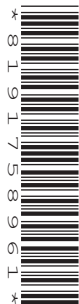


**Friday 20 November 2020 – Morning**

**GCSE (9–1) Combined Science (Chemistry) A  
(Gateway Science)**

**J250/10 Paper 10 (Higher Tier)**

**Time allowed: 1 hour 10 minutes**



**You must have:**

- a ruler (cm/mm)
- the Data Sheet for GCSE (9–1) Combined Science (Chemistry) A (inside this document)

**You can use:**

- a scientific or graphical calculator
- an HB pencil



Please write clearly in black ink. **Do not write in the barcodes.**

Centre number

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Candidate number

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First name(s)

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Last name

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**INSTRUCTIONS**

- Use black ink. You can use an HB pencil, but only for graphs and diagrams.
- Write your answer to each question in the space provided. If you need extra space use the lined pages at the end of this booklet. The question numbers must be clearly shown.
- Answer **all** the questions.
- Where appropriate, your answer should be supported with working. Marks might be given for using a correct method, even if your answer is wrong.

**INFORMATION**

- The total mark for this paper is **60**.
- The marks for each question are shown in brackets [ ].
- Quality of extended response will be assessed in questions marked with an asterisk (\*).
- This document has **24** pages.

**ADVICE**

- Read each question carefully before you start your answer.

**2**  
**SECTION A**

Answer **all** the questions.

You should spend a maximum of 20 minutes on this section.

**Write your answer to each question in the box provided.**

**1** What is an example of a **biological** catalyst?

- A** A lipid
- B** An amino acid
- C** An enzyme
- D** A substrate

Your answer

**[1]**

**2** The table shows the boiling points of the first five Group 0 elements.

Element	Boiling point (°C)
Helium	-269
Neon	-246
Argon	-186
Krypton	-152
Xenon	-107

Which statement describes the trend in the boiling points?

- A** The boiling points decrease as the molecules get larger.
- B** The boiling points decrease as the molecules get smaller.
- C** The boiling points increase as the atoms get larger.
- D** The boiling points increase as the atoms get smaller.

Your answer

**[1]**

- 3 The table shows the melting and boiling points of bromine.

Melting point (°C)	Boiling point (°C)
-7	59

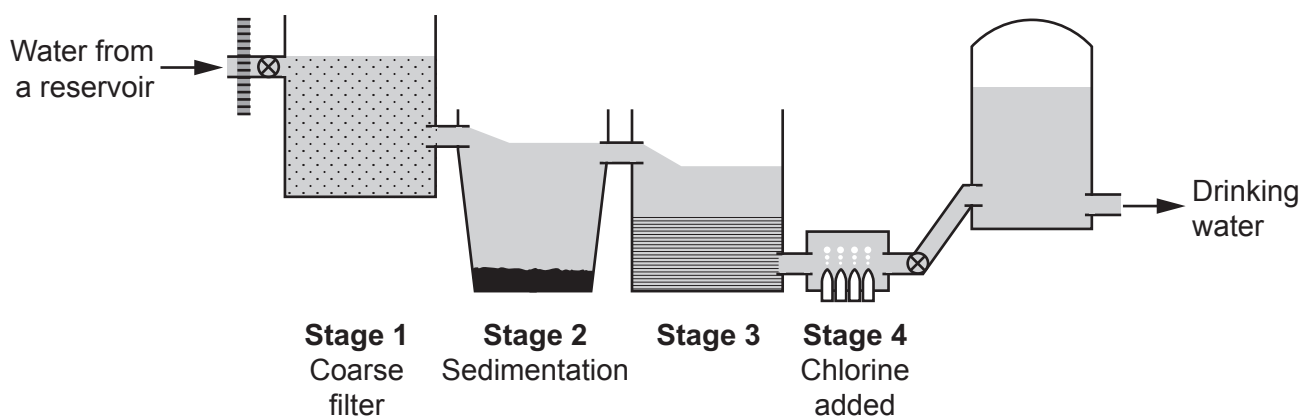
Which change of state happens when bromine is cooled from 65 °C to -5 °C?

- A Condensation
- B Evaporation
- C Freezing
- D Melting

Your answer

[1]

- 4 The diagram shows how drinking water can be produced from water from a reservoir.



