SPECIMEN MATERIAL

GCSE CHEMISTRY

H

Higher Tier Chemistry 2H

Specimen 2018

Time allowed: 1 hour 45 minutes

Materials

For this paper you must have:
• a ruler
• a calculator
• the periodic table (enclosed).

Instructions

- Answer all questions in the spaces provided.
- Do all rough work in this book. Cross through any work you do not want to be marked.

Information

• There are 100 marks available on this paper.
• 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. •
When answering questions 03.3 and 04.2 you need to make sure that your answer:
- is clear, logical, sensibly structured
- fully meets the requirements of the question
- shows that each separate point or step supports the overall answer.

Advice

In all calculations, show clearly how you work out your answer.

Please write clearly, in block capitals.

Centre number Candidate number

Surname

Forename(s)

Candidate signature

0 1 This question is about organic compounds.

Hydrocarbons can be cracked to produce smaller molecules.

The equation shows the reaction for a hydrocarbon, $C_{18}H_{38}$

$$C_{18}H_{38} \rightarrow C_6H_{14} + C_4H_8 + 2\,C_3H_6 + C_2H_4$$

Which product of the reaction shown is an alkane?

0 1 . 1 Tick one box. [1 mark]

- C_2H_4 ☐
- C_3H_6 ☐
- C_4H_8 ☐
- C_6H_{14} ☐

0 1 . 2 Table 1 shows the boiling point, flammability and viscosity of $C_{18}H_{38}$ compared with the other hydrocarbons shown in the equation.

Table 1

	Boiling point	Flammability	Viscosity
A	highest	lowest	highest
B	highest	lowest	lowest
C	lowest	highest	highest
D	lowest	highest	lowest

Which letter, A, B, C or D, shows how the properties of $C_{18}H_{38}$ compare with the properties of C_2H_4, C_3H_6, C_4H_8 and C_6H_{14}?

[1 mark]

Tick one box.

A ☐

B ☐

C ☐

D ☐

0 1 . 3 The hydrocarbon C4H8 was burnt in air.

Incomplete combustion occurred.

Which equation, A, B, C or D, correctly represents the incomplete combustion reaction?

[1 mark]

A $C_4H_8 + 4O \rightarrow 4CO + 4H_2$

B $C_4H_8 + 4O_2 \rightarrow 4CO + 4H_2O$

C $C_4H_8 + 6O_2 \rightarrow 4CO_2 + 4H_2O$

D $C_4H_8 + 8O \rightarrow 4CO_2 + 4H_2$

Tick one box.

A ☐

B ☐

C ☐

D ☐

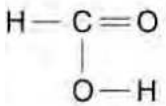
Question 1 continues on the next page

0 1 . 4 Propanoic acid is a carboxylic acid.

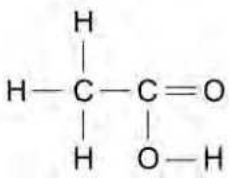
Which structure, A, B, C or D, shows propanoic acid?

[1 mark]

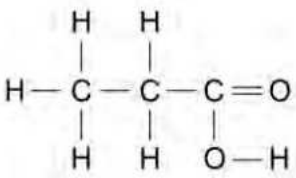
A



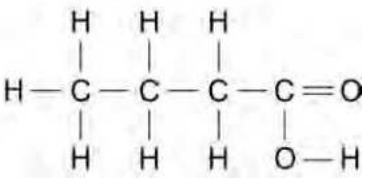
B



C



D



Tick one box.

A ☐

B ☐

C ☐

D ☐

0 1 . 5 Propanoic acid is formed by the oxidation of which organic compound?

[1 mark]

Tick one box.

Propane ☐

Propene ☐

Propanol ☐

Polyester ☐

0 2 Water from a lake in the UK is used to produce drinking water.

0 2 . 1 What are the two main steps used to treat water from lakes?

Give a reason for each step.

[2 marks]

Step 1

Reason

Step 2

Reason

0 2 . 2 Explain why it is more difficult to produce drinking water from waste water than from water in lakes.

[3 marks]

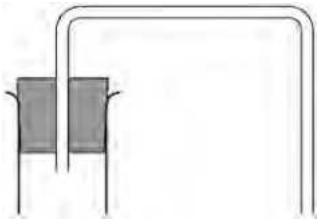
Question 2 continues on the next page

0 2 . 3 Some countries make drinking water from sea water.

Complete Figure 1 to show how you can distil salt solution to produce and collect pure water.
Label the following:
• pure water
• salt solution.

[3 marks]

Figure 1



0 2 . 4 How could the water be tested to show it is pure?

Give the expected result of the test for pure water.

[2 marks]

0 2 . 5 Why is producing drinking water from sea water expensive?

[1 mark]

Turn over for the next question

0 3

Figure 2 shows four test tubes a student set up to investigate the rusting of iron.

This is the method used for each test tube.

