AQA GCSE CHEMISTRY (HIGHER) · 8462

# CHEMISTRY



EXAM QUESTION PACK

## 4.3.5 USE OF AMOUNT OF SUBSTANCE IN RELATION TO VOLUMES OF GASES

| SCORE | PERCENTAGE |
| --- | --- |
| /46 | % |

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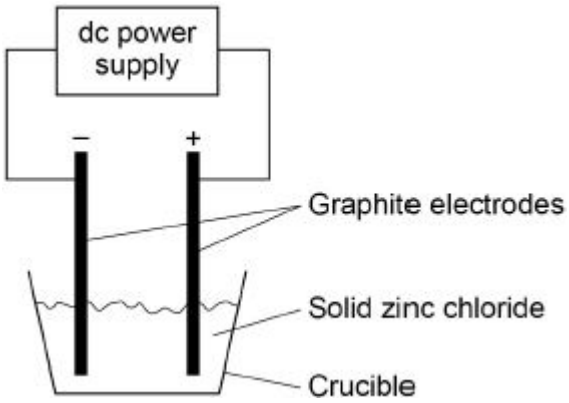
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## Q1.

A student investigated the electrolysis of different substances.

**Figure 1** shows the apparatus.

**Figure 1**




(a) Explain why electrolysis would not take place in the apparatus shown in **Figure 1**.

_____

_____

_____

_____

**(2)**

(b) Explain why graphite conducts electricity.

Answer in terms of the structure and bonding in graphite.

_____

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**(3)**

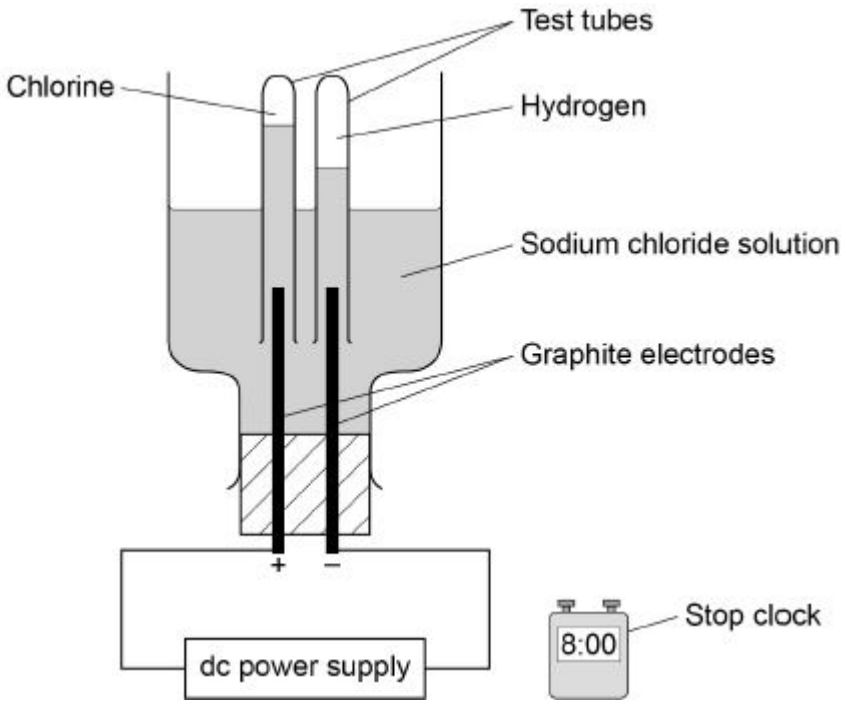
The student investigated how the volume of gases produced changes with time in the electrolysis of sodium chloride solution.

**Figure 2** shows the apparatus.

**Figure 2**



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(c) The student made an error in selecting the apparatus for this investigation.

How should the apparatus be changed?

Give **one** reason for your answer.

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_____

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**(2)**

Another student used the correct apparatus.

