A

AQA

Surname _____

Other Names _____

Centre Number _____

Candidate Number _____

Candidate Signature _____

GCSE

COMBINED SCIENCE: SYNERGY

Higher Tier

Paper 3 Physical sciences

8465/3H

H

Monday 11 June 2018 Morning

Time allowed: 1 hour 45 minutes

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

[Turn over]

JUN188465 3H 01

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.**
- **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

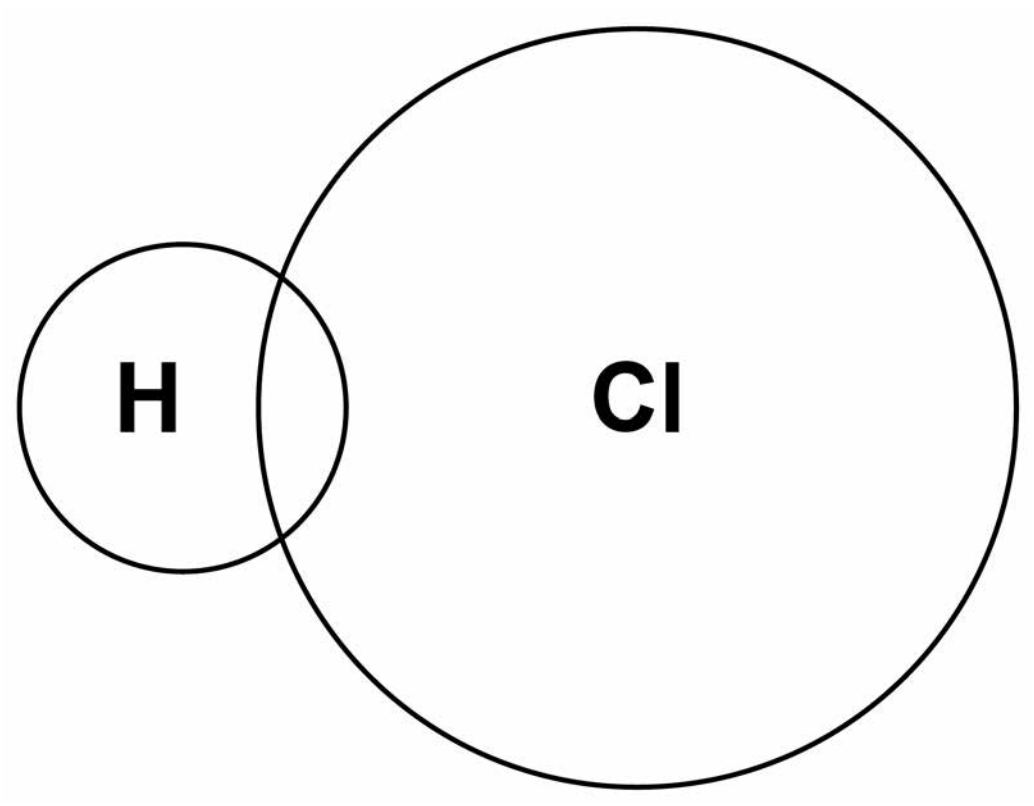
0 1 This question is about hydrogen chloride.

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.

