Please write clearly in block capitals.

Centre number | | | | | | Candidate number | | | | |

Surname

Forename(s)

Candidate signature

GCSE
CHEMISTRY

H

Higher Tier Paper 2

Wednesday 13 June 2018 Morning Time allowed: 1 hour 45 mins

Materials

For this paper you must have:
- a ruler
- a scientific calculator
- the periodic table (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 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

- 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.

For Examiner's Use	
Question	Mark
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
TOTAL	

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0 1 This question is about chemicals in fireworks.

Coloured flames are produced because of the metal ions present in fireworks.

0 1 . 1 What colour flame would sodium ions produce?

[1 mark]

0 1 . 2 Name a metal ion that would produce a green flame.

[1 mark]

0 1 . 3 Some fireworks contain a mixture of metal ions.

Why is it difficult to identify the metal ions from the colour of the flame?

[1 mark]

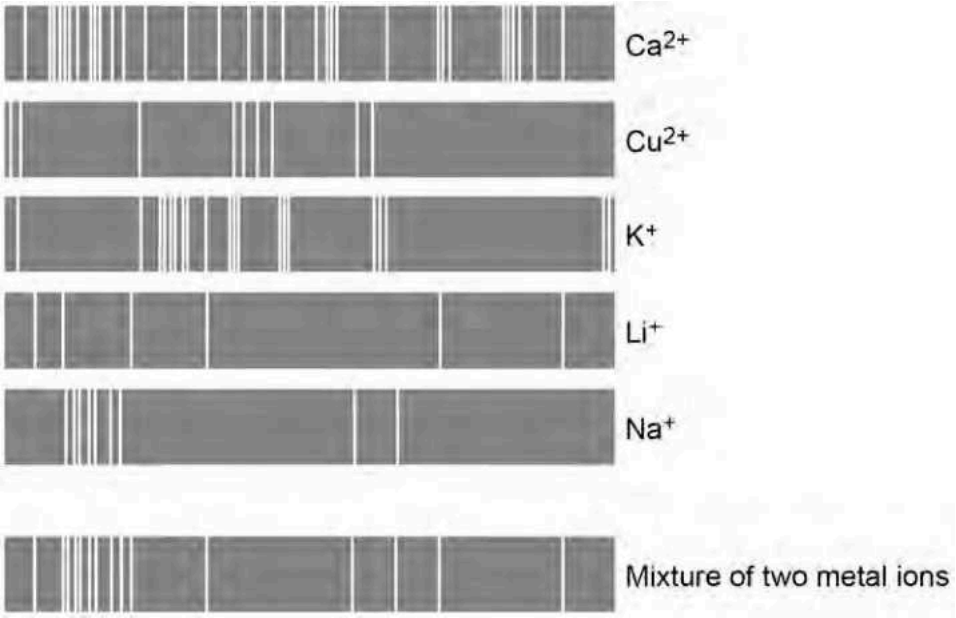
Do not write outside the box

0 1 . 4 Flame emission spectroscopy is used to identify metal ions in a firework.

Figure 1 shows:

- the flame emission spectra of five individual metal ions
- a flame emission spectrum for a mixture of two metal ions.

Figure 1



Which two metal ions are in the mixture?

[2 marks]

Tick two boxes.

Ca2+ ☐

Cu^{2+} ☐

K+ ☐

Li^+ ☐

Na+ ☐

Do not write outside the box

The compounds in fireworks also contain non-metal ions.

A scientist tests a solution of the chemicals used in a firework.

0 1 . 5 Silver nitrate solution and dilute nitric acid are added to the solution.

A cream precipitate forms.

Which ion is shown to be present by the cream precipitate?

[1 mark]

0 1 . 6 Describe a test to show the presence of sulfate ions in the solution.

Give the result of the test if there are sulfate ions in the solution.

[3 marks]

Test

Result

9

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0 2 Methylated spirit is a useful product made from a mixture of substances.