What happens at **Stage 3**?

- A Any remaining solids are removed.
- B Bacteria are used to break down sludge.
- C Harmful bacteria are killed.
- D The pH of the water is checked and corrected.

Your answer

[1]

- 5 The composition of the Earth's atmosphere has changed over the last 4.5 billion years.

Which gas has increased by the **largest** amount?

- A Ammonia
- B Nitrogen
- C Oxygen
- D Water vapour

Your answer

[1]

- 6 Copper can be extracted from copper sulfide by heating it in air.

Copper sulfide contains 74.0% copper by mass.

An ore contains 2.00% copper sulfide.

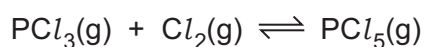
What is the maximum mass of copper that can be extracted from 150 kg of the ore?

- A 1.48 kg
- B 2.22 kg
- C 3.00 kg
- D 111 kg

Your answer

[1]

- 7 Look at the reaction.



Which statement explains why the rate of reaction changes as the pressure **increases**?

- A The energy of the particles increases.
- B The particles collide with more force.
- C The particles move faster.
- D There are more particles in the same volume.

Your answer

[1]

- 8 The rate of reaction of marble chips with dilute hydrochloric acid depends on the surface area of the marble chips.

Which surface area of the marble chips gives the **highest** rate of reaction?

- A** 0.673 mm<sup>2</sup>
- B** 1030 mm<sup>2</sup>
- C**  $2.18 \times 10^3$  mm<sup>2</sup>
- D**  $4.98 \times 10^{-2}$  mm<sup>2</sup>

Your answer

7

[1]

- 9** The Earth's early atmosphere is thought to have contained large amounts of carbon dioxide.

Which process does **not** explain how the amount of carbon dioxide in the atmosphere was decreased?

- A** It became 'locked up' in fossil fuels.
- B** It dissolved in the oceans.
- C** It reacted to produce metal oxides found in metal ores.
- D** It was used in photosynthesis by green plants.

Your answer

11

[1]

- 10** Look at the diagram of the Periodic Table.

A																B				
C																				
																				D

Which element, **A**, **B**, **C** or **D**, has the greatest tendency to form **positive ions** when it reacts with dilute hydrochloric acid?

Your answer

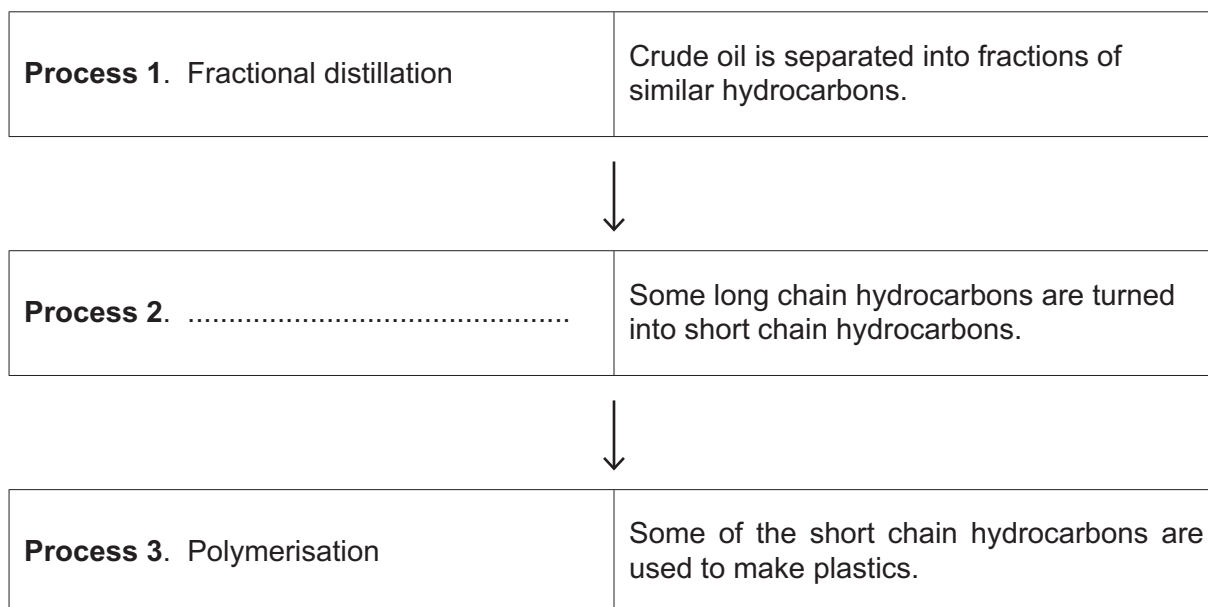
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[1]

## SECTION B

Answer **all** the questions.