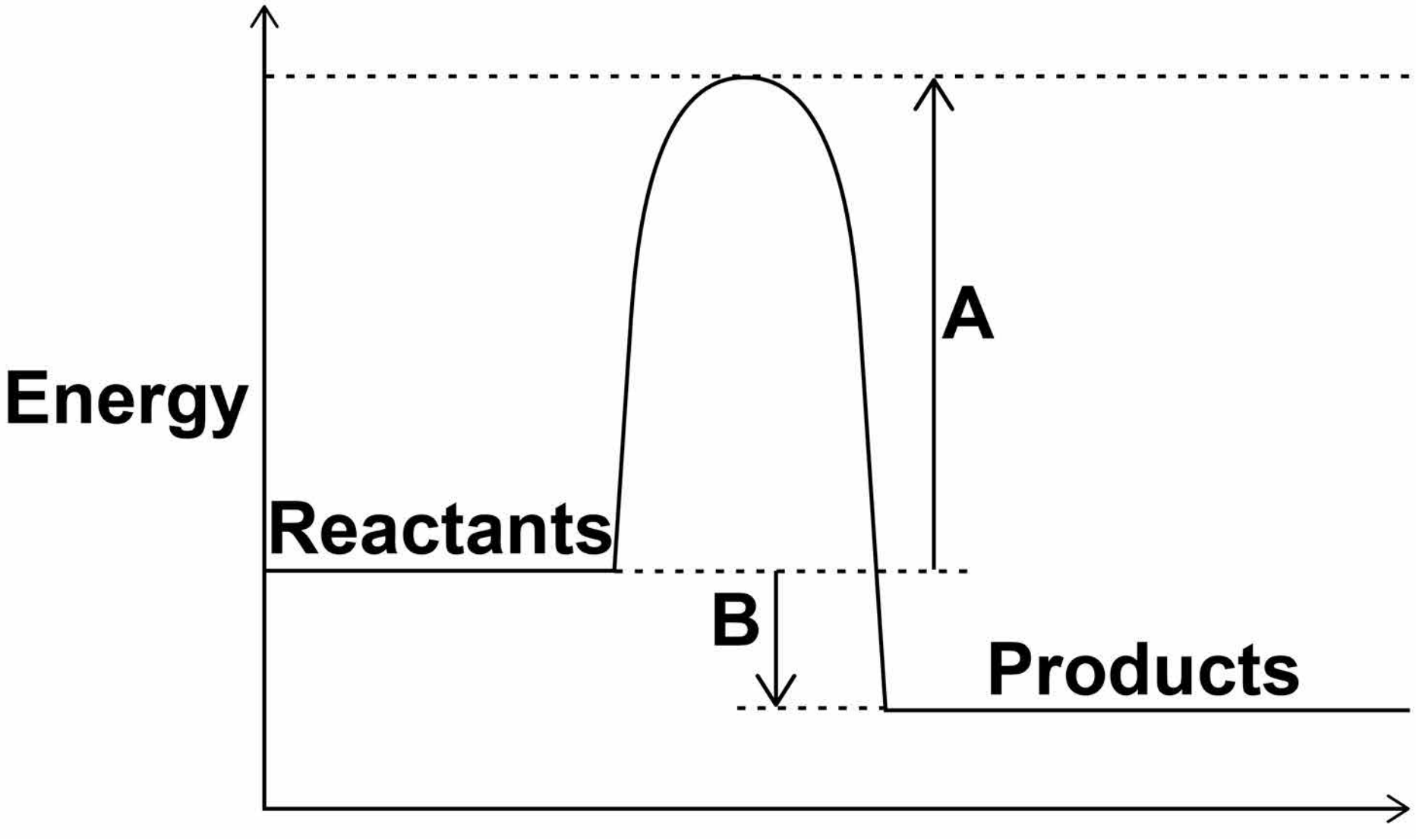
[2 marks]

H_2 + _____ → _____

[Turn over]

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 _____

_____

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

_____

_____

_____

[Turn over]

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]

9

[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 _____

_____

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]

[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]

Efficiency = _____

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]**

_____

_____

_____

[Turn over]

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]

Energy transferred =

kJ

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[Turn over]

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

[Turn over]

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

0 4 . 2 **Describe a method using a compass to plot the magnetic field lines around a bar magnet. [4 marks]**

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

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 _____

_____

2 _____

_____

_____

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

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]

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

$Zn + CuO \rightarrow ZnO + Cu$

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]

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]

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

$$Zn + Cu^{2+} \rightarrow Zn^{2+} + Cu$$

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.**

[Turn over]

10

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]**

1 _____

_____

2 _____

_____

_____

3 _____

_____

_____

[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]

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

Include state symbols.

_____ (___) + $CuSO_4$ (___) →

_____ (___) + _____ **(aq)**

[Turn over]

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]

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.

[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

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[Turn over]

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.

