AQA GCSE Chemistry | 8462

SPECIFICATION POINT 4.10.4.2

Production and uses of NPK fertilisers

Past-paper questions

Tier	**Foundation**
Question groups	**21**
Available paper years	**2008–2025**

Using this booklet

1. Answer the questions in order and show your working.
2. Original question numbers and marks are retained.
3. Print at actual size (100%) for measuring questions.
4. Use the companion answer booklet to check your work.

Name: _____ **Date:** _____

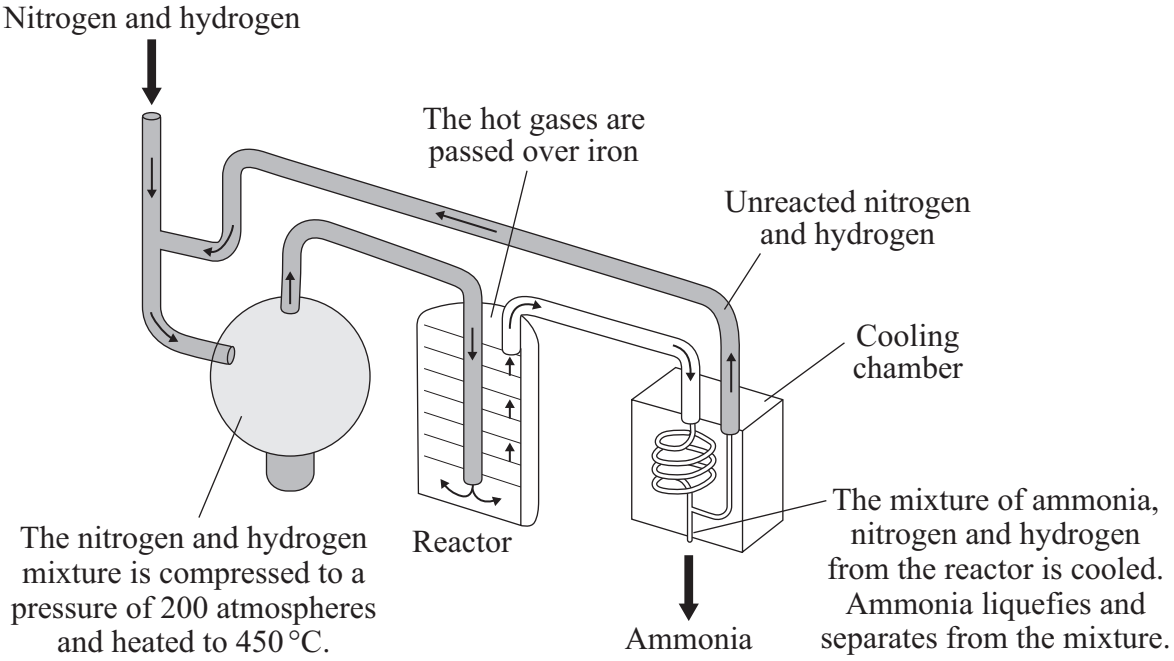
Whole questions are retained for context, so some parts assess other specification points. Current and legacy sources are labelled. Continue on extra paper if needed.

4.10.4.2 Production and uses of NPK fertilisers

Question 01

January 2008 | CHY2F | Original Q5 | Legacy

5 The Haber process is named after the German chemist, Fritz Haber.
The diagram shows the main stages in the Haber process.



(a) Use the diagram to help you to answer these questions.

(i) Complete the word equation for the reaction that takes place in the reactor.

nitrogen + ... ⇌ .....

(1 mark)

(ii) What does the symbol ⇌ mean?

.....

(1 mark)

(iii) What is the purpose of the iron in the reactor?

.....

(1 mark)

(iv) Ammonia is separated from unreacted nitrogen and hydrogen.
Draw a ring around the physical property that allows this separation to take place.

boiling point **density** **melting point**

(1 mark)

(v) What is done with the unreacted nitrogen and hydrogen?

.....

(1 mark)

4.10.4.2 Production and uses of NPK fertilisers

Question 01 · continued

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(b) Some of the products that can be made from ammonia are:

- fertilisers
- dyes
- explosives
- medicines
- plastics

(i) The Haber process was invented a few years before the start of the First World War. It is thought that the First World War would have finished earlier if the Germans had **not** invented the Haber process.

Suggest why.

.....

.....

(1 mark)

(ii) The Haber process has helped to increase food production.

Explain why.

.....

.....

(1 mark)

(c) Factories that make ammonia are very large and operate night and day.

(i) Ammonia factories are often near towns.

Suggest why.

.....

(1 mark)

(ii) Suggest and explain **one** reason why local people might not want an ammonia factory near their town.

.....

.....

.....

.....

(2 marks)

10

4.10.4.2 Production and uses of NPK fertilisers

Question 02

January 2008 | CHY2F | Original Q8 | Legacy

8 (a) A chemist was asked to identify a nitrogen compound. The chemist carried out an experiment to find the relative formula mass (M_r) of the compound.

The M_r of the compound was **44**.

Relative atomic masses: N = 14, O = 16

Draw a ring around the formula of the compound.

NO **NO_2** **N_2O_4** **N_2O**

(1 mark)

(b) Potassium nitrate is another nitrogen compound. It is used in fertilisers.
It has the formula **KNO_3**.

The M_r of potassium nitrate is **101**.

Calculate the percentage of **nitrogen** by mass in potassium nitrate.

Relative atomic mass: N = 14.

.....

.....

Percentage of nitrogen = ... %

(2 marks)

3

4.10.4.2 Production and uses of NPK fertilisers

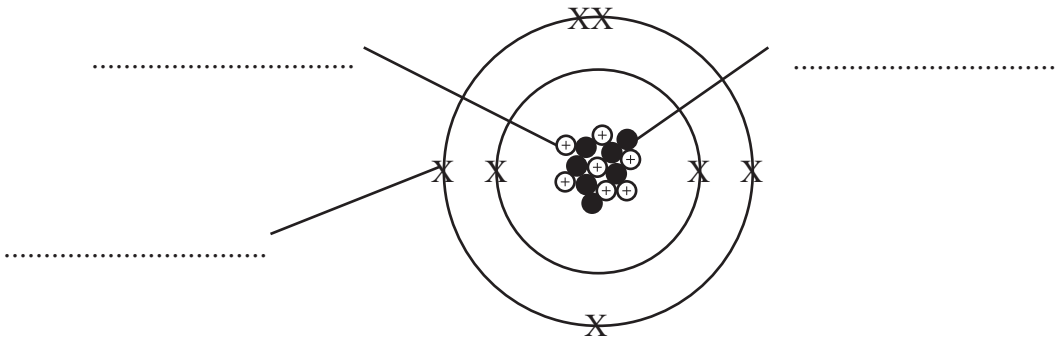
Question 03

June 2008 | CHY2F | Original Q5 | Legacy

5 (a) The diagram represents an atom of nitrogen.

5 (a) (i) Use words from the box to label the diagram.

electron	**neutron**	**nucleus**	**proton**



(2 marks)

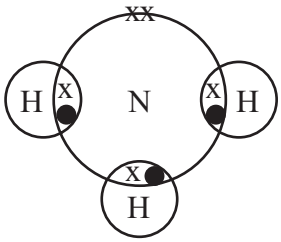
5 (a) (ii) Draw a ring around the mass number of this atom.

5 **7** **14** **21**

(1 mark)

5 (b) Nitrogen can react with hydrogen to make ammonia, NH_3.

A



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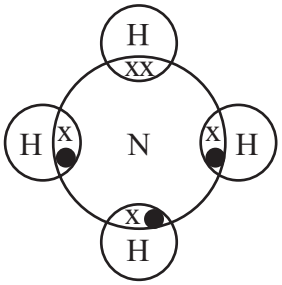

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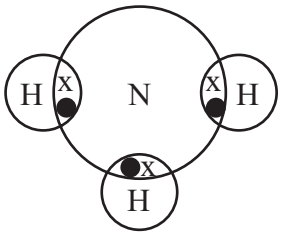
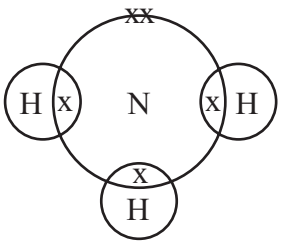


D



Which diagram, **A**, **B**, **C** or **D**, best represents an ammonia molecule?

(1 mark)

4.10.4.2 Production and uses of NPK fertilisers

Question 03 · continued

for mark

5 (c) Ammonia is made using the Haber process. The word equation for this reaction is shown below.

nitrogen + hydrogen $\rightleftharpoons$ ammonia

5 (c) (i) Which **two** of the statements in the table do you know are true **only** by looking at the word equation?

Put a tick (✓) next to these **two** true statements.

Statement	(✓)
The reaction is very fast.	
Ammonia can break up to form nitrogen and hydrogen.	
Ammonia is made from nitrogen and hydrogen.	
The reaction that makes ammonia is endothermic.	