- 11** Look at the flowchart. It shows how crude oil is changed into useful substances.



- (a) Complete the flowchart with the name of **Process 2**.

[1]

- (b) **Table 11.1** shows the supply and demand of two fractions of crude oil.

Fraction	Millions of barrels per day	
	Supply	Demand
Petrol	26	39
Fuel oil	19	11

**Table 11.1**

Explain the importance of **Process 2**.

Use information from **Table 11.1** in your answer.

.....

.....

.....

..... [2]

(c) The hydrocarbon fractions from **Process 1** contain different alkanes.

**Table 11.2** shows the boiling point of different alkanes produced in **Process 1**.

Number of carbon atoms in a molecule of the alkane	Boiling point (°C)
1	-162
2	-89
3	.....
4	-1
5	36

**Table 11.2**

(i) Complete **Table 11.2** with an estimate of the missing boiling point for an alkane molecule with **3 carbon atoms**. [1]

(ii) Write the formula for an alkane with **7 carbon atoms**.

..... [1]

12 A student investigates the rate of a reaction at different concentrations.

Fig. 12.1 shows the apparatus he uses.

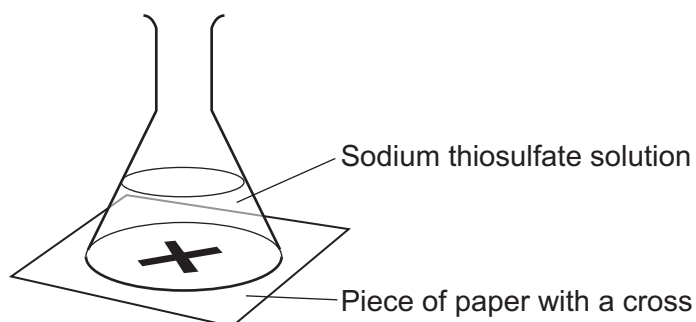


Fig. 12.1

The student adds dilute hydrochloric acid to the sodium thiosulfate solution. He times how long it takes for the cross to disappear. This is the reaction time.

The student repeats the experiment at different concentrations of sodium thiosulfate solution.

The concentration of hydrochloric acid is the same in each experiment.

He plots the results of the experiment on a graph, as shown in Fig. 12.2.