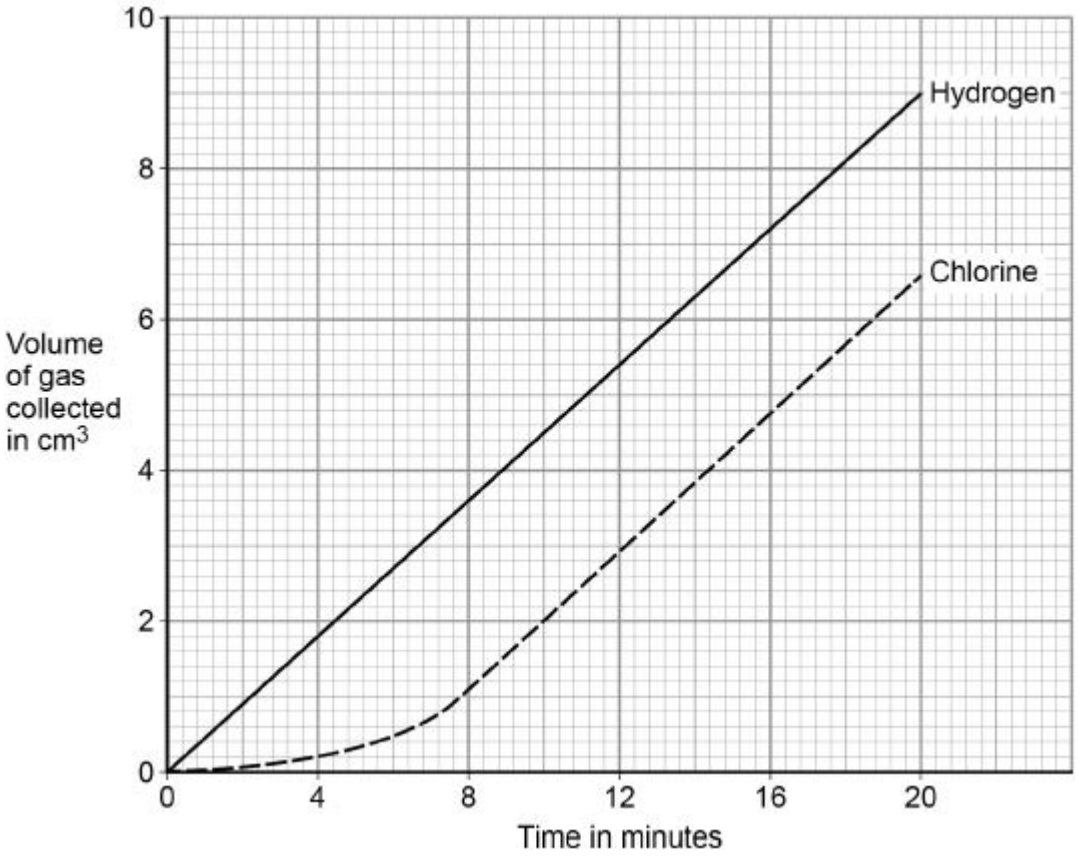
This student measured the volumes of gases collected every minute for 20 minutes.

**Figure 3** shows the student's results.

**Figure 3**



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(d) Describe the trends shown in the results.

Use values from **Figure 3**.

_____

_____

_____

_____

_____

_____

**(3)**

(e) The number of moles of each gas produced at the electrodes is the same.

No gas escapes from the apparatus.

Suggest **one** reason for the difference in volume of each gas collected.

_____

_____

**(1)**

(f) Calculate the amount in moles of chlorine collected after 20 minutes.

Use **Figure 3**.



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The volume of one mole of any gas at room temperature and pressure is 24.0 $dm^3$

Give your answer in standard form.

_____

_____

_____

_____

Moles of chlorine = _____ mol

**(3)**

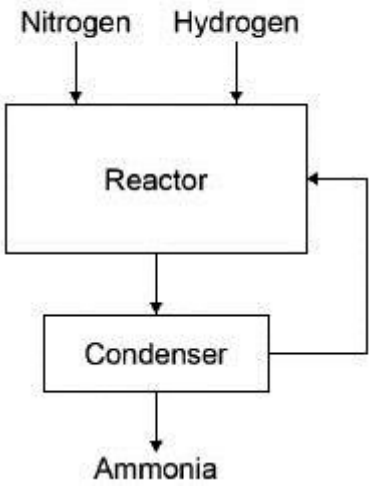
**(Total 14 marks)**

## Q2.

Nitrogen and hydrogen react to produce ammonia in the Haber process.

**Figure 1** shows the Haber process.

**Figure 1**




A gaseous mixture of ammonia, hydrogen and nitrogen leaves the reactor.