(2 marks)

5 (c) (ii) Draw a ring around the name of the raw material from which nitrogen is obtained.

air **methane** **oil** **water**

(1 mark)

5 (d) Some of the ammonia produced is neutralised by nitric acid to make a salt. This salt is used as a fertiliser.

Put a tick (✓) next to the name of the salt produced when ammonia is neutralised with nitric acid.

Name of salt	(✓)
ammonia nitrate	
ammonia nitride	
ammonium nitrate	
ammonium nitride	

(1 mark)

8

4.10.4.2 Production and uses of NPK fertilisers

Question 04

January 2010 | CHY2F | Original Q2 | Legacy

2 Ammonium salts are used to help farmers grow crops.



2 (a) Use the correct word from the box to complete the sentence.

fertilisers	**insecticides**	**pesticides**

Ammonium salts contain nitrogen and are used by farmers as ..... to replace the nitrogen lost from the soil.

(1 mark)

2 (b) Ammonia is made by reacting nitrogen with hydrogen.

Draw a ring around the name of the raw material that provides the nitrogen.

air **crude oil** **water**

(1 mark)

2 (c) Methane and water react together to form the hydrogen.

methane and water → reactor containing a catalyst → hydrogen and carbon monoxide

2 (c) (i) Complete the word equation for this reaction.

methane + ... → hydrogen + ...

(1 mark)

4.10.4.2 Production and uses of NPK fertilisers

Question 04 · continued

for mark

2 (c) (ii) How does the catalyst help this reaction?

.....

.....

(1 mark)

2 (d) The reaction between nitrogen and hydrogen to make ammonia can be represented by this equation.

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

Draw a ring around the meaning of the symbol, $\rightleftharpoons$

endothermic reaction **precipitation reaction** **reversible reaction**

(1 mark)

2 (e) A solution of ammonia in water is alkaline.

2 (e) (i) Which **one** of these values could be the pH of this ammonia solution?

Draw a ring around your answer.

4 **7** **10**

(1 mark)

2 (e) (ii) The ammonium salt called ammonium sulfate can be made by reacting ammonia solution with an acid.

Use the correct words from the box to complete the sentences.

hydrochloric	**hydrogen**	**sulfuric**	**water**

Ammonia solution is reacted with ..... acid to make ammonium sulfate.

During the reaction the hydrogen ions from the acid react with hydroxide

ions from the alkali to make..... .

(2 marks)

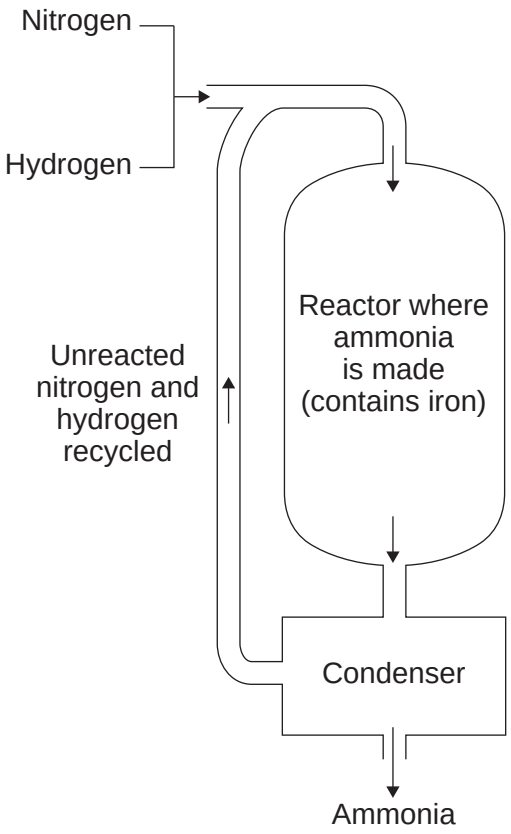
8

4.10.4.2 Production and uses of NPK fertilisers

Question 05

June 2010 | CHY2F | Original Q6 | Legacy

6 (a) The diagram shows how ammonia is made.



6 (a) (i) Complete the word equation for the reaction that takes place in the reactor.

nitrogen + ... → .....

(1 mark)

6 (a) (ii) Ammonia is made by passing nitrogen and hydrogen over hot iron.
Why is iron used in the reactor?

.....

.....

(1 mark)

6 (a) (iii) Explain how ammonia is separated from the unreacted nitrogen and hydrogen.

.....

.....

.....

.....

(2 marks)

4.10.4.2 Production and uses of NPK fertilisers

Question 05 · continued

6 (b) Ammonia is used to make the fertiliser ammonium nitrate.

Calculate the relative formula mass (M_r) of ammonium nitrate, NH_4NO_3

Relative atomic masses (A_r): H = 1; N = 14; O = 16

.....

.....

.....

.....

Relative formula mass = ...

(2 marks)

6 (c) Another fertiliser is potassium nitrate, KNO_3

The relative formula mass (M_r) of potassium nitrate is 101.

Relative atomic masses (A_r): N = 14; O = 16; K = 39

The table shows the percentage by mass of potassium and nitrogen in four fertilisers, **A**, **B**, **C** and **D**.

Fertiliser	Percentage by mass of potassium (%)	Percentage by mass of nitrogen (%)
A	12.45	25.21
B	19.91	24.12
C	38.61	13.86
D	24.89	9.25

Which fertiliser, **A**, **B**, **C** or **D**, is potassium nitrate?

You **must** show your working to gain full marks.

.....

.....

.....

.....

Potassium nitrate is fertiliser ☐

(2 marks)

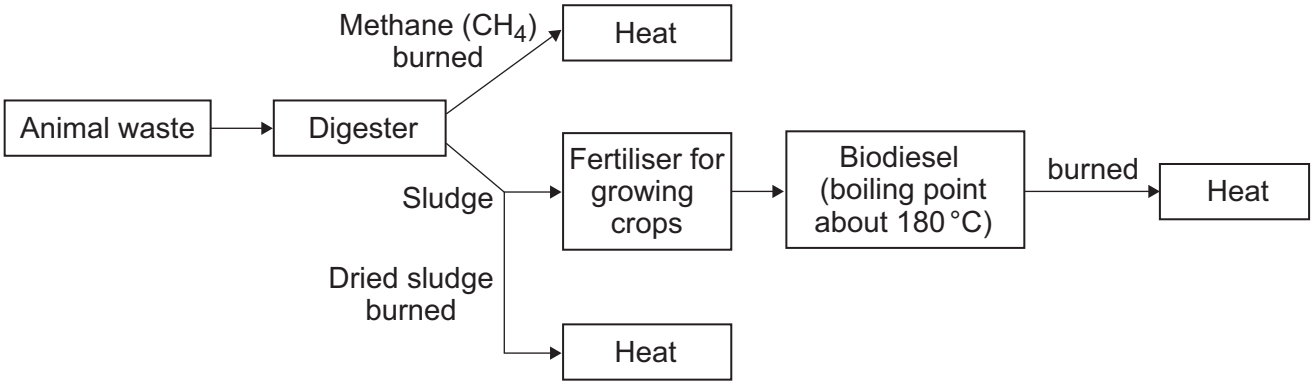
8

4.10.4.2 Production and uses of NPK fertilisers

Question 06

QUESTION THREE

The diagram shows how animal waste can be used to produce heat.



Match words, **A**, **B**, **C** and **D**, with the numbers **1–4** in the table.

A Biodiesel

B Methane

C Animal waste

D Dried sludge

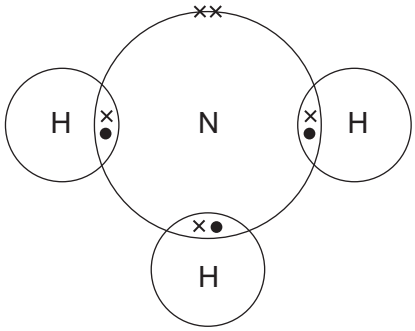
1	This substance is the raw material for the process.
2	This fuel is a gas.
3	This fuel is a liquid.
4	This fuel is a solid.

4.10.4.2 Production and uses of NPK fertilisers

Question 07

June 2011 | CHY2F | Original Q1 | Legacy

1 The diagram shows how the atoms are bonded in ammonia.



1 (a) Draw a ring around the correct answer.

1 (a) (i) The formula of an ammonia molecule is

NH^3 **N_3H** **NH_3**

(1 mark)

1 (a) (ii) The particles represented by the dots (•) and crosses (×) in the diagram are

electrons **neutrons** **protons**

(1 mark)

1 (a) (iii) The bonds between the nitrogen and hydrogen atoms in ammonia are

covalent **ionic** **metallic**

(1 mark)

4.10.4.2 Production and uses of NPK fertilisers

Question 07 · continued

1 (b) Ammonia is made by reacting nitrogen with hydrogen in the Haber process.
The equation for this reaction is shown below.

nitrogen + hydrogen $\rightleftharpoons$ ammonia

1 (b) (i) Use words from the box to complete the sentences.

air	**limestone**	**iron ore**	**natural gas**

Nitrogen is obtained from ..... .

