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GCSE

CHEMISTRY

H

Higher Tier Paper 2

8462/2H

Wednesday 13 June 2018 Morning

Time allowed: 1 hour 45 mins

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

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

INSTRUCTIONS

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

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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.**

DO NOT TURN OVER UNTIL TOLD TO DO SO

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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]**

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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]

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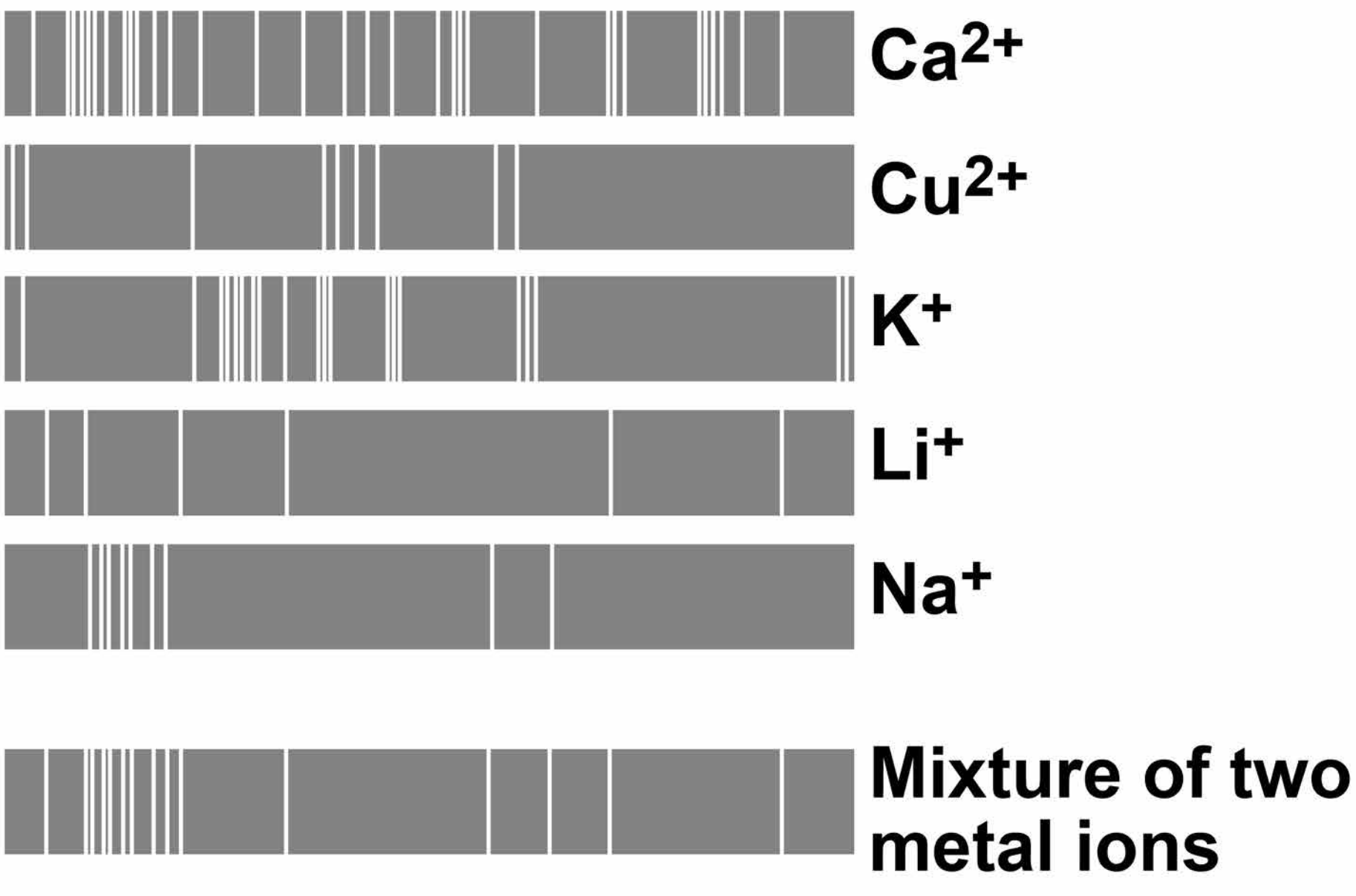
0 1 . 4 **Flame emission spectroscopy is used to identify metal ions in a firework.**

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



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Which TWO metal ions are in the mixture?