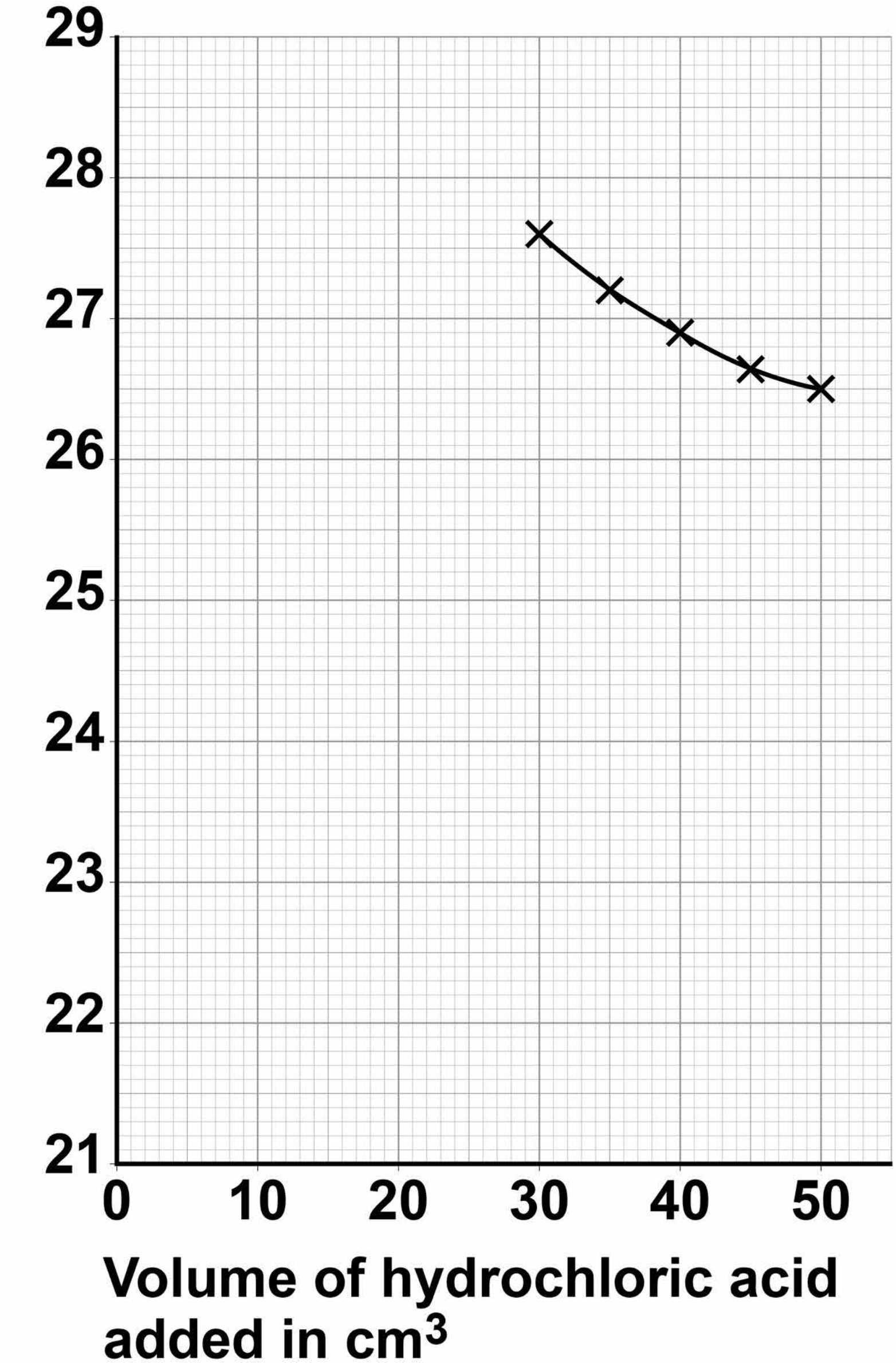
Complete FIGURE 4.