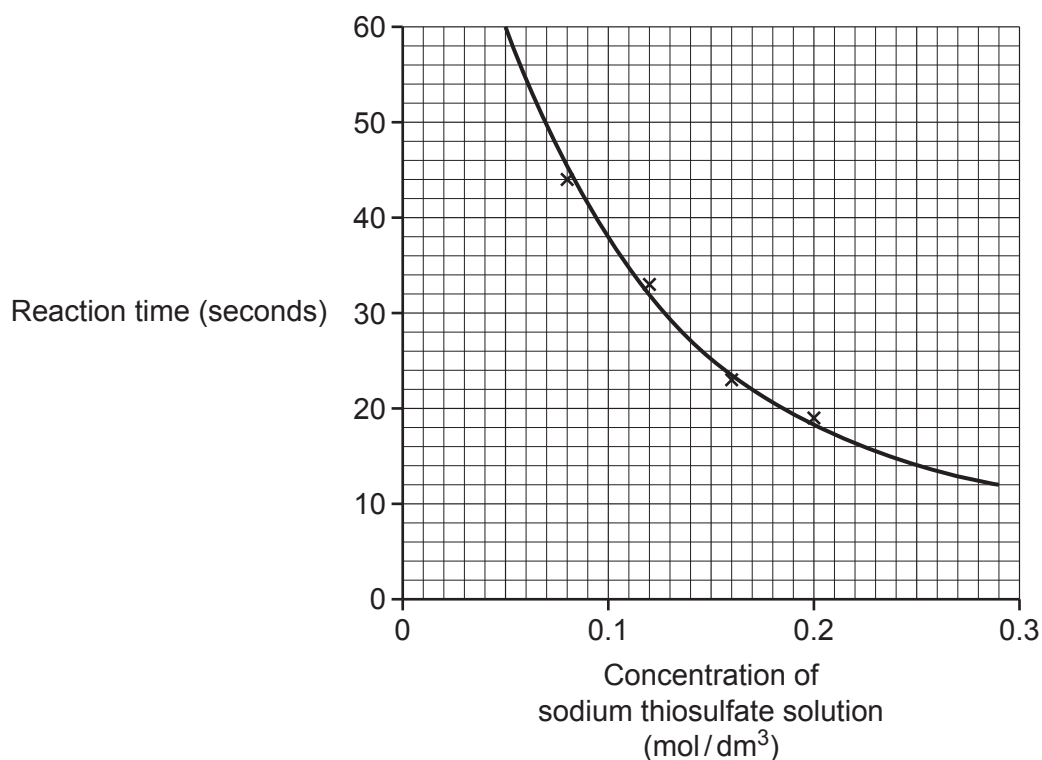


Fig. 12.2



- (a) Look at the equation for the reaction.



Which product in the reaction makes the cross disappear?

Tick (✓) **one** box.

$\text{NaCl}(\text{aq})$  ☐

$\text{S}(\text{s})$  ☐

$\text{SO}_2(\text{g})$  ☐

[1]

- (b) The rate of reaction can be calculated using the equation:

$$\text{Rate of reaction} = \frac{1}{\text{reaction time}}$$

Use the graph in **Fig. 12.2** to calculate the rate of reaction when the concentration of sodium thiosulfate solution is  $0.25 \text{ mol/dm}^3$ .

Give your answer to **2** decimal places.

Rate of reaction = ..... /s [3]

- (c) (i) Describe the trend shown by the graph in **Fig. 12.2**.

.....  
 ..... [1]

- (ii) State how the rate of reaction changes as the sodium thiosulfate concentration changes.

.....  
 ..... [1]

- (d) Another student investigates the effect of temperature on the rate of reaction.

She calculates the rate of reaction at different temperatures, as shown in the table.

Temperature (°C)	Rate of reaction (/s)
30	0.015
40	0.030
50	0.060
60	0.120

Predict the rate of reaction at 70 °C.

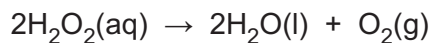
Predicted rate of reaction = ..... /s [1]

**11**  
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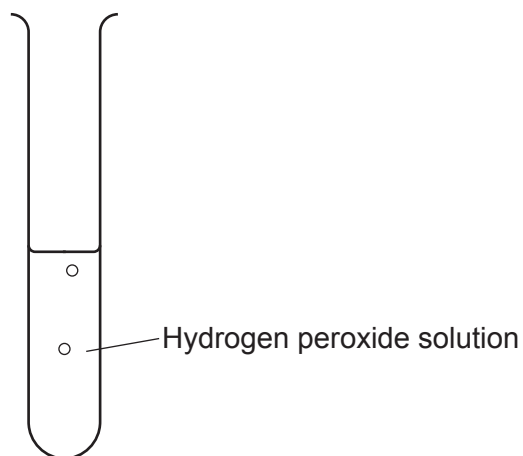
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**13** Hydrogen peroxide solution decomposes slowly to form water and oxygen.

Look at the equation for the reaction.



