3 marks]

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2 _____

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3 _____

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[Turn over]

The biological methods produce copper compounds such as copper sulfate.

0 6 . 3 Copper can be extracted from copper sulfate solution by adding scrap iron.

Explain why. [2 marks]

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0 6 . 4 Complete the chemical equation for the reaction between iron and copper sulfate solution. [2 marks]

Include state symbols.

_____ (____) + $CuSO_4$ (____) $\longrightarrow$

_____ (____) + _____ (aq)
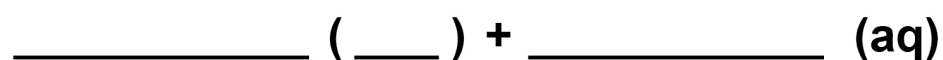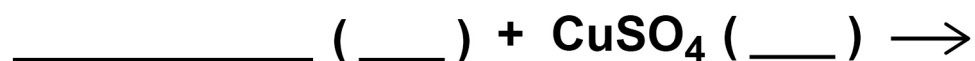
0 6 . 5 **A solution of copper sulfate contains 3.175 g of copper ions.**

Calculate the number of copper ions in the solution.

Give your answer in standard form.

Relative atomic mass (A_r):   Cu = 63.5

The Avogadro constant is 6.02×10^{23} per mole.   [4 marks]

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Number of copper ions = _____

[Turn over]

15

0 7 A teacher demonstrated the temperature change when hydrochloric acid is added to sodium hydroxide solution.

This is the method used.

1. Measure 25 cm^3 of sodium hydroxide solution using a measuring cylinder.

2. Add the sodium hydroxide solution to a polystyrene cup.

3. Record the temperature of the sodium hydroxide solution.

4. Add 5 cm^3 of hydrochloric acid from a burette to the sodium hydroxide solution.

5. Stir the solution.

6. Record the temperature of the solution.

7. Repeat steps 4–6 until 50 cm^3 of hydrochloric acid in total is added.

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[Turn over]

TABLE 1 shows some of the teacher's results.

TABLE 1

Volume of hydrochloric acid added in cm^3	Temperature in °C
0	21.30
5	24.25
10	26.15
15	27.05
20	27.70

0 7 . 1 FIGURE 4 shows the results when 30 cm^3 to 50 cm^3 of hydrochloric acid was added to sodium hydroxide solution.

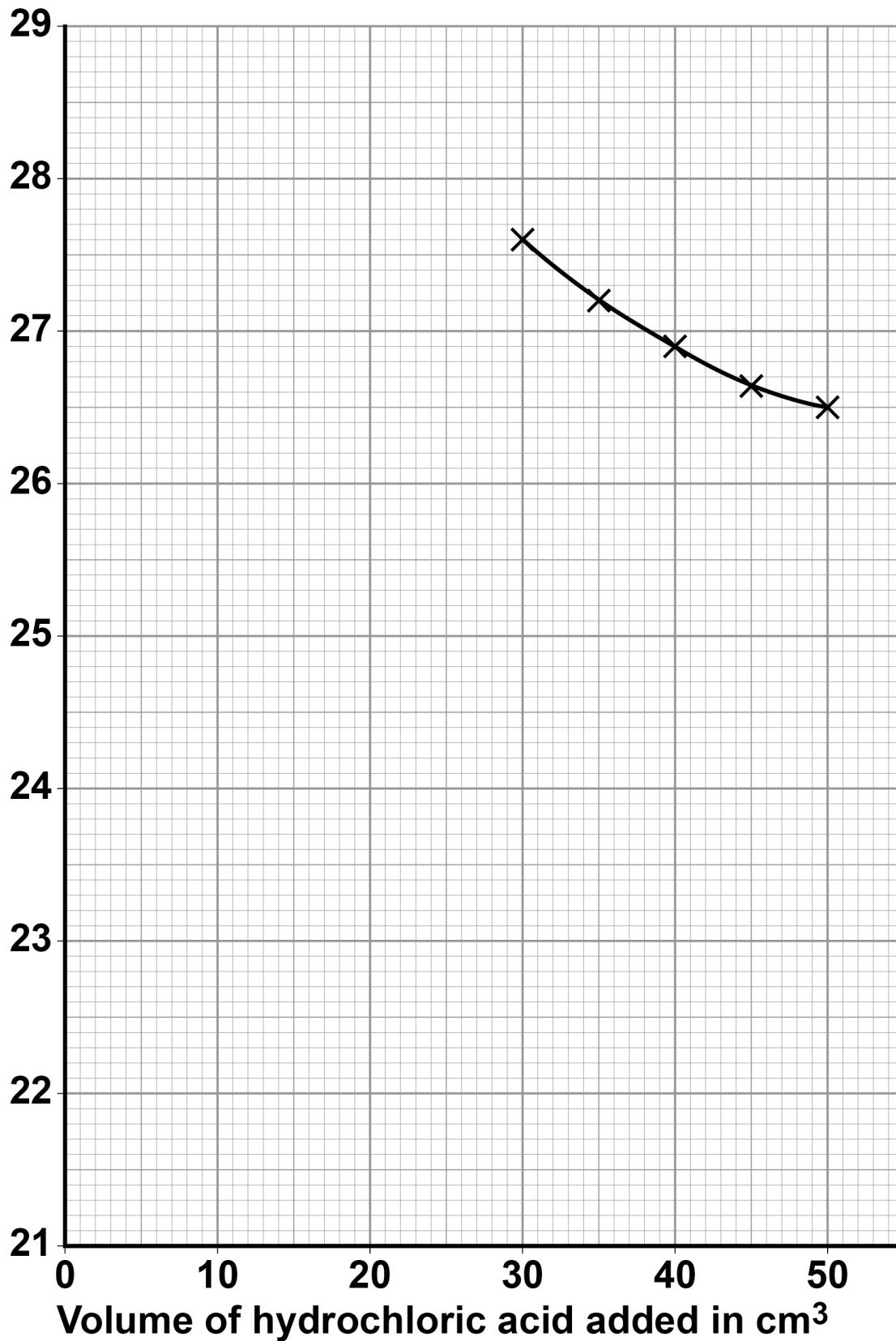A line of best fit has been drawn through these results.

