AQA GCSE Chemistry | 8462

SPECIFICATION POINT 4.6.2.2

Energy changes and reversible reactions

Past-paper questions

Tier	**Foundation**
Question groups	**6**
Available paper years	**2010–2025**

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:** _____

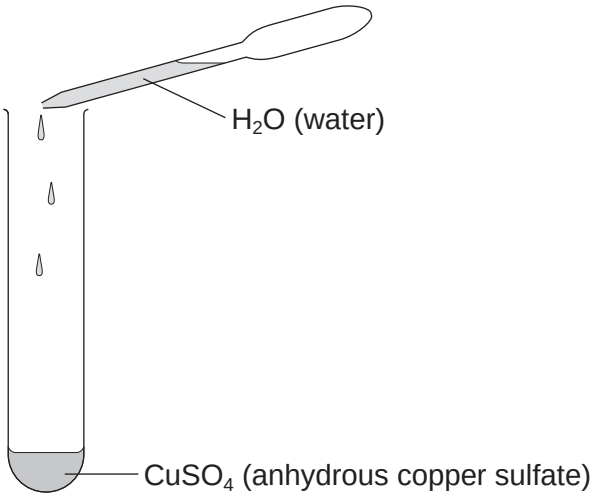
Whole questions are retained for context, so some parts assess other specification points. Current and legacy sources are labelled. Continue on extra paper if needed.

4.6.2.2 Energy changes and reversible reactions

Question 01

June 2010 | CHY2F | Original Q1 | Legacy

1 The diagram shows how anhydrous copper sulfate can be used to test for water.



$$\underset{\text{white}}{CuSO_4} + \underset{\text{colourless}}{5H_2O} \rightleftharpoons \underset{\text{blue}}{CuSO_4.\,5H_2O}$$

1 (a) What colour change will you see when water is added to the $CuSO_4$?

Colour changes from .....to .....

(1 mark)

1 (b) Draw a ring around the meaning of the symbol $\rightleftharpoons$

endothermic **exothermic** **reversible**

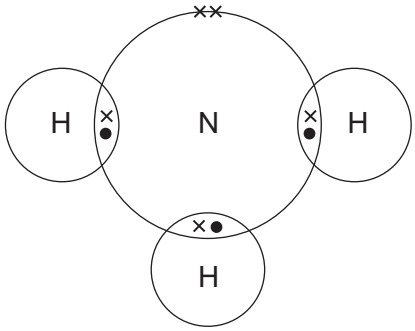
(1 mark)

2

4.6.2.2 Energy changes and reversible reactions

Question 02

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)

4.6.2.2 Energy changes and reversible reactions

Question 02 · 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

4.6.2.2 Energy changes and reversible reactions

Question 02 · 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

4.6.2.2 Energy changes and reversible reactions

Question 03

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 = _____%

4.6.2.2 Energy changes and reversible reactions

Question 03 · 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

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.

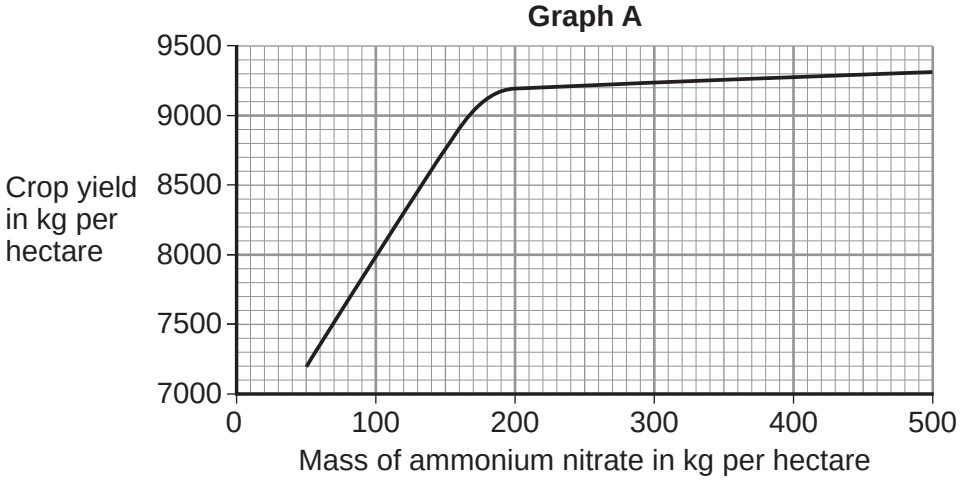
Rainwater dissolves ammonium nitrate in the soil.

