AQA - Using the Earth's resources and obtaining potable water – GCSE 2022 Chemistry

1. June/2022/Paper_8462/2F/No.5

0 5 Ammonia is produced in the Haber process.

The raw materials for the Haber process are nitrogen and hydrogen.

0 5 . 1 Draw **one** line from each raw material to the source of that raw material.

[2 marks]

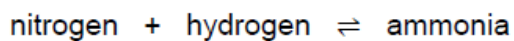| Raw material		Source of raw material
		Air
		Clay
Nitrogen		Limestone
Hydrogen		Natural gas
		Sand

0 5 . 2 What are the states of nitrogen and of hydrogen when used in the Haber process?

[1 mark]

Tick (✓) **one** box.

State of nitrogen	State of hydrogen	
Gas	Gas	
Gas	Liquid	
Liquid	Gas	
Liquid	Liquid	

0 5 . 3   The word equation for the production of ammonia is:

$$nitrogen \; + \; hydrogen \; \rightleftharpoons \; ammonia$$

The atom economy of the reaction is 100%.

How does the word equation show that the atom economy is 100%?

[1 mark]

Tick (✓) **one** box.

The reaction is reversible. ☐

There are two reactants. ☐

There is one product. ☐

0 5 . 4   **Figure 5** represents the Haber process.

Figure 5
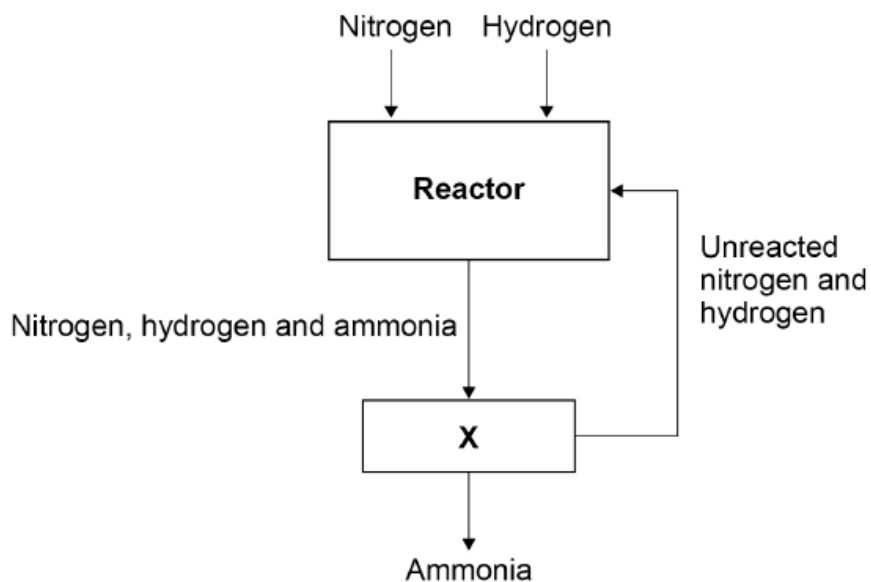
A mixture of nitrogen, hydrogen and ammonia enters **X**.

Complete the sentences.

Choose answers from the box.

[2 marks]

evaporated	filtered	liquefied	recycled

In **X**, the mixture is cooled.

The ammonia can be removed from **X** because the ammonia is

_____.

The unreacted nitrogen and hydrogen are

_____.

Table 8 shows the percentage yield of ammonia at different pressures.

Table 8

Pressure in atmospheres	Percentage (%) yield of ammonia
50	20
100	33
150	44
200	52
250	59
300	64

0 5 . 5 Plot the data from **Table 8** on **Figure 6**.

Draw a line of best fit.