Complete FIGURE 4.

You should:

- plot the data from TABLE 1 on FIGURE 4
- draw a line of best fit through these results
- continue both lines of best fit until the lines meet.

[4 marks]

3 6

FIGURE 4

Temperature in °C (y-axis) against Volume of hydrochloric acid added in cm³ (x-axis)

[Turn over]

0 7 . 2 Estimate the maximum temperature reached in the reaction.

Use FIGURE 4. [1 mark]

Maximum temperature = _____ °C

0 7 . 3 The teacher used a temperature sensor to measure the temperature of the reaction mixture.

What is the resolution of the temperature sensor? [1 mark]

Tick ONE box.

☐ 1×10^{-1} °C

☐ 1×10^{-2} °C

☐ 1×10^{-3} °C

☐ 1×10^{-4} °C

| 0 | 7 | . | 4 |

Suggest TWO ways of improving the accuracy of the results.   [2 marks]

1 _____

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2 _____

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[Turn over]

0 7 . 5 The pH of the solution changes as hydrochloric acid is gradually added to sodium hydroxide solution, until hydrochloric acid is in excess.

Describe how the pH of the solution changes.

Give reasons for these changes.

You should refer to the pH value of the solution at different stages in the procedure. **[6 marks]**

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[Turn over]

| 0 | 7 | . | 6 |

In a different demonstration the teacher used a 25 cm^3 solution containing 1.4 g of sodium hydroxide.

Calculate the concentration of the sodium hydroxide solution in g/dm^3 [2 marks]

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_____

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Concentration of sodium hydroxide solution =

_____ **g/dm^3**

| 16 |

4 2

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[Turn over]

0 8 An athlete takes part in a race on a straight, horizontal running track.

FIGURE 5 shows the velocity-time graph for the athlete during the race.