Hydrogen is obtained from ..... .

(2 marks)

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

The symbol $\rightleftharpoons$ means that the reaction is

exothermic.
endothermic.
reversible.

(1 mark)

1 (b) (iii) A catalyst is used in the Haber process.

Draw a ring around the name of this catalyst.

iron **magnesium** **sodium**

(1 mark)

1 (c) Ammonium nitrate is a fertiliser that can be made by reacting ammonia with an acid.

Draw a ring around the name of the acid used in this reaction.

hydrochloric acid **nitric acid** **sulfuric acid**

(1 mark)

Question 1 continues on the next page

4.10.4.2 Production and uses of NPK fertilisers

Question 07 · continued

1 (d) Humberstone was a town in the desert of Northern Chile in South America. It was built for the people who worked in the nearby sodium nitrate mines.

The sodium nitrate was used as a fertiliser.

The sodium nitrate was exported by ship to countries all around the world.

Today the mines have closed and nobody lives in Humberstone.



One of the reasons for the mines closing was the invention of the Haber process.

Haber process factories can be built anywhere in the world.

1 (d) (i) How did the invention of the Haber process affect the people of Humberstone?

.....

.....

(1 mark)

1 (d) (ii) Suggest **two** advantages of making ammonium nitrate in the UK rather than importing sodium nitrate from Chile.

1 .....

.....

2 .....

.....

(2 marks)

11

4.10.4.2 Production and uses of NPK fertilisers

Question 08

June 2011 | CHY2F | Original Q2 | Legacy

2 The picture shows lumps of phosphate rock.



Phosphoric acid is made by reacting phosphate rock with sulfuric acid.

Only **three** of the methods shown below will **increase** the rate of this reaction.

Put a **tick** (✓) next to each of the **three** methods that will **increase** the rate of this reaction.

Method	Tick (✓)
Use a more concentrated solution of sulfuric acid	
Use larger lumps of phosphate rock	
Cool the mixture of phosphate rock and sulfuric acid	
Grind the phosphate rock into a powder before adding the acid	
Increase the temperature of the sulfuric acid	
Dilute the sulfuric acid solution with water	

(3 marks)

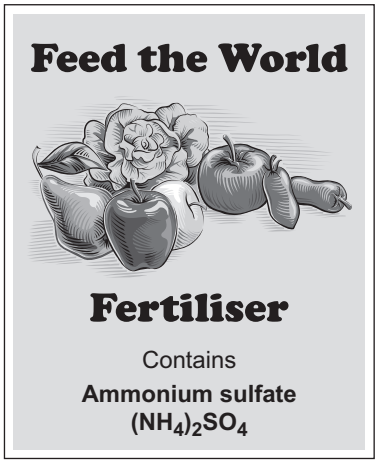
3

4.10.4.2 Production and uses of NPK fertilisers

Question 09

June 2011 | CHY3F | Original Q3 | Legacy

3 Ammonium sulfate is an artificial fertiliser.



3 (a) A student tested this fertiliser to prove that it contained ammonium ions and sulfate ions.

Draw a ring around the correct answer to complete each sentence.

3 (a) (i) Test for ammonium ions (NH_4^+).

The student added [sodium chloride solution / sodium hydroxide solution / dilute sulfuric acid] to the fertiliser.

A gas called ammonia was produced.

Ammonia turns damp litmus paper [blue. / green. / red.]

(2 marks)

3 (a) (ii) Test for sulfate ions (SO_4^{2-}).

The student added [barium chloride / silver nitrate / sodium chloride] solution to a solution of the fertiliser.

A [blue / red / white] precipitate was formed.

(2 marks)

4.10.4.2 Production and uses of NPK fertilisers

Question 09 · continued June 2011 | CHY3F | Original Q3 | Legacy

3 (b) Ammonium sulfate is made by reacting sulfuric acid with ammonia solution.

Sulfuric acid is a *strong* acid.

Draw a ring around the correct answer to complete the sentence.

The word *strong* means that the acid is

- difficult to break.
- very concentrated.
- fully ionised in water.

(1 mark)

3 (c) Use the information about acids in the table to help you answer these questions.

Name of chemical	Ions produced in aqueous solution		pH	Universal Indicator added
Ethanoic acid	H^+	CH_3COO^-	5	Goes orange
Sulfuric acid	H^+	SO_4^{2-}	1	Goes red

Draw a ring around the correct answer to complete each sentence.

3 (c) (i) Sulfuric acid and ethanoic acid are both acids because they contain

- CH_3COO^- ions.
- H^+ ions.
- SO_4^{2-} ions.

(1 mark)

3 (c) (ii) Sulfuric acid is a stronger acid than ethanoic acid.

The pH of stronger acids is

- higher than
- lower than
- the same as

the pH of weaker acids.

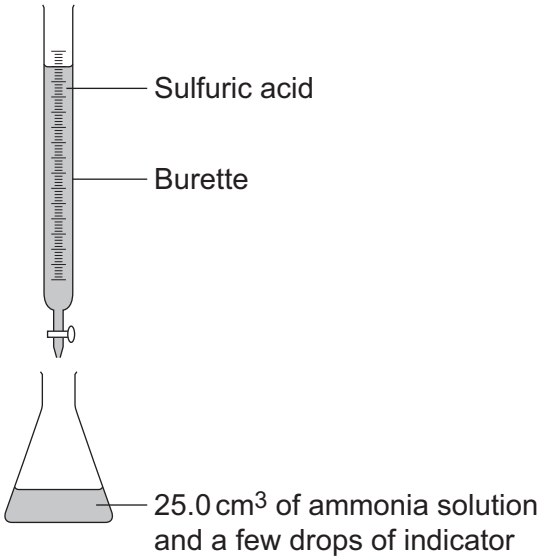
(1 mark)

4.10.4.2 Production and uses of NPK fertilisers

Question 09 · continued

3 (d) The volume of sulfuric acid that reacts with 25.0 cm^3 of ammonia solution can be found by titration.

The diagram shows the apparatus used for the titration.



A student did the titration five times and recorded the following results.

Titration	1	2	3	4	5
Volume of acid added in cm^3	13.3	13.9	13.2	13.1	13.2

3 (d) (i) How did the student know when enough sulfuric acid had been added to neutralise the ammonia solution?

.....

.....

(1 mark)

3 (d) (ii) The student did **not** use one of the results because it was anomalous.

Which result was anomalous? .....

(1 mark)

3 (d) (iii) Use the **other** four results to calculate the mean volume of sulfuric acid that reacted with the ammonia.

.....

.....

Mean volume = ... cm^3

(1 mark)

10

4.10.4.2 Production and uses of NPK fertilisers

Question 10

June 2013 | CH2FP | Original Q2 | Legacy

2 This question is about salts of ammonia and salts of lead.

2 (a) Ammonia dissolves in water to make an alkaline solution.

Draw a ring around the correct answer to complete the sentence.

The pH of a solution of ammonia is

2.
7.
11.

(1 mark)

2 (b) Ammonia can be reacted with an acid to produce the salt ammonium nitrate.

2 (b) (i) Name the acid used to produce ammonium nitrate.

.....

(1 mark)

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

The reaction of ammonia with an acid is a

neutralisation
polymerisation
reduction

reaction.

(1 mark)

2 (c) Why do farmers use ammonium nitrate on their fields?

.....

.....

(1 mark)

4.10.4.2 Production and uses of NPK fertilisers

Question 10 · continued June 2013 | CH2FP | Original Q2 | Legacy

2 (d) Lead iodide is a salt that can be produced without using an acid.

2 (d) (i) Lead iodide is produced by mixing two solutions.

Complete the word equation.

lead ..... + potassium ..... ⟶ lead iodide + potassium nitrate

(2 marks)

2 (d) (ii) The lead iodide is produced as a solid.

Complete the sentence.

A solid that is produced when two solutions are mixed is called a ..... .

(1 mark)

2 (d) (iii) How could the solid lead iodide be separated from the solution?

.....

(1 mark)

2 (d) (iv) A student mixed two solutions to make sodium chloride.

The equation for the reaction the student used is:

$$HCl(aq) + NaOH(aq) \longrightarrow NaCl(aq) + H_2O(l)$$

How could the student obtain solid sodium chloride from the solution?

.....

(1 mark)

9

4.10.4.2 Production and uses of NPK fertilisers

Question 11

June 2014 | CH2FP | Original Q4 | Legacy

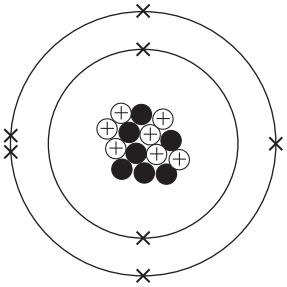
4 Fertilisers contain elements that plants need.

AQAGROW
Plant Fertiliser

Contains:
- Nitrogen
- Phosphorus
- Potassium

4 (a) **Figure 5** represents a nitrogen atom.

