IV. Multiple Choice Questions

Question 1. The equilibrium expression, $K_c = [CO_2]$ represents the reaction.

(a) $C(s) + O_2(g) \rightleftharpoons CO_2(g)$ (b) $CaCO_3(s) \rightleftharpoons CaO(s) + CO_2(g)$

(c) $CO(g) + \frac{1}{2} O_2(g) \rightleftharpoons CO_2(g)$ (d) $CaO(s) + CO_2(g) \rightleftharpoons CaCO_3(s)$

Question 2. Hydrogen molecule (H_2) can be dissociated into hydrogen atoms (H). Which one of the following changes will not increase the number of atoms present at equilibrium?

(a) adding H atoms
(b) increasing the temperature
(c) increasing the total pressure
(d) increasing the volume of the container

Question 3. What is the expression for K_{eq}? for the reaction

$$2N_2O(g) + O_2(g) \rightleftharpoons 4NO(g)?$$

(a) $\frac{[N_2][O_2]}{[NO]}$ (b) $\frac{[NO]^4}{[N_2O]^2}$ (c) $\frac{[NO]^4}{[N_2O]^2[O_2]}$ (d) $\frac{[N_2O]^2[O_2]}{[NO]^4}$

Question 4. A catalyst will increase the rate of a chemical reaction by

(a) shifting the equilibrium to the right
(b) shifting the equilibrium to the left
(c) lowering the activation energy
(d) increasing the activation energy

Question 5. What is the correct expression for the representation of the solubility product constant of $Ag_2 Cr0_4$?

(a) $[Ag^+]^2 [CrO_4^{2-}]$ (b) $[2Ag^+] [CrO_4^{2-}]$ (c) $[Ag^+] [CrO_4^{2-}]$ (d) $[2Ag^+]^2 [CrO_4^{2-}]$

Question 6. In a closed system

$$A(S) \rightleftharpoons 4\,B(g) + 3\,C(g)$$

If partial pressure of C is doubled, then partial pressure of B will be

(a) $2\sqrt{2}$ times the original value (b) $\frac{1}{2}$ times the original value

(c) 2 times of the original value (d) $\frac{1}{2\sqrt{2}}$ times of the original value

Question 7. $H_2 + S \rightarrow H_2S$ + energy.

In this reversible reaction, select the factor which will shift the equilibrium to the right.

(a) adding heat
(b) adding H_2S
(c) blocking hydrogen gas reaction
(d) removing hydrogen sulphide gas

Question 8. What effect does a catalyst have on the equilibrium position of a reaction?

(a) a catalyst favours the formation of products
(b) a catalyst favours the formation of reactants
(c) a catalyst does not change the equilibrium position of a reaction
(d) a catalyst may favour reactants or product formation, depending upon the directiofi in which the reaction is written.

Question 9. A chemist dissolves an excess of $BaSO_4$ in pure water at 25°C if its $K_{sp} = 1 \times 10^{-10}$ what is the concentration of barium in the water?

(a) 10^{-4} M (b) 10^{-5} M
(c) 10^{-15} M (d) 10^{-6} M

Question 10. If in a mixture where Q = k is combined, then what happens?
(a) the reaction shift towards products
(b) the reaction shift towards reactants
(c) nothing appears to happen, but forward and reverse are continuing at the same rate
(d) nothing happens
Answer:
1.(b)
2.(c)
3.(c)
4.(c)
5.(a)
6.(d)
7.(a)
8.(c)
9.(c)
10.(c)

V. Hots Questions

Question 1. For the equilibrium $2\ NOCl(g) \rightarrow 2NO(g) + Cl_2(g)$ the value of the equilibrium constant Kc is 3.75×10^{-6} at 1069 K. Calculate the K_p for the reaction at this temperature?
Answer:
We know that $K_p = K_c(RT)^{\Delta n}$
For the above reaction, $\Delta n = (2 + 1) - 2 = 1$ $K_p = 3.75 \times 10^{-6}$ (0.0831 x 1069)
$K_p = 0.033$.

Question 2. The values of Ksp of two sparingly soluble salts $Ni(OH)_2$ and AgCN are 2.0×10^{-15} and 6×10^{-17} respectively. Which salt is more soluble? Explain.
Answer:

$AgCN \rightleftharpoons Ag^+ + CN^-$

$Ksp = [Ag^+][CN^-] = 6 \times 10^{-17}$

$Ni(OH)_2 \rightleftharpoons Ni^{2+} + 2OH^-$

$Ksp = [Ni^{2+}][OH^-]^2 = 2 \times 10^{-15}$

Let $[Ag^+] = S_1$, then $[CN^-] = S_1$

Let $[Ni^{2+}] = S_2$, then $[OH^-] = 2S_2$

$S_1^2 = 6 \times 10^{-17}$, $S_1 = 7.8 \times 10^{-9}$

$(S_2)\ (2S_2)^2 = 2 \times 10^{-15}$, $S_2 = 0.58 \times 10^{-4}$

$Ni(OH)_2$ is more soluble than AgCN.

Question 3. The value of Kc for the reaction $2A \rightarrow B + C$ is 2×10^{-3}. At a given time, the composition of reaction mixture is [A] = [B] = [C] = 3×10^{-4} M. In which direction the reaction will proceed?
Answer: For the reaction the reaction quotient Q_c is given by Q_c = [B] [C]/[A]2 as [A] = [B] = [C] = 3 x 10-4 M $Q_c = (3 \times 10^{-4})\ (3 \times 10^{-3})/(3 \times 10) = 1$
as $Q_c > K_c$, so, the reaction will proceed in the reverse direction.

Question 4. PCl_5, PCl_3 and Cl_2 are at equilibrium at 500 K and having concentration 1.59M PCl_5 1.59M Cl_2 and 1.41M PCl_5. Calculate K_c for

the reaction $PCl_5 \rightarrow PC_{13} + Cl_2$
Answer: The equilibrium constant Kc for the above reaction can be written as:

$$Kc = \frac{[PCl_3][Cl_2]}{[PCl_5]}$$

$$= \frac{(1.59)^2}{1.41} = 1.79$$

Question 5. Dihydrogen gas is obtained from natural gas by partial oxidation with steam as per following endothermic reaction:
$CH_4(g) + H_2O(g) \rightarrow CO(g) + 3\ H_2(g)$
(a) Write an expression for K_p for the above reaction.
(b) How will the values of K_p and composition of equilibrium mixture be affected by (i) increasing the pressure (ii) increasing the temperature (iii) using a catalyst?
Answer:

$$(a)\quad K_p = \frac{[p_{CO}][p_{H_2}]^3}{[p_{CH_4}][p_{H_2O}]}$$

(b) (i) value of K_p will not change, equilibrium will shift in backward direction.
(ii) value of K_p will increase and reaction will proceed in forward direction.
(iii) no effect.

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