

PREVIOUS HSE QUESTIONS FROM THE CHAPTER "EQUILIBRIUM"

- Equilibrium constant helps in predicting the direction in which a given reaction will proceed at any stage.
 - In which one of the following conditions a chemical reaction Proceeds in the forward direction?
 - $Q_c < K_c$
 - $Q_c > K_c$
 - $Q_c = 1/K_c$
 - $Q_c = -K_c$
 (1)
 - Write whether the following statement is true or false:
 "High value of equilibrium constant suggests high concentration of the reactants in the equilibrium mixture". (1)
 - State the Le-Chatliers principle. Applying this principle, explain the effect of pressure in the following equilibrium.
 $\text{CO(g)} + 3 \text{H}_2\text{(g)} \rightarrow \text{CH}_4\text{(g)} + \text{H}_2\text{O(g)}$ (3) [September 2015]
- Give the Arrhenius concept about acids and bases. (1)
 - Give one example each for Arrhenius acid and base. (1)
 - Write the expression for equilibrium constant K_p for the following equilibrium.
 $2\text{NOCl}_{(g)} \rightleftharpoons 2\text{NO}_{(g)} + \text{Cl}_{2(g)}$ (1)
 - Find the value of K_c for the above equilibrium if the value of K_p is 1.8×10^{-2} atm at 600 K. ($R = 0.0821 \text{ Latm K}^{-1}\text{mol}^{-1}$) (2) [March 2015]
- Le-Chatlier's principle makes a qualitative prediction about the change in conditions on equilibrium.
 - State Le-Chatlier's principle. (1)
 - $\text{N}_2\text{(g)} + \text{O}_2\text{(g)} \rightleftharpoons 2\text{NO(g)}$.
 What is the effect of pressure on the above equilibrium? (2)
 - The species HCO_3^- and HSO_4^- can act both as Bronsted acids and bases. Write the corresponding conjugate acid and conjugate base of the above species. (2) [August 2014]
- Write an equation for equilibrium constant in terms of concentration (K_c) for the equilibrium reaction given below.
 $\text{Ag}_2\text{O(s)} + 2\text{HNO}_3\text{(aq)} \rightleftharpoons 2\text{AgNO}_3\text{(aq)} + \text{H}_2\text{O(l)}$ (1)
 - What are buffer solutions? Give an example for a buffer solution. (2)
 - The concentration of H^+ ion in a sample of soft drink is $3.8 \times 10^{-3} \text{ M}$. Determine its pH. (2) [March 2014]
- What is conjugate acid – base pair? Illustrate with an example. (1)
 - Define the pH scale. The pH of a soft drink is 2.42. Give the nature of the solution. (2)
 - An aqueous solution of CuSO_4 is acidic while that of Na_2SO_4 is neutral. Explain. (2) [September 2013]
- Equilibrium is possible only in a closed system at a given temperature.
 - Write the expression for equilibrium constant, K_c for the reaction
 $4 \text{NH}_3\text{(g)} + 5 \text{O}_2\text{(g)} \rightleftharpoons 4 \text{NO(g)} + 6 \text{H}_2\text{O(l)}$ (1)
 - What happens to the value of the equilibrium constant (K_c) when the above reaction is reversed? (1)
- Weak acids are partially ionized in aqueous solutions.
 - The ionization constants of some acids are given below:

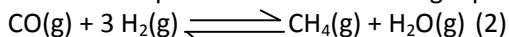
Acid	Ionisation constant (K_a)
Formic acid (HCOOH)	1.8×10^{-4}
Hypochlorous acid (HClO)	3.0×10^{-8}
Nitrous acid (HNO_2)	4.5×10^{-4}
Hydrocyanic acid (HCN)	4.9×10^{-10}