1. Measure the mass of the nail using a balance.
2. Leave the nail in the test tube for 6 days.
3. Measure the mass of the nail after 6 days.

Figure 2

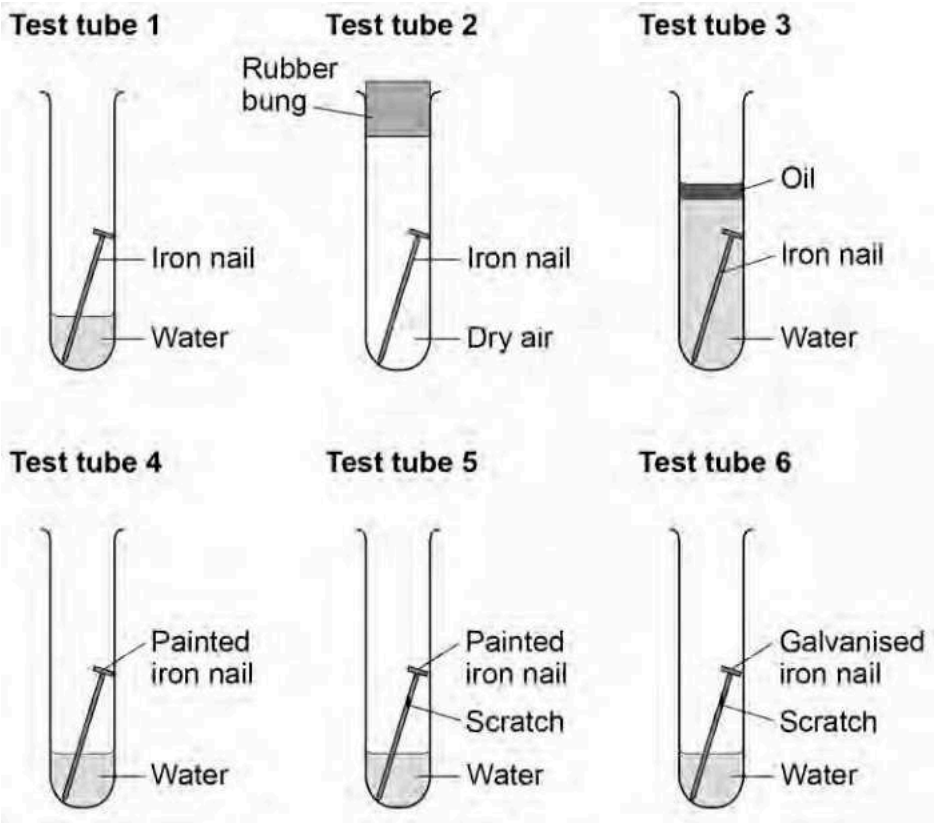


Table 2 shows the student's measurements.

Table 2

Test tube	Mass of nail in g	Mass of nail after 6 days in g
1	8.45	8.91
2	8.46	8.46
3	8.51	8.51
4	9.65	9.65
5	9.37	9.45
6	9.79	9.79

0 3 . 1 What is the resolution of the balance the student used?

[1 mark]

Tick one box.

1 × 10–3 g ☐

1 × 10–2 g ☐

1 × 10–1 g ☐

1 × 102 g ☐

Question 3 continues on the next page

0 3 . 2 Calculate the difference in percentage increase in mass after 6 days of the nail in test tube 1 and the nail in test tube 5.

Give your answer to three significant figures.

[4 marks]

Difference in percentage increase in mass = _____ %

0 3 . 3 Use the results of the student's investigations to draw conclusions about the factors affecting the rusting of iron. Include an evaluation of the effectiveness of different coatings at preventing the rusting of iron.

[6 marks]

0 3 . 4 Rust is hydrated iron(III) oxide.

Complete the word equation for the reaction.

[2 marks]

