

1. For the reaction  $2A \rightleftharpoons B + C$ ,  $K_c = 4 \times 10^{-3}$ . At a given time, the composition of reaction mixture is :  $[A] = [B] = [C] = 2 \times 10^{-3} M$ .

Then, which of the following is correct?

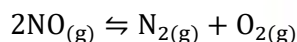
**(2024)**

- (a) Reaction has a tendency to go in forward direction  
(b) Reaction has a tendency to go in backward direction  
(c) Reaction has gone to completion in forward direction  
(d) Reaction is at equilibrium

2. In which of the following equilibria,  $k_p$  and  $k_c$  are **NOT** equal? **(2024)**

- (a)  $H_{2(g)} + I_{2(g)} \rightleftharpoons 2HI_{(g)}$   
(b)  $CO_{(g)} + H_2O_{(g)} \rightleftharpoons CO_{2(g)} + H_{2(g)}$   
(c)  $2BrCl_{(g)} \rightleftharpoons Br_{2(g)} + Cl_{2(g)}$   
(d)  $PCl_{5(g)} \rightleftharpoons PCl_{3(g)} + Cl_{2(g)}$

3. Consider the following reaction in a sealed vessel at equilibrium with concentrations of  $N_2 = 3.0 \times 10^{-3} M$ ,  $O_2 = 4.2 \times 10^{-3} M$  and  $NO = 2.8 \times 10^{-3} M$ .



If  $0.1 \text{ mol L}^{-1}$  of  $NO_{(g)}$  is taken in a closed vessel.

What will be degree of dissociation ( $\alpha$ ) of  $NO_{(g)}$  at equilibrium? **(2024)**

- (a) 0.0889 (b) 0.8889  
(c) 0.717 (d) 0.00889

4. For a weak acid HA, the percentage of dissociation is nearly 1% at equilibrium. If the concentration of acid is  $0.1 \text{ mol L}^{-1}$ , then the correct option for its  $K_a$  at the same temperature is: **(2023)**

- (a)  $1 \times 10^{-4}$  (b)  $1 \times 10^{-6}$   
(c)  $1 \times 10^{-5}$  (d)  $1 \times 10^{-3}$

5. An acidic buffer is prepared by mixing:

**(2023)**

- (a) weak acid and its salt with strong base  
(b) equal volumes of equimolar solutions of weak acid and weak base  
(c) strong acid and its salt with strong base  
(d) strong acid and its salt with base (The  $pK_a$  of acid =  $pK_b$  of the base)

6. 0.01 M acetic acid solution is 1% ionised, then pH of this acetic acid solution is: **(2022)**

- (a) 1  
(b) 3  
(c) 2  
(d) 4

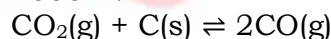
7.  $K_H$  value for some gases at the same temperature 'T' are given: **(2022)**

Gas	$K_H/k \text{ bar}$
Ar	40.3
$CO_2$	1.67
HCHO	$1.83 \times 10^{-5}$
$CH_4$	0.413

Where  $K_H$  is Henry's Law constant in water. The order of their solubility in water is:

- (a)  $HCHO < CH_4 < CO_2 < Ar$   
(b)  $Ar < CO_2 < CH_4 < HCHO$   
(c)  $Ar < CH_4 < CO_2 < HCHO$   
(d)  $HCHO < CO_2 < CH_4 < Ar$

8.  $K_p$  for the following reaction is 3.0 at 1000 K.



What will be the value of  $K_c$  for the reaction at the same temperature?

(Given:  $R = 0.083 \text{ L bar K}^{-1} \text{ mol}^{-1}$ ) **(2022)**

- (a) 3.6  
(b) 0.36  
(c)  $3.6 \times 10^{-2}$   
(d)  $3.6 \times 10^{-3}$

9. The pH of the solution containing 50 mL each of 0.10 M sodium acetate and 0.01 M acetic acid is **(2022)**

[Given:  $pK_a$  of  $CH_3COOH = 4.57$ ]