Tick TWO boxes. [2 marks]

- ☐ Ca^{2+}
- ☐ Cu^{2+}
- ☐ K^{+}
- ☐ Li^{+}
- ☐ Na^{+}

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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]

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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

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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]**

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

Use TABLE 1. [2 marks]

Percentage = _____ %

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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]

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

Give the name of this process.
[3 marks]

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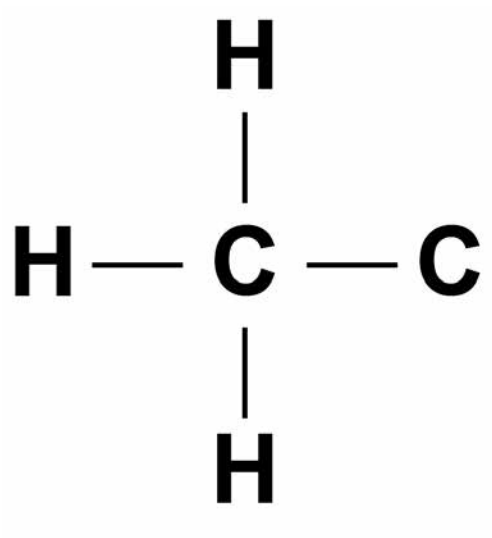
0 2 . 6 **FIGURE 2 shows part of the displayed formula for ethanol.**

Complete FIGURE 2. [1 mark]

FIGURE 2



0 2 . 7 **Name the gas produced when sodium is added to ethanol. [1 mark]**

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

What type of substance reacts with methanol to produce methanoic acid? [1 mark]

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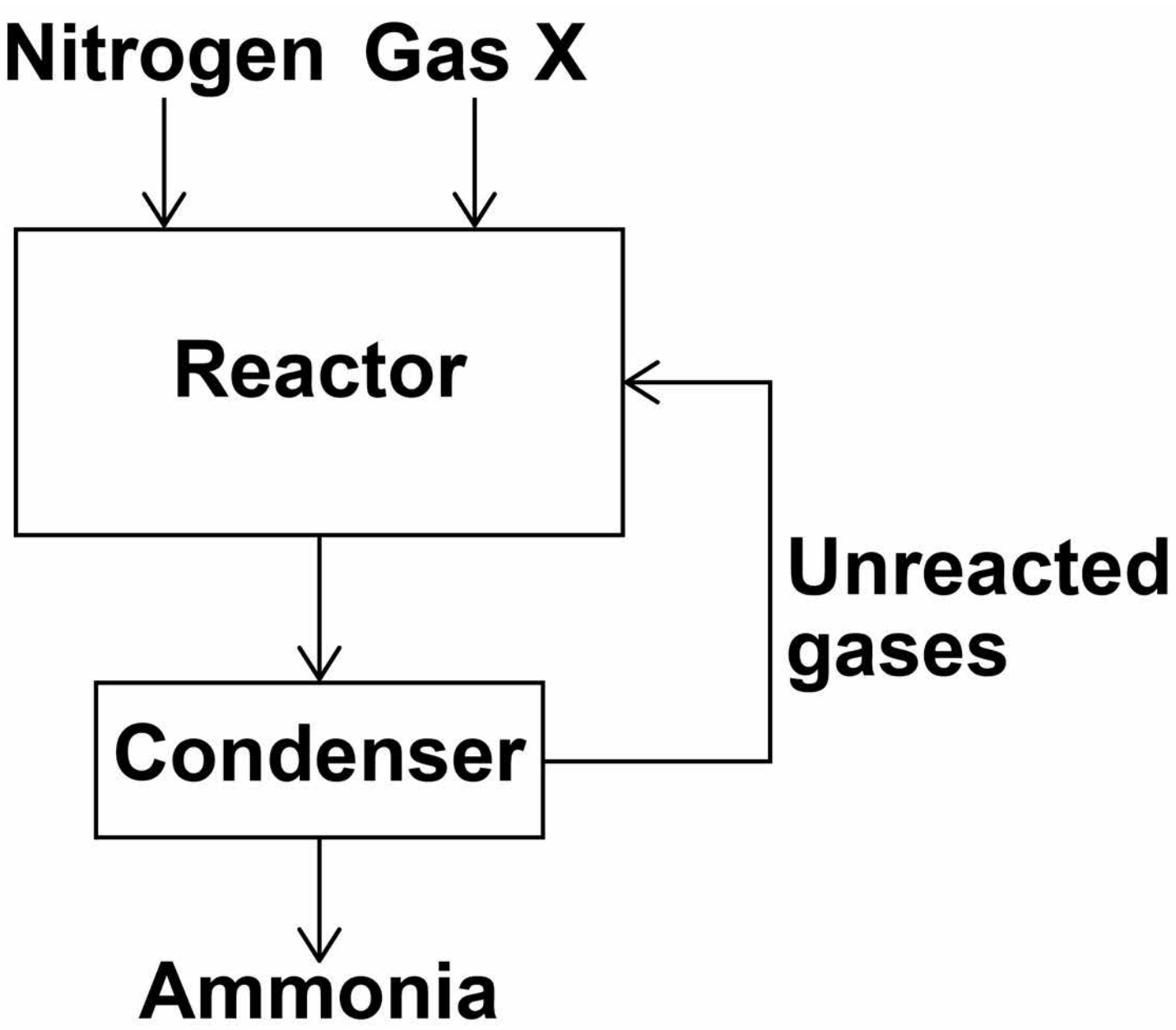
0 3 **This question is about gases.**