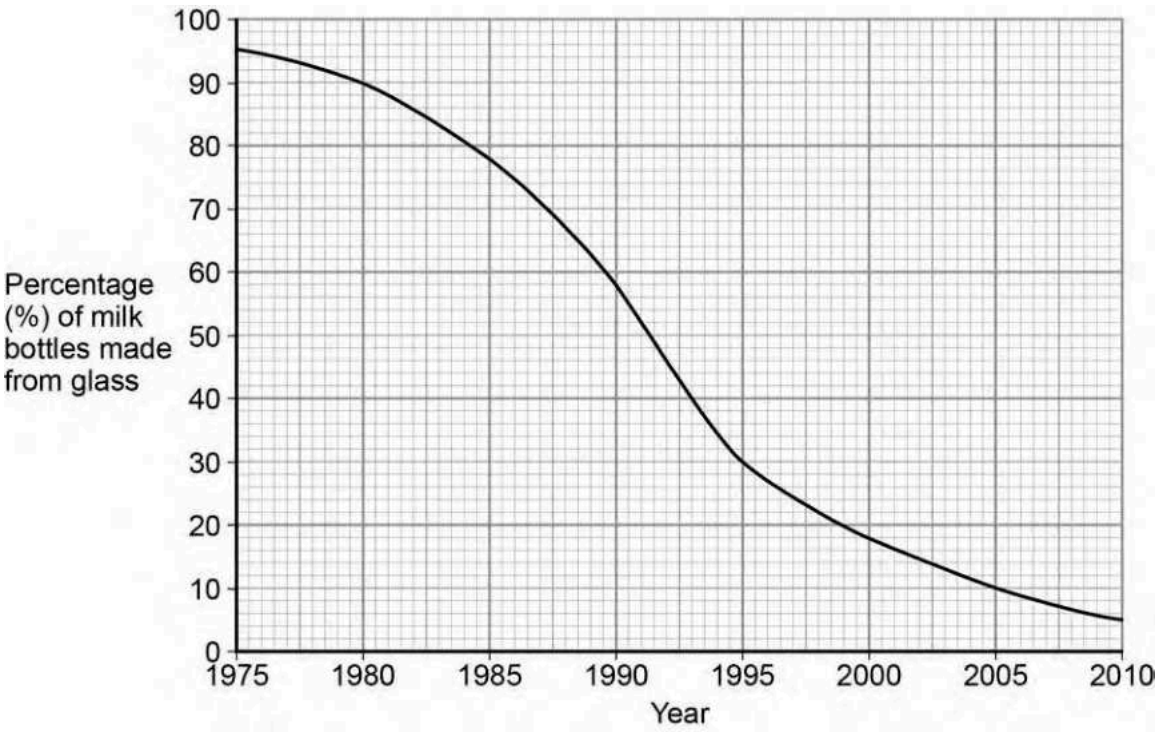
\+ _____ + _____ → hydrated iron(III) oxide

Turn over for the next question

0 4 Plastic and glass can be used to make milk bottles.

Figure 3 shows the percentage of milk bottles made from glass between 1975 and 2010.

Figure 3



0 4 . 1 Plot the points and draw a line on Figure 3 to show the percentage of milk bottles made from materials other than glass between 1975 and 2010.

[3 marks]

Question 4 continues on the next page

Table 3 gives information about milk bottles.

Table 3

	Glass milk bottle	Plastic milk bottle
Raw materials	Sand, limestone, salt	Crude oil
Bottle material	Soda-lime glass	HD poly(ethene)
Initial stage in production of bottle material	Limestone and salt used to produce sodium carbonate.	Production of naphtha fraction.
Maximum temperature in production process	1600 °C	850 °C
Number of times bottle can be used for milk	25	1
Size(s) of bottle	0.5 dm3	0.5 dm3, 1 dm3, 2 dm3, 3 dm3
Percentage (%) of recycled material used in new bottles	50 %	10 %

0 4 . 2 Evaluate the production and use of bottles made from soda-lime glass and those made from HD poly(ethene).

Use the information given and your knowledge and understanding to justify your choice of material for milk bottles.

[6 marks]

Turn over for the next question

0 5 This question is about the temperature of the Earth's atmosphere.

0 5 . 1 Give one reason why it is difficult to produce models for future climate change.

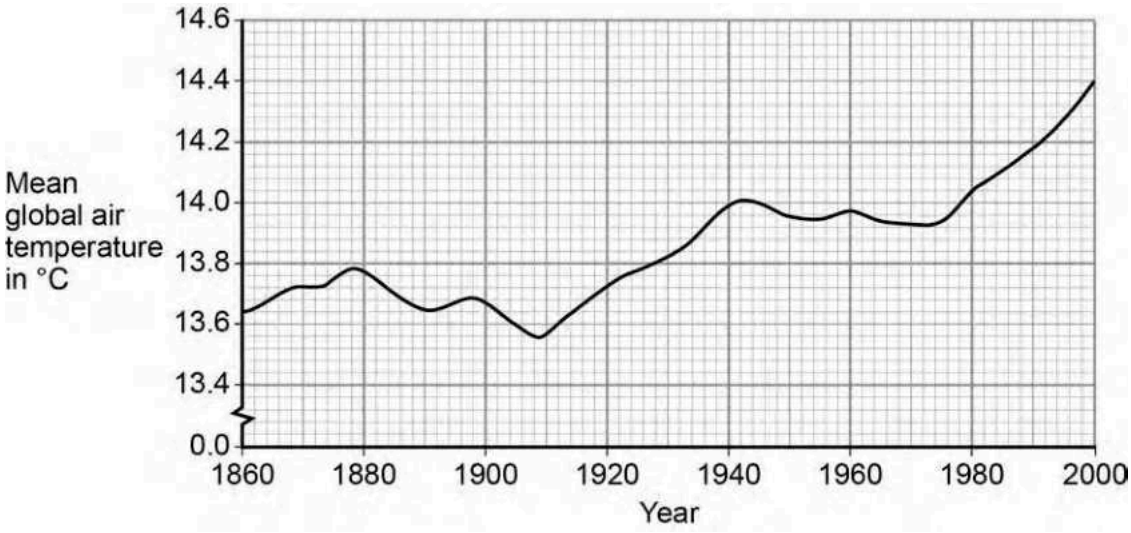
[1 mark]

0 5 . 2 Describe how carbon dioxide helps to maintain temperatures on Earth.

