Dynamic equilibrium and Kc

AQA 7404 and 7405 · AS and A level

Show your working where needed.

Name _____ Date _____

1. Why equilibrium is dynamic

State the conditions for dynamic equilibrium in a reversible reaction. Explain why the concentrations stay constant.

2. Changing the pressure

$2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)$

The gas mixture is compressed at constant temperature. Explain the effect on the equilibrium yield of SO_3.

3. Adding hydrogen

$H_2(g) + I_2(g) \rightleftharpoons 2HI(g)$

Hydrogen is added at constant temperature and volume. Once equilibrium has been restored, how do the HI and I_2 concentrations compare with their original values? Explain.

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4. Equilibrium in a hydrogen iodide mixture

$H_2(g) + I_2(g) \rightleftharpoons 2HI(g)$

Equilibrium concentrations of H_2, I_2 and HI are 0.0150, 0.0120 and 0.0900 mol dm^{-3} respectively. Write the expression for Kc and calculate its value. State whether Kc has units for this equation.

5. Equilibrium in an ammonia mixture

$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$

At equilibrium, $[N_2] = 0.600$, $[H_2] = 0.400$ and $[NH_3] = 0.720$ mol dm^{-3}. Write the expression for Kc and calculate its value. Give units.

6. What can Kc tell you?

Two equilibria of the form reactant ⇌ product have Kc values of 0.012 and 58. In which mixture is the ratio of product concentration to reactant concentration greater? Can you tell which reaction is faster?

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7. Two equations for one equilibrium

A(aq) + B(aq) ⇌ C(aq) + D(aq). At equilibrium, [A], [B], [C] and [D] are 0.400, 0.200, 0.600 and 0.400 mol dm^{-3} respectively. Calculate Kc for this equation and for C(aq) + D(aq) ⇌ A(aq) + B(aq).

8. Decomposition of phosphorus pentachloride

$PCl_5(g) \rightleftharpoons PCl_3(g) + Cl_2(g)$. A 0.800 dm^3 vessel initially contains only 0.1250 mol PCl_5 and 0.0150 mol PCl_3. At equilibrium there is 0.0450 mol Cl_2. Calculate Kc with units.

9. Extra challenge · Use the total amount at equilibrium

$N_2O_4(g) \rightleftharpoons 2NO_2(g)$. A 1.50 dm^3 container initially contains 0.108 mol N_2O_4 and 0.018 mol NO_2. The total amount at equilibrium is 0.163 mol.

Calculate Kc, including units. Then predict the direction of shift and the effect on Kc if the vessel volume is halved at the same temperature.

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