

Reversible reactions and dynamic equilibrium – GCSE Chemistry

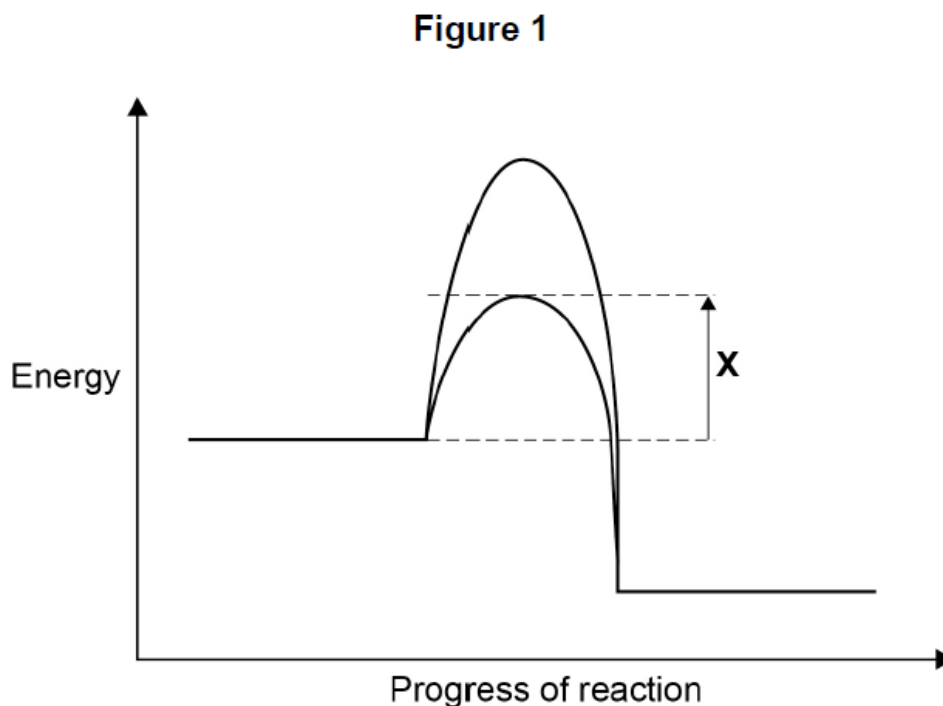
1. No.1.1

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

[1 mark]

2. No.1.3

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



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

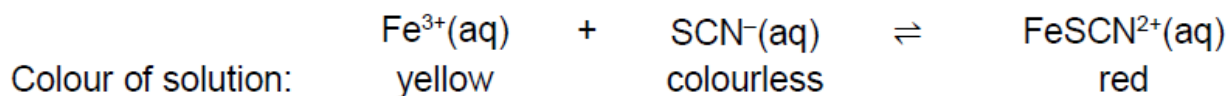
☐

3. No.10

This question is about a reversible reaction.

The reaction between solutions of iron(III) ions (Fe^{3+}) and thiocyanate ions (SCN^-) is reversible.

The ionic equation for the reaction is:



The colour of the equilibrium mixture is orange at room temperature.

Give the name of the solvent used to dissolve the ions in this reaction.

[1 mark]

A few drops of a colourless solution containing a high concentration of thiocyanate ions (SCN^-) are added to the orange equilibrium mixture.

Explain the colour change observed.

[3 marks]

A water bath is set up at a temperature above room temperature.

When a test tube containing the orange equilibrium mixture is placed in the water bath, the mixture becomes more yellow.

Explain what this shows about the energy change for the forward reaction.

[3 marks]

Explain why a change in pressure does **not** affect the colour of the equilibrium mixture.

[2 marks]

Other metal ions form coloured equilibrium mixtures with thiocyanate ions.

Which metal ion could form a coloured equilibrium mixture with thiocyanate ions?

[1 mark]

Tick (✓) **one** box.

Al³⁺

☐

Co²⁺

☐

Mg²⁺

☐

Na⁺

☐

4. No.4

This question is about the corrosion of metals.