[3 marks]

Figure 4 shows the change in mean global air temperature from 1860 to 2000.

Figure 4



0 5 . 3 Explain how human activities have contributed to the main trend shown from 1910 in Figure 4.

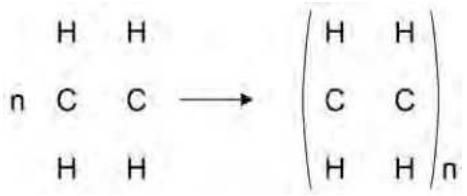
[3 marks]

Turn over for the next question

0 6 Ethene is used to produce poly(ethene).

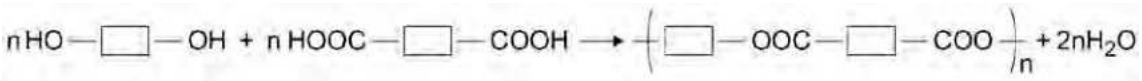
0 6 . 1 Draw the bonds to complete the displayed formulae of ethene and poly(ethene) in the equation.

[2 marks]



0 6 . 2 Polyesters are made by a different method of polymerisation.

The equation for the reaction to produce a polyester can be represented as:



Compare the polymerisation reaction used to produce poly(ethene) with the polymerisation reaction used to produce a polyester.

[4 marks]

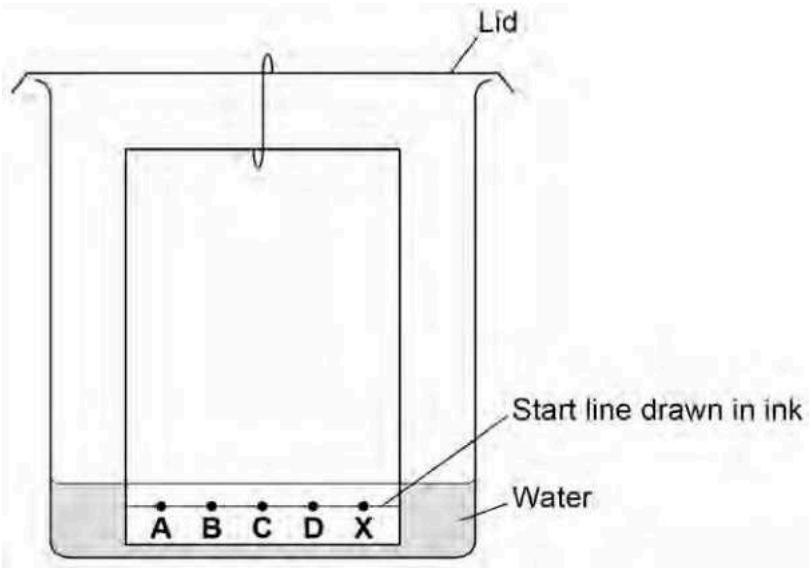
0 7 A student investigated food dyes using paper chromatography.

This is the method used.

1. Put a spot of food colouring X on the start line.
2. Put spots of four separate dyes, A, B, C and D, on the start line.
3. Place the bottom of the paper in water and leave it for several minutes.

Figure 5 shows the apparatus the student used.

Figure 5



0 7 . 1 Write down two mistakes the student made in setting up the experiment and explain what problems one of the mistakes would cause.

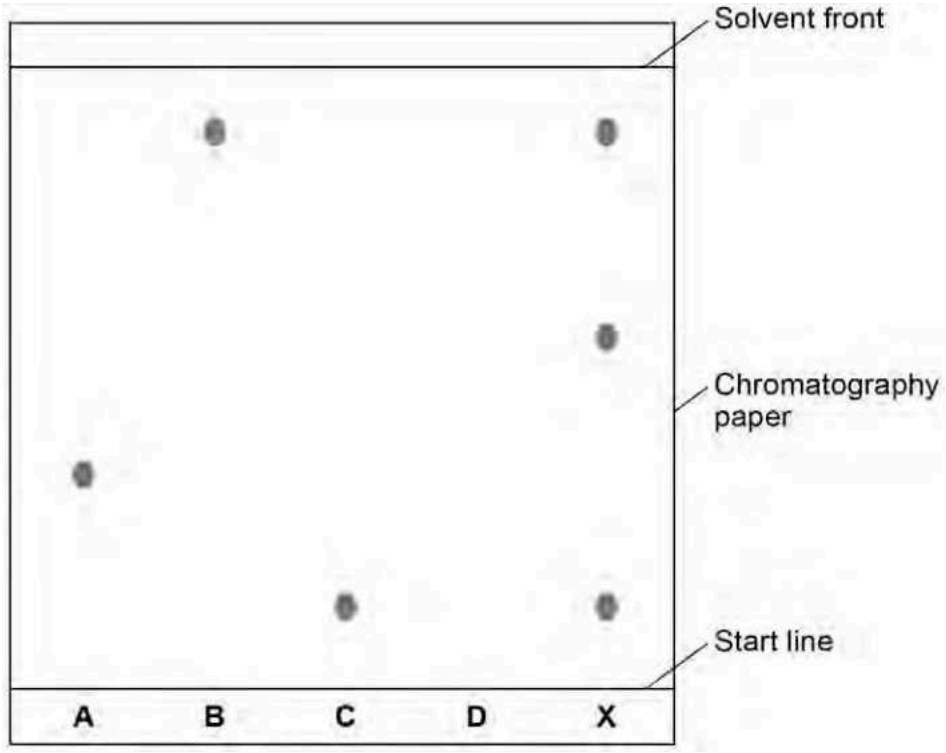
[2 marks]