Table 1 shows the mass of the substances in a sample of methylated spirit.

Table 1

Substance	Mass in grams
Ethanol	265.5
Methanol	23.3
Pyridine	3.0
Methyl violet	1.5

0 2 . 1 What name is given to a useful product such as methylated spirit?

[1 mark]

0 2 . 2 Calculate the percentage by mass of methanol in methylated spirit.

Use Table 1.

[2 marks]

Percentage = _____ %

Question 2 continues on the next page

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Methylated spirit contains ethanol and is available cheaply.

Methylated spirit also contains:

- pyridine which has a very unpleasant smell
- methyl violet which makes the mixture purple.

0 2 . 3 Suggest why pyridine and methyl violet are added to ethanol to make methylated spirit.

[1 mark]

0 2 . 4 Suggest one use of methylated spirit.

[1 mark]

0 2 . 5 Describe how ethanol is produced from sugar solution.

Give the name of this process.

[3 marks]

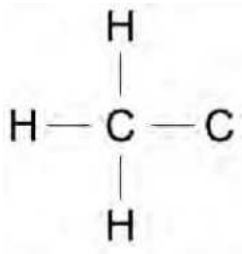
Do not write outside the box

0 2 . 6 Figure 2 shows part of the displayed formula for ethanol.

Complete Figure 2.

[1 mark]

Figure 2



0 2 . 7 Name the gas produced when sodium is added to ethanol.

[1 mark]

0 2 . 8 Methanol is used to produce methanoic acid.

What type of substance reacts with methanol to produce methanoic acid?

[1 mark]

11

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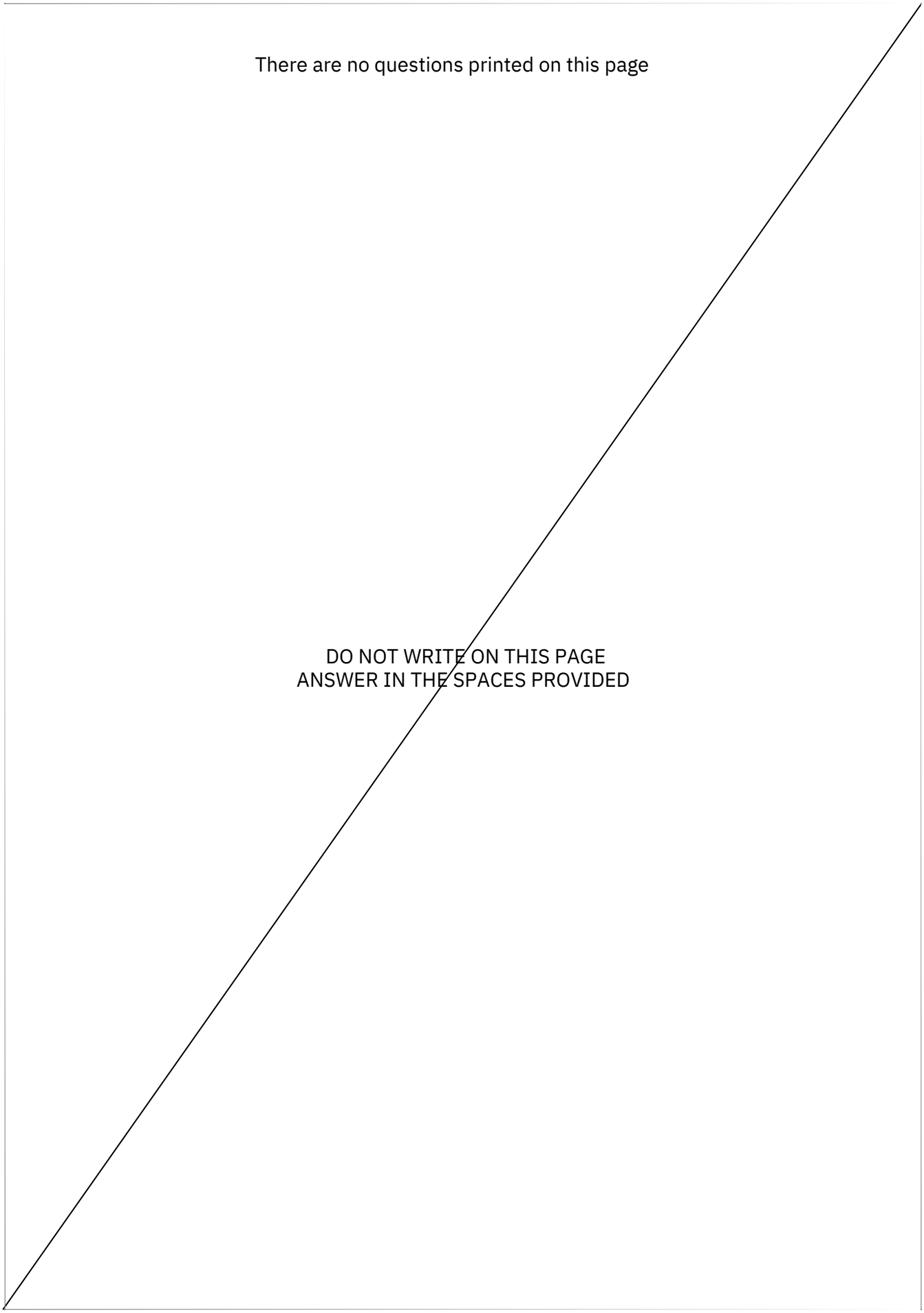
ANSWER IN THE SPACES PROVIDED