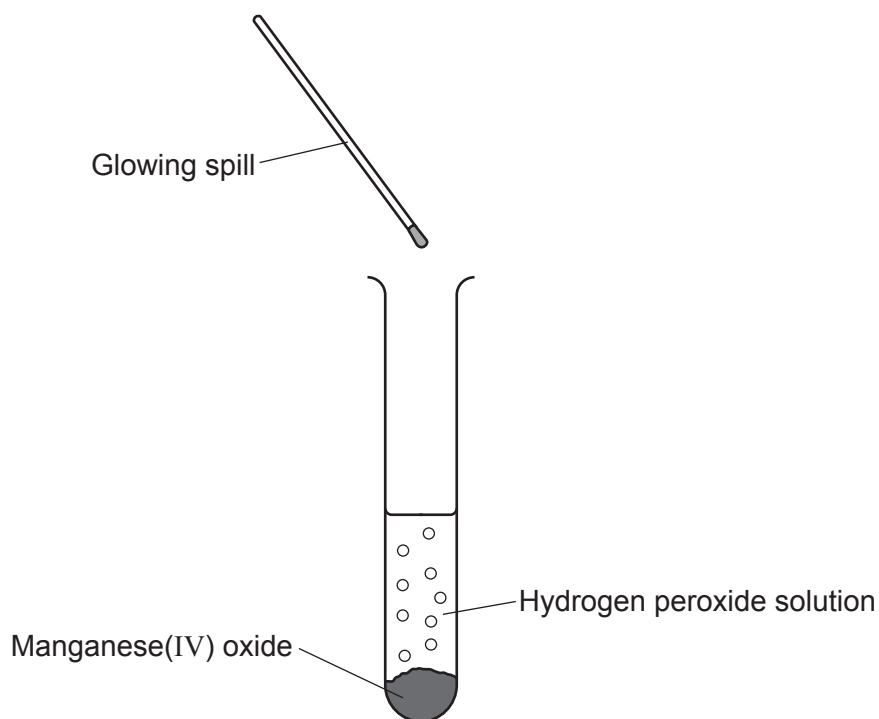
This reaction, shown in **Fig. 13.1**, is very slow.



**Fig. 13.1**

A student thinks that adding manganese(IV) oxide,  $\text{MnO}_2$ , will catalyse the decomposition reaction.

Her experiment is shown in **Fig. 13.2**.



**Fig. 13.2**

When she puts the glowing spill into the test tube in **Fig. 13.2** the spill relights.

The student separates the manganese(IV) oxide from the reaction mixture.

She adds this manganese(IV) oxide to a new solution of hydrogen peroxide.

Predict the results of this experiment if manganese(IV) oxide **is** a catalyst.

Explain your answer.

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..... [4]

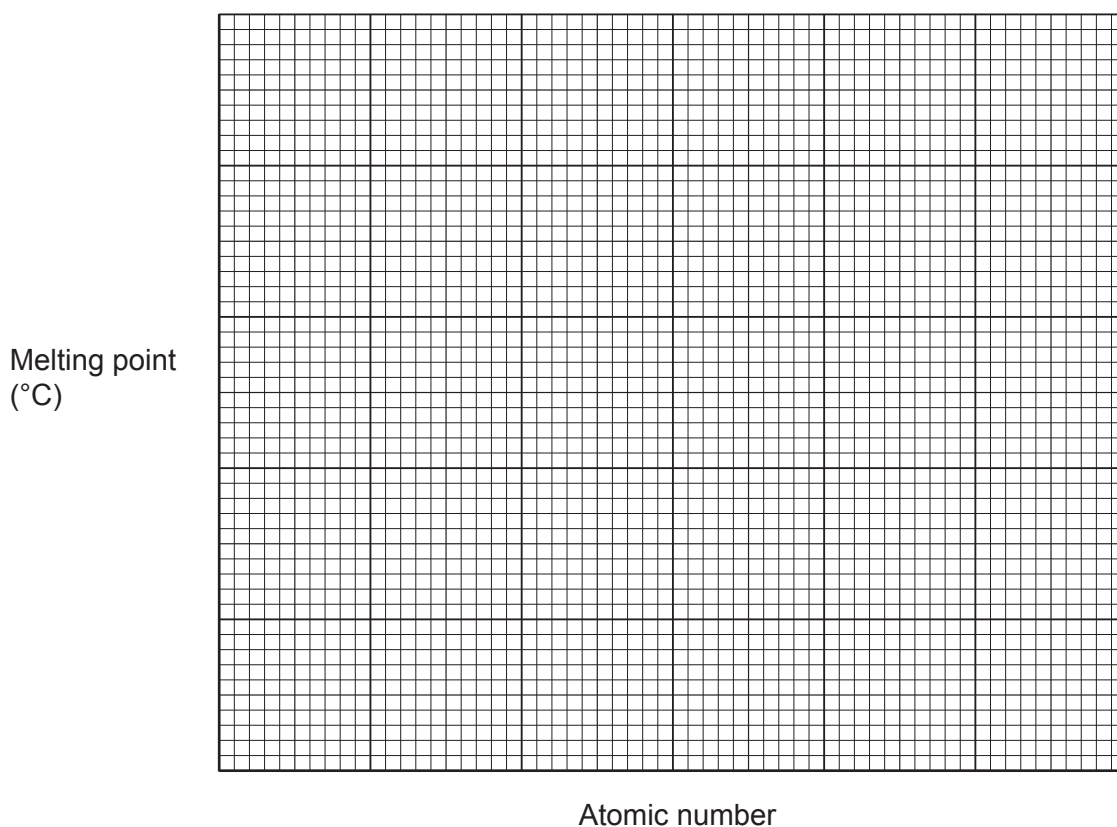
**14** Table 14.1 shows the melting points of some of the Group 1 metals.