Figure 5



Complete each sentence.

4 (a) (i) The mass number of this nitrogen atom is ..... .

[1 mark]

4 (a) (ii) Atoms of nitrogen with different numbers of neutrons are called ..... .

[1 mark]

4 (a) (iii) Compared with a proton, the mass of an electron is ..... .

[1 mark]

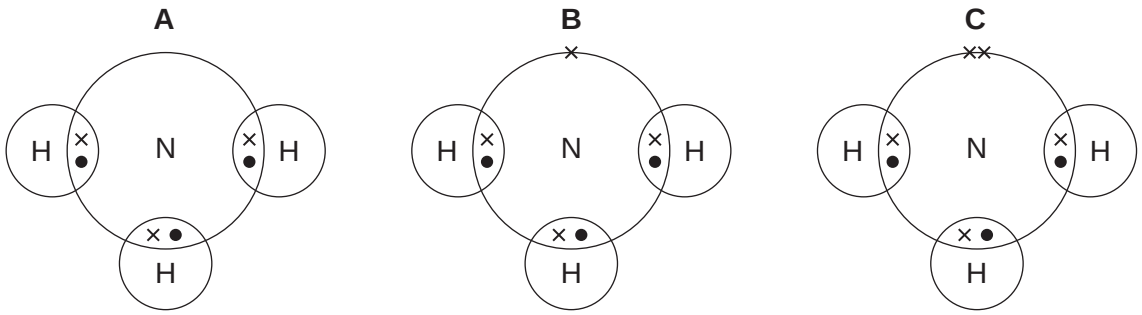
4.10.4.2 Production and uses of NPK fertilisers

Question 11 · continued

4 (b) Fertilisers can be made from ammonia.

4 (b) (i) Which diagram, **A**, **B**, or **C**, represents the electronic structure of an ammonia molecule?

[1 mark]



The electronic structure of an ammonia molecule is shown in diagram ☐

4 (b) (ii) What is the correct formula of ammonia?

Draw a ring around the correct answer.

[1 mark]

N_3H NH_3 NH^3

Question 4 continues on the next page

4.10.4.2 Production and uses of NPK fertilisers

Question 11 · continued

4 (c) A student made ammonium nitrate by reacting ammonia solution with an acid.

4 (c) (i) Name the acid used to make ammonium nitrate.

[1 mark]

.....

4 (c) (ii) Complete the sentence.

[1 mark]

The student added a few drops of ....., which changed colour when the ammonia solution had neutralised the acid.

4 (c) (iii) The student added charcoal and filtered the mixture.

This produced a colourless solution of ammonium nitrate.

How is solid ammonium nitrate obtained from the solution?

[1 mark]

.....

4 (c) (iv) A farmer put ammonium nitrate fertiliser onto a field of grass.

Suggest what would happen to the grass.

[1 mark]

.....

.....

4.10.4.2 Production and uses of NPK fertilisers

Question 11 · continued

4 (d) Some fertilisers contain potassium chloride.

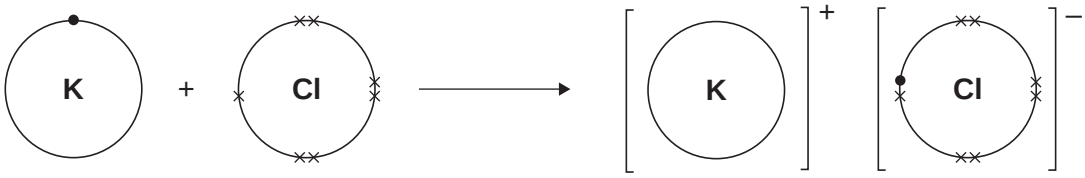
Potassium reacts with chlorine to produce potassium chloride.

Figure 6 shows how this happens.

The dots (•) and crosses (x) represent electrons.

Only the outer shell is shown.

Figure 6



Use **Figure 6** to help you answer this question.

Describe, as fully as you can, what happens when potassium reacts with chlorine to produce potassium chloride.

[4 marks]

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.....

13

4.10.4.2 Production and uses of NPK fertilisers

Question 12

June 2014 | CH3FP | Original Q4 | Legacy

4 In 1909 Fritz Haber invented a process to produce ammonia from nitrogen and hydrogen.

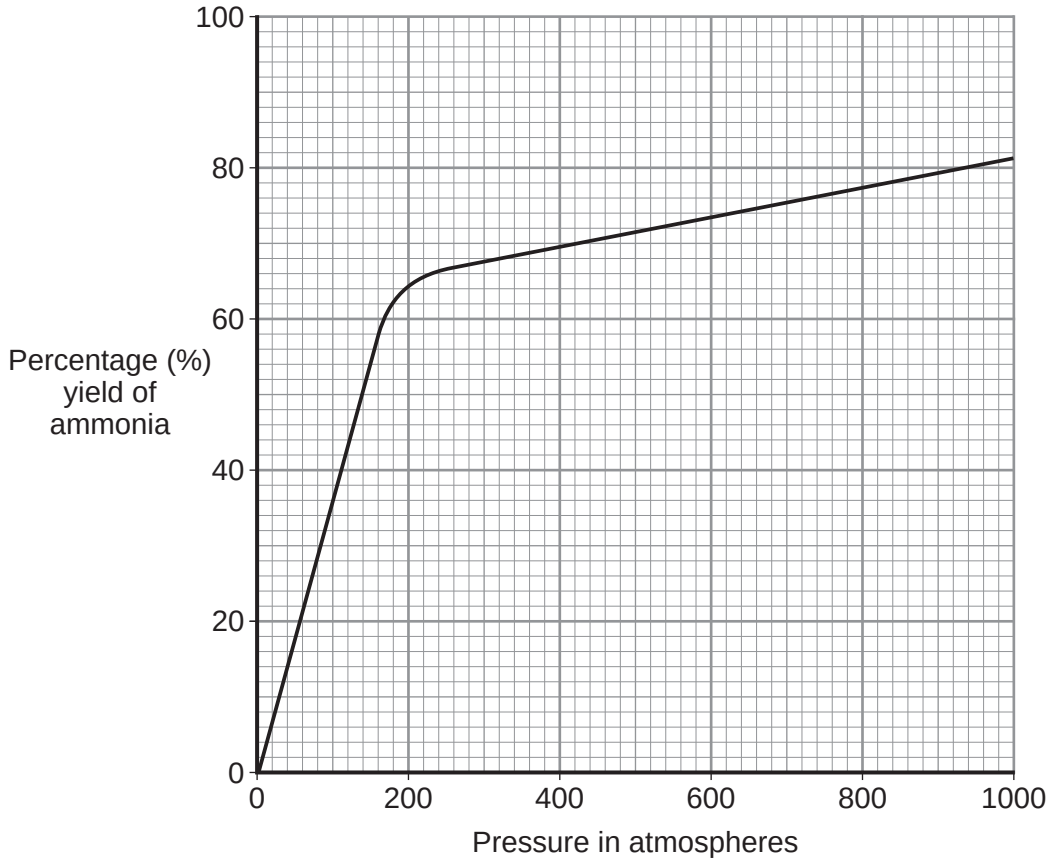
4 (a) Complete the word equation, showing that the reaction is reversible.

[2 marks]

nitrogen + hydrogen ....

4 (b) **Figure 3** shows how the yield of ammonia at 300 °C changes with pressure.

Figure 3



Describe how the yield of ammonia changes as the pressure increases.

[3 marks]

.....

.....

.....

.....

.....

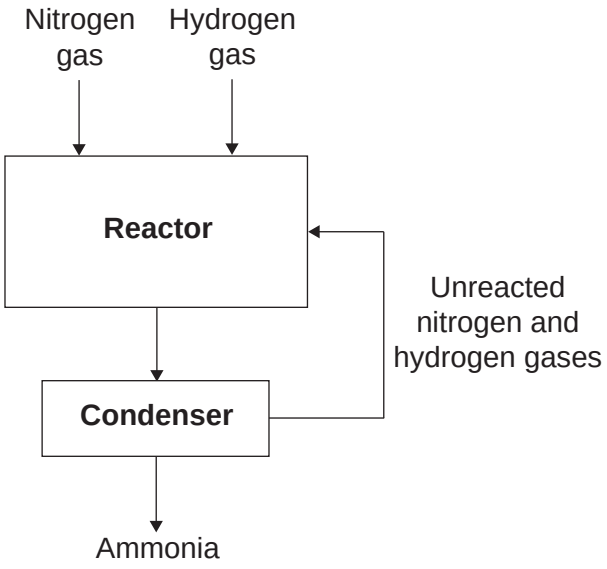
.....

4.10.4.2 Production and uses of NPK fertilisers

Question 12 · continued

4 (c) **Figure 4** represents the Haber process.

Figure 4



How does the Haber process avoid wasting nitrogen and hydrogen?

[1 mark]

.....

.....

4 (d) Before the Haber process, nitrates had been mined in South America. Nitrates are used for making fertilisers.