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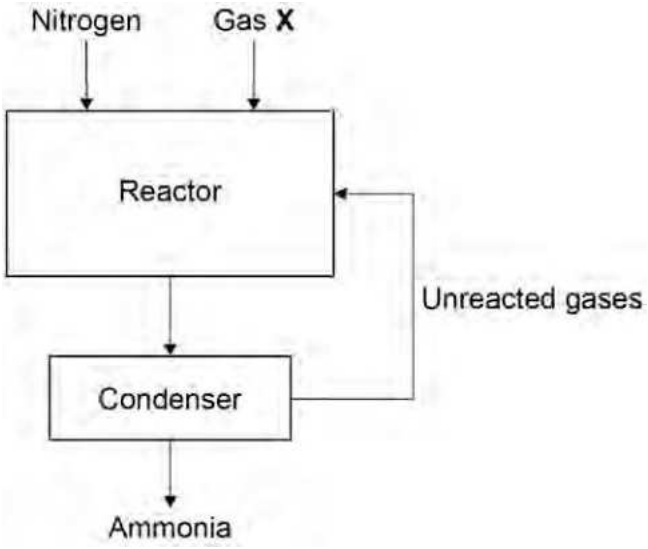
0 3 This question is about gases.

Figure 3 shows how nitrogen is used in the Haber Process to produce ammonia.

Figure 3



0 3 . 1 Gas X in Figure 3 is obtained from methane.

Name gas X.

[1 mark]

0 3 . 2 Give the approximate temperature and pressure used in the reactor.

[2 marks]

Temperature _____

Pressure _____

0 3 . 3 The mixture of gases from the reactor cools in the condenser.

Suggest why ammonia condenses but the other gases do not.

[1 mark]

_____

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The Earth's early atmosphere was different to Earth's atmosphere today.

Scientists think that the Earth's early atmosphere was like the atmosphere found on Venus today.
Table 2 shows the amounts of carbon dioxide and oxygen in the atmospheres of Venus and Earth today.

Table 2

Gas	Percentage (%) in Venus' atmosphere today	Percentage (%) in Earth's atmosphere today
Carbon dioxide	96.50	0.04
Oxygen	0.00	20.95

0 3 . 4 The percentages of carbon dioxide and oxygen have changed from Earth's early atmosphere to Earth's atmosphere today.