Question 7 continues on the next page

Another student set up the apparatus correctly.

Figure 6 shows the student's results. The result for dye D is not shown.

Figure 6



0 7 . 2 Calculate the Rf value of dye A

Give your answer to two significant figures.

[3 marks]

Rf value =

0 7 . 3 Dye D has an Rf value of 0.80. Calculate the distance that dyeD moved on the chromatography paper.

[1 mark]

Distance moved by dye D =

0 7 . 4 Explain how the different dyes in X are separated by paper chromatography.

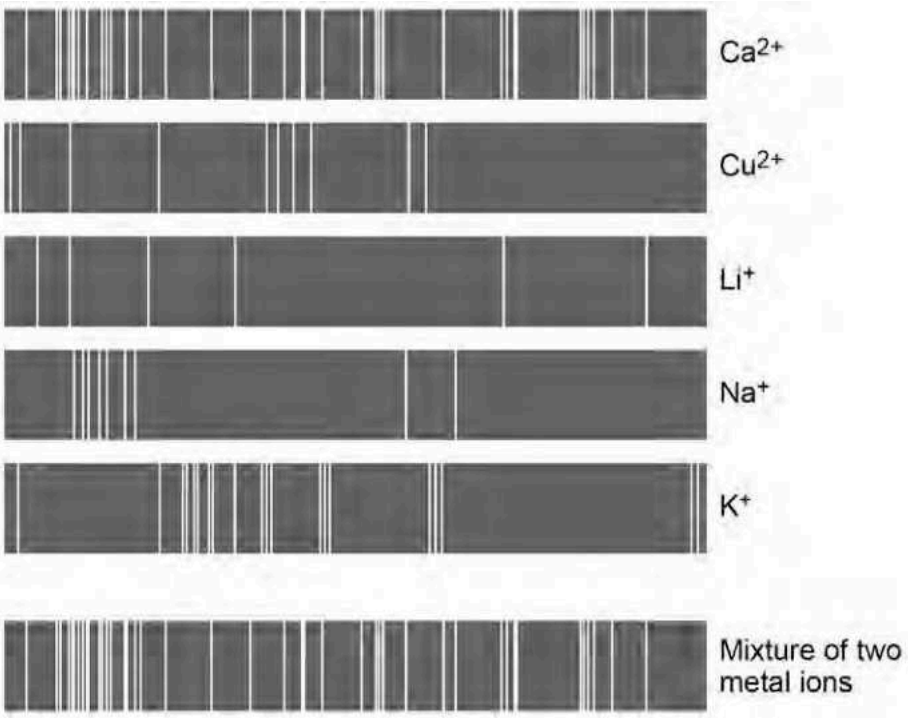
[4 marks]

Question 7 continues on the next page

0 7 . 5 Flame emission spectroscopy can be used to analyse metal ions in solution.

Figure 7 gives the flame emission spectra of five metal ions, and of a mixture of two metal ions.

Figure 7



Use the spectra to identify the two metal ions in the mixture.

[2 marks]

0 7 . 6 Explain why a flame test could not be used to identify the two metal ions in the mixture.

[2 marks]

0 7 . 7 Two students tested a green compound X.
The students added water to compound X.
Compound X did not dissolve.

The students then added a solution of ethanoic acid to compound X.
A gas was produced which turned limewater milky.

Student A concluded that compound X was sodium carbonate.
Student B concluded that compound X was copper chloride.

Which student, if any, was correct?

Explain your reasoning.

[4 marks]

Turn over for the next question

0 8 Fertilisers are used to improve agricultural productivity.

0 8 . 1 Ammonium nitrate is used in fertilisers.

Name the two compounds used to manufacture ammonium nitrate.