**Table 1** shows the boiling points of the gases.

**Table 1**

| Gas | Boiling point in °C |
|---|---|
| Ammonia | −33 |
| Nitrogen | −196 |
| Hydrogen | −253 |

(a) Suggest how ammonia is separated from the other gases.

_____



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_____

_____

_____

_____

**(2)**

(b) What happens to the unreacted hydrogen and nitrogen?

_____

_____

**(1)**

The equation for the reaction is:

$$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$$

The forward reaction is exothermic.

(c) Calculate the volume of ammonia produced from the complete reaction of 825 $dm^3$ of hydrogen.

_____

_____

_____

_____

Volume of ammonia = _____ $dm^3$

**(2)**

(d) The Haber process uses a temperature of 450 °C and a pressure of 200 atmospheres.

Why are these conditions used?

Tick **two** boxes.

- A higher pressure is maintained using less energy ☐
- A higher temperature would increase the equilibrium yield ☐
- A lower pressure would decrease the equilibrium yield ☐
- A lower temperature would make the reaction too slow ☐



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There are more product molecules than reactant molecules ☐

**(2)**

Most of the ammonia produced is used to make fertilisers.

**Table 2** shows information about compounds used as fertilisers.

**Table 2**

| Compound | Formula | Cost in £ / tonne |
|---|---|---|
| **A** | $NH_4NO_3$ | 220 |
| **B** | $(NH_4)_2HPO_4$ | 350 |
| **C** | KCl | 235 |

(e) Which element in compound A improves agricultural productivity?

_____

**(1)**

(f) Which **two** compounds can be mixed to make a fertiliser containing three elements that improve agricultural productivity?

Give a reason why you have chosen these compounds.

Compounds _____ and _____

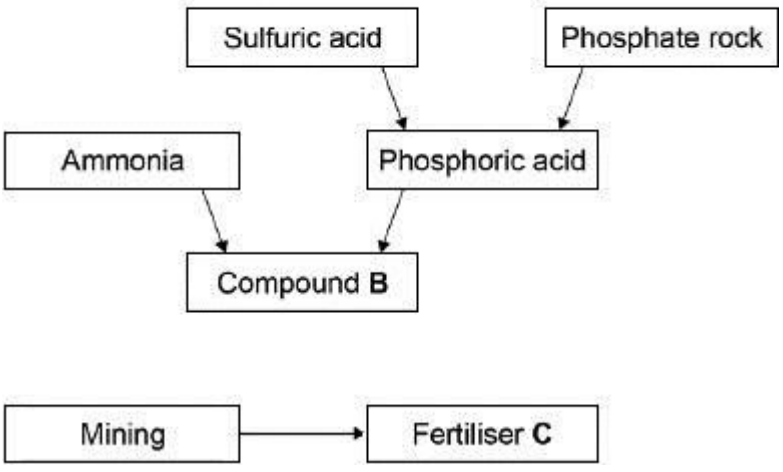
Reason _____

_____

**(2)**

(g) **Figure 2** shows a flow chart for the production of compounds B and C.

**Figure 2**






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Suggest **two** possible reasons for the difference in cost between compounds **B** and **C**.

1. _____

_____

2. _____

_____

**(2)**

**(Total 12 marks)**

## Q3.

Lead bromide is a solid. Some students were measuring how soluble lead bromide is at different temperatures.

This is the method they used.

**A** Pour 100 $cm^3$ of water into a beaker.

**B** Heat or cool the water to the required temperature.

**C** Add lead bromide to the water.

**D** Stir until no more lead bromide dissolves.

**E** Transfer 50 $cm^3$ of the lead bromide solution into an evaporating basin of known mass.

**F** Heat the evaporating basin until all of the water has evaporated.

**G** Measure the mass of the evaporating basin containing the dry lead bromide.

(a) (i) How could the lead bromide solution be separated from the undissolved solid lead bromide after step **D**?

Draw a ring around the correct answer.

**electrolysis** **filtration** **neutralisation**

**(1)**

(ii) Draw a ring around the correct answer to complete the sentence.

A suitable item of apparatus for measuring 50 $cm^3$ of the lead bromide solution in step **E** is a measuring

| |
|---|
| cylinder. |
| funnel. |
| tube. |

**(1)**

(iii) One student's results are shown in **Table 1**.