Explain the processes that led to these changes.

[6 marks]

Do not write outside the box

0 3 . 5 Why are scientists not certain about the percentage of each gas in the Earth's early atmosphere?

[1 mark]

11

Turn over for the next question

Do not write outside the box

0 4 A student investigated the colours in three different flowers, A, B and C.

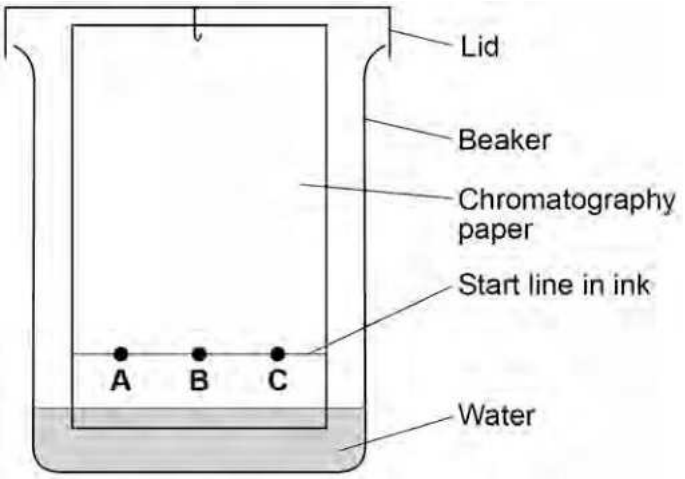
The colours are soluble in ethanol but are insoluble in water.

This is the method used.

1. Crush flower A.
2. Add ethanol to flower A.
3. Filter the mixture.
4. Put spots of the coloured filtrate on to the chromatography paper.
5. Repeat steps 1-4 with flowers B and C.

Figure 4 shows the apparatus used.

Figure 4



0 4 . 1 The student made two mistakes in setting up the apparatus.

Give one problem caused by each mistake.

[4 marks]

Mistake 1 _____

Problem caused _____

_____

Mistake 2 _____

Problem caused _____

_____

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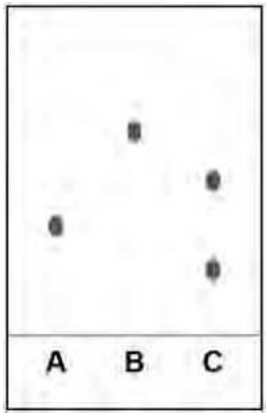
0 4 . 2 Another student set up the apparatus correctly.

Figure 5 represents the student's results.

Figure 5



Give two conclusions you can make from Figure 5 .

[2 marks]

1 _____

2 _____

_____

0 4 . 3 Colour A has an Rf value of 0.65

Colour A moves 3.2 cm

Calculate the distance moved by the solvent.

[2 marks]

_____

Distance moved by solvent = _____ cm

8

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0 5 Sodium thiosulfate solution reacts with dilute hydrochloric acid.

The solution becomes cloudy as the reaction takes place.

0 5 . 1 The equation for the reaction is:

$$Na_2S_2O_3(aq) + 2\,HCl(aq) \rightarrow 2\,NaCl(aq) + SO_2(g) + H_2O(l) + S(s)$$

Explain why the solution becomes cloudy.

[2 marks]

0 5 . 2 Plan an investigation to show how the concentration of the sodium thiosulfate solution affects the rate of the reaction with dilute hydrochloric acid.

Your plan should give valid results.

[6 marks]

Do not write outside the box

8

Turn over for the next question

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0 6 This question is about polymers.

0 6 . 1 Polyesters are produced when monomers join together and lose a small molecule.

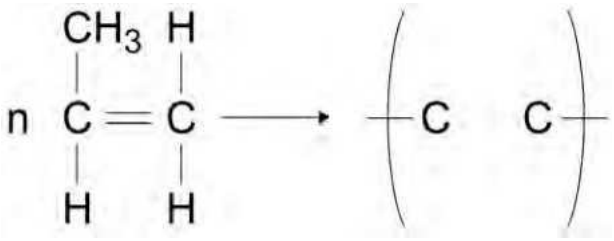
Name the small molecule lost.