The Haber process allowed nitrates to be produced on a large scale, anywhere in the world.

4 (d) (i) Suggest what effect the Haber process had on the miners in South America.

[1 mark]

.....

.....

4 (d) (ii) Suggest **one** advantage of producing nitrates on a large scale.

[1 mark]

.....

.....

8

4.10.4.2 Production and uses of NPK fertilisers

Question 13

June 2016 | CH2FP | Original Q6 | Legacy

6 This question is about ammonia and fertilisers.

6 (a) Ammonia is produced by a reversible reaction.

The equation for the reaction is:

$$N_2 + 3H_2 \rightleftharpoons 2NH_3$$

Complete the sentence.

[1 mark]

The forward reaction is exothermic, so the reverse reaction is _____ .

6 (b) Calculate the percentage by mass of nitrogen in ammonia (NH_3).
Relative atomic masses (A_r): H = 1; N = 14
You **must** show how you work out your answer.

[3 marks]

_____

_____

_____

_____

_____

_____

Percentage by mass of nitrogen = _____%

4.10.4.2 Production and uses of NPK fertilisers

Question 13 · continued

6 (c) A neutral solution can be produced when ammonia reacts with an acid.

6 (c) (i) Give the pH of a neutral solution.

[1 mark]

pH _____

6 (c) (ii) Which of these ionic equations shows a neutralisation reaction?

[1 mark]

Tick (✓) **one** box.

$H^+ + OH^- \longrightarrow H_2O$ ☐

$NH_4^+ + OH^- \longrightarrow NH_4OH$ ☐

$H^+ + Cl^- \longrightarrow HCl$ ☐

$H^+ + H_2O \longrightarrow H_3O^+$ ☐

6 (c) (iii) Name the salt produced when ammonia reacts with hydrochloric acid.

[1 mark]

_____

Question 6 continues on the next page

Question 13 · continued

6 (d) **In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.**

Farmers use ammonium nitrate as a fertiliser for crops.

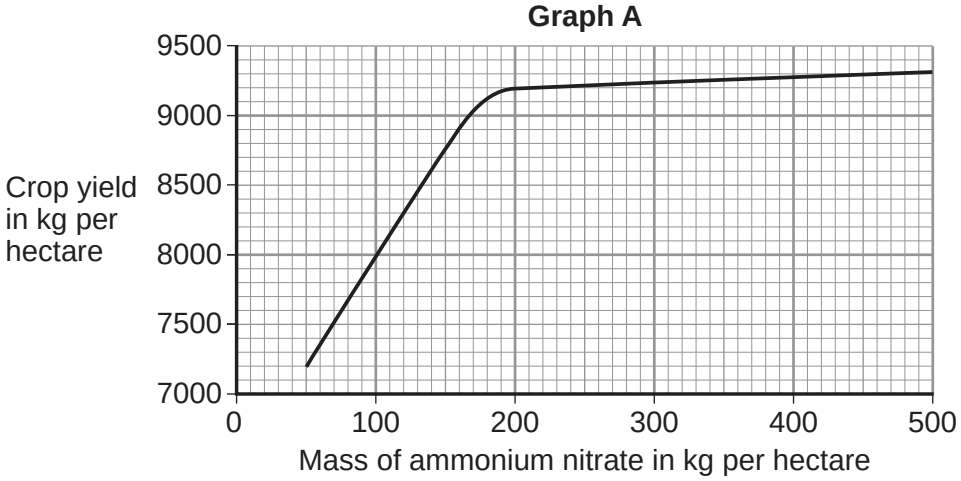
Rainwater dissolves ammonium nitrate in the soil.

Some of the dissolved ammonium nitrate runs off into rivers and lakes.

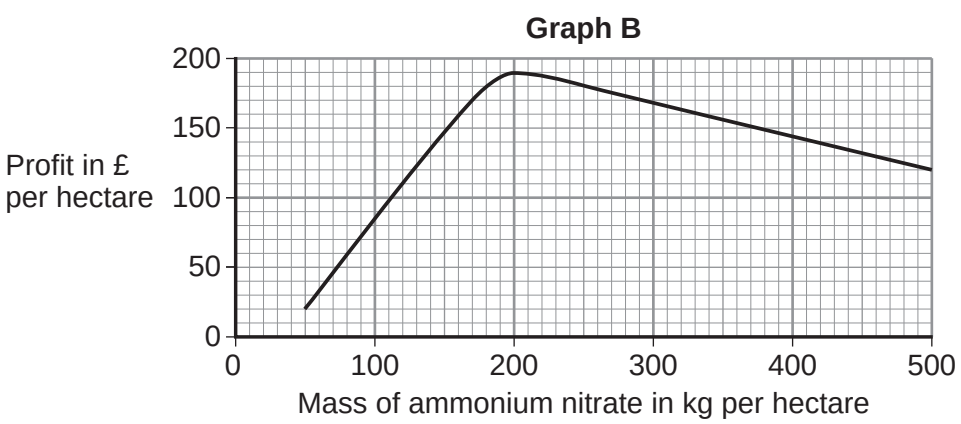
Figure 12 shows three graphs **A**, **B** and **C**. The graphs show information about the use of ammonium nitrate as a fertiliser. A hectare is a measurement of an area of land.

Figure 12

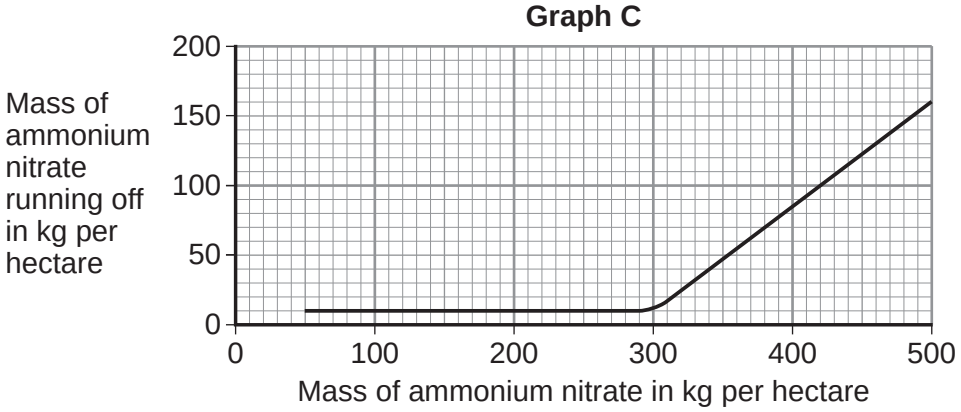
Graph A



Graph B



Graph C



4.10.4.2 Production and uses of NPK fertilisers

Question 13 · continued

Suggest how much ammonium nitrate farmers should use per hectare.
Give reasons for your answer.
Use information from graphs **A**, **B** and **C**.

[6 marks]

Extra space

13

4.10.4.2 Production and uses of NPK fertilisers

Question 14

June 2019 | 8462/2F | Original Q3

0 3 Hydrogen is a raw material in the Haber process.

Hydrogen is produced from methane.

The word equation for the reaction is:

methane + steam ⇌ carbon monoxide + hydrogen

0 3 . 1 How can you tell that the reaction is reversible?

[1 mark]

0 3 . 2 The forward reaction is endothermic.

Name the type of energy change in the reverse reaction.

[1 mark]

0 3 . 3 A nickel catalyst is used in this reaction.

Why is a catalyst used in this reaction?

[2 marks]

Tick (✓) **two** boxes.

- To increase the temperature ☐
- To produce less carbon monoxide ☐
- To reduce costs ☐
- To use less energy ☐
- To use less methane ☐