**Table 1**



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| | |
|---|---|
| Volume of lead bromide solution | 50 $cm^3$ |
| Mass of empty evaporating basin | 35.4 g |
| Mass of the evaporating basin containing dry lead bromide | 36.0 g |

Calculate the mass of lead bromide dissolved in 50 $cm^3$ of lead bromide solution.

_____

_____

Mass of lead bromide dissolved = _____ g

**(2)**

(b) A different student got the results shown in **Table 2**.

**Table 2**

| **Temperature of lead bromide solution in °C** | **Mass of lead bromide dissolved in 50 $cm^3$ of solution in g** |
|---|---|
| 0 | 0.20 |
| 20 | 0.40 |
| 40 | 0.70 |
| 60 | 1.70 |
| 80 | 1.55 |
| 100 | 2.30 |

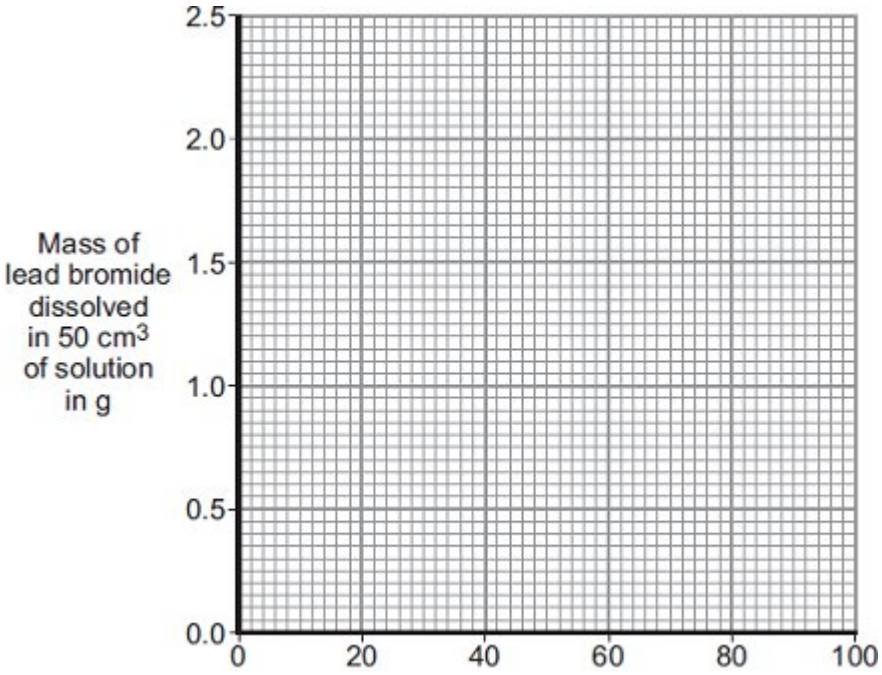
(i) Plot these results on the grid in **Graph 1**.

Draw a smooth curve of best fit.

**Graph 1**



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**(3)**

(ii) One of the points is anomalous.

Draw a ring around the anomalous point on the graph.

Suggest **one** possible error in the experiment, and give a reason why this error would cause the anomalous point.

_____

_____

_____

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**(3)**

(c) The solubility of lead bromide is so low that it can be made using a precipitation reaction.

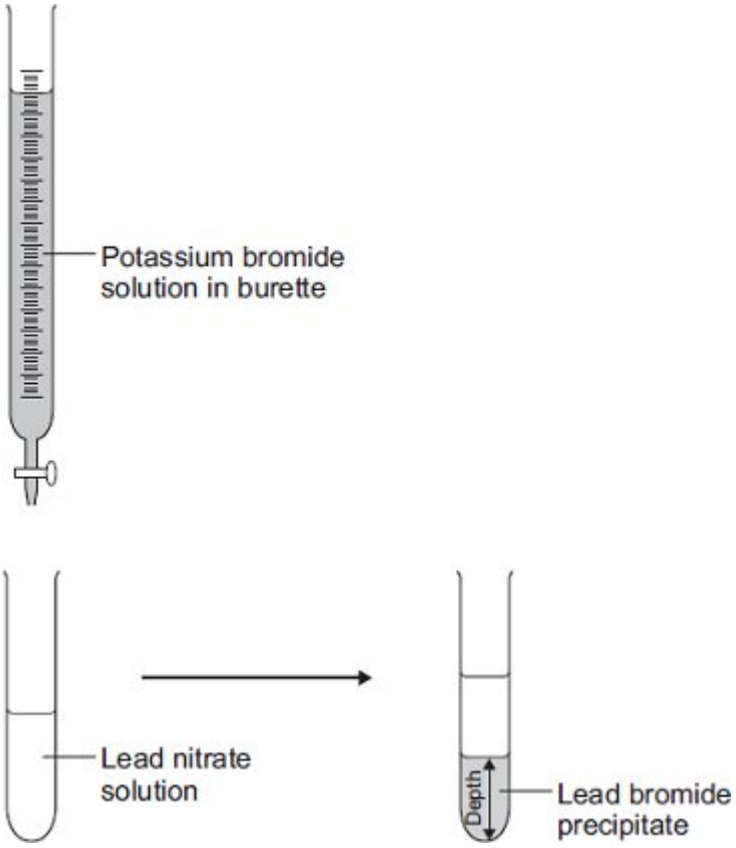
A student investigated how much lead bromide was precipitated when different volumes of potassium bromide and lead nitrate solutions were mixed together.