You should:

- **plot the data from TABLE 1, on page 42, on FIGURE 4**
- **draw a line of best fit through these results**
- **continue both lines of best fit until the lines meet.**

[4 marks]

FIGURE 4


Temperature in °C
29
28
27
26
25
24
23
22
21
0
10
20
30
40
50
Volume of hydrochloric acid added in cm3

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

Use FIGURE 4, on page 45.
[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

[Turn over]

0 7 . 4 **Suggest TWO ways of improving the accuracy of the results. [2 marks]**

1 _____

_____

2 _____

_____

_____

BLANK PAGE

[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]

[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]

Concentration of sodium hydroxide solution =

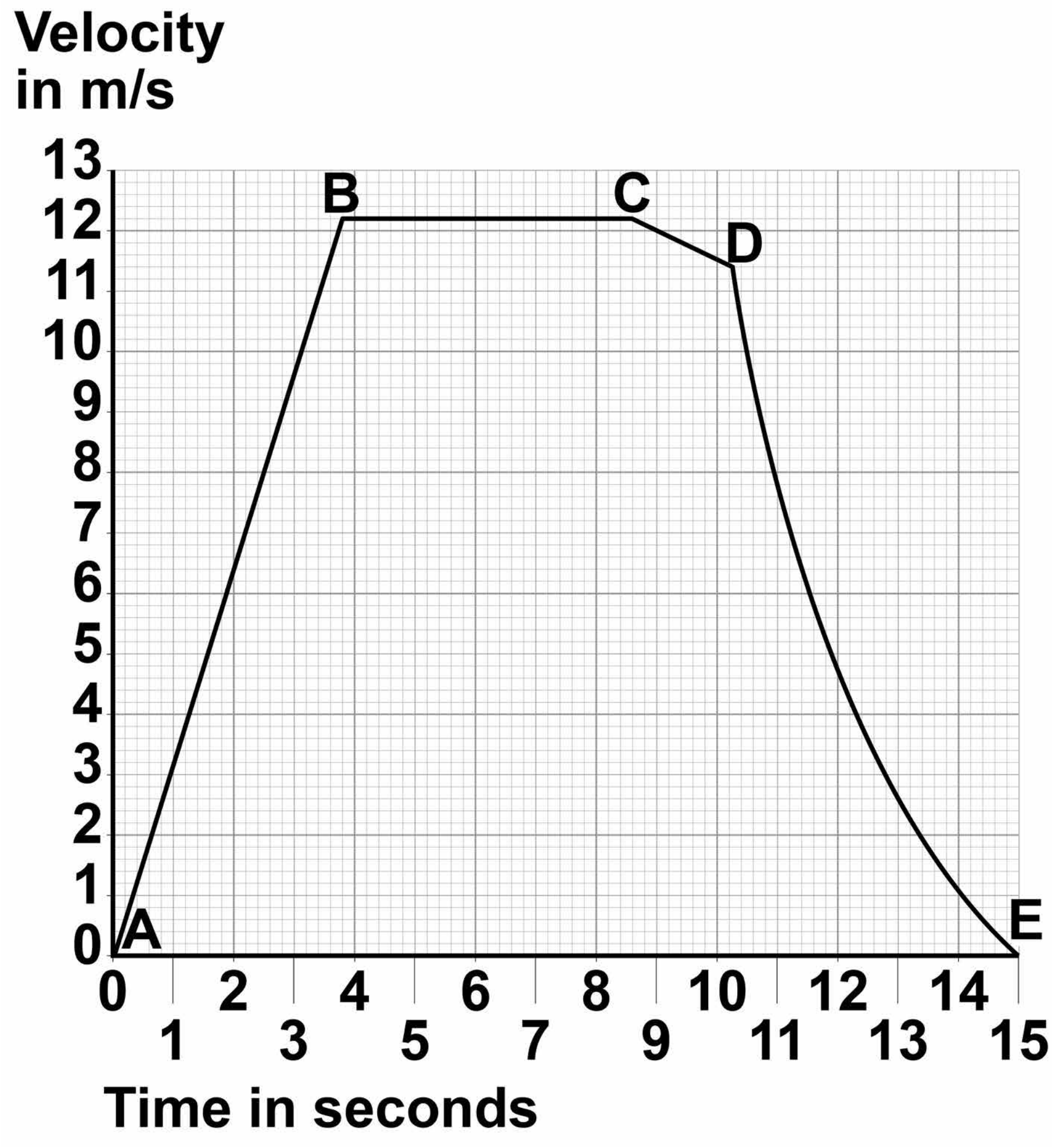
_____ g/dm^3

16

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**

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 54.