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

FIGURE 3



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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

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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]

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0 3 . 5 Why are scientists NOT certain about the percentage of each gas in the Earth's early atmosphere? [1 mark]

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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, on page 22, shows the apparatus used.

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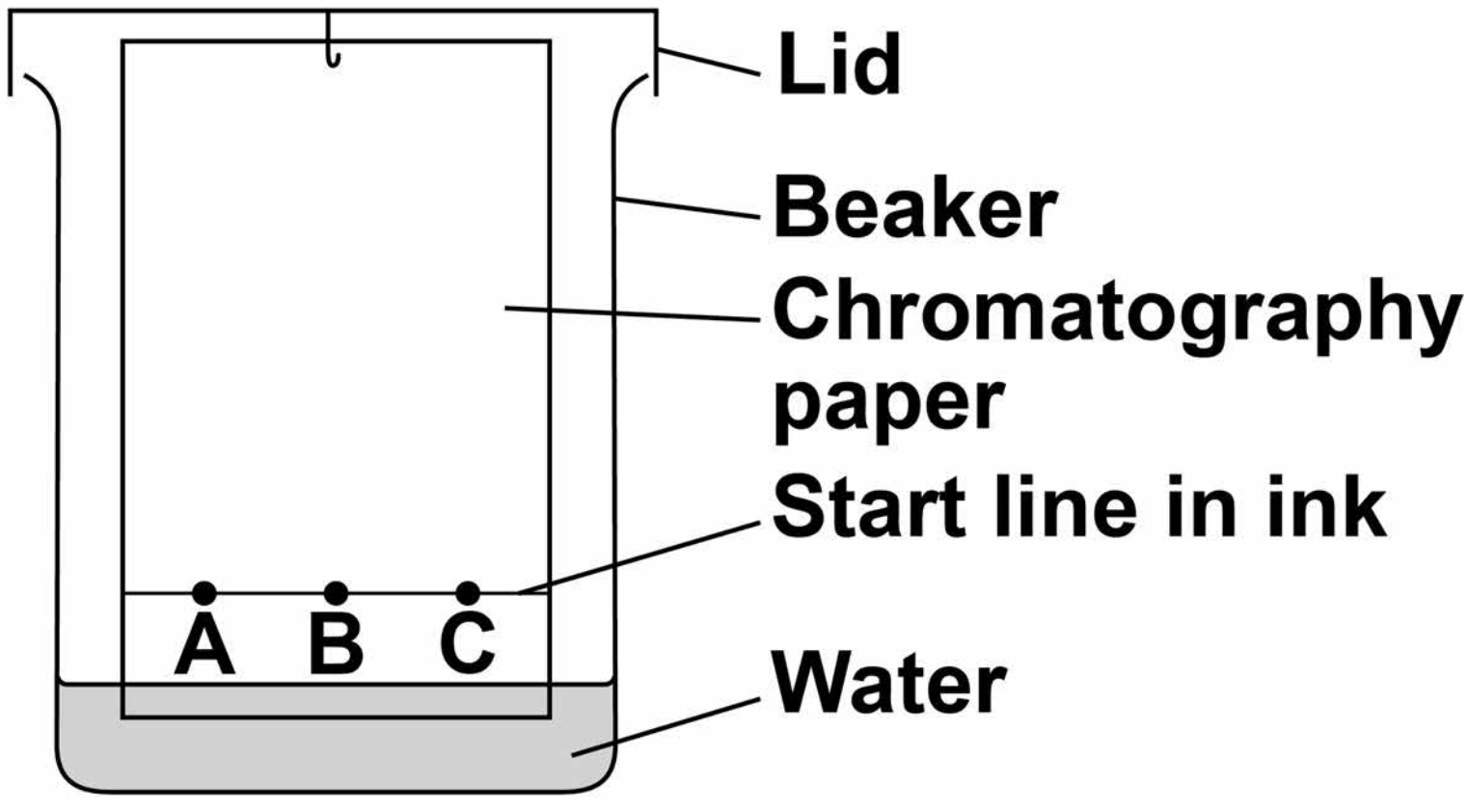
FIGURE 4