This is the method the student used.

- Place 10 $cm^3$ of lead nitrate solution in a boiling tube.
- Using a burette, add 2 $cm^3$ of potassium bromide solution to the boiling tube containing the lead nitrate solution.
- Leave the mixture to stand.
- Measure the depth of the lead bromide precipitate using a ruler.
- Repeat using different volumes of potassium bromide solution.



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(i) A teacher suggested that the student should do the reaction in a measuring cylinder.

Explain why it is a good idea to do the reaction in a measuring cylinder.

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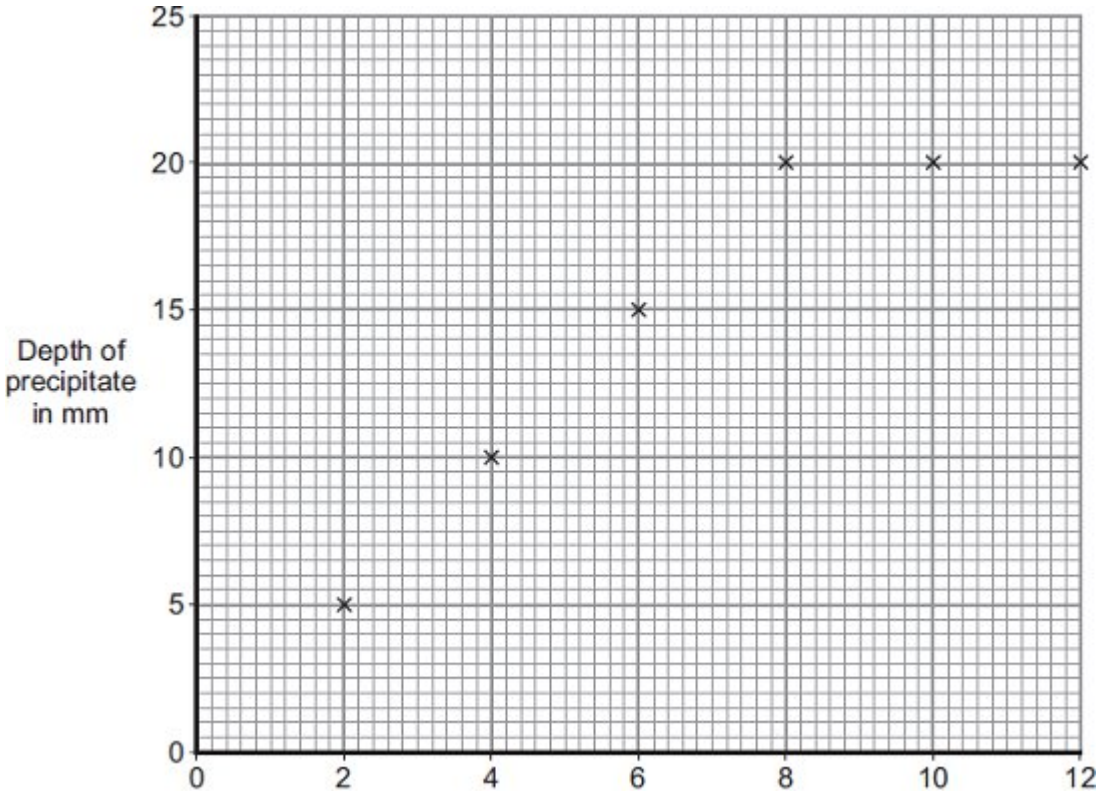
**(2)**

(ii) The student's results are plotted on **Graph 2**.

