Chapter Summary Worksheet

Chapter 4 Application of rates and equilibrium

Print out and complete this worksheet to generate a summary for Chapter 4.

1 The value of the equilibrium constant for a homogeneous gas reaction depends on:

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

2 This question concerns the exothermic reaction between ammonia and oxygen, which is the first step in the manufacture of nitric acid.

$$4NH_3(g) + 5O_2(g) \rightleftharpoons 4NO(g) + 6H_2O(g)$$

Which of the following statements is **not** true?

- ☐ **A** a higher temperature results in a lower equilibrium yield of nitric oxide, NO
- ☐ **B** a lower temperature results in a larger value of the equilibrium constant, K_p
- ☐ **C** a lower pressure results in an increase in the value of the equilibrium constant, K_p
- ☐ **D** a lower pressure results in an increase in the equilibrium yield of nitric oxide, NO

Questions 3, 4 and 5 are about the second step in the manufacture of nitric acid. In this step, the nitric oxide is oxidised to nitrogen dioxide in a homogeneous reaction:

$$2NO(g) + O_2(g) \rightleftharpoons 2NO_2(g) \qquad \Delta H^{\ominus} = -114\ \text{kJ mol}^{-1}$$

3 Which set of conditions would enable equilibrium to be reached in the shortest time?

- ☐ **A** a low pressure and a high temperature
- ☐ **B** a high pressure and a high temperature
- ☐ **C** a low pressure and a low temperature
- ☐ **D** a high pressure and a low temperature

4 Which set of conditions would result in the greatest equilibrium yield?

- ☐ **A** a low pressure and a high temperature
- ☐ **B** a high pressure and a high temperature
- ☐ **C** a low pressure and a low temperature
- ☐ **D** a high pressure and a low temperature

5 In practice, the reaction is carried out at room temperature and at a pressure of just over 1 atm. This indicates that:

- ☐ **A** at room temperature, the value of the equilibrium constant is large and the rate is fast
- ☐ **B** at room temperature, the value of the equilibrium constant is small and the rate is slow
- ☐ **C** at room temperature, the value of the equilibrium constant is small and the rate is fast
- ☐ **D** the reaction has a high atom economy

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6 Hydrogen can be manufactured from coke (impure carbon) and steam:

$$C(s) + H_2O(g) \rightleftharpoons H_2(g) + CO(g) \qquad \Delta H^{\ominus} = +131\ \text{kJ mol}^{-1}$$

Which of the following statements is **not** true?

- ☐ **A** An increase in pressure will have no effect on the position of equilibrium as there are the same number of molecules on each side of the equation.
- ☐ **B** An increase in pressure will drive the position of equilibrium to the left.
- ☐ **C** An increase in temperature will drive the position of equilibrium to the right and will also reduce the time taken to reach equilibrium.
- ☐ **D** Removal of carbon monoxide from the equilibrium mixture will increase the percentage conversion of steam to hydrogen.

7 Consider an exothermic reaction $A + B \rightleftharpoons C$. An increase in temperature will:

- ☐ **A** reduce the value of the equilibrium constant because the position of equilibrium is driven to the left
- ☐ **B** reduce the value of the equilibrium constant because $-\Delta H/T$ becomes less positve
- ☐ **C** increase the value of the equilibrium constant because the position of equilibrium is driven to the right
- ☐ **D** increase the value of the equilibrium constant because $-\Delta H/T$ becomes less negative

8 Consider an endothermic reaction $D + E \rightleftharpoons F$. An increase in temperature will:

- ☐ **A** make the value of ΔS_{total} less positive
- ☐ **B** make the value of ΔS_{total} more positive
- ☐ **C** make the value of ΔS_{system} more positive
- ☐ **D** make the value of ΔS_{surr} more negative

9 For a given exothermic reaction such as that in the Contact process, an increase in temperature will cause:

- ☐ **A** a decrease in the value of the equilibrium constant and a decrease in the time taken to reach equilibrium
- ☐ **B** a decrease in the value of the equilibrium constant and an increase in the time taken to reach equilibrium
- ☐ **C** an increase in the value of the equilibrium constant and an increase in the time taken to reach equilibrium
- ☐ **D** an increase in the value of the equilibrium constant and a decrease in the time taken to reach equilibrium

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