- (a) 5.57 (b) 3.57  
(c) 4.57 (d) 2.57

10.  $3O_{2(g)} \rightleftharpoons 2O_{3(g)}$

For the above reaction at 298 K,  $K_c$  is found to be  $3.0 \times 10^{-59}$ . If the concentration of  $O_2$  at equilibrium is 0.040 M then concentration of  $O_3$  in M is **(2022)**

- (a)  $4.38 \times 10^{-32}$  (b)  $1.9 \times 10^{-63}$   
(c)  $2.4 \times 10^{31}$  (d)  $1.2 \times 10^{21}$

11. The  $pK_b$  of dimethylamine and  $pK_a$  of acetic acid are 3.27 and 4.77 respectively at T(K). The correct option for the pH of dimethylammonium acetate solution is: **(2021)**  
 (a) 5.50 (b) 7.75  
 (c) 6.25 (d) 8.50
12. Find out the solubility of  $Ni(OH)_2$  in 0.1 M NaOH. Given that the ionic product of  $Ni(OH)_2$  is  $2 \times 10^{-15}$ . **(2020)**  
 (a)  $2 \times 10^{-8}$  M (b)  $1 \times 10^{-13}$  M  
 (c)  $1 \times 10^8$  M (d)  $2 \times 10^{-13}$  M
13. HCl was passed through a solution of  $CaCl_2$ ,  $MgCl_2$  and NaCl. Which of the following compound(s) crystallize? **(2020)**  
 (a) Only NaCl  
 (b) Only  $MgCl_2$   
 (c) NaCl,  $MgCl_2$  and  $CaCl_2$   
 (d) Both  $MgCl_2$  and  $CaCl_2$
14. Which among the following salt solutions is basic in nature? **(2020 covid Re-NEET)**  
 (a) Ammonium sulphate  
 (b) Ammonium nitrate  
 (c) Sodium acetate  
 (d) Ammonium chloride
15. The solubility product for a salt of the type AB is  $4 \times 10^{-8}$ . What is the molarity of its standard solution? **(2020 Covid Re-NEET)**  
 (a)  $16 \times 10^{-16}$  mol/L  
 (b)  $2 \times 10^{-16}$  mol/L  
 (c)  $4 \times 10^{-4}$  mol/L  
 (d)  $2 \times 10^{-4}$  mol/L
16. Hydrolysis of sucrose is given by the following reaction.  
 $Sucrose + H_2O \rightleftharpoons Glucose + Fructose$   
 If the equilibrium constant ( $K_c$ ) is  $2 \times 10^{13}$  at 300 K, the value of  $\Delta_r G^\circ$  at the same temperature will be :  
 (a)  $8.314 J mol^{-1} K^{-1} \times 300 K \times \ln(2 \times 10^{13})$   
 (b)  $8.314 J mol^{-1} K^{-1} \times 300 K \times \ln(3 \times 10^{13})$   
 (c)  $-8.314 J mol^{-1} K^{-1} \times 300 K \times \ln(4 \times 10^{13})$   
 (d)  $-8.314 J mol^{-1} K^{-1} \times 300 K \times \ln(2 \times 10^{13})$
17. pH of a saturated solution of  $Ca(OH)_2$  is 9. The solubility product ( $K_{sp}$ ) of  $Ca(OH)_2$  is: **(2019)**  
 (a)  $0.5 \times 10^{-15}$  (b)  $0.25 \times 10^{-10}$   
 (c)  $0.125 \times 10^{-15}$  (d)  $0.5 \times 10^{-10}$
18. Conjugate base for Bronsted acids  $H_2O$  and HF are : **(2019)**  
 (a)  $OH^-$  and  $H_2F^+$ , respectively  
 (b)  $H_3O^+$  and  $F^-$ , respectively  
 (c)  $OH^-$  and  $F^-$ , respectively  
 (d)  $H_3O^+$  and  $H_2F^+$ , respectively
19. Which will make basic buffer? **(2019)**  
 (a) 50 mL of 0.1 M NaOH + 25 mL of 0.1 M  $CH_3COOH$   
 (b) 100 mL of 0.1 M  $CH_3COOH$  + 100 mL of 0.1 M NaOH  
 (c) 100 mL of 0.1 M HCl + 200 mL of 0.1 M  $NH_4OH$   
 (d) 100 mL of 0.1 M HCl + 100 mL of 0.1 M NaOH
20. Which one of the following conditions will favour maximum formation of the product in the reaction,  
 $A_2(g) + B_2(g) \rightleftharpoons X_2(g) \Delta_r H = -X kJ$  **(2018)**  
 (a) Low temperature and high pressure  
 (b) Low temperature and low pressure  
 (c) High temperature and low pressure  
 (d) High temperature and high pressure
21. The solubility of  $BaSO_4$  in water is  $2.42 \times 10^{-3} g L^{-1}$  at 298 K. The value of its solubility product ( $K_{sp}$ ) will be: **(2018)**  
 (Given molar mass of  $BaSO_4 = 233 g mol^{-1}$ )  
 (a)  $1.08 \times 10^{-10} mol^2 L^{-2}$   
 (b)  $1.08 \times 10^{-12} mol^2 L^{-2}$   
 (c)  $1.08 \times 10^{-8} mol^2 L^{-2}$   
 (d)  $1.08 \times 10^{-14} mol^2 L^{-2}$
22. Following solutions were prepared by mixing different volumes of NaOH and HCl of different concentrations : **(2018)**  
 (A)  $60 mL \frac{M}{10} HCl + 40 mL \frac{M}{10} NaOH$   
 (B)  $55 mL \frac{M}{10} HCl + 45 mL \frac{M}{10} NaOH$   
 (C)  $75 mL \frac{M}{5} HCl + 25 mL \frac{M}{5} NaOH$   
 (D)  $100 mL \frac{M}{10} HCl + 100 mL \frac{M}{10} NaOH$   
 pH of which one of them will be equal to 1?  
 (a) B (b) A  
 (c) C (d) D
23. The equilibrium constants of the following are : **(2017-Delhi)**  
 $N_2 + 3H_2 \rightleftharpoons 2NH_3$   $K_1$   
 $N_2 + O_2 \rightleftharpoons 2NO$   $K_2$   
 $H_2 + \frac{1}{2}O_2 \rightarrow H_2O$   $K_3$   
 The equilibrium constant (K) of the reaction:  
 $2NH_3 + \frac{5}{2}O_2 \xrightleftharpoons{K} 2NO + 3H_2O$ , will be:  
 (a)  $K_2^3 K_3 / K_1$  (b)  $K_1 K_3^3 / K_2$