**Graph 2**



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There are no anomalous points.

Complete the graph by drawing two straight lines through the points.

**(2)**

(iii) What depth of precipitate would you expect to get if 14 $cm^3$ of potassium bromide was used?

Give a reason for your answer.

Depth of precipitate _____ mm

Reason _____

_____

_____

**(2)**

(iv) How would the results be different if the experiment was repeated using solutions at a higher temperature?

Give a reason for your answer.

_____

_____

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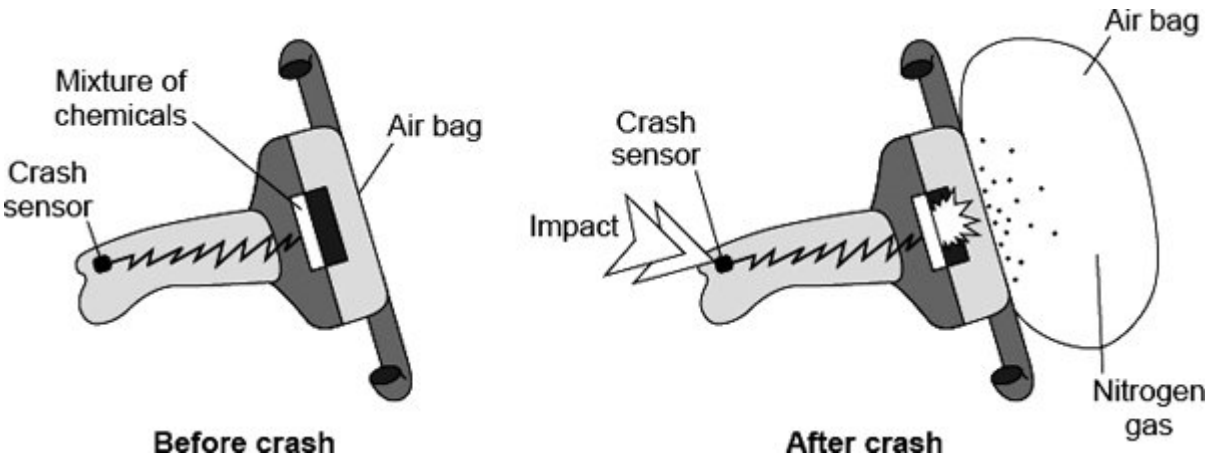
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**(2)**

**(Total 18 marks)**

## Q4.

Air bags are used to protect the passengers in a car during an accident. When the crash sensor detects an impact it causes a mixture of chemicals to be heated to a high temperature. Reactions take place which produce nitrogen gas. The nitrogen fills the air bag.




(a) The mixture of chemicals contains sodium azide ($NaN_3$) which decomposes on heating to form sodium and nitrogen.

$$2NaN_3 \rightarrow 2Na + 3N_2$$

A typical air bag contains 130 g of sodium azide.

(i) Calculate the mass of nitrogen that would be produced when 130 g of sodium azide decomposes.

Relative atomic masses ($A_r$): N = 14; Na = 23

_____

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_____

Mass of nitrogen = _____ g

**(3)**

(ii) 1 g of nitrogen has a volume of 0.86 litres at room temperature and pressure.

What volume of nitrogen would be produced from 130 g of sodium azide?

(If you did not answer part (a)(i), assume that the mass of nitrogen produced from 130 g of sodium azide is 80 g. This is **not** the correct answer to part (a)(i).)

_____



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Volume = _____ litres

**(1)**

(b) The sodium produced when the sodium azide decomposes is dangerous.
The mixture of chemicals contains potassium nitrate and silicon dioxide which help to make the sodium safe.

(i) Sodium reacts with potassium nitrate to make sodium oxide, potassium oxide and nitrogen. Complete the balancing of the equation for this reaction.

$10Na + _____KNO_3 \rightarrow Na_2O + K_2O + N_2$

**(1)**

(ii) The silicon dioxide reacts with the sodium oxide and potassium oxide to form silicates.

Suggest why sodium oxide and potassium oxide are dangerous in contact with the skin.

_____

_____

**(1)**

**(Total 6 marks)**



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