[3 marks]

Figure 6
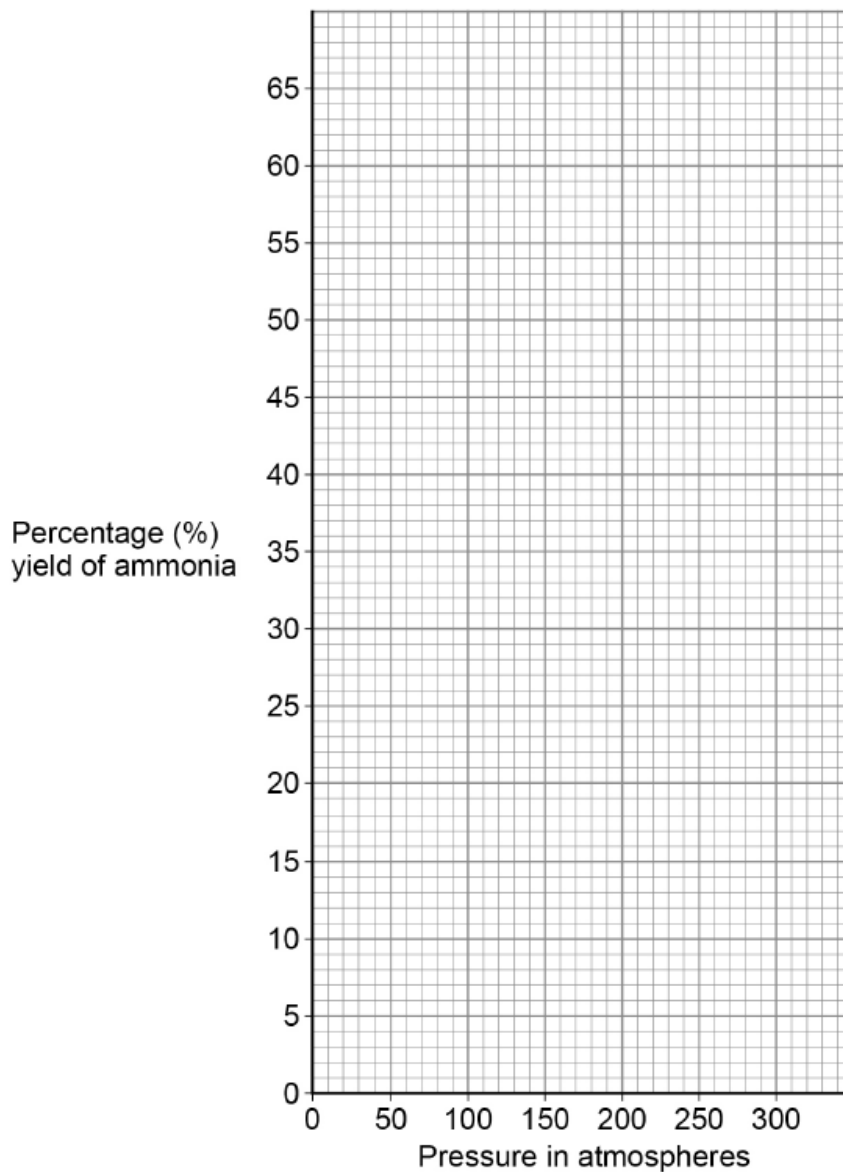
0 5 . 6 What is the effect of increasing the pressure on the percentage yield of ammonia?

Use **Table 8**.

[1 mark]

_____

_____

2. June/2022/Paper_8462/2F/No.7

| 0 | 7 |

This question is about fertilisers.

Ammonium nitrate is a fertiliser containing nitrogen.

| 0 | 7 |.| 1 |

Complete the sentence.

Choose the answer from the box.

[1 mark]

| hydrochloric acid | nitric acid | sulfuric acid |

Ammonium nitrate is produced by reacting ammonia with

_____ .

| 0 | 7 |.| 2 |

Ammonium nitrate fertiliser is sold in 600 kg bags.

A farmer spreads 40 bags of ammonium nitrate fertiliser on land with an area of 800 000 m^2.

Calculate the mass of ammonium nitrate fertiliser spread per m^2 of land.

[2 marks]

_____

_____

_____

Mass per m^2 = _____ kg/m^2

| 0 | 7 |.| 3 |

A scientist works for a company which makes ammonium nitrate fertiliser.

The scientist investigates the effect of different fertilisers on crop growth.

The scientist concludes that the ammonium nitrate fertiliser improves crop growth more than other fertilisers.

Suggest **one** reason why this conclusion might **not** be valid.

[1 mark]

_____

_____

A different fertiliser containing nitrogen has the formula $K_2NH_4PO_4$

0 7 . 4   How many atoms of nitrogen are in the formula $K_2NH_4PO_4$?