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

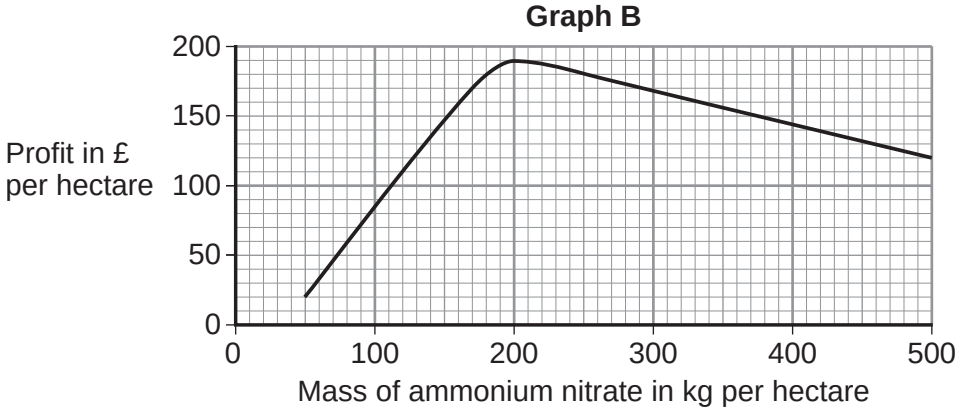
Figure 12 shows three graphs **A**, **B** and **C**. The graphs show information about the use of ammonium nitrate as a fertiliser. A hectare is a measurement of an area of land.

Figure 12

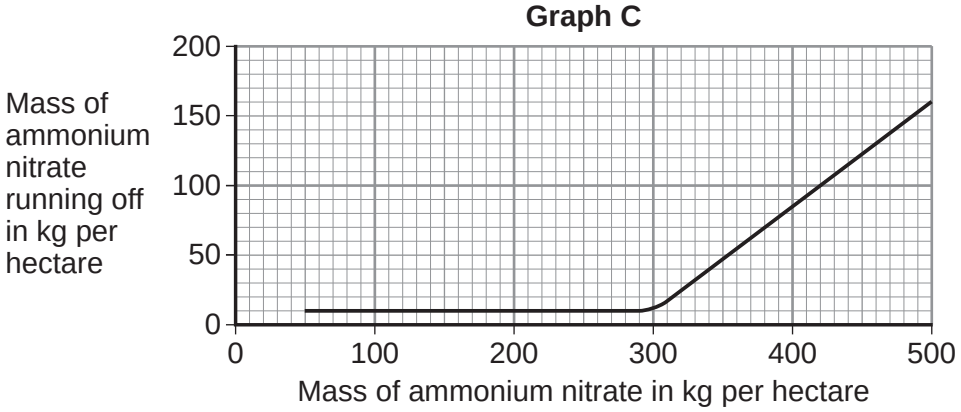
Graph A



Graph B



Graph C



4.6.2.2 Energy changes and reversible reactions

Question 03 · 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

4.6.2.2 Energy changes and reversible reactions

Question 04

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 ☐

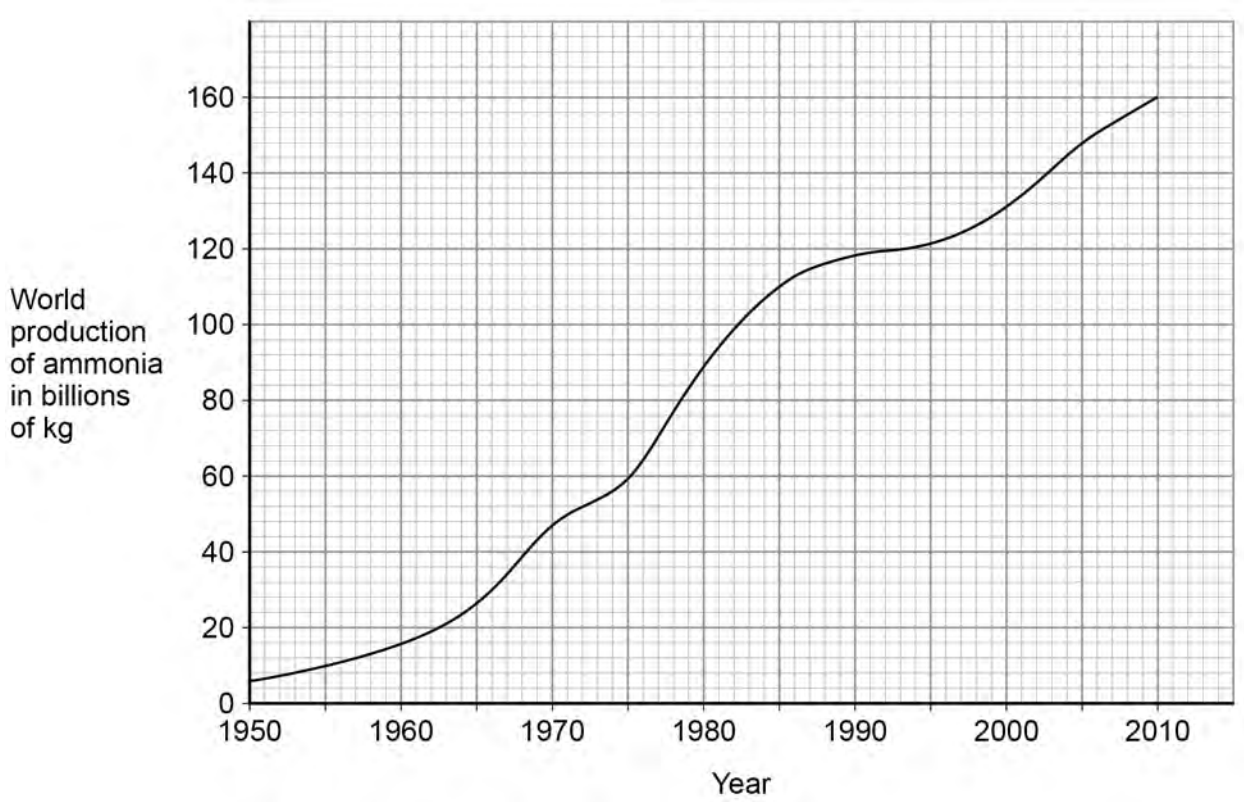
4.6.2.2 Energy changes and reversible reactions