[1 mark]

0 6 . 2 Poly(propene) is produced from propene.

Complete the structure of poly(propene) in the equation.

[3 marks]



0 6 . 3 Carpets are made from:

- poly(propene)
- wool
- a mixture of poly(propene) and wool.

Poly(propene) wears out more slowly than wool.

A mixture of poly(propene) and wool to make carpets is more sustainable than using just poly(propene) or just wool.
Suggest why.

[2 marks]

Do not write outside the box

Polymer fibres are used to make firefighter uniforms.

Table 3 shows some properties of two polymer fibres.

Table 3

Property	Polymer fibres	
	Poly(propene)	Polyester
Density in g/cm3	0.90	1.38
Melting point in °C	165	260
Flame resistance	Poor	Good
Water absorption	Low	High

0 6 . 4 Evaluate the suitability of poly(propene) and polyester for firefighter uniforms.

[4 marks]

10

Turn over ►

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0 7 Older cars are tested each year to measure the amount of pollutants contained in exhaust fumes.

Table 4 shows the maximum allowed percentages of exhaust pollutants for petrol cars.

Table 4

Age of car in years	Maximum allowed percentage (%) of exhaust pollutant	
	Carbon monoxide	Unburned hydrocarbons
16–24	0.30	0.02
3–16	0.20	0.02

0 7 . 1 Explain how carbon monoxide is produced when petrol is burned in car engines.

[2 marks]

0 7 . 2 Suggest two reasons why the maximum allowed percentage of carbon monoxide has been decreased for newer cars.

[2 marks]

1

2

Turn over ►

Do not write outside the box

0 7 . 3 Give one reason for having a maximum allowed percentage of unburned hydrocarbons in exhaust fumes.

[1 mark]

Oxides of nitrogen are also pollutants contained in exhaust fumes.

0 7 . 4 Describe how oxides of nitrogen are produced when petrol is burned in car engines.

[2 marks]

Catalytic converters are fitted to car exhausts to reduce the amount of pollutants released into the atmosphere.

0 7 . 5 Nitrogen dioxide is an oxide of nitrogen.

Nitrogen dioxide reacts to produce nitrogen and oxygen in catalytic converters.

Complete the equation for the reaction.

The equation should be balanced.

[2 marks]

___ NO_2 (g) → _____ + ___ O_2 (g)

Do not write outside the box

0 7 . 6 Give two effects of atmospheric pollution which are reduced by using catalytic converters.

[2 marks]

1 _____

_____

2 _____

_____

0 7 . 7 The catalyst in catalytic converters is a mixture of three elements.

Where in the periodic table are these elements most likely to be found?

[1 mark]

Tick one box.

Alkali metals ☐

Halogens ☐

Noble gases ☐

Transition metals ☐

12

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0 8 A student investigated how temperature affects the rate of reaction between magnesium carbonate and dilute hydrochloric acid.

This is the method used.

1. Heat hydrochloric acid to 30 °C in a conical flask.

2. Add magnesium carbonate powder to the conical flask.

3. Measure the loss in mass of the flask and contents every 20 seconds for 140 seconds.

4. Repeat steps 1-3 with hydrochloric acid heated to 50 °C

Explain why the contents of the conical flask lose mass.