FIGURE 5
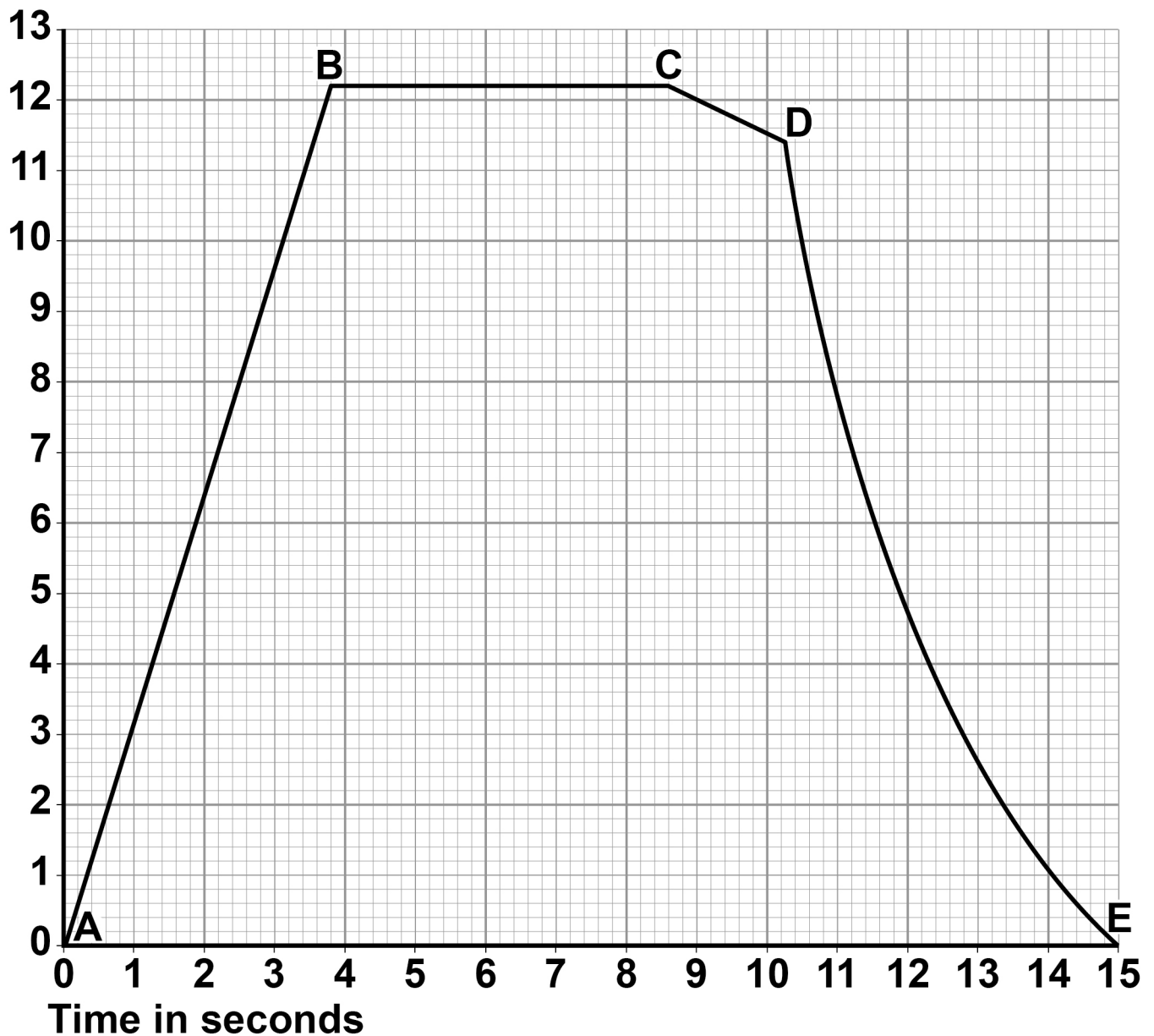
`0` `8` . `1` **What is the main force that opposes the athlete's forward motion? [1 mark]**

_____

_____

_____

`0` `8` . `2` **Which section of the graph 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**

[Turn over]

0 8 . 3 **The athlete has a mass of 94.8 kg**

Calculate the momentum of the athlete at a time of 6.0 s

Use FIGURE 5, on page 44.   [3 marks]

_____

_____

_____

_____

_____

Momentum = _____ **kg m/s**

0 8 . 4 **The acceleration is NOT constant from D to E.**

Determine the acceleration at a time of 12.0 s

Use FIGURE 5.

Give the unit. [5 marks]

_____

_____

_____

_____

_____

Acceleration = _____

Unit = _____

[Turn over]

FIGURE 6 is a copy of FIGURE 5 to help you answer the following questions.