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

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Mistake 2 _____

_____

Problem caused _____

_____

_____

_____

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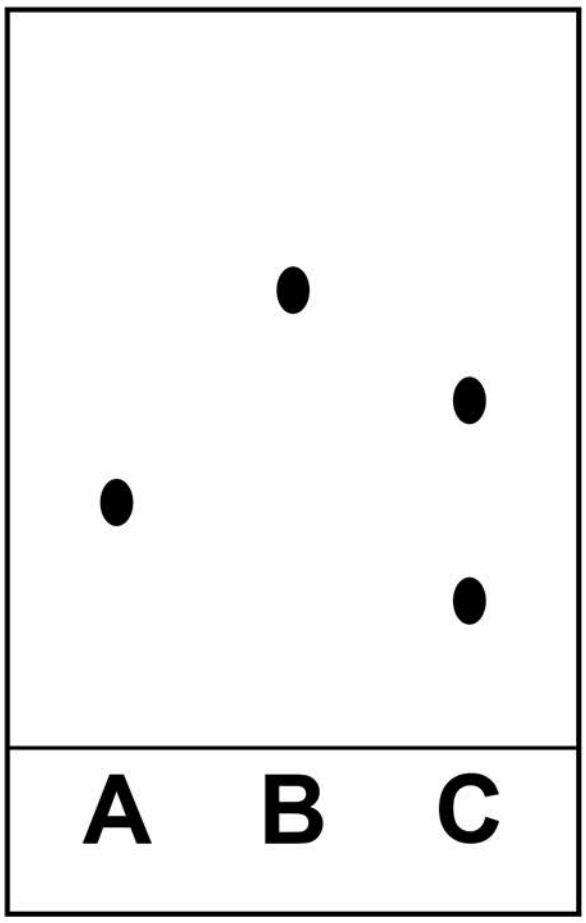
0 4 . 2 Another student set up the apparatus correctly.

FIGURE 5 represents the student's results.