Group 1 metal	Atomic number	Melting point (°C)
Lithium	3	181
Sodium	11	98
Potassium	19	63
Rubidium	37	39
Caesium	55	29

**Table 14.1**

(a) (i) Plot the data in Table 14.1 on the grid in Fig. 14.1.

Draw a line of best fit.



**Fig. 14.1**

[3]

(ii) Describe the relationship between the atomic number of the Group 1 metals and their melting points shown in Fig. 14.1.

.....

..... [1]

(b) Fig. 14.2 shows the structure of sodium.

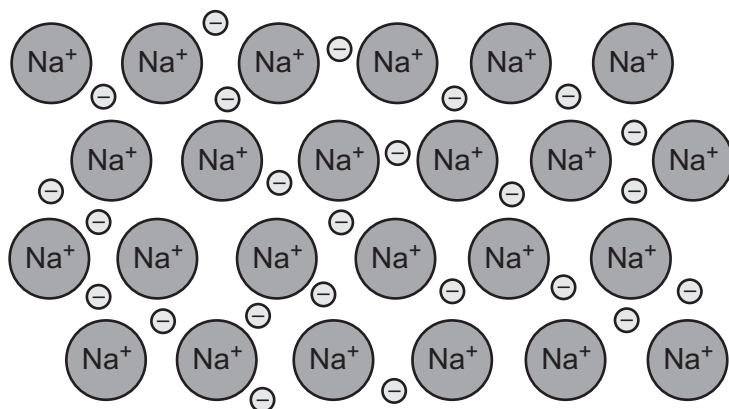


Fig. 14.2

(i) Describe the metallic bonding in sodium.

Use information from Fig. 14.2 in your answer.

.....

.....

.....

..... [2]

(ii) Look at the melting points of sodium and lithium in Table 14.1.

Suggest a reason for the difference in their melting points.

.....

..... [1]

15 This question is about the Earth's atmosphere and the greenhouse effect.

- (a) Scientists think that without the greenhouse effect the average temperature of the Earth's surface would be about  $-18^{\circ}\text{C}$ .

Explain how the greenhouse effect keeps the average temperature above  $-18^{\circ}\text{C}$ .

.....

.....

.....

..... [2]

- (b) Many scientists think that human activity is enhancing the greenhouse effect and leading to global warming.

Explain this statement.

.....

.....

.....

..... [2]

- (c) Student **A** thinks that the increased use of electric cars would help reduce the greenhouse effect.

Student **B** thinks that the increased use of electric cars would **not** help reduce the greenhouse effect.

Explain why **each** student may be correct.

.....

.....

.....

.....

..... [2]



(d) The waste gases from vehicle engines contain oxides of nitrogen.

(i) Explain how the oxides of nitrogen are formed in an engine.

.....

.....

.....

..... [2]

(ii) Most vehicles are fitted with catalytic converters. They reduce the amount of the oxides of nitrogen released into the atmosphere.

Describe why this is important.

.....

..... [1]



Pressure (MPa)	Amount of ammonia formed at different temperatures and pressure (%)				
	100 °C	200 °C	300 °C	400 °C	500 °C
2.5	92	64	27	9	3
5.0	95	74	40	15	6
10.0	97	82	53	25	11
20.0	98	89	67	39	18
40.0	99	95	80	55	32

Describe **and** explain how the percentage of ammonia formed changes with temperature and pressure.