Question 04 · 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 04 · 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

4.6.2.2 Energy changes and reversible reactions

Question 04 · 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

4.6.2.2 Energy changes and reversible reactions

Question 05

November 2021 | 8462/2F | Original Q4

0 4 This question is about reactions between gases.

When hydrogen gas is heated with iodine gas, hydrogen iodide gas is produced.

The equation for this reversible reaction is:

$$\text{hydrogen} + \text{iodine} \rightleftharpoons \text{hydrogen iodide}$$

This reversible reaction reaches equilibrium in a sealed container.

0 4 . 1 How does the equation show that the reaction is reversible?

[1 mark]

0 4 . 2 Which **two** statements are correct when the reaction reaches equilibrium?

[2 marks]

Tick (✓) **two** boxes.

- The forward reaction and reverse reaction are both exothermic. ☐
- The gases have escaped from the container. ☐
- The hydrogen no longer reacts with iodine. ☐
- The mass of each substance does not change. ☐
- The rates of the forward reaction and reverse reaction are equal. ☐

4.6.2.2 Energy changes and reversible reactions

Question 05 · continued

0 4 . 3 The initial mixture of hydrogen and iodine in the sealed container is purple.

Hydrogen iodide is colourless.

How will the colour of the mixture in the sealed container have changed when equilibrium is reached?

[1 mark]

Tick (✓) **one** box.

The mixture will have become a deeper purple. ☐

The mixture will have become a paler purple. ☐

The mixture will have become colourless. ☐

0 4 . 4 The rate of reaction between gases is affected by changing the pressure.

Complete the sentences.

[3 marks]

When the pressure of the reacting gases is increased,

the rate of reaction _____.

This is because at higher pressures the distance

between the particles _____.

This means that the frequency of collisions _____.

0 4 . 5 Give **one** other way of changing the rate of reaction between gases.

You should **not** refer to pressure in your answer.

[1 mark]

_____

_____

8

4.6.2.2 Energy changes and reversible reactions

Question 06

June 2025 | 8462/2F | Original Q3

0 3 Cement, concrete and steel are building materials.

Cement contains calcium oxide.

Calcium oxide reacts with water to produce calcium hydroxide.

The equation for the reaction is:

calcium oxide + water ⇌ calcium hydroxide

0 3 . 1 How does the equation show that this reaction is reversible?

[1 mark]

0 3 . 2 The forward reaction is exothermic.

What type of reaction is the reverse reaction?

[1 mark]

0 3 . 3 When excess water is added to 20 g of calcium oxide, 23 kJ of energy is released.

Calculate the energy released when excess water is added to 4 g of calcium oxide.

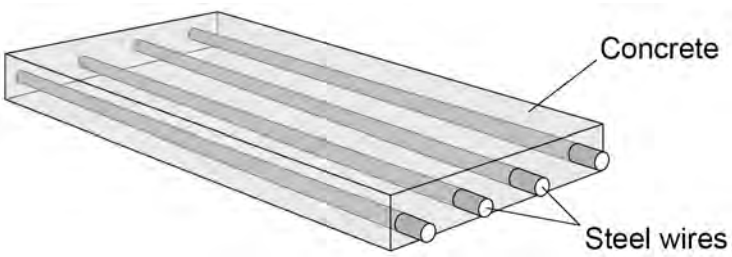
[2 marks]

Energy released = _____ kJ

Pre-stressed concrete contains steel wires within the concrete.

Figure 2 shows the structure of a piece of pre-stressed concrete.

Figure 2



0 3 . 4 Pre-stressed concrete is a composite.

Draw **one** line from each component of a composite to a material in pre-stressed concrete.

[2 marks]

Component of composite	Material in pre-stressed concrete
Binder	Concrete
Reinforcement	Pre-stressed concrete
	Steel wires

0 3 . 5 Which metal do **all** steels contain?

[1 mark]

_____

4.6.2.2 Energy changes and reversible reactions

Question 06 · continued

0 3 . 6 Bricks are also building materials.

Bricks are ceramics.

Which material is used to make bricks?

[1 mark]

Tick (✓) **one** box.

Aluminium ☐

Clay ☐

Poly(ethene) ☐

8

Turn over for the next question