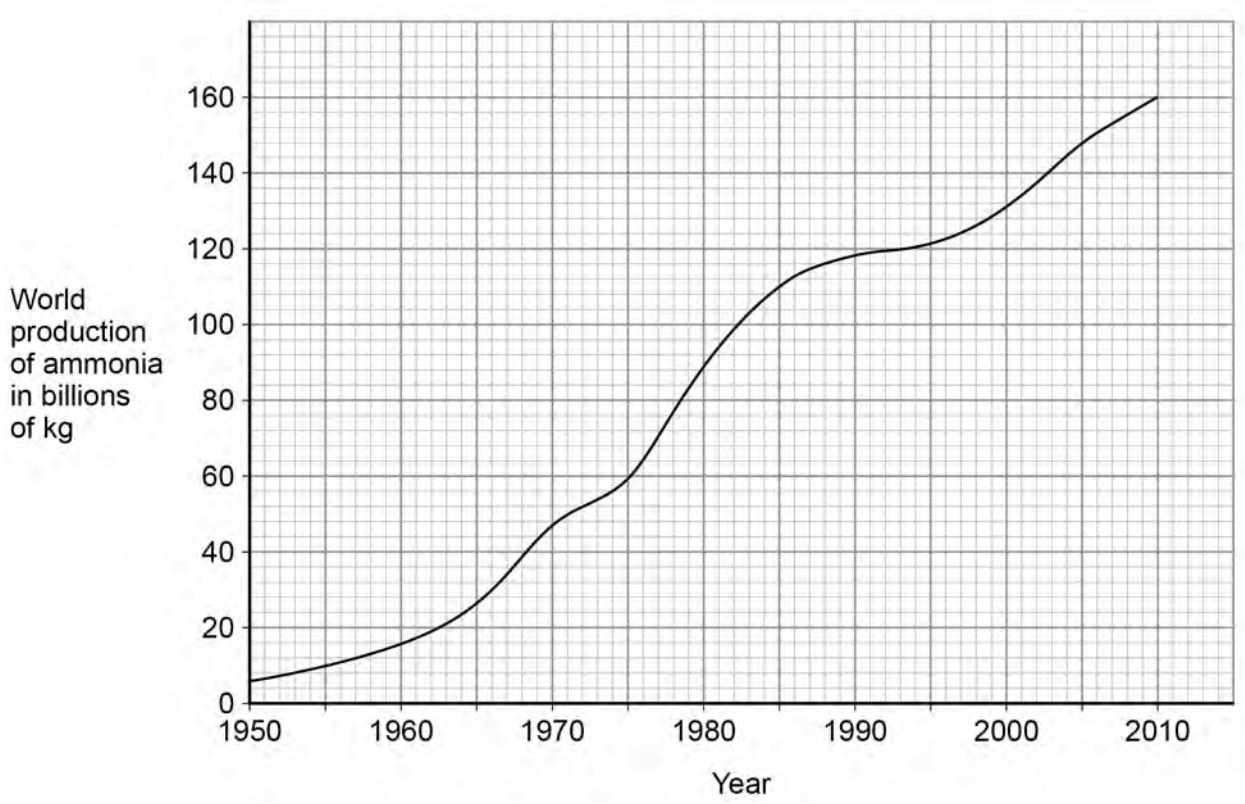
4.10.4.2 Production and uses of NPK fertilisers

Question 14 · continued

0 3 . 4 The Haber process also uses nitrogen to produce ammonia.

Figure 1 shows how the world production of ammonia changed between 1950 and 2010.

Figure 1



Describe how the world production of ammonia changed between 1950 and 2010.

[2 marks]

Question 14 · continued

Most of the ammonia produced is used to make fertilisers.

0 3 . 5 Why did the world production of ammonia change between 1950 and 2010?

[2 marks]

Tick (✓) **two** boxes.

- The demand for food changed. ☐
- The demand for fuels changed. ☐
- The nitrogen percentage in air changed. ☐
- The number of cars changed. ☐
- The world population changed. ☐

Table 1 shows data about four fertilisers, **A**, **B**, **C** and **D**.

Table 1

Fertiliser	Percentage by mass of nitrogen (%)	Percentage by mass of phosphorus (%)	Percentage by mass of potassium (%)
A	35.0	0.0	0.0
B	21.2	0.0	0.0
C	21.2	23.5	0.0
D	0.0	0.0	52.3

4.10.4.2 Production and uses of NPK fertilisers

Question 14 · continued

0 3 . 6 Which combination of fertilisers **A**, **B**, **C** and **D** provides **all** of the elements needed for an NPK fertiliser?

Use **Table 1**.

[1 mark]

Tick (✓) **one** box.

A and **C** ☐

A and **D** ☐

B and **C** ☐

C and **D** ☐

0 3 . 7 Which fertiliser is **not** made using ammonia?

Use **Table 1**.

[1 mark]

Tick (✓) **one** box.

A ☐

B ☐

C ☐

D ☐

10

4.10.4.2 Production and uses of NPK fertilisers

Question 15

November 2020 | 8462/2F | Original Q1

0 1 This question is about ammonia and fertilisers.

Ammonia is produced from nitrogen and hydrogen.

A catalyst is used to speed up the reaction.

The word equation for the reaction is:

nitrogen + hydrogen ⇌ ammonia

0 1 . 1 What does the symbol ⇌ show about the reaction?

[1 mark]

0 1 . 2 Which catalyst is used when ammonia is produced from nitrogen and hydrogen?

[1 mark]

Tick (✓) **one** box.

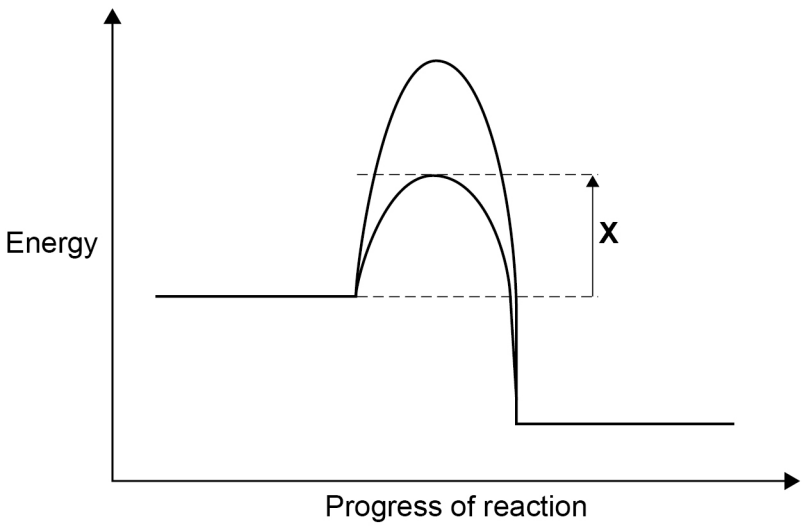
- Chlorine ☐
- Iron ☐
- Oxygen ☐

4.10.4.2 Production and uses of NPK fertilisers

Question 15 · continued

0 1 . 3 **Figure 1** shows the reaction profile for the production of ammonia both with a catalyst and without a catalyst.

Figure 1



What is represented by label **X**?

[1 mark]

Tick (✓) **one** box.

- Activation energy with a catalyst ☐
- Activation energy without a catalyst ☐
- Overall energy change with a catalyst ☐
- Overall energy change without a catalyst ☐

4.10.4.2 Production and uses of NPK fertilisers

Question 15 · continued

Ammonia is used to produce fertilisers.

NPK fertilisers contain the elements nitrogen, phosphorus and potassium.

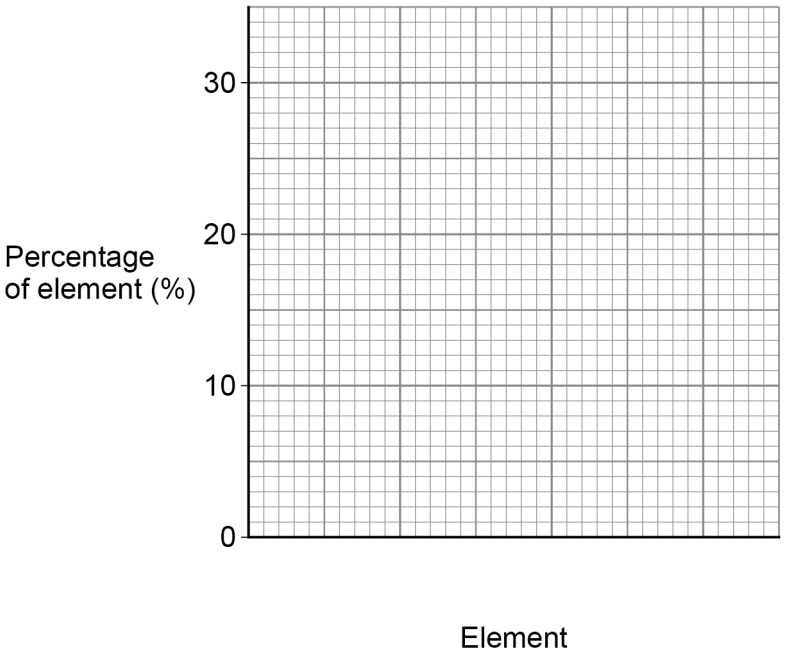
A fertiliser contains:

- 22% phosphorus
- 25% potassium.

0 1 . 4 Draw a bar chart on **Figure 2** to show the percentages of phosphorus and of potassium in this fertiliser.

[2 marks]

Figure 2



0 1 . 5 Why do the percentages of phosphorus and of potassium in this fertiliser **not** add up to 100%?

[1 mark]

Question 15 · continued

Fertilisers help plants grow by adding essential elements to soil.

Table 1 shows the percentages of nitrogen, phosphorus and potassium in four fertilisers, **A**, **B**, **C** and **D**.

Table 1

Fertiliser	Percentage (%) of essential element		
	Nitrogen (N)	Phosphorus (P)	Potassium (K)
A	14	0	39
B	25	16	23
C	21	23	0
D	21	0	0

0 1 . 6 Plants lacking essential elements do not grow well because:

- too little phosphorus can cause slow plant growth
- too little potassium can cause leaves to have brown edges.

Which fertiliser helps prevent slow plant growth **and** brown leaf edges?

Use **Table 1**.

[1 mark]

Tick (✓) **one** box.

