

Reactions that go both ways

Chemistry grades 9-10 (GCSE · IGCSE · O Level · Class 9-10) · Test

Name: _____ Date: _____ Class: _____ Mark: ____ / 20

This test lasts 45 minutes and is worth 20 marks. Answer every question. For explanations, link the change to the direction of shift and say why using Le Chatelier's principle. Show each step in calculations.

Level: Chemistry grades 9-10 (GCSE · IGCSE · O Level · Class 9-10) · **Curriculum:** HS-PS1-6

Time: 45 minutes · 8 questions · Total: 20 marks · Calculator allowed

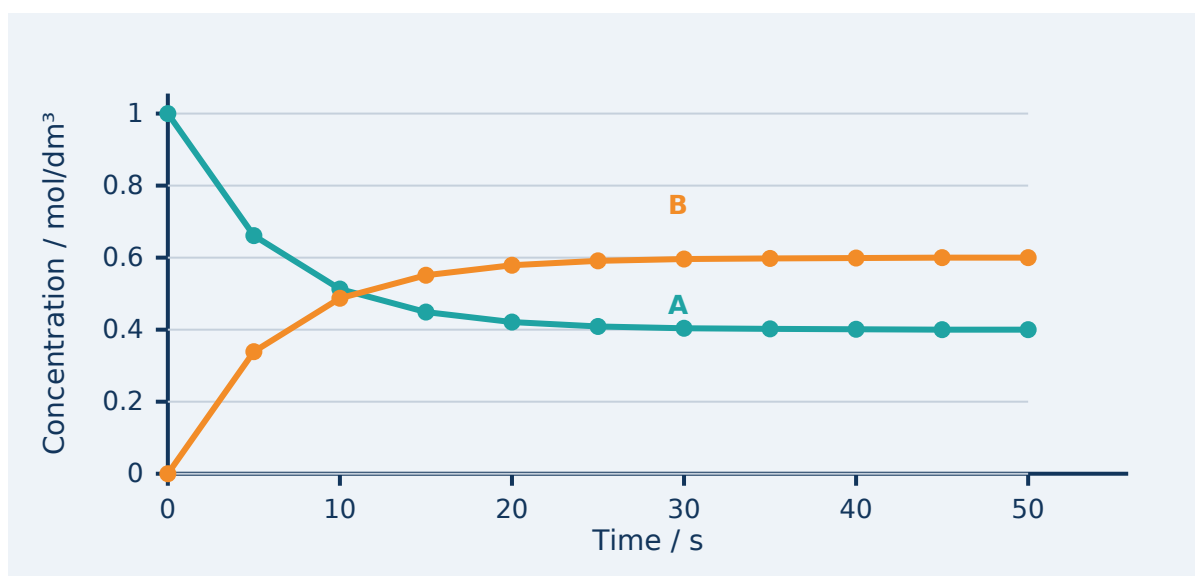
Question 1 Key terms (3 marks)

- State what is meant by a reversible reaction. (1 mark)
- Explain what is meant by dynamic equilibrium. (2 marks)

Question 2 Concentration graph (4 marks)

Reaction $A \rightleftharpoons B$ is followed in a closed container. The graph shows the concentrations.

- State the time when equilibrium is reached. (1 mark)
- State the concentration of A and of B at equilibrium. (1 mark)
- Explain why the concentrations stop changing although the reactions have not stopped. (2 marks)



Concentrations of A and B against time.

Question 3 Phosphorus pentachloride (3 marks)

$\text{PCl}_5(\text{g}) \rightleftharpoons \text{PCl}_3(\text{g}) + \text{Cl}_2(\text{g}), \Delta H = +93 \text{ kJ/mol}.$

- Predict the shift when the pressure is increased and explain why. (2 marks)
- Predict the shift when the temperature is raised. (1 mark)

Question 4 Conditions in the Haber process (3 marks)

The Haber process uses about 450 °C, 200 atm and an iron catalyst for $\text{N}_2 + 3\text{H}_2 \rightleftharpoons 2\text{NH}_3$ (ΔH negative). Explain why 450 °C is used instead of a lower temperature. (3 marks)

Question 5 Catalyst (2 marks)

A catalyst is added to a system at equilibrium. State and explain its effect on the position of equilibrium and on the time to reach it. (2 marks)

Question 6 Ammonia calculation (2 marks)

A reactor holds 60 mol of N_2 and 180 mol of H_2 . At equilibrium 20% of the nitrogen has reacted. Calculate the moles of ammonia and of nitrogen left. (2 marks)

Question 7 Recycling (2 marks)

Explain why unreacted nitrogen and hydrogen are returned to the reactor in the Haber process. (2 marks)

Question 8 Use of ammonia (1 mark)

State one important use of ammonia. (1 mark)