[1 mark]

0 8 . 2 A fertiliser contains the following information on the label:

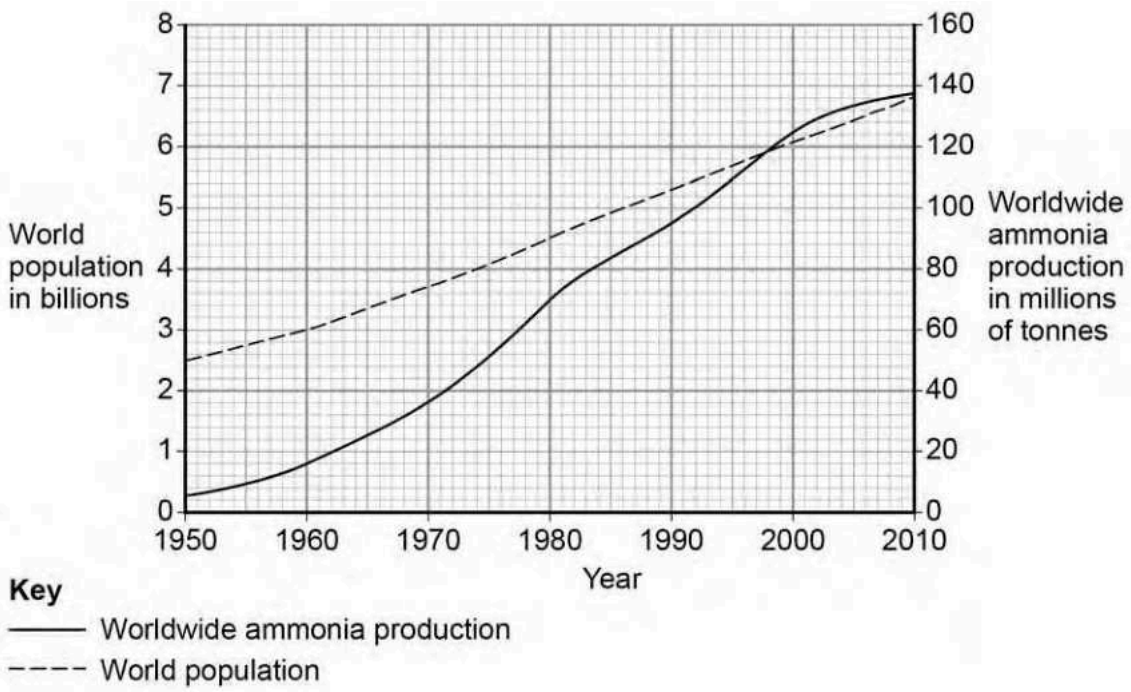
NPK value = 14 : 11 : 11

Explain why this information is useful to farmers.

[2 marks]

0 8 . 3 Figure 8 shows worldwide ammonia production and world population from 1950 to 2010.

Figure 8



Use Figure 8 and your knowledge to explain the relationship between ammonia production and world population.

[3 marks]

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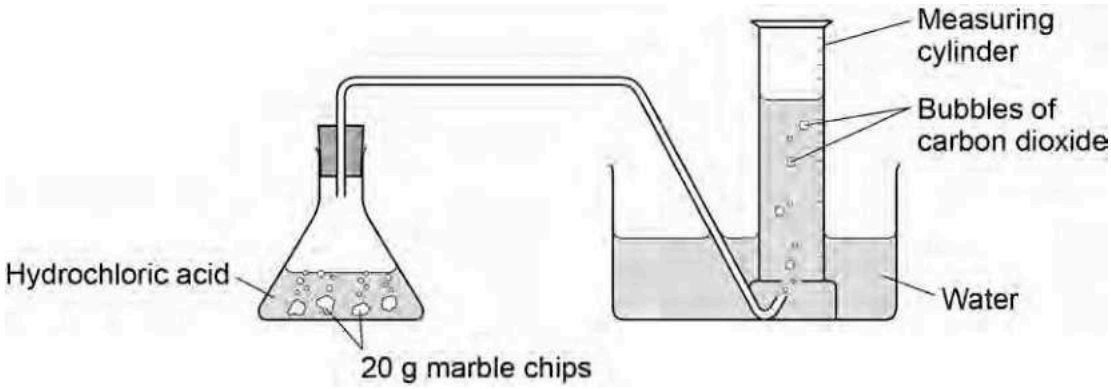
0 9 Marble chips are mainly calcium carbonate ($CaCO_3$).

A student investigated the rate of reaction between marble chips and hydrochloric acid (HCl).

Figure 9 shows the apparatus the student used.

Figure 9



0 9 . 1 Complete and balance the equation for the reaction between marble chips and hydrochloric acid.

[2 marks]

_____ + _____ → $CaCl_2$ + _____ + _____

Question 9 continues on the next page

0 9 . 2 Table 4 shows the student's results.

