Chemical Equilibrium

Test bank chapter (14)

<u>Choose the most correct answer</u>

1. Which is the correct equilibrium constant expression for the following reaction?

$$Fe_2O_3\ (s) + 3H_2\ (g) \leftrightarrow 2Fe\ (s) + 3H_2O\ (g)$$

a) $K_c = [Fe_2O_3]\,[H_2]^3/[Fe]^2\,[H_2O]^3$

b) $K_c = [H_2]/[H_2O]$

c) $K_c = [H_2O]^3/[H_2]^3$

d) $K_c = [Fe]^2\,[H_2O]^3/[Fe_2O_3]\,[H_2]^3$

2. The following reactions occur at 500 K. Arrange them in order of increasing tendency to proceed to completion (least → greatest tendency).

1. $2NOCl \leftrightarrow 2NO + Cl_2$	**$K_p = 1.7 \times 10^{-2}$**
2. $2SO_3 \leftrightarrow 2SO_2 + O_2$	**$K_p = 1.3 \times 10^{-5}$**
3. $2NO_2 \leftrightarrow 2NO + O_2$	**$K_p = 5.9 \times 10^{-5}$**

a) 2 < 1 < 3

b) 1 < 2 < 3

c) 2 < 3 < 1

d) 3 < 2 < 1

3.Calculate Kp for the below reaction if Kc at for this reaction is 2.1×10^{-2} at 400°C.

$$2NOCl\ (g) \leftrightarrow 2NO\ (g) + Cl_2\ (g)$$

a) 0.689

b) 0.115

c) 0.137

d) 1.2

4. For the following reaction:

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

Kc= 50.2 at 445 °C. If $[H_2] = [I_2] = [HI] = 1.75 \times 10^{-3}$M at 445 °C, which one of these statements is true?

a) The system is not at equilibrium; thus, no concentration changes will occur.

b) The concentrations of HI and I_2 will increase as the system approaches equilibrium.

c) The concentration of HI will increase as the system approaches equilibrium.

d) The concentrations of H_2 and HI will decrease as the system moves toward equilibrium.

5. For the below reaction at equilibrium, which choice gives a change that will shift the position of equilibrium to favor formation of more products?

$$2NOBr(g) \leftrightarrow 2NO(g) + Br_2(g) \qquad \Delta H^o_{rxn} = 30 \text{ kJ/mol}$$

a) Increase the total pressure by decreasing the volume.

b) Add more NO.

c) Remove Br_2.

d) Lower the temperature.

6 - For the following reaction at equilibrium in a reaction vessel, which one of these changes would cause the Br_2 concentration to decrease?

$$2NOBr(g) \leftrightarrow 2NO(g) + Br_2(g), \qquad \Delta H^o_{rxn} = 30 \text{ kJ/mol}$$

a) Increase the temperature.

b) Remove some NO.

c) Add more NOBr.

d) Compress the gas mixture into a smaller volume.

7. For the below reaction at equilibrium, if we increase the reaction temperature, the equilibrium will:

$$2SO_3 \leftrightarrow 2SO_2 + O_2 \qquad (\Delta H^o_{rxn} = 198 \text{ kJ/mol})$$

a) shift to the right.

b) shift to the left.

c) not shift.

d) The question cannot be answered because the equilibrium constant is not given.

8. For the equilibrium reaction:

$$2SO_2\,(g) + O_2\,(g) \leftrightarrow 2SO_3\,(g), \qquad \Delta H^{o}_{rxn} = -198 \text{ kJ/mol.}$$

Which one of these factors would cause the equilibrium constant to increase?

a) Decrease the temperature.

b) Increase the temperature.

c) Add SO_2 gas.

d) Remove O_2 gas.

9. The reaction below is endothermic. If the temperature is increased,

$$2SO_3\,(g) \leftrightarrow 2SO_2\,(g) + O_2\,(g)$$

a) more SO_3 will be produced.

b) Kc will increase.

c) Kc will decrease.

d) no change will occur in Kc.

10. If a catalyst is added to a chemical reaction, the equilibrium yield of a product will be ………, and the time taken to come to equilibrium will be ……than before.

a) higher; less

b) lower; the same

c) higher; the same

d) the same; less

11- For the reaction:

$$N_2\,(g) + 3H_2\,(g) \leftrightarrow 2NH_3\,(g)$$

Kc = 0.0600 at a certain temperature. In an equilibrium mixture of the three gases, $[NH_3]$ = 0.242 M and $[H_2]$ = 1.03 M. What is the concentration of N_2 in this system?

a) 3.9 M

b) 0.003 M

c) 0.89 M

d) 1.12 M

12. Consider the reaction,

$$NH_4Cl\ (s) \leftrightarrow NH_3\ (g) + HCl\ (g)$$

If an equilibrium mixture of these three substances is compressed, equilibrium will …… , because ……….

