



#### IV. Multiple Choice Questions

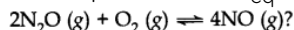
Question 1. The equilibrium expression,  $K_c = [\text{CO}_2]$  represents the reaction.

- (a)  $\text{C(s)} + \text{O}_2(\text{g}) \rightleftharpoons \text{CO}_2(\text{g})$  (b)  $\text{CaCO}_3(\text{s}) \rightleftharpoons \text{CaO(s)} + \text{CO}_2(\text{g})$   
 (c)  $\text{CO(g)} + \frac{1}{2} \text{O}_2(\text{g}) \rightleftharpoons \text{CO}_2(\text{g})$  (d)  $\text{CaO(s)} + \text{CO}_2(\text{g}) \rightleftharpoons \text{CaCO}_3(\text{s})$

Question 2. Hydrogen molecule ( $\text{H}_2$ ) 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



- (a)  $\frac{[\text{N}_2][\text{O}_2]}{[\text{NO}]}$  (b)  $\frac{[\text{NO}]^4}{[\text{N}_2\text{O}]^2}$  (c)  $\frac{[\text{NO}]^4}{[\text{N}_2\text{O}]^2 [\text{O}_2]}$  (d)  $\frac{[\text{N}_2\text{O}]^2 [\text{O}_2]}{[\text{NO}]^4}$

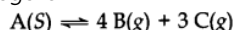
Question 4. A catalyst will increase the rate of a chemical reaction by

- (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  $\text{Ag}_2\text{CrO}_4$ ?

- (a)  $[\text{Ag}^+]^2 [\text{CrO}_4^{2-}]$  (b)  $[2\text{Ag}^+] [\text{CrO}_4^{2-}]$  (c)  $[\text{Ag}^+] [\text{CrO}_4^{2-}]$  (d)  $[2\text{Ag}^+]^2 [\text{CrO}_4^{2-}]$

Question 6. In a closed system



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.  $\text{H}_2 + \text{S} \rightarrow \text{H}_2\text{S} + \text{energy}$ .

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

- (a) adding heat  
 (b) adding  $\text{H}_2\text{S}$   
 (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 direction in which the reaction is written.

Question 9. A chemist dissolves an excess of  $\text{BaSO}_4$  in pure water at  $25^\circ\text{C}$  if its  $K_{sp} = 1 \times 10^{-10}$  what is the concentration of barium in the water?

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

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  $2 \text{NOCl(g)} \rightarrow 2 \text{NO(g)} + \text{Cl}_2\text{(g)}$  the value of the equilibrium constant  $K_c$  is  $3.75 \times 10^{-6}$  at 1069 K. Calculate the  $K_p$  for the reaction at this temperature?

Answer:

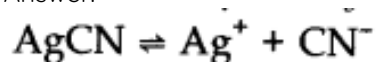
We know that  $K_p = K_c(RT)^{\Delta n}$

For the above reaction,  $\Delta n = (2 + 1) - 2 = 1$   $K_p = 3.75 \times 10^{-6} (0.0831 \times 1069)$

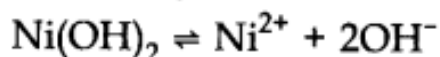
$K_p = 0.033$ .

Question 2. The values of  $K_{sp}$  of two sparingly soluble salts  $\text{Ni(OH)}_2$  and  $\text{AgCN}$  are  $2.0 \times 10^{-15}$  and  $6 \times 10^{-17}$  respectively. Which salt is more soluble? Explain.

Answer:



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



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

$$\text{Let } [\text{Ag}^+] = S_1, \text{ then } [\text{CN}^-] = S_1$$

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

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

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

**$\text{Ni(OH)}_2$  is more soluble than  $\text{AgCN}$ .**

Question 3. The value of  $K_c$  for the reaction  $2\text{A} \rightarrow \text{B} + \text{C}$  is  $2 \times 10^3$ . At a given time, the composition of reaction mixture is  $[\text{A}] = [\text{B}] = [\text{C}] = 3 \times 10^{-4} \text{ M}$ . In which direction the reaction will proceed?

Answer: For the reaction the reaction quotient  $Q_c$  is given by  $Q_c =$

$$\frac{[\text{B}][\text{C}]}{[\text{A}]^2} \text{ as } [\text{A}] = [\text{B}] = [\text{C}] = 3 \times 10^{-4} \text{ M } Q_c = \frac{(3 \times 10^{-4})(3 \times 10^{-4})}{(3 \times 10^{-4})^2} = 1$$

as  $Q_c > K_c$ , so, the reaction will proceed in the reverse direction.

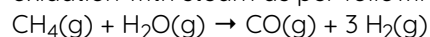
Question 4.  $\text{PCl}_5$ ,  $\text{PCl}_3$  and  $\text{Cl}_2$  are at equilibrium at 500 K and having concentration 1.59M  $\text{PCl}_5$  1.59M  $\text{Cl}_2$  and 1.41M  $\text{PCl}_3$ . Calculate  $K_c$  for

the reaction  $\text{PCl}_5 \rightarrow \text{PCl}_3 + \text{Cl}_2$

Answer: The equilibrium constant  $K_c$  for the above reaction can be written as:

$$K_c = \frac{[\text{PCl}_3][\text{Cl}_2]}{[\text{PCl}_5]}$$
$$= \frac{(1.59)^2}{1.41} = 1.79$$

Question 5. Dihydrogen gas is obtained from natural gas by partial oxidation with steam as per following endothermic reaction:



(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:

$$(a) \quad K_p = \frac{[p_{\text{CO}}][p_{\text{H}_2}]^3}{[p_{\text{CH}_4}][p_{\text{H}_2\text{O}}]}$$

(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.

\*\*\*\*\* END \*\*\*\*\*