Table 4

Time in s	Volume of gas in dm3
0	0.000
30	0.030
60	0.046
90	0.052
120	0.065
150	0.070
180	0.076
210	0.079
240	0.080
270	0.080

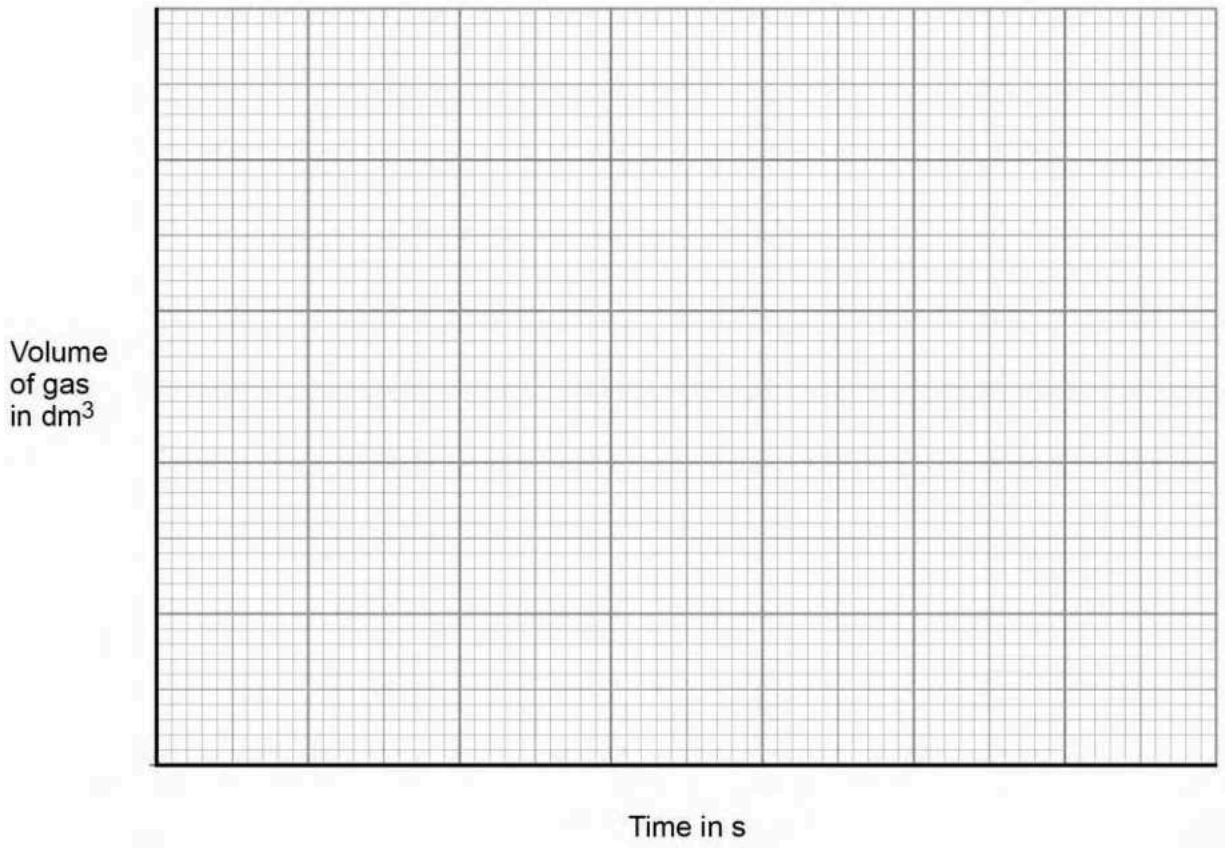
On Figure 10:

• Plot these results on the grid.

• Draw a line of best fit.

[4 marks]

Figure 10



0 9 . 3 Sketch a line on the grid in Figure 10 to show the results you would expect if the experiment was repeated using 20 g of smaller marble chips.
Label this line A.

[2 marks]