 Arrange the above acids in the increasing order of their acid strength. (1)
 - Calculate the pH of a 0.01 M acetic acid solution with the degree of ionization 0.045. (2)
- Salts can be classified into different categories on the basis of their solubility.
 - Identify the solubility range of sparingly soluble salts from the following:
 (Between 0.01 M and 0.1 M, less than 0.01 M, greater than 0.1 M). (1)
 - Calculate the solubility (S) of CaSO_4 at 298 K, if its solubility product constant (K_{sp}) at this temperature is 9×10^{-6} . (2) [March 2013]
- During a class room discussion one of your friends argues that equilibrium constant is not altered with change in temperature. What is your view towards this argument? Justify. (2)
 - Dissociation of CaCO_3 in a closed vessel is given as $\text{CaCO}_3\text{(s)} \rightleftharpoons \text{CaO(s)} + \text{CO}_2\text{(g)}$
 - Write an expression for K_c . (1)

- ii) Explain the effect of increase in pressure on the above reaction. Name the principle behind this. (2)
[September 2012]

10. Le-Chatlier's principle helps to explain the effect of change in conditions on equilibrium.

Discuss the effect of pressure in the following equilibrium on the basis of Le-Chatlier's principle:



11. The behaviour of acids and bases can be explained by using different concepts.

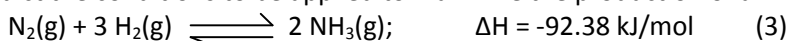
- a) Select the Lewis acid from the following: (NH_3 , OH^- , BCl_3 , Cl^-) (1)
b) What are conjugate acid – base pairs? Illustrate using a suitable example. (2)

12. The pH of a salt solution depends on the hydrolysis of its ions.

- a) Out of the following, which can produce an acidic solution in water?
(CH_3COONa , NH_4Cl , $\text{CH}_3\text{COONH}_4$, NaCl) (1)
b) Explain the phenomenon of common ion effect with a suitable example. (2) [March 2012]

13. The principal goal of chemical synthesis is to maximize the conversion of reactants into products. Le-Chatlier's principle can be applied to achieve this goal.

- a) State Le-Chatlier's principle. (1)
b) Predict the conditions to be applied to maximize the production of ammonia in the following reaction.



- c) Comment on the effect of increasing pressure in the reaction, $2 \text{SO}_3\text{(g)} \rightleftharpoons 2 \text{SO}_2\text{(g)} + \text{O}_2\text{(g)}$ (1)
[October 2011]

14. Common ion effect is a phenomenon based on Le-Chatlier's principle.

- a) Illustrate the common ion effect with an example. (2)
b) If the concentration of hydrogen ion in a soft drink is $3 \times 10^{-3} \text{ M}$, calculate its pH. (2)
c) Identify the Lewis acids from the following: OH^- , BCl_3 , NH_3 , H^+ (1) [March 2011]

15. Lowry-Bronsted concept of acid and bases is based on the exchange of H^+ during a reaction.

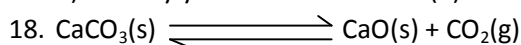
- a) Illustrate with an example of the conjugate acid – base pair. (1½)
b) Explain the Lewis concept of acids and bases. (1½)
c) According to Lewis theory, classify the following into acids and bases:
 H_2O , NH_3 , AlCl_3 , OH^- (2) [September 2010]

16. When some sodium acetate is added to a solution of acetic acid, the concentration of unionized acetic acid increases.

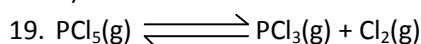
- a) What is the phenomenon involved? Substantiate. (2)
b) Consider the equilibrium, $\text{AgCl(s)} \rightleftharpoons \text{Ag}^+\text{(aq)} + \text{Cl}^-\text{(aq)}$
The solubility of AgCl is $1.06 \times 10^{-5} \text{ mol/L}$ at 298K. Find out its K_{sp} at this temperature. (2)
c) What happens to the value of solubility and solubility product when HCl is passed through AgCl solution? (1)
[March 2010]

17. The aqueous solutions of the ionic compounds NaCl , CH_3COONa and NH_4Cl show different pH.

- a) Identify the acidic, basic and neutral solutions among these. (2)
b) Justify your answer. (3) [March 2009]



- a) Write down the expression for K_p . (1)
b) What is the relation between K_p and K_c in the above reaction? (1) [June 2008]



- a) What happens to K_p of the above system if more chlorine is added to the system in equilibrium. (1)
b) Give the relation between K_p and K_c in the above system. (1) [February 2008]

=====