[1 mark]

_____

0 7 . 5   Nitrogen and potassium in the fertiliser $K_2NH_4PO_4$ are important for good crop growth.

Which other element in the fertiliser $K_2NH_4PO_4$ is important for good crop growth?

[1 mark]

Tick (✓) **one** box.

Hydrogen   ☐

Oxygen   ☐

Phosphorus ☐

0 7 . 6   Some fertilisers are mixtures of different compounds in fixed proportions.

What name is given to a mixture of different compounds in fixed proportions?

[1 mark]

_____

3. June/2022/Paper_8462/2F/No.10

| 1 | 0 | This question is about life cycle assessments (LCAs).

| 1 | 0 |.| 1 | Milk bottles can be made from glass or from a polymer.

Table 10 shows information about milk bottles of equal volume.

Table 10

	Glass	Polymer
Raw materials	Limestone Sand Sodium carbonate	Crude oil
Energy needed to process raw materials in kilojoules	6750	1710
Energy needed to manufacture bottle in kilojoules	750	90
Mass of bottle in grams	200	20
Mean number of times used during lifetime of bottle	25	1
One disposal method at end of useful life	Recycled to make different glass products	Recycled to make different polymer products

Evaluate the use of glass for milk bottles compared with the use of a polymer for milk bottles.

Use features of life cycle assessments (LCAs) in your answer.

Use **Table 10**.

[6 marks]

_____

_____

_____

_____

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_____

_____

| 1 | 0 |. 2 | Milk is also sold in cardboard cartons.

A carton is made using 40 cm³ of cardboard.

The density of the cardboard is 0.40 g/cm³.

Calculate the mass of the carton.

Use the equation:

$$\text{density} = \frac{\text{mass}}{\text{volume}}$$

[3 marks]

_____

_____

_____

_____

Mass = _____ g

4. June/2022/Paper_8462/2H/No.3

| 0 | 3 |

This question is about life cycle assessments (LCAs).

| 0 | 3 | . | 1 |

Milk bottles can be made from glass or from a polymer.

Table 2 shows information about milk bottles of equal volume.

Table 2

	Glass	Polymer
Raw materials	Limestone Sand Sodium carbonate	Crude oil
Energy needed to process raw materials in kilojoules	6750	1710
Energy needed to manufacture bottle in kilojoules	750	90
Mass of bottle in grams	200	20
Mean number of times used during lifetime of bottle	25	1
One disposal method at end of useful life	Recycled to make different glass products	Recycled to make different polymer products

Evaluate the use of glass for milk bottles compared with the use of a polymer for milk bottles.

Use features of life cycle assessments (LCAs) in your answer.

Use **Table 2**.

[6 marks]

_____

_____

_____

_____

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_____

_____

_____

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_____

_____

_____

| 0 | 3 |.| 2 | Milk is also sold in cardboard cartons.

A carton is made using 40 cm³ of cardboard.

The density of the cardboard is 0.40 g/cm³.

Calculate the mass of the carton.

Use the equation:

$$\text{density} = \frac{\text{mass}}{\text{volume}}$$

[3 marks]

_____

_____

_____

_____

Mass = _____ g

5. June/2022/Paper_8462/2H/No.5

| 0 | 5 |

This question is about water.

| 0 | 5 | . | 1 |

Sewage is waste water.

Sewage contains organic matter.

Describe how sewage is treated to remove organic matter.

[4 marks]

_____

_____

_____

_____

_____

_____

_____

Sea water and ground water are treated to make them potable.

Table 5 shows information about the composition and treatment of sea water and of ground water.

Table 5

	Sea water	**Ground water**
Concentration of sodium ions and chloride ions before **Process 1**	Na^+ : 0.5 mol/dm³ Cl^- : 0.5 mol/dm³	Na^+ : 0.001 mol/dm³ Cl^- : 0.001 mol/dm³
Process 1	Reverse osmosis	Filtration
Concentration of sodium ions and chloride ions after **Process 1**	**X**	Na^+ : 0.001 mol/dm³ Cl^- : 0.001 mol/dm³
Process 2	Add ozone	Expose to ultraviolet light

| 0 | 5 |.| 2 | Sea water is desalinated during **Process 1**.

Which pair of concentrations could represent **X** in **Table 5**?