a) shift to the right; higher pressure favors fewer moles of gas

b) shift top the right; higher pressure favors more moles of gas

c) shift to the left; higher pressure favors fewer moles of gas

d) shift to the left; higher pressure favors more moles of gas

13- Consider the equilibrium system:

$$C\ (s) + CO_2\ (g) \leftrightarrow 2CO\ (g)$$

If more C(s) is added, the equilibrium will …..; if CO is removed the equilibrium will …….

a) shift to the left; shift to the left

b) shift to the right; shift to the left

c) be unchanged; shift to the right

d) be unchanged; shift to the left

14. Consider the exothermic reaction at equilibrium:

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

If the system is cooled, the equilibrium will ……, because ……..

a) shift to the left; decreased temperature favors an exothermic reaction

b) shift to the right; decreased temperature favors an exothermic reaction

c) shift to the right; decreased temperature favors an endothermic reaction

d) shift to the left; decreased temperature favors an endothermic reaction

15. A large value of the equilibrium constant indicates that when the reaction reaches equilibrium, mostly ______ will be present.

a) reactants

b) products

c) catalysts

d) shrapnel

16. When equilibrium is achieved?

a) $Q > K$

b) $Q < K$

c) $Q = K$

d) $Q2 = K$

17. for the following reaction:

$$CO_2 + H_2 \leftrightarrow CO + H_2O$$

If all species are gases and H_2 is added, the amount of CO present at equilibrium will:

a) increase.

b) decrease.

c) remain unchanged.

d) disappear.

18. For the reaction:

$$CO_2 + H_2 \leftrightarrow CO + H_2O$$

If all species are gases and H_2O is added, the amount of CO present at equilibrium will:

a) increase.

b) decrease.

c) remain unchanged.

d) disappear.

19. For the reaction:

$$CO_2 + H_2 \leftrightarrow CO + H_2O$$

If the reaction is endothermic and the temperature is raised, the amount of CO present will:

a) increase.

b) decrease.

c) remain unchanged.

d) disappear.

20. For the reaction:

$$CO_2 + H_2 \leftrightarrow CO + H_2O$$

If all species are gases and the container is compressed, the amount of CO present will:

a) increase.

b) decrease.

c) remain unchanged.

d) disappear.

21. What is K_P in terms of Kc for the following reaction?

$$2\ NO(g) + O_2(g) \leftrightarrow 2\ NO_2(g)$$

a) Kp = Kc RT

b) Kp = Kc / RT

c) Kp = Kc R/T

d) $Kp = Kc / (RT)^2$

22. What is the correct equilibrium constant expression for the reaction:

$$P(s) + 6Cl_2\ (g) \longrightarrow 4PCl_3\ (l)$$

a. $\dfrac{[PCl_3]^4}{[P_4][Cl_2]^6}$

c. $\dfrac{[PCl_3]^4}{[Cl_2]^6}$

b. $\dfrac{1}{[Cl_2]^6}$

d. $\dfrac{[PCl_3]^4}{[P][6Cl_3]}$

23. The equation relating Kp and Kc is:

a) $Kp = kc\ (RT)^{\Delta n}$

b) $Kp = Kc\ RT^{\Delta n}$

c) $Kc = Kp\ RT^{\Delta n}$

d) $Kc = Kp\ (RT)^{\Delta n}$

24. Kp will be equal to Kc if:

a) $\Delta n = 1$

b) $\Delta n = 0$

c) $\Delta n = -1$

d) $RT = 0$

25. Consider the reversible reaction at equilibrium at 392 ^oC:

$$2A\ (g) + B\ (g) \leftrightarrow C\ (g)$$

The partial pressures are found to be: A: 6.70 atm, B: 10.1 at, C: 3.60 atm. Evaluate Kp for this reaction.

a) 7.94×10^{-3}

b) 0.0794

c) 0.794

d) 7.94

26. Which of the following will result in an equilibrium shift to the right?

$$PCl_3\ (g) + Cl_2\ (g) \leftrightarrow PCl_5\ (g) \qquad \Delta H = -87.9\ KJ/mol$$

a) Increase temperature/increase volume

b) Increase temperature/decrease volume

c) decrease temperature/increase volume

d) decrease temperature/decrease volume

27. Which accurately reflects the change in concentration that will occur if O_2 is added to disturb the equilibrium?

$$2NO\ (g) + O_2\ (g) \leftrightarrow 2NO_2\ (g)$$

	[NO]	[O_2]	[NO_2]
a)	Increase	Increase	Increase
b)	Increase	Increase	Decrease
c)	Decrease	Decrease	Decrease
d)	Decrease	Increase	Increase