0 8 . 1

[2 marks]

0 8 . 2 Table 5 shows the student's results for hydrochloric acid at 30 °C

Table 5

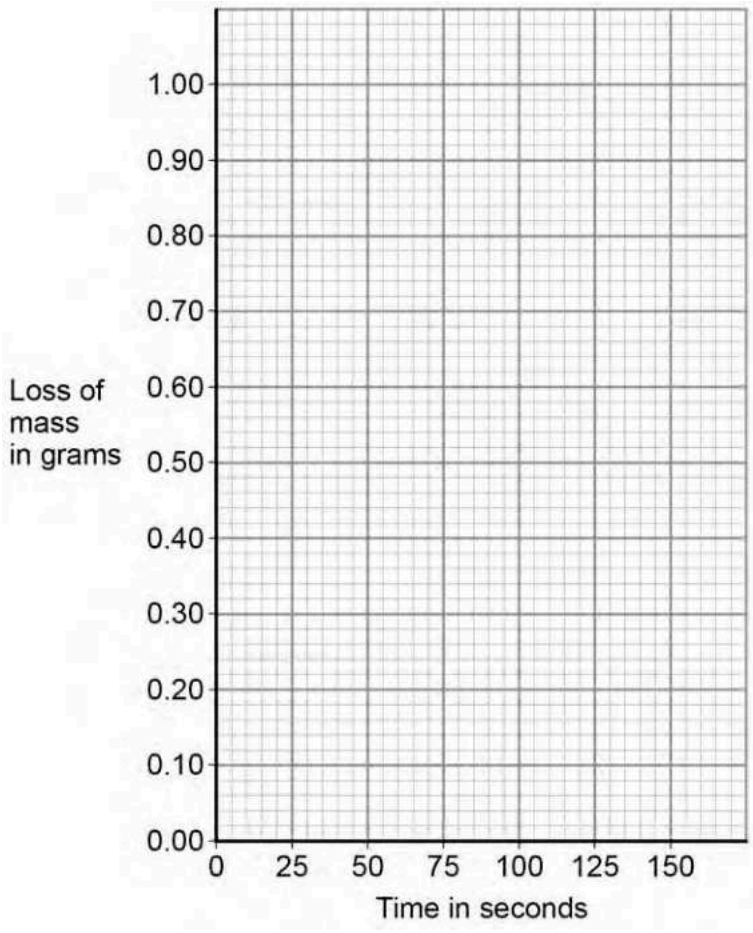
Time in seconds	Loss of mass in grams
0	0.00
20	0.26
40	0.48
60	0.67
80	0.82
100	0.91
120	0.96
140	0.99

Plot the data from Table 5 on Figure 6 .

Draw a line of best fit.

[3 marks]

Figure 6



Question 8 continues on the next page

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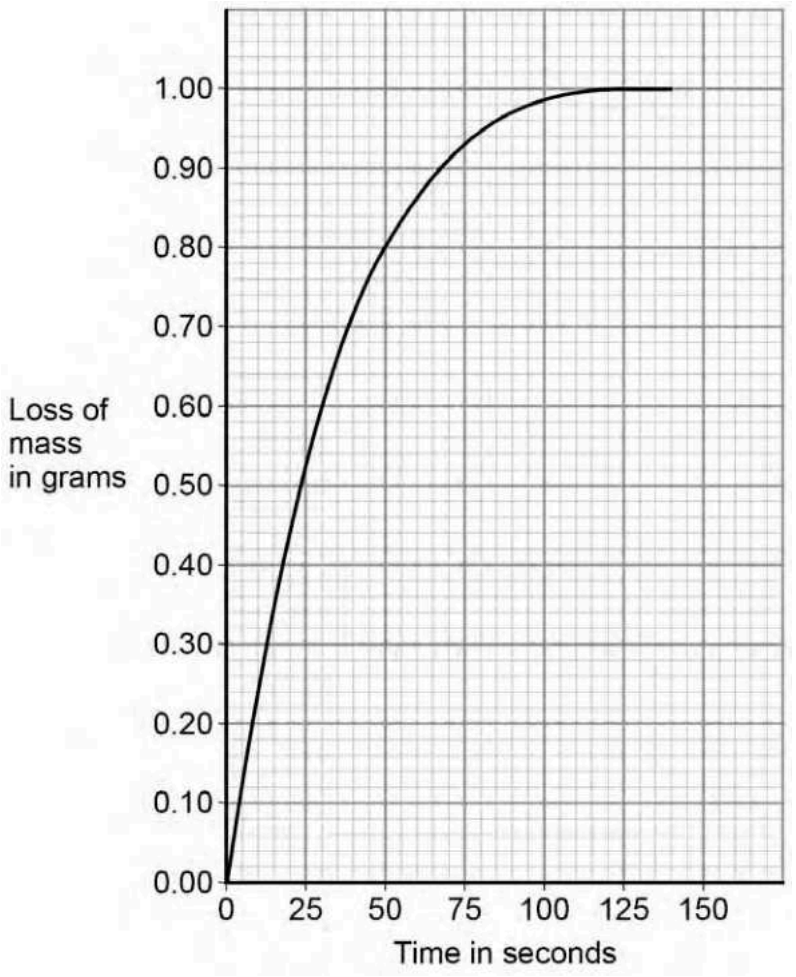
Figure 7 shows the student's results for hydrochloric acid at 50 °C