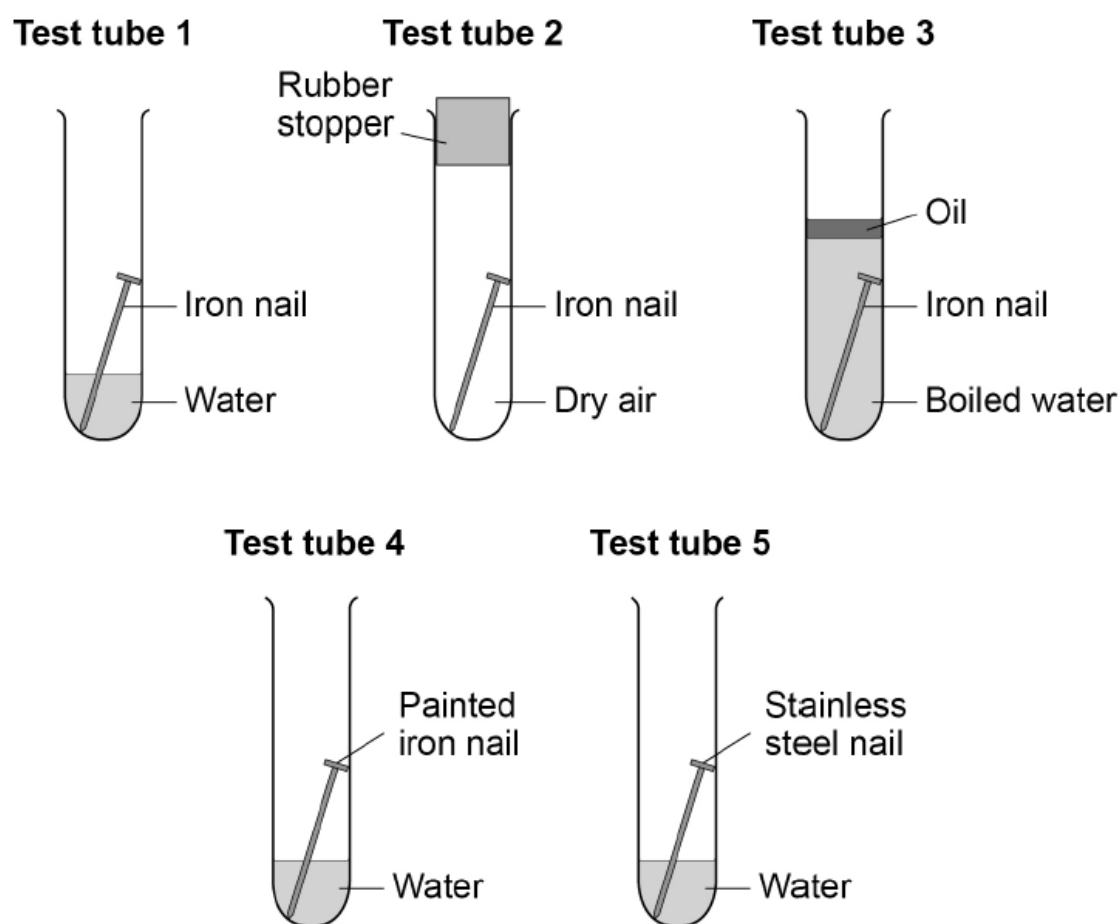
The corrosion of iron is called rusting.

A student investigated the rusting of iron.

This is the method used.

1. Set up the test tubes as shown in **Figure 4**.
2. Leave the test tubes for 1 week.
3. Examine the nails for signs of rust.

Figure 4



Explain what would happen to the nails in each of the test tubes.

[5 marks]

Magnesium is fixed to some steel ships.

Explain how this prevents the steel from rusting.

[2 marks]

Explain why aluminium window frames do **not** corrode after they are made.

[2 marks]

5. No.10

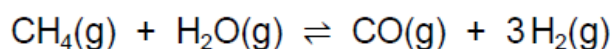
This question is about reversible reactions and equilibrium.

Hydrogen is used to produce ammonia in the Haber process.

The hydrogen is made in two stages.

Stage 1 is the reaction of methane and steam to produce carbon monoxide and hydrogen.

The equation for the reaction is:



Calculate the atom economy for the formation of hydrogen in **stage 1**.

Relative atomic masses (A_r): H = 1 C = 12 O = 16

[2 marks]

Atom economy = _____ %

Explain why a low pressure is used in **stage 1**.

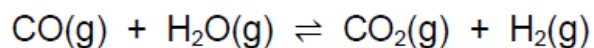
Give your answer in terms of equilibrium.