[1 mark]

Tick (✓) **one** box.

Na^+ : 0.003 mol/dm³ Cl^- : 0.003 mol/dm³ ☐

Na^+ : 0.003 mol/dm³ Cl^- : 0.5 mol/dm³ ☐

Na^+ : 0.5 mol/dm³ Cl^- : 0.003 mol/dm³ ☐

Na^+ : 0.5 mol/dm³ Cl^- : 0.5 mol/dm³ ☐

| 0 | 5 |.| 3 | Explain why the concentrations of sodium ions and of chloride ions in the ground water in **Table 5** are unchanged by **Process 1**.

[2 marks]

_____

_____

_____

0 5 . 4 Explain why the ground water in **Table 5** requires **Process 2** before the water is safe to drink.

[2 marks]

_____

_____

_____

_____

0 5 . 5 After treatment the ground water in **Table 5** is sold by a company as pure water.

The ground water in **Table 5** is not chemically pure because the water contains sodium ions and chloride ions.

Suggest what the company means by 'pure'.

[1 mark]

_____

_____

0 5 . 6 Chlorine is also used to treat some ground water.

Describe the test for chlorine gas.
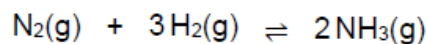
Give the result of the test.

[2 marks]

Test _____

_____

Result _____

_____

6. June/2022/Paper_8462/2H/No.7

| 0 | 7 |

Ammonia is produced in the Haber process.

The raw materials for the Haber process are nitrogen and hydrogen.

The equation for the reaction is:

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

| 0 | 7 |.| 1 |

Give the sources of the nitrogen and of the hydrogen used in the Haber process.
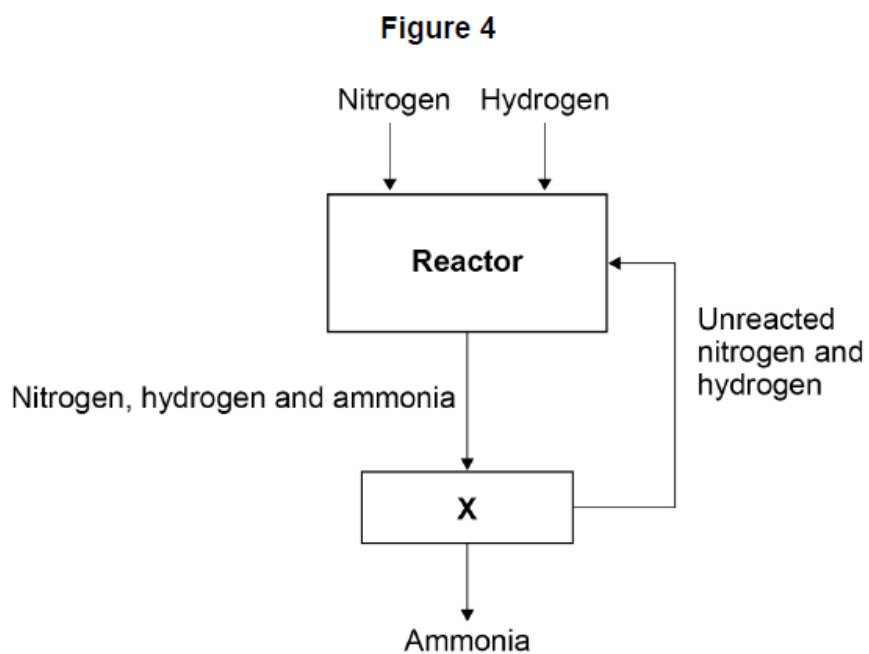
[2 marks]

Nitrogen _____

Hydrogen _____

| 0 | 7 |.| 2 |

How does the equation for the reaction show that the atom economy of the forward reaction is 100%?

[1 mark]

_____

_____

0 7 . 3 **Figure 4** represents the Haber process.

Figure 4

Nitrogen   Hydrogen

Reactor

Unreacted nitrogen and hydrogen

Nitrogen, hydrogen and ammonia

X

Ammonia

Explain how the ammonia produced is separated from the unreacted nitrogen and hydrogen in **X**.

[2 marks]

_____

_____

_____

_____

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

Table 6 shows the percentage yield of ammonia produced at 450 °C using different pressures.

