Chapter Summary Worksheet

Chapter 3 Equilibrium

Print out and complete this worksheet to generate a summary for Chapter 3.

1 Consider the equilibrium:

$$CH_4(g) + H_2O(g) \rightleftharpoons CO(g) + 3H_2$$

The expression for K_p is:

- ☐ **A** $K_p = \dfrac{p[CO]\ p[H_2]^3}{p[CH_4]\ p[H_2O]}$
- ☐ **B** $K_p = \dfrac{p(CO)\ p(H_2)^3}{p(CH_4)}$
- ☐ **C** $K_p = \dfrac{p(CO)\ p(H_2)^3}{p(CH_4)\ p(H_2O)}$
- ☐ **D** $K_p = \dfrac{p(CH_4)\ p(H_2O)}{p(CO)\ p(H_2)^3}$

2 Consider the equilibrium:

$$CH_3OOCCH_2COOCH_3(l) + 2H_2O(l) \rightleftharpoons 2CH_3OH(l) + HOOCCH_2COOH(l)$$

The correct expression for K_c is:

- ☐ **A** $K_c = \dfrac{[CH_3OH]\ [HOOCCH_2COOH]}{[CH_3OOCCH_2COOCH_3]\ [H_2O]}$
- ☐ **B** $K_c = \dfrac{[CH_3OH]^2\ [HOOCCH_2COOH]}{[CH_3OOCCH_2COOCH_3]\ [H_2O]^2}$
- ☐ **C** $K_c = \dfrac{[CH_3OH]\ [HOOCCH_2COOH]}{[CH_3OOCCH_2COOCH_3]]}$
- ☐ **D** $K_c = \dfrac{[CH_3OH]^2\ [HOOCCH_2COOH]}{[CH_3OOCCH_2COOCH_3]}$

3 Consider the equilibrium

$$Fe_3O_4(s) + 4CO(g) \rightleftharpoons 3Fe(s) + 4CO_2(g)$$

The correct expression for K_p is:

- ☐ **A** $K_p = \dfrac{p(Fe)^3\ p(CO_2)^4}{p(Fe_3O_4)\ p(CO)^4}$
- ☐ **B** $K_p = \dfrac{p(CO_2)}{p(CO)}$
- ☐ **C** $K_p = \dfrac{p(CO)}{p(CO_2)}$
- ☐ **D** $K_p = \dfrac{p(CO_2)^4}{p(CO)^4}$

4 The value of the equilibrium constant K_p for a given reaction is altered by:

- ☐ **A** temperature only
- ☐ **B** pressure only
- ☐ **C** temperature and pressure only
- ☐ **D** temperature, pressure and a catalyst

5 Consider the equilibrium:

$$A(aq) + B(aq) \rightleftharpoons C(aq) + D(aq) \qquad K_c = 3$$

When 1.0 mol of A and 1.0 mol of B are mixed with 1.0 mol of C and 2.0 mol of D in a vessel of volume 10 dm^3:

- ☐ **A** the system is at equilibrium so there is no change in the concentrations of any substance
- ☐ **B** the system is not at equilibrium because the fraction is smaller than K_c and reacts so that the value of K_c is lowered in order to equal the fraction
- ☐ **C** the system is not at equilibrium because the fraction is smaller than K_c and reacts by the position moving to the right so that the fraction gets bigger and becomes equal to 3
- ☐ **D** the system is not at equilibrium because the fraction is smaller than K_c and reacts so that the fraction gets bigger and becomes equal to 3 by the position moving to the left

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6 In a particular reversible reaction, $\Delta H = +40\ \text{kJ mol}^{-1}$ and $\Delta S_{system} = +150\ \text{J K}^{-1}\ \text{mol}^{-1}$. (The gas constant $R = 8.31\ \text{J K}^{-1}\ \text{mol}^{-1}$) At a temperature of 25°C, the numerical value of the equilibrium constant is:

- ☐ **A** 0.64
- ☐ **B** 6.67
- ☐ **C** 79
- ☐ **D** 7.1×10^{14}

7 Consider the equilibrium reaction:

$$A(g) + 2B(g) \rightleftharpoons C(g) + 3D(g)$$

When 0.10 mol of A and 0.20 mol of B were allowed to reach equilibrium, 80% of A reacted and the total pressure was 2.0 atm. The value of K_p/atm^2 is:

- ☐ **A** 182
- ☐ **B** 11.6
- ☐ **C** 16.5
- ☐ **D** 0.95

8 An equilibrium reaction has $\Delta H = -75\ \text{kJ mol}^{-1}$ and $\Delta S_{system} = -100\ \text{J K}^{-1}\ \text{mol}^{-1}$. (The gas constant $R = 8.31\ \text{J K}^{-1}\ \text{mol}^{-1}$.) An increase in temperature from 200°C to 300°C causes the value of ΔS_{total} to:

- ☐ **A** decrease from +58.6 to +30.9
- ☐ **B** increase from +58.6 to +650
- ☐ **C** decrease from –258.6 to –850
- ☐ **D** increase from –258.6 to –100.13

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