[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]

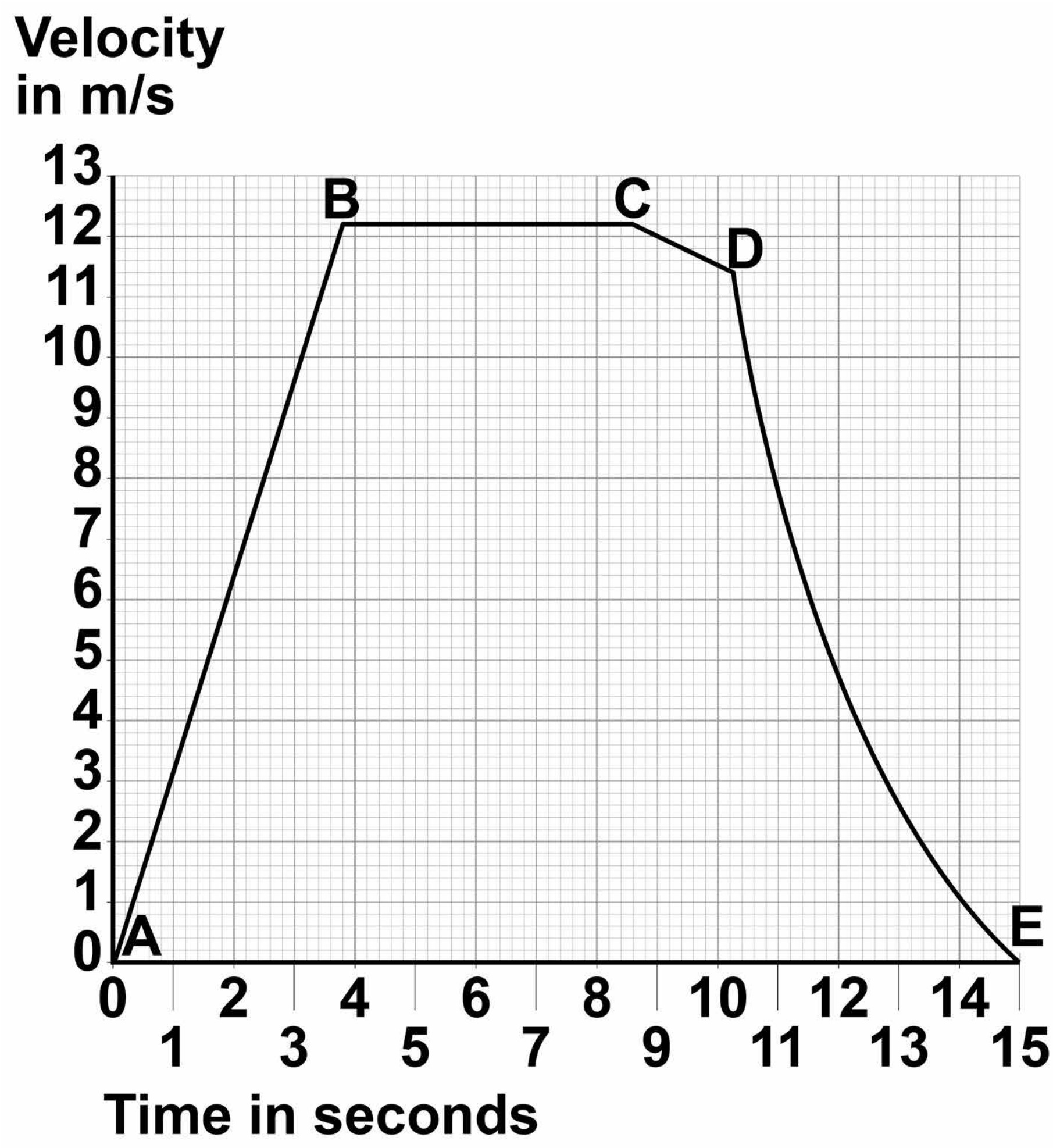
Acceleration = _____

Unit = _____

[Turn over]