FIGURE 5



Give TWO conclusions you can make from FIGURE 5. [2 marks]

1 _____

_____

_____

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2 _____

_____

_____

0 4 . 3 Colour A has an R_f 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]

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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]

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[Turn over]

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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]

_____

_____

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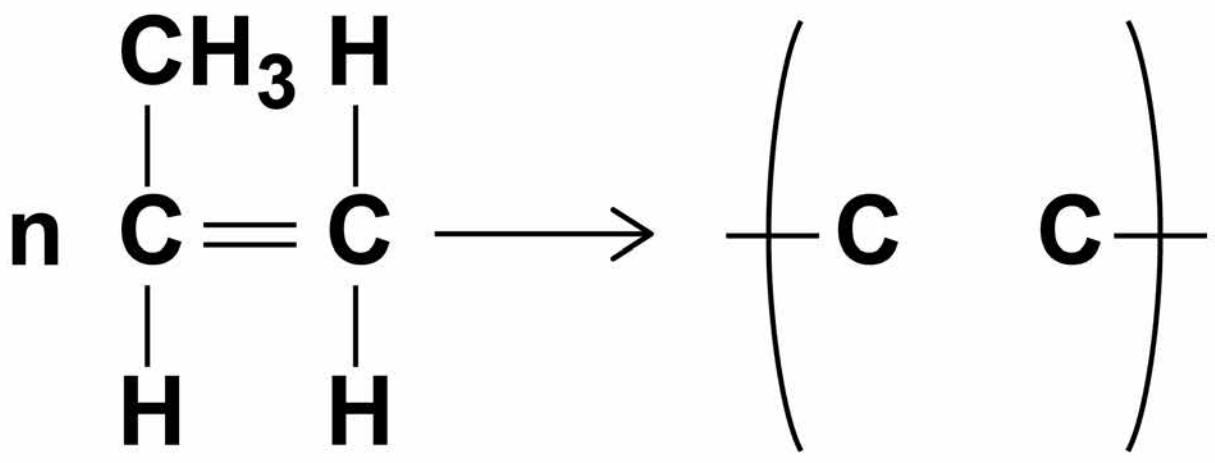
0 6 . 2 **Poly(propene) is produced from propene.**

Complete the structure of poly(propene) in the equation.
[3 marks]



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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]

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Polymer fibres are used to make firefighter uniforms.

TABLE 3 shows some properties of two polymer fibres.

TABLE 3

	Polymer fibres	
Property	**Poly(propene)**	**Polyester**
Density in g/cm^3	**0.90**	**1.38**
Melting point in °C	**165**	**260**
Flame resistance	**Poor**	**Good**
Water absorption	**Low**	**High**

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

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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

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0 7 . 1 **Explain how carbon monoxide is produced when petrol is burned in car engines. [2 marks]**

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0 7 . 2 **Suggest TWO reasons why the maximum allowed percentage of carbon monoxide has been decreased for newer cars. [2 marks]**

1 _____

_____

2 _____

_____

_____

0 7 . 3 **Give ONE reason for having a maximum allowed percentage of unburned hydrocarbons in exhaust fumes. [1 mark]**

_____

_____

_____

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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]

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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 this reaction.

The equation should be balanced. [2 marks]

_____ NO_2 (g) $\rightarrow$

_____ + _____ O_2 (g)

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0 7 . 6 **Give TWO effects of atmospheric pollution which are reduced by using catalytic converters.**
[2 marks]

1 _____

_____

2 _____

_____

_____

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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**

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[Turn over]

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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**

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0 8 . 1 **Explain why the contents of the conical flask lose mass.**
[2 marks]

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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

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Plot the data from TABLE 5 on FIGURE 6.

Draw a line of best fit. [3 marks]

