Topic 11: Equilibrium II

Edexcel A Level Chemistry • Paper 1 (9CH0/01)

11.1 Be able to deduce an expression for Kp, for homogeneous and heterogeneous systems, in terms of equilibrium partial pressures in atm.

For the reaction: $aA(g) + bB(g) \rightleftharpoons cC(g) + dD(g)$

$K_p = p(C)^c \times p(D)^d / p(A)^a \times p(B)^b$ (partial pressures in atm)

Partial pressure: p(A) = mole fraction of A × total pressure.

Mole fraction = moles of A / total moles of gas.

Heterogeneous systems: only gaseous species are included in the Kp expression. Solids and liquids are omitted.

11.2 Be able to calculate a value, with units where appropriate, for the equilibrium constant (Kc and Kp) for homogeneous and heterogeneous reactions, from experimental data.

Method for Kc: (1) Write the balanced equation. (2) Use an ICE table (Initial, Change, Equilibrium) to find equilibrium concentrations. (3) Substitute into the Kc expression. (4) Calculate the units by substituting (mol dm^{-3}) raised to the appropriate powers.

Method for Kp: (1) Calculate moles at equilibrium. (2) Find mole fractions. (3) Multiply by total pressure for partial pressures. (4) Substitute into Kp expression. (5) Calculate units by substituting (atm) raised to appropriate powers.

If Σ(product powers) = Σ(reactant powers), K has no units.

11.3 Know the effect of changing temperature on the equilibrium constant (Kc and Kp), for both exothermic and endothermic reactions.

Exothermic reaction (forward ΔH negative):

- Increasing temperature decreases K (equilibrium shifts left, less products at equilibrium).
- Decreasing temperature increases K (equilibrium shifts right, more products).

Endothermic reaction (forward ΔH positive):

- Increasing temperature increases K (equilibrium shifts right, more products).
- Decreasing temperature decreases K (equilibrium shifts left, less products).

11.4 Understand that the effect of temperature on the position of equilibrium is explained using a change in the value of the equilibrium constant.

When temperature changes, K changes, and this is what causes the position of equilibrium to shift. A new equilibrium is established with different concentrations/partial pressures that satisfy the new value of K. The shift in position is a consequence of K changing, not the other way around.

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11.5 Understand that the value of the equilibrium constant is not affected by changes in concentration or pressure or by the addition of a catalyst.

Only temperature changes K. Changing concentration or pressure causes the position of equilibrium to shift, but the system adjusts so that the ratio of concentrations/pressures still equals K. A catalyst speeds up both forward and reverse reactions equally, so equilibrium is reached faster but K and the equilibrium position are unchanged.

ABOUT THESE NOTES

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