A ☐ **B** ☐ **C** ☐ **D** ☐

0 1 . 7 Which fertiliser has the greatest total percentage of essential elements?

Use **Table 1**.

[1 mark]

Tick (✓) **one** box.

A ☐ **B** ☐ **C** ☐ **D** ☐

8

4.10.4.2 Production and uses of NPK fertilisers

Question 16

November 2020 | 8462/2F | Original Q9

0 9 This question is about water.

0 9 . 1 In the UK, potable (drinking) water is produced from different sources of fresh water.

Explain how potable water is produced from fresh water.

[4 marks]

0 9 . 2 A different country has:

- very little rainfall
- a long coastline
- plentiful energy supplies.

Suggest **one** process this country could use to obtain most of its potable water.

[1 mark]

4.10.4.2 Production and uses of NPK fertilisers

Question 16 · continued

0 9 . 3 Waste water is not fit to drink.

Treatment of waste water produces two substances:

- liquid effluent
- solid sewage sludge.

Draw **one** line from each substance to the way the substance is processed.

[2 marks]

Substance	Process
	Aerobic biological treatment
Liquid effluent	Anaerobic digestion
	Grit removal
Solid sewage sludge	Screening
	Sedimentation

Question 9 continues on the next page

4.10.4.2 Production and uses of NPK fertilisers

Question 16 · continued

Table 6 shows information about the disposal of processed solid sewage sludge in the UK in 1992 and in 2010.

Table 6

Year	Mass of processed solid sewage sludge in millions of kilograms				
	Used as fertiliser	Sent to landfill	Burned	Other methods	Total
1992	440	130	90	338	998
2010	1118	9	260	26	1413

0 9 . 4 Calculate the percentage of processed solid sewage sludge that was burned in 2010.

Give your answer to 3 significant figures.

Use **Table 6**.

[3 marks]

Percentage (3 significant figures) = _____ %

4.10.4.2 Production and uses of NPK fertilisers

Question 16 · continued

0 9 . 5 Suggest **one** reason why the total mass of processed solid sewage sludge increased between 1992 and 2010.

[1 mark]

0 9 . 6 Between 1992 and 2010 the proportion of processed solid sewage sludge used as fertiliser increased.

Suggest **two** reasons why.

[2 marks]

1

2

13

4.10.4.2 Production and uses of NPK fertilisers

Question 17

November 2021 | 8462/2F | Original Q7

0 7 This question is about organic compounds.

0 7 . 1 Butane is an alkane with small molecules.

Complete the sentence.

Choose the answer from the box.

[1 mark]

fertiliser	**formulation**	**fuel**

Butane can be used as a _____.

0 7 . 2 Poly(propene) is a polymer.

What is the name of the monomer used to produce poly(propene)?

[1 mark]

Tick (✓) **one** box.

- Propane ☐
- Propanoic acid ☐
- Propanol ☐
- Propene ☐

4.10.4.2 Production and uses of NPK fertilisers

Question 17 · continued

Ethene and steam react to produce ethanol.

The equation for the reversible reaction is:

ethene + steam ⇌ ethanol

0 7 . 3 The reaction produces a maximum theoretical mass of 400 kg of ethanol from 243 kg of ethene and 157 kg of steam.

A company produces 380 kg of ethanol from 243 kg of ethene and 157 kg of steam.

The percentage yield of ethanol is less than 100%

Calculate the percentage yield of ethanol.

Use the equation:

$$\text{percentage yield of ethanol} = \frac{\text{mass of ethanol actually made}}{\text{maximum theoretical mass of ethanol}} \times 100$$

[2 marks]

Percentage yield = _____ %

0 7 . 4 What are **two** possible reasons why the percentage yield of ethanol is less than 100%?

[2 marks]

Tick (✓) **two** boxes.

- Ethanol is the only product of the reaction. ☐
- Ethanol is very unreactive. ☐
- Some ethanol changes back into ethene and steam. ☐
- Some ethanol escapes from the apparatus. ☐
- Some ethanol reacts with steam. ☐

4.10.4.2 Production and uses of NPK fertilisers

Question 17 · continued

0 7 . 5 Ethanol burns in oxygen.

Balance the equation for the reaction.

[1 mark]

$$C_2H_5OH + ___ O_2 \rightarrow 3H_2O + 2CO_2$$

0 7 . 6 Two processes for producing ethanol are:

- fermentation
- hydration (reacting ethene with steam).

Table 5 shows information about the processes.

Table 5

Feature	Process	
	Fermentation	Hydration
Raw material	sugar	crude oil
Energy usage	low	high
Rate of reaction	slow	fast
Purity of ethanol	15%	98%

Give **two** advantages and **two** disadvantages of using fermentation to produce ethanol.

[4 marks]

Advantage of fermentation 1 _____

_____

Advantage of fermentation 2 _____

_____

Disadvantage of fermentation 1 _____

_____

Disadvantage of fermentation 2 _____

_____

11

4.10.4.2 Production and uses of NPK fertilisers

Question 18

June 2022 | 8462/2F | Original Q7

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

Question 7 continues on the next page

4.10.4.2 Production and uses of NPK fertilisers

Question 18 · continued

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]

4.10.4.2 Production and uses of NPK fertilisers

Question 18 · continued

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]

7

4.10.4.2 Production and uses of NPK fertilisers

Question 19

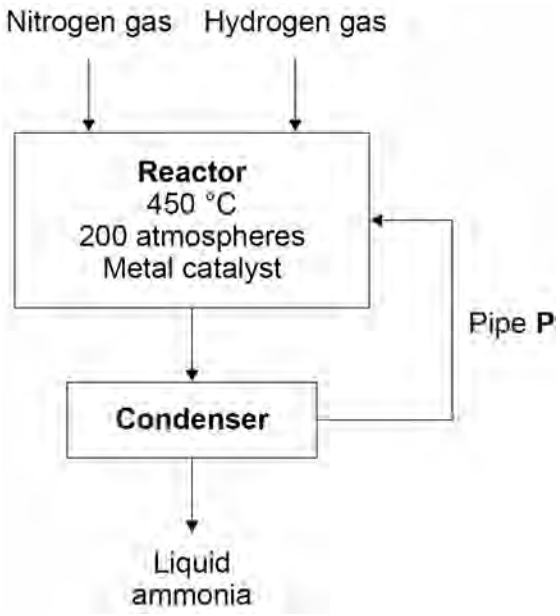
June 2024 | 8462/2F | Original Q9

0 9 This question is about ammonia and nitric acid.

In the Haber process ammonia is produced from nitrogen and hydrogen.

Figure 10 represents the Haber process.

Figure 10



0 9 . 1 Pipe **P** links the condenser to the reactor.

Why is the condenser linked to the reactor?

Use **Figure 10**.

[1 mark]

0 9 . 2 Which metal is used as a catalyst in this reaction?

[1 mark]

Question 19 · continued

Nitric acid is produced by reacting ammonia with oxygen.

The word equation for the production of nitric acid is:

ammonia + oxygen → water + nitric acid

Platinum is a catalyst in this reaction.

0 9 . 3 Describe the test for oxygen gas.

Give the result if oxygen gas is present.

[2 marks]

Test _____

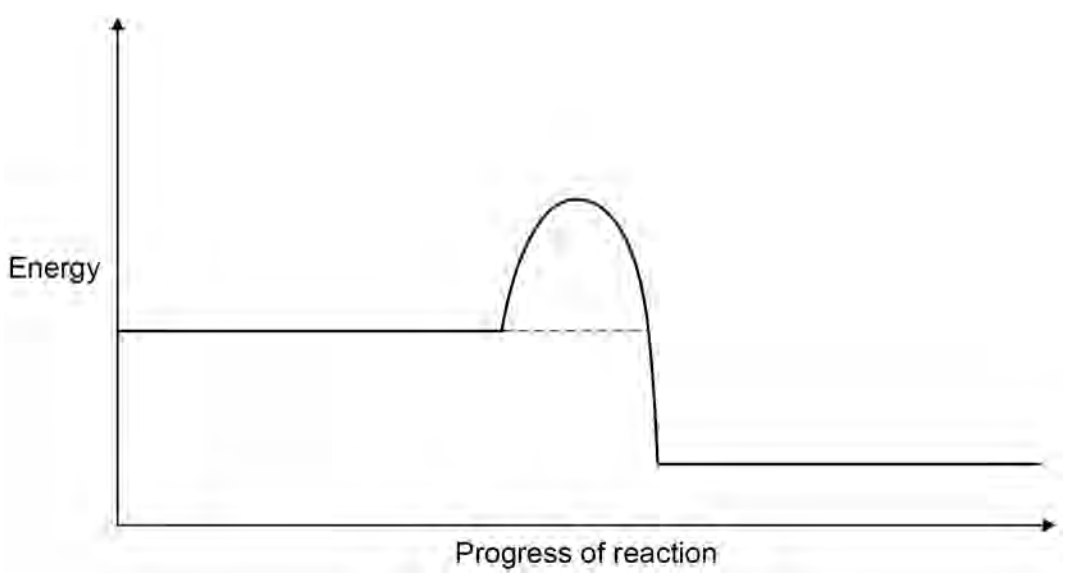
_____

Result _____

_____

Figure 11 represents the reaction profile of the catalysed reaction between ammonia and oxygen.