FIGURE 6
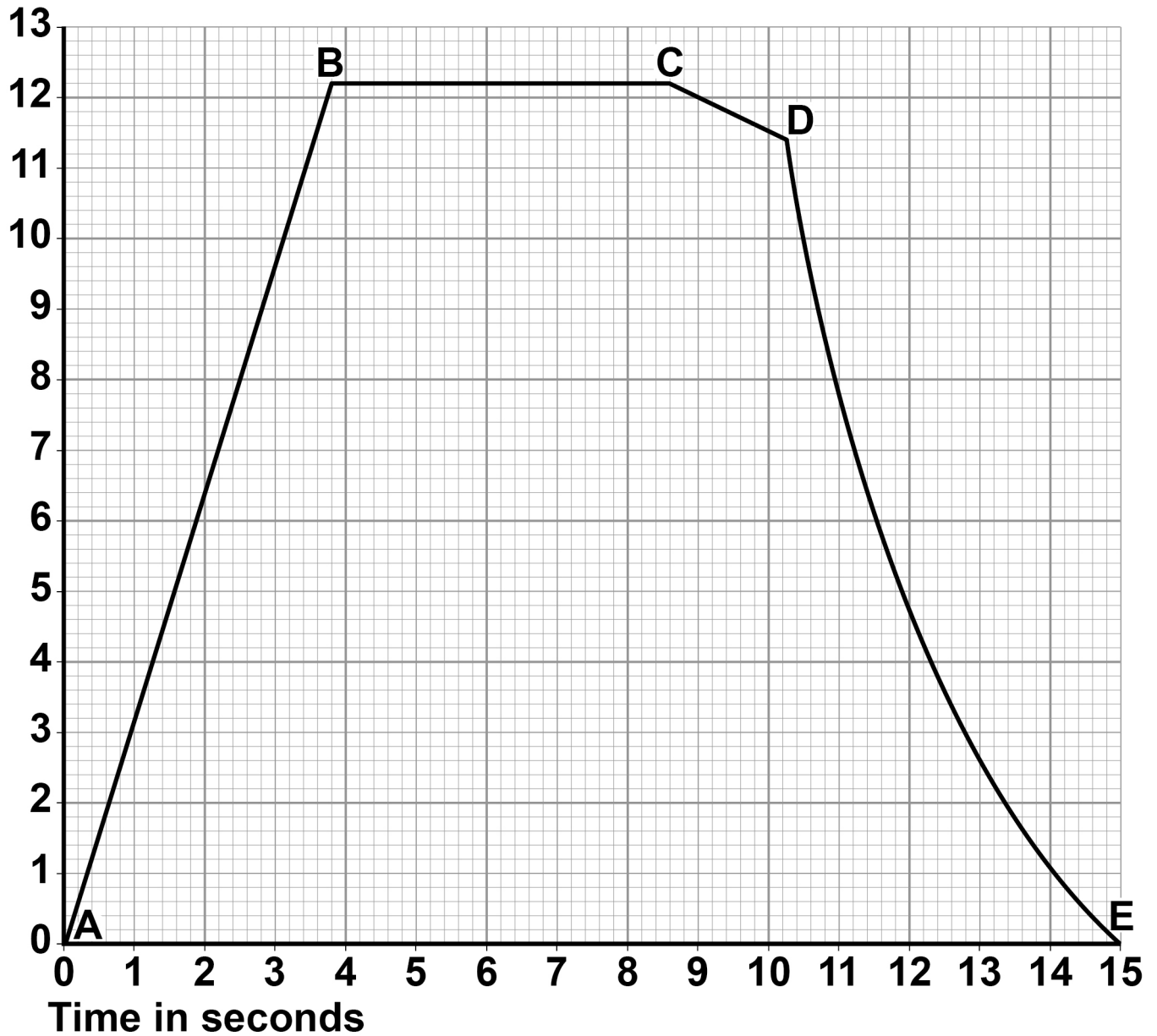
A second athlete starts the race at the same time as the first athlete.

The second athlete moves with a constant acceleration of 1.6 m/s^2 for the first 6.0 seconds of the race.