Use the information provided in the table and your knowledge of reactions in dynamic equilibrium.

..... [6

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17 The alkanes in crude oil can be separated by fractional distillation.

This is because they have different boiling points.

The table shows the boiling points of hexane and octane.

Alkane	Boiling point (°C)
Hexane	69
Octane	126

(a) Hexane molecules are smaller than octane molecules.

Explain the difference in the boiling points of hexane and octane.

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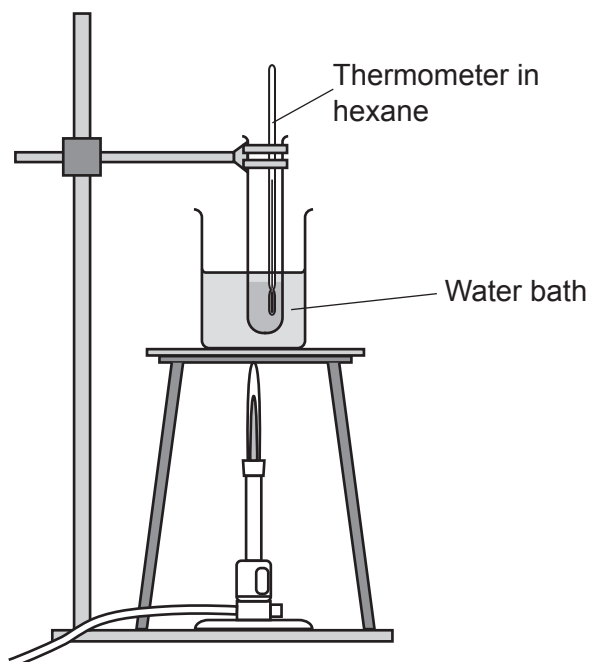
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..... [2]

(b) A teacher checks the boiling point of hexane.

The diagram shows his experiment.



The teacher slowly heats up the water until hexane boils.

He records the temperature at the boiling point of hexane.

A student thinks that this method can be used to determine the boiling point of hexane but **not** the boiling point of octane.

Explain why the student is correct.

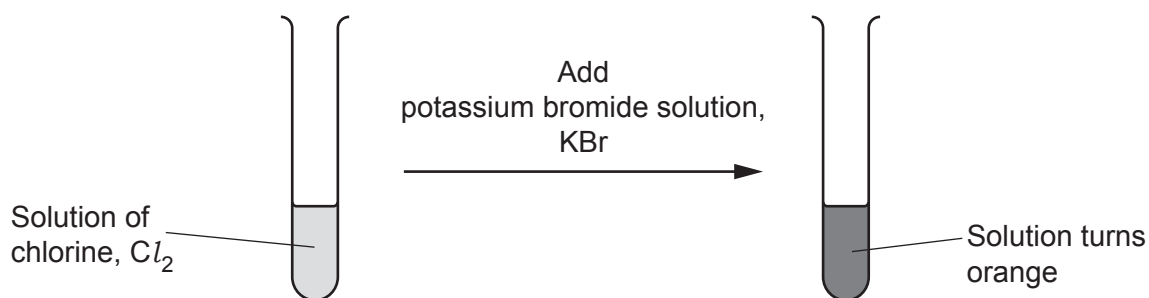
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..... [2]

- 18 The diagram shows what happens when a small amount of potassium bromide solution, KBr, is added to a solution of chlorine,  $\text{Cl}_2$ .



- (a) Write the **balanced symbol** equation for the reaction between potassium bromide, KBr, and chlorine,  $\text{Cl}_2$ .

..... [2]

- (b) Write down the name of the chemical which makes the solution orange.

..... [1]

- (c) (i) Write the **half equation** for the formation of chloride ions,  $\text{Cl}^-$ , from chlorine,  $\text{Cl}_2$ .

..... [1]

- (ii) In this reaction is chlorine oxidised or reduced?

Explain your answer.

.....

..... [1]

- (d) Explain why chlorine is **more** reactive than bromine.

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..... [3]

**END OF QUESTION PAPER**

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