FIGURE 6

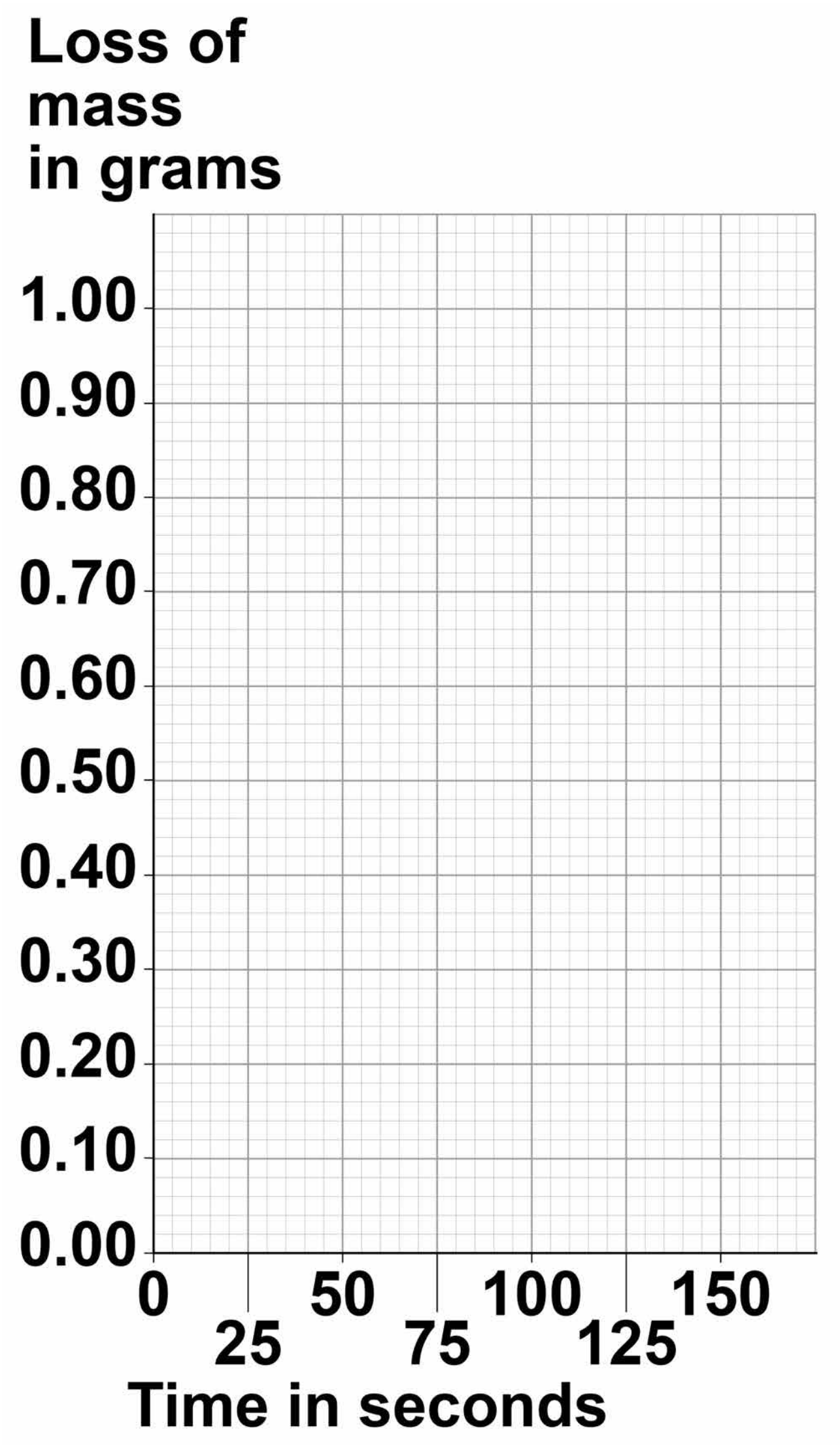

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FIGURE 7 shows the student's results for hydrochloric acid at 50 ºC

FIGURE 7

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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

[Turn over]

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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

[Turn over]

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

The equation for the reaction is:

$$CO(g) + 2H_2(g) \rightleftharpoons CH_3OH(g)$$

0 9 . 2 How many moles of carbon monoxide react completely with 4.0×10^3 moles of hydrogen?

Tick ONE box. [1 mark]

- ☐ 1.0×10^3 moles
- ☐ 2.0×10^3 moles
- ☐ 4.0×10^3 moles
- ☐ 8.0×10^3 moles

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0 9 . 3 **The reaction is carried out at a temperature of 250 ºC 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 ºC is used. [2 marks]

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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]

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[Turn over]

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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]

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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]**

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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

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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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Repeat of 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

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1 0 . 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

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

Melamine does NOT melt when it is heated.

Explain why. [2 marks]

END OF QUESTIONS

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