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

FIGURE 6



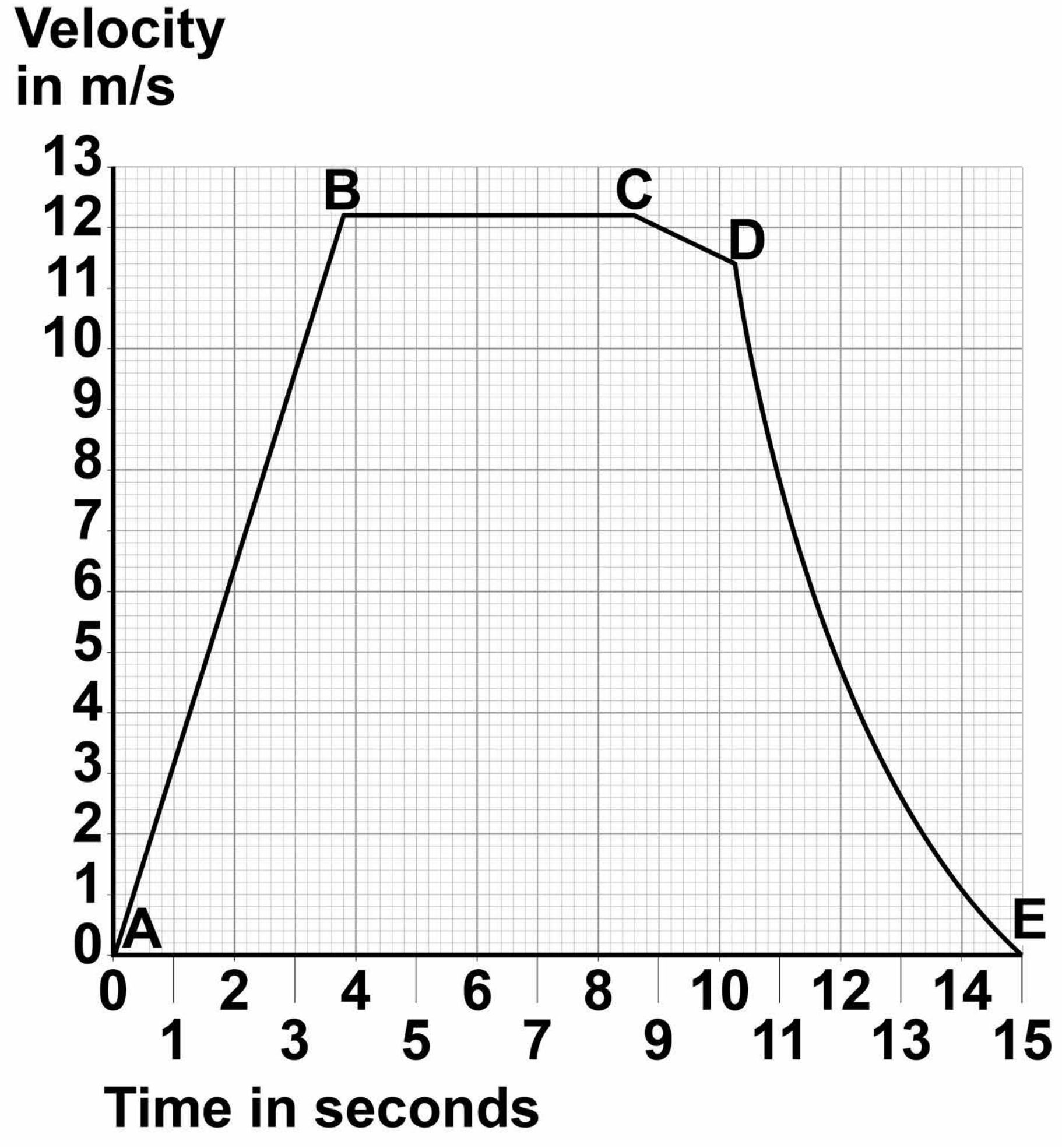
A second athlete starts the race at the same time as the first athlete.

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]

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]

Extra distance travelled by first athlete =

m

END OF QUESTIONS

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There are no questions printed on this page

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