Figure 11



4.10.4.2 Production and uses of NPK fertilisers

Question 19 · continued

0 9 . 4 Complete the reaction profile for the catalysed reaction in **Figure 11**.

You should:

- label the activation energy
- label the reactants and products, using the names of the reactants and products.

[2 marks]

0 9 . 5 How would **Figure 11** be different if **no** catalyst was used?

[1 mark]

Tick (✓) **one** box.

The final energy level would be higher. ☐

The final energy level would be lower. ☐

The line would reach a higher peak. ☐

The line would reach a lower peak. ☐

0 9 . 6 Ammonia and nitric acid react to produce the salt, ammonium nitrate.

Ammonium ions and nitrate ions both contain nitrogen.

Suggest **one** use of ammonium nitrate.

[1 mark]

_____

_____

8

4.10.4.2 Production and uses of NPK fertilisers

Question 20

June 2025 | 8462/2F | Original Q2

0 2 Alkanes and alkenes are hydrocarbons.

Hydrocarbon molecules are made up of hydrogen and carbon atoms only.

An alkene has the formula C_3H_6

0 2 . 1 Which alkene has the formula C_3H_6?

[1 mark]

Tick (✓) **one** box.

Butene ☐

Ethene ☐

Propene ☐

0 2 . 2 How many atoms are there in a molecule of C_3H_6?

[1 mark]

Tick (✓) **one** box.

2 ☐ 3 ☐ 6 ☐ 9 ☐

0 2 . 3 Which is a use of C_3H_6?

[1 mark]

Tick (✓) **one** box.

Making a polymer ☐

Making ammonia ☐

Making glass ☐

0 2 . 4 The percentage (%) by mass of each element in a molecule of C_3H_6 is:

- hydrogen 14%
- carbon 86%.

Figure 1 shows the percentage by mass of hydrogen in a molecule of C_3H_6

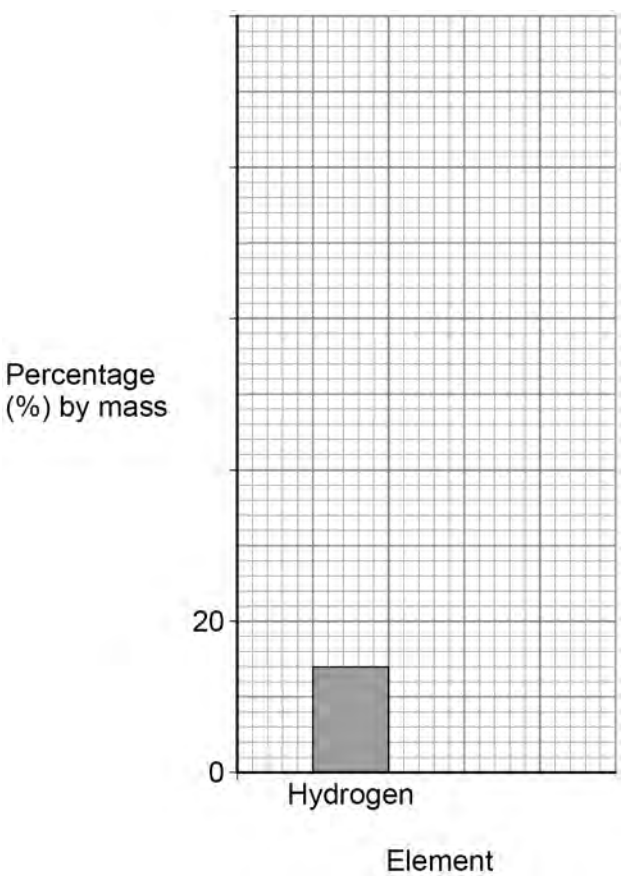
Complete **Figure 1**.

You should:

- complete the *y*-axis scale
- plot the percentage by mass of carbon as a bar
- label the bar plotted for carbon.

[3 marks]

Figure 1



4.10.4.2 Production and uses of NPK fertilisers

Question 20 · continued

Alkanes can be cracked to produce alkenes and smaller alkane molecules.

0 2 . 5 Describe a test for alkenes.

Give the result of the test.

[2 marks]

Test _____

_____

Result _____

_____

0 2 . 6 $C_{10}H_{22}$ can be cracked to produce C_3H_6 and an alkane.

Complete the equation for the reaction.

[1 mark]

$$C_{10}H_{22} \longrightarrow C_3H_6 + C___H_{16}$$

0 2 . 7 Complete the sentence.

Choose the answer from the box.

[1 mark]

ceramics	**fertilisers**	**fuels**

Smaller alkanes from cracking are useful as _____.

4.10.4.2 Production and uses of NPK fertilisers

Question 20 · continued

High temperatures between 450 °C and 750 °C are used in cracking reactions.

0 2 . 8 Which statement describes the molecules at 750 °C compared with the molecules at 450 °C?

[1 mark]

Tick (✓) **one** box.

- The molecules collide more frequently at 750 °C. ☐
- The molecules have less energy at 750 °C. ☐
- The molecules move more slowly at 750 °C. ☐

0 2 . 9 How does the rate of reaction at 750 °C compare with the rate of reaction at 450 °C?

[1 mark]

_____

_____

12

4.10.4.2 Production and uses of NPK fertilisers

Question 21

June 2025 | 8462/2F | Original Q4

0 4 Ammonia is produced in the Haber process.

The word equation for the reaction to produce ammonia is:

nitrogen + hydrogen ⇌ ammonia

0 4 . 1 Draw **one** line from each element to a source of that element.

[2 marks]

Element	Source of element
Nitrogen	Air
Hydrogen	Clay
	Limestone
	Natural gas
	Sand

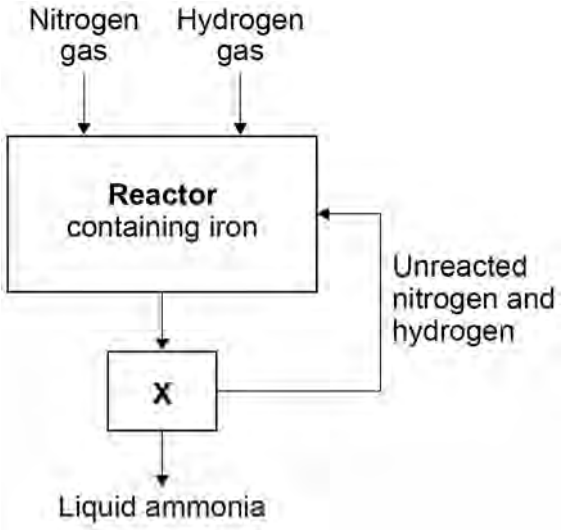
4.10.4.2 Production and uses of NPK fertilisers

Question 21 · continued

Ammonia is a gas at room temperature.

Figure 3 shows how ammonia is produced from nitrogen and hydrogen.

Figure 3



0 4 . 2 Which process takes place at **X** in **Figure 3**?

[1 mark]

Tick (✓) **one** box.

Cooling ☐

Filtering ☐

Melting ☐

0 4 . 3 Complete the sentence.

Use **Figure 3**.

[1 mark]

The iron in the reactor is used as a _____.

4.10.4.2 Production and uses of NPK fertilisers

Question 21 · continued

Table 1 shows the world production of ammonia between 1990 and 2020.

Table 1

Year	World production of ammonia in arbitrary units
1990	120
2000	130
2010	155
2020	165

0 4 . 4 How did the world production of ammonia change between 1990 and 2020?

Use **Table 1**.

[1 mark]

0 4 . 5 Determine the mean change in mass of ammonia produced per year between 2000 and 2020.

Use **Table 1** and the equation:

$$\text{mean change in mass produced per year} = \frac{\text{change in mass produced between 2000 and 2020}}{\text{number of years}}$$

[4 marks]

Change in mass = _____ arbitrary units

Number of years = _____

Mean change = _____ arbitrary units per year

4.10.4.2 Production and uses of NPK fertilisers

Question 21 · continued

Most of the ammonia produced in the Haber process is used to make fertilisers.

0 4 . 6 Which is a reason for the change in the world production of ammonia shown in **Table 1**?

[1 mark]

Tick (✓) **one** box.

- Change in amount of acid rain ☐
- Change in global temperatures ☐
- Change in world population ☐

0 4 . 7 Fertilisers produced using ammonia contain nitrogen.

Which **two** compounds used in fertilisers contain nitrogen?

Use the periodic table.

[2 marks]

Tick (✓) **two** boxes.

- $Ca(NO_3)_2$ ☐
- $Ca_3(PO_4)_2$ ☐
- KCl ☐
- K_2SO_4 ☐
- $(NH_4)_2SO_4$ ☐

12