

Reactions that go both ways

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

Award marks as indicated. For shift questions, a mark is given for the direction and another for the reason, so a correct direction without a reason does not earn full marks. Accept clear alternative wording.

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Question 1 Key terms (3 marks)

- a. A reaction in which the products can react to re-form the reactants. (1 mark)
- b. The forward and reverse reactions both continue at the same rate in a closed system, so the concentrations stay constant. (2 marks)

Marking: 1 mark for both reactions continuing, 1 mark for equal rates or constant concentrations.

Question 2 Concentration graph (4 marks)

- a. About 30 s. (1 mark)
- b. $[A] = 0.40 \text{ mol/dm}^3$ and $[B] = 0.60 \text{ mol/dm}^3$. (1 mark)
- c. The forward and reverse reactions continue; their rates are equal, so A is made as fast as it is used up. (2 marks)

Marking: (c) 1 mark for both reactions continuing, 1 mark for equal rates.

Question 3 Phosphorus pentachloride (3 marks)

- a. Shifts left, because there is 1 gas molecule on the left and 2 on the right, and the equilibrium moves to the side with fewer molecules. (2 marks)
- b. Shifts right, because the forward reaction is endothermic. (1 mark)

Marking: 1 mark for direction, 1 mark for the counting of molecules; 1 mark for (b).

Question 4 Conditions in the Haber process (3 marks)

A lower temperature favours the exothermic forward reaction and would give a higher yield. But the rate would be far too slow because few particles have the activation energy. 450 °C is a compromise that gives a reasonable rate and an acceptable yield, helped by the catalyst. **Compromise between rate and yield.**

Marking: 1 mark for yield at low temperature, 1 for too slow, 1 for compromise.

Question 5 Catalyst (2 marks)

The position does not change, because the catalyst speeds up the forward and reverse reactions equally. Equilibrium is reached sooner. **No shift; faster.**

Marking: 1 mark for no change in position, 1 mark for reached sooner.

Question 6 Ammonia calculation (2 marks)

N_2 reacted = $0.20 \times 60 = 12$ mol, so N_2 left = 48 mol. $\text{NH}_3 = 2 \times 12 = \mathbf{24 \text{ mol.}}$

Marking: 1 mark for 48 mol N_2 , 1 mark for 24 mol NH_3 .

Question 7 Recycling (2 marks)

Only a fraction of the gases reacts on each pass. Returning them gives them another chance to react, which saves raw materials and increases the overall yield. **Recycling raises the overall yield.**

Marking: 1 mark for only part reacts, 1 mark for the saving or higher yield.

Question 8 Use of ammonia (1 mark)

Making fertilisers (for example ammonium nitrate). **Fertilisers.**

Marking: 1 mark.