Figure 7



0 8 . 3 Determine the rate of reaction at 50 °C when the loss of mass is 0.95 g

Show your working on Figure 7.

Give your answer to 2 significant figures.

[4 marks]

Rate of reaction = _____ g/s

9

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0 9 This question is about methanol.

0 9 . 1 Methanol is broken down in the body during digestion.

What type of substance acts as a catalyst in this process?

[1 mark]

Tick one box.

Amino acid ☐

Enzyme ☐

Ester ☐

Nucleotide ☐

In industry, methanol is produced by reacting carbon monoxide with hydrogen.

The equation for the reaction is:

$$CO(g) + 2H2(g) \rightleftharpoons CH3OH(g)$$

0 9 . 2 How many moles of carbon monoxide react completely with 4.0 × 103 moles of hydrogen?

[1 mark]

Tick one box.

1.0 × 103 moles ☐

2.0 × 103 moles ☐

4.0 × 103 moles ☐

8.0 × 103 moles ☐

Do not write outside the box

0 9 . 3 The reaction is carried out at a temperature of 250 °C and a pressure of 100 atmospheres.

The forward reaction is exothermic.

Explain what happens to the yield of methanol if a temperature higher than 250 °C is used.

[2 marks]

0 9 . 4 A pressure of 100 atmospheres is used instead of atmospheric pressure.

The higher pressure gives a greater yield of methanol and an increased rate of reaction.
Explain why.

[4 marks]

Question 9 continues on the next page

Do not write outside the box

A catalyst is used in the reaction to produce methanol from carbon monoxide and hydrogen.

0 9 . 5 Explain how a catalyst increases the rate of a reaction.

[2 marks]

0 9 . 6 Suggest why a catalyst is used in this industrial process.

Do not give answers in terms of increasing the rate of reaction.

[1 mark]

0 9 . 7 Suggest the effect of using the catalyst on the equilibrium yield of methanol.

[1 mark]

12

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Turn over for the next question

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1 0 Disposable cups are made from coated paper or poly(styrene).

Table 6 shows information on the life cycle assessments (LCAs) of disposable cups.

Table 6

	Coated paper cups	Poly(styrene) cups
	Raw materials	Wood Crude oil
Mass of 1 cup in g 8.3 1.9		
Energy to produce 1 cup in kJ 550 200		
Energy released when 1 cup is burned in kJ 166 76		
Biodegradable Yes No		
Recyclable No Yes		

1 0 . 1 Evaluate the use of coated paper compared with poly(styrene) to make disposable cups.
Use Table 6 and your knowledge and understanding of LCAs.

[6 marks]

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10.2 Calculate the energy needed to produce 1.00 kg of coated paper cups.

Use Table 6.

Give your answer in standard form.

[2 marks]

Energy = _____ kJ

10.3 Melamine is a polymer used to make non-disposable cups.

Melamine does not melt when it is heated.

Explain why.

[2 marks]

10

END OF QUESTIONS

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