Table 6

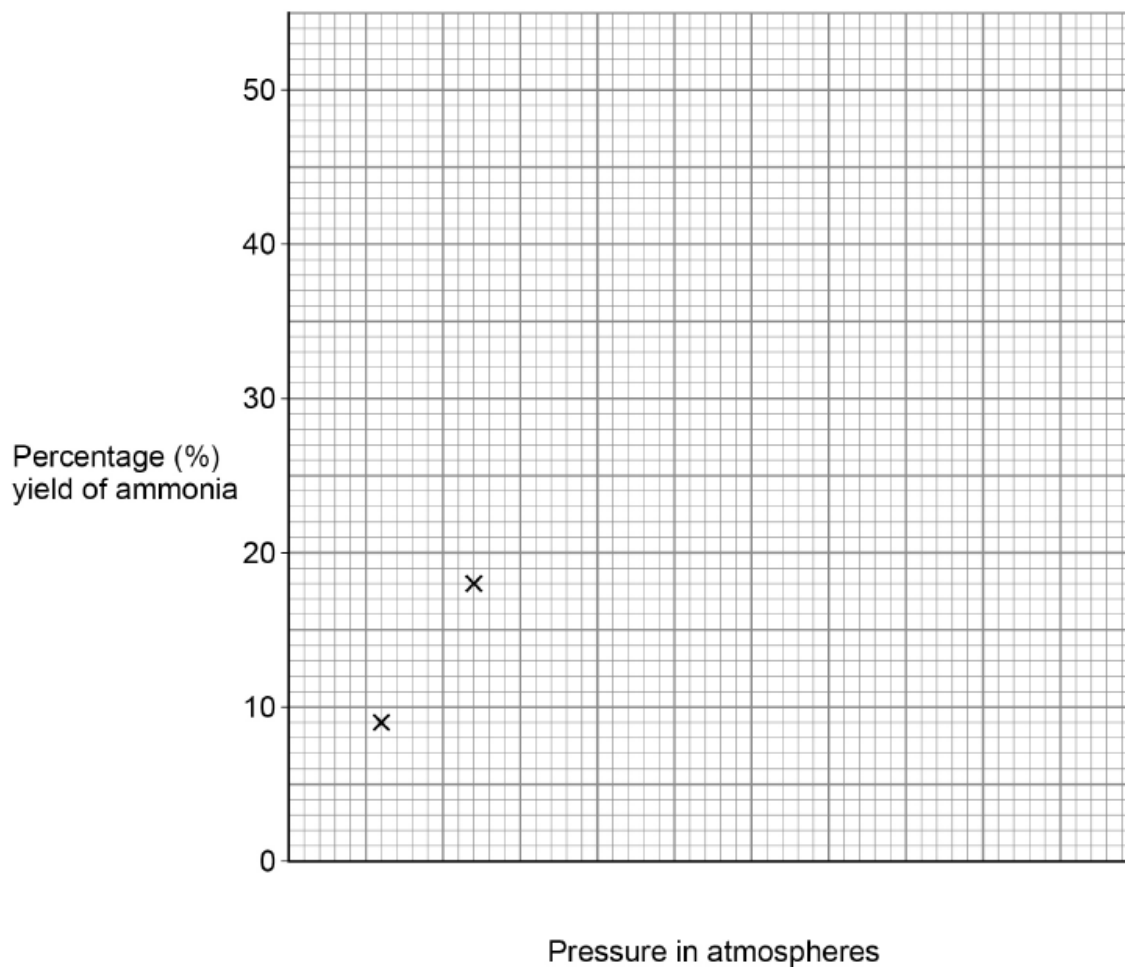| Pressure in atmospheres	Percentage (%) yield of ammonia
60	9
120	18
180	25
240	31
300	36
360	40
420	43

0 7 . 4   Complete **Figure 5**.

The first two points have been plotted.

You should:

- use a suitable scale for the *x*-axis
- plot the remaining data from **Table 6**
- draw a line of best fit.

[4 marks]

Figure 5

Pressure in atmospheres

0 7 . 5   Determine the percentage yield of ammonia at 450 °C and 500 atmospheres.

Show your working on **Figure 5**.

[2 marks]

Percentage yield = _____ %