[2 marks]

Stage 2 uses the carbon monoxide produced in **stage 1**.

The carbon monoxide is reacted with more steam to produce carbon dioxide and more hydrogen.

The equation for the reaction in **stage 2** is:

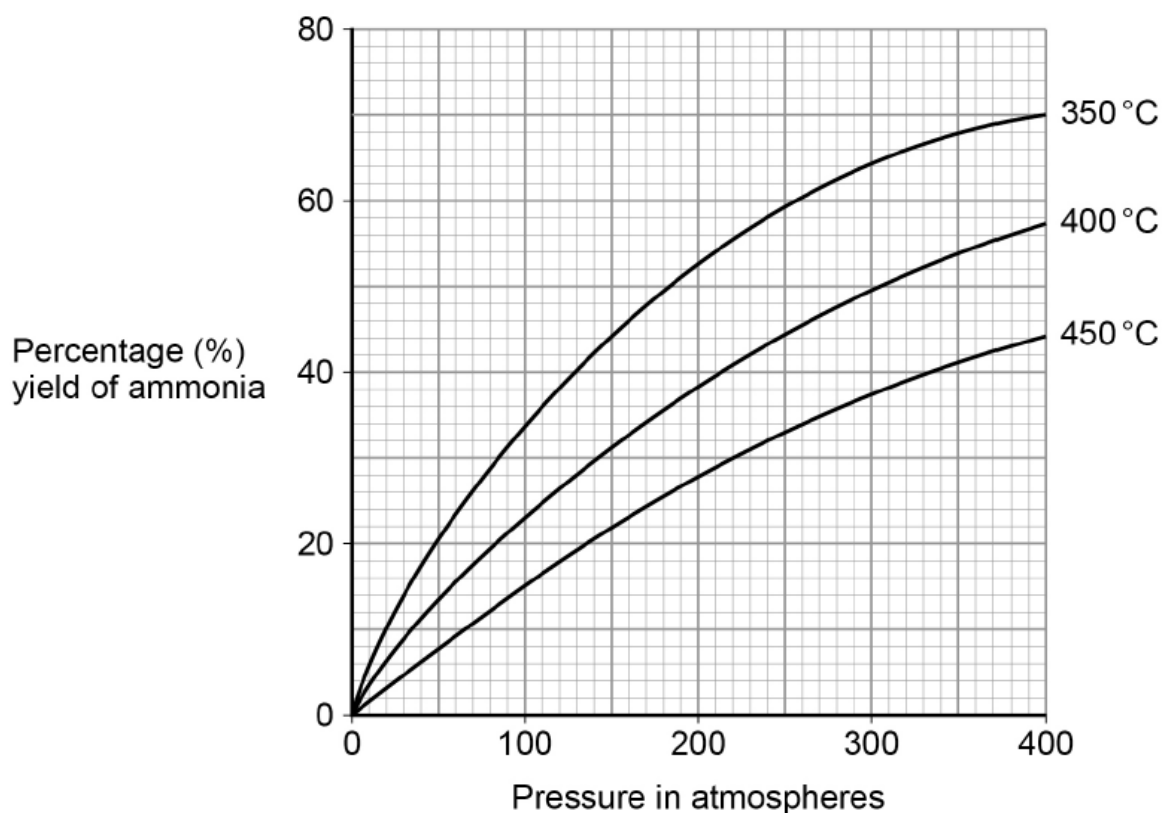


What is the effect of increasing the pressure on the equilibrium yield of hydrogen in **stage 2**?

[1 mark]

Figure 10 shows the percentage yield of ammonia produced at different temperatures and pressures in the Haber process.

Figure 10



A temperature of 450 °C and a pressure of 200 atmospheres are used in the Haber process.

A student suggested that a temperature of 350 °C and a pressure of 285 atmospheres could be used instead of those used in the Haber process.

Determine how many times greater the percentage yield of ammonia obtained would be.

Use **Figure 10**.

[3 marks]

Percentage yield = _____ times greater

A pressure of 285 atmospheres is **not** used in the Haber process instead of 200 atmospheres.

Give **one** reason why.

[1 mark]

How does **Figure 10** show that the forward reaction in the Haber process is exothermic?

[1 mark]

World production of ammonia is now about 30 times greater than it was in 1950.

Suggest why the demand for ammonia has increased.

[2 marks]
