

GCSE Chemistry

Worksheet: The Haber process

TIME 20 min	TOTAL 20 marks	CALCULATOR Allowed	DIFFICULTY Easy, Medium
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Topics: The Haber process

NAME	CLASS	DATE
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- Use black ink or black ball-point pen. Pencil should only be used for drawing.
- Answer all questions in the spaces provided.
- In all calculations, show clearly how you work out your answer.
- The marks for questions are shown in brackets.

0 1

Ammonia is manufactured by the Haber process.

0 1 . 1

Give the source of the nitrogen used in the Haber process.

.....

.....

[1 mark]

0 1 . 2

Give the source of the hydrogen used in the Haber process.

.....

.....

[1 mark]

0 1 . 3

Which catalyst is used in the Haber process?

Tick (✓) **one** box.

Iron

☐

Nickel

☐

Platinum

☐

Vanadium(V) oxide

☐

[1 mark]

0 1 . 4

Give the approximate temperature and pressure used in the Haber process.

.....

.....

.....

.....

[2 marks]

0 2

0 2 . 1

Which of these is **not** true of the Haber process?

Tick (✓) **one** box.

It uses an iron catalyst

☐

It is a reversible reaction

☐

All of the nitrogen and hydrogen react to form ammonia

☐

Unreacted gases are recycled

☐

[1 mark]

0 2 . 2

State the formula of ammonia.

.....

.....

.....

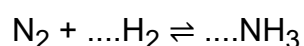
[1 mark]

0 3

In the Haber process, purified nitrogen and hydrogen are passed over a catalyst. Some of the nitrogen and hydrogen react to form ammonia.

0 3 . 1

Balance the equation for the reaction.



.....

.....

[1 mark]

0 3 . 2

What does the symbol $\rightleftharpoons$ show about the reaction?

.....

.....

[1 mark]

0 3 . 3

Describe how the ammonia is separated from the unreacted nitrogen and hydrogen.

.....

.....

.....

.....

[2 marks]

0 3 . 4

What happens to the unreacted nitrogen and hydrogen?
Give a reason for your answer.

.....

.....

.....

.....

[2 marks]

0 4

A student says: 'The Haber process is wasteful, because only some of the nitrogen and hydrogen react to form ammonia each time the gases pass through the reactor.'

0 4 . 1

Evaluate this statement.

[3 marks]

0 5

Nitrogen for the Haber process is obtained from the air, which is a free and effectively unlimited raw material.

0 5 . 1

Explain why hydrogen, unlike nitrogen, has a raw material cost for the manufacturer.

[2 marks]

0 6

Before the Haber process was invented, farmers relied mainly on natural sources of nitrogen compounds, e.g. manure and mined sodium nitrate, to fertilise crops.

0 6 . 1

Suggest why the invention of the Haber process is sometimes described as one of the most important chemical discoveries in history.

.....

.....

.....

.....

[2 marks]

END OF QUESTIONS

Original practice questions written to match the specification. Not produced by, affiliated with or endorsed by AQA.

Mark scheme

GCSE Chemistry · Worksheet: The Haber process · 20 marks

Question 1 (5 marks)

01.1 [1 mark]

- the air (1)
-

01.2 [1 mark]

- natural gas / methane (reacted with steam) (1)

Notes: Allow electrolysis of water. Allow cracking of hydrocarbons / crude oil fractions.

01.3 [1 mark]

Correct: Iron

01.4 [2 marks]

- (about) 450 °C (1)
- (about) 200 atmospheres (1)

Notes: Allow any temperature from 400 °C to 450 °C and any pressure from 150 to 250 atmospheres. Each value needs a unit.

Question 2 (2 marks)

02.1 [1 mark]

Correct: All of the nitrogen and hydrogen react to form ammonia

02.2 [1 mark]

Answer: NH₃

- NH₃ (1)
-

Question 3 (6 marks)

03.1 [1 mark]

Answer: $\text{N}_2 + 3\text{H}_2 \rightleftharpoons 2\text{NH}_3$

- $\text{N}_2 + 3\text{H}_2 \rightleftharpoons 2\text{NH}_3$ (1)
-

03.2 [1 mark]

- the reaction is reversible (1)
-

03.3 [2 marks]

- the gases are cooled (1)
 - the ammonia liquefies (and is removed) but nitrogen and hydrogen stay as gases (1)
-

03.4 [2 marks]

- they are recycled (back into the reactor) (1)
 - so raw materials are not wasted / more ammonia is made from them (1)
-

Question 4 (3 marks)

04.1 [3 marks]

- it is true that only a proportion of the nitrogen and hydrogen react on each single pass through the reactor, because the reaction is reversible and reaches equilibrium before completion (1)
 - however, the unreacted nitrogen and hydrogen are separated from the ammonia and recycled back into the reactor, rather than being wasted (1)
 - so, over time, almost all of the nitrogen and hydrogen fed into the process are eventually converted into ammonia, making the overall process much less wasteful than a single pass alone would suggest (1)
-

Question 5 (2 marks)

05.1 [2 marks]

- hydrogen is usually obtained by reacting natural gas (methane) with steam, or by another process such as electrolysis of water (1)
 - natural gas (or the energy for electrolysis) has to be bought and has a cost, unlike nitrogen, which is simply extracted from the freely available air (1)
-

Question 6 (2 marks)

06.1 [2 marks]

- it allows ammonia, and so nitrogen fertilisers, to be manufactured on a huge scale from abundant raw materials (air and, e.g., natural gas and water), rather than relying on limited natural or mined sources (1)
 - this has allowed much larger amounts of fertiliser to be produced and used, greatly increasing global food production and supporting a much larger world population than would otherwise be possible (1)
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