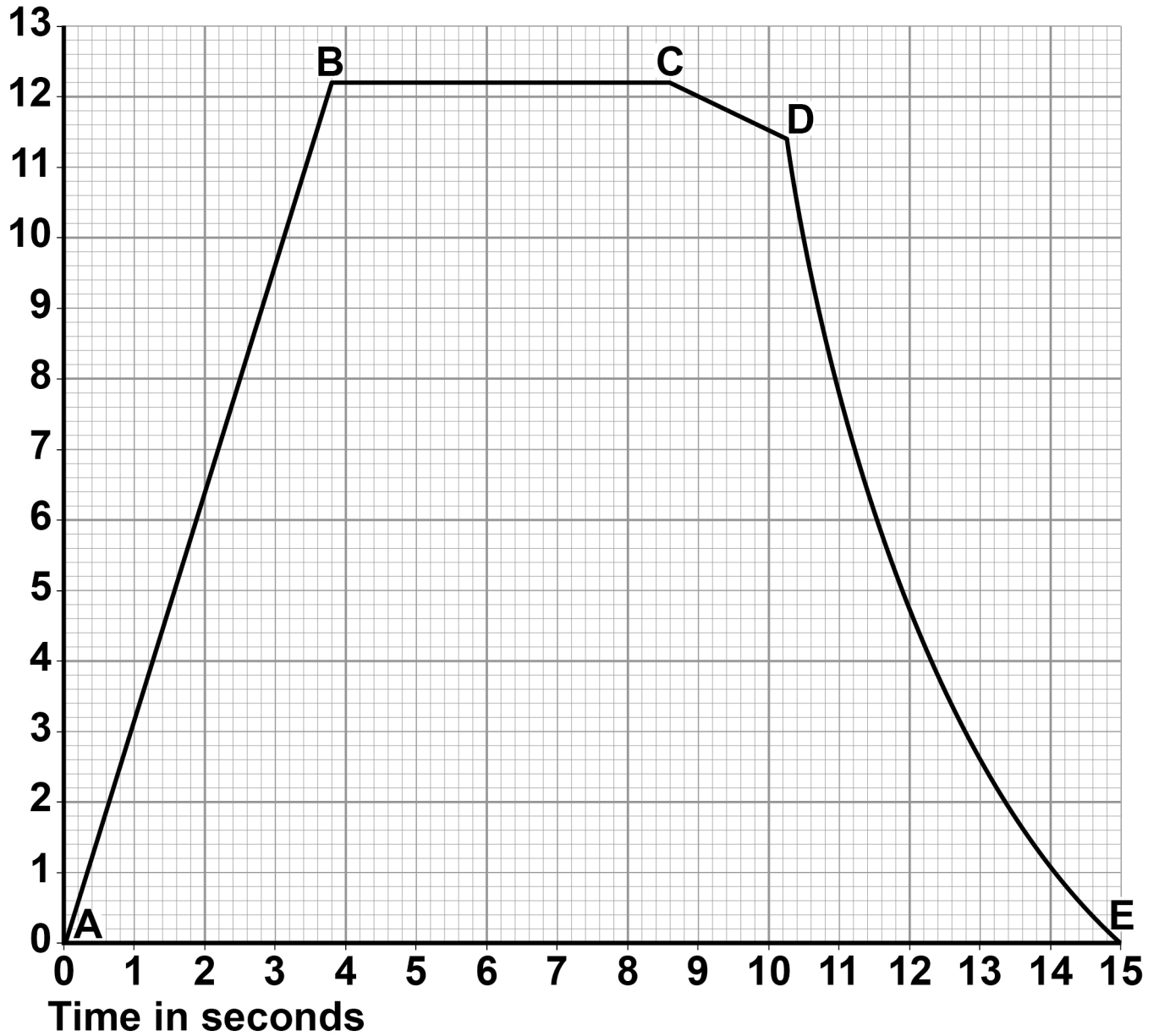The first athlete travels further than the second athlete during the first 6.0 seconds.

| 0 | 8 | . | 5 | Draw a line on FIGURE 6 to represent the motion of the second athlete for the first 6.0 seconds of the race. [2 marks]

_____

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[Turn over]

Repeat of FIGURE 6

0 8 . 6 **Determine the extra distance travelled by the first athlete over the first 6.0 seconds of the race.**

Use FIGURE 6. [4 marks]

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_____

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_____

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_____

_____

Extra distance travelled by first athlete =

_____ **m**

END OF QUESTIONS

16

5 1

52

There are no questions printed on this page

For Examiner's Use	
Question	Mark
1	
2	
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TOTAL	

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