Question 9 continues on the next page

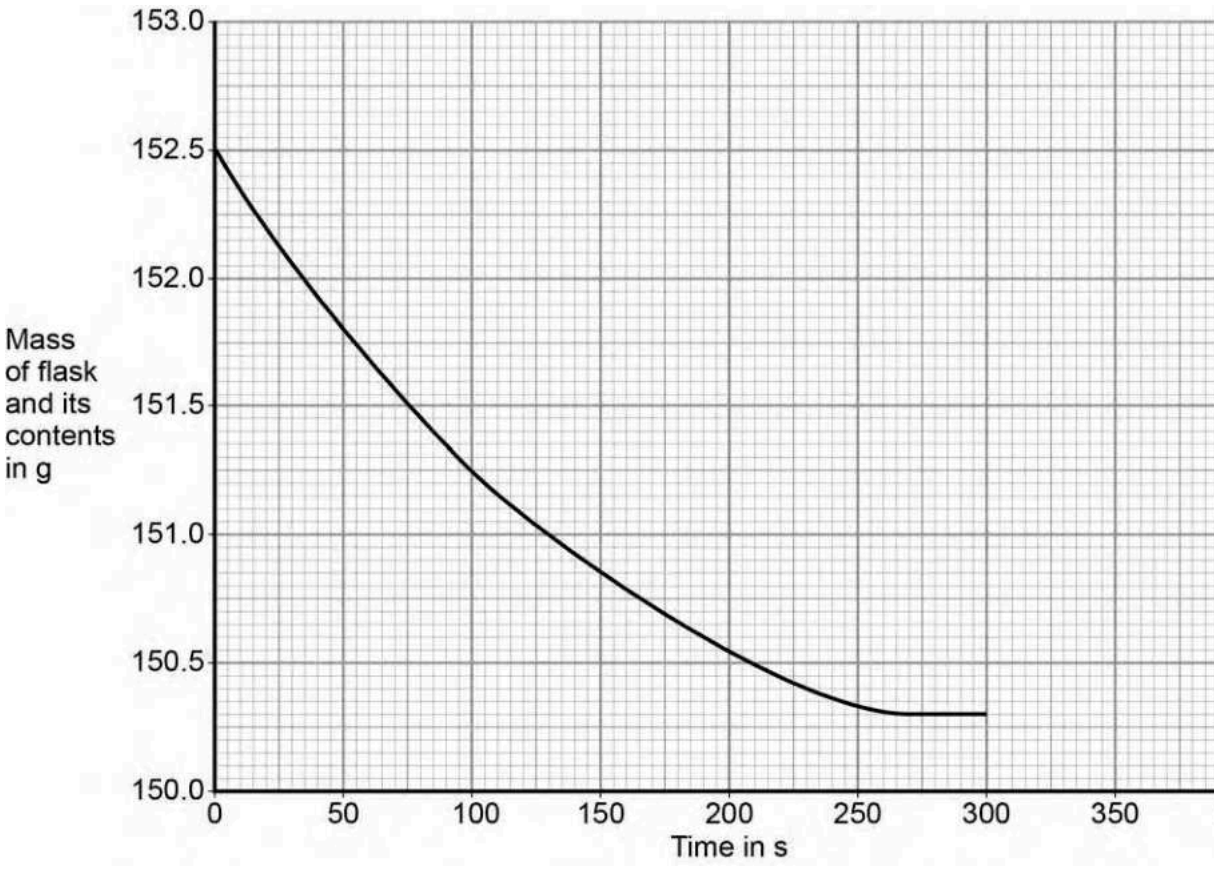
0 9 . 4 Explain, in terms of particles, how and why the rate of reaction changes during the reaction of calcium carbonate with hydrochloric acid.

[4 marks]

Another student investigated the rate of reaction by measuring the change in mass.

Figure 11 shows the graph plotted from this student's results.

Figure 11



0 9 . 5 Use Figure 11 to calculate the mean rate of the reaction up to the time the reaction is complete.

Give your answer to three significant figures.

[4 marks]

Mean rate of reaction = g/s

Use Figure 11 to determine the rate of reaction at 150 seconds.

Show your working on Figure 11.

0 9 . 6 Give your answer in standard form.

[4 marks]

Rate of reaction at 150 s

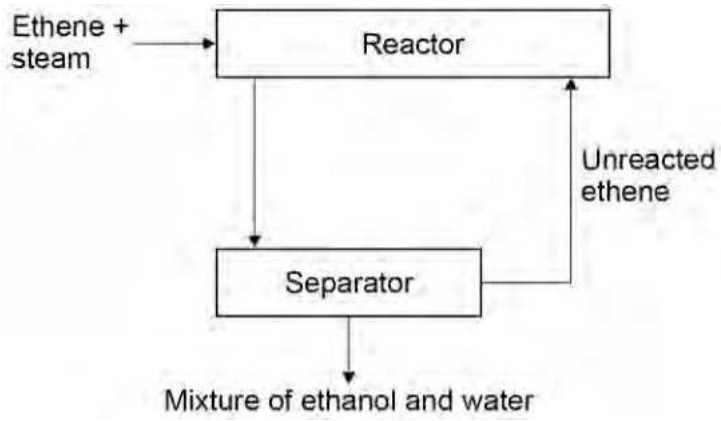
= g/s

1 0 In industry ethanol is produced by the reaction of ethene and steam at 300°C and 60 atmospheres pressure using a catalyst.
The equation for the reaction is:

$C_2H_4 (g) + H_2O (g) \rightleftharpoons C_2H_5OH (g)$

Figure 12 shows a flow diagram of the process.

Figure 12



Why does the mixture from the separator contain ethanol and water?

1 0 . 1

[1 mark]

1 0 . 2 The forward reaction is exothermic.

Use Le Chatelier's Principle to predict the effect of increasing temperature on the amount of ethanol produced at equilibrium.
Give a reason for your prediction.

[2 marks]

1 0 . 3 Explain how increasing the pressure of the reactants will affect the amount of ethanol produced at equilibrium.

[2 marks]

END OF QUESTIONS

There are no questions printed on this page