24. (c)  $K_2K_3^3/K_1$  (d)  $K_2K_3/K_1$   
Concentration of  $\text{Ag}^+$  ions in a saturated solution of  $\text{Ag}_2\text{C}_2\text{O}_4$  is  $2.2 \times 10^{-4} \text{ mol L}^{-1}$ . Solubility product of  $\text{Ag}_2\text{CO}_3$  is: **(2017-Delhi)**  
(a)  $5.3 \times 10^{-12}$  (b)  $2.42 \times 10^{-8}$   
(c)  $2.66 \times 10^{-12}$  (d)  $4.5 \times 10^{-11}$
25. Which one of the following statements is not correct? **(2017-Delhi)**  
(a) Coenzymes increase the catalytic activity of enzyme  
(b) Catalyst does not initiate any reaction  
(c) The value of equilibrium constant is changed in the presence of a catalyst in the reaction at equilibrium  
(d) Enzymes catalyse mainly biochemical reactions
26. The standard equilibrium constant  $K_p$  at 298 K for the reaction,  $\text{N}_2(\text{g}) + 3\text{H}_2(\text{g}) \rightleftharpoons 2\text{NH}_3(\text{g})$  is  $5.8 \times 10^5$ . The value of standard equilibrium constant, if the concentration of gases is expressed in terms of  $\text{mol L}^{-1}$ , will be:  
[Given :  $R = 0.08314 \text{ L bar K}^{-1} \text{ mol}^{-1}$ ] **(2017-Gujarat)**  
(a)  $3.99 \times 10^9$  (b)  $3.51 \times 10^6$   
(c)  $3.84 \times 10^7$  (d)  $3.56 \times 10^8$
27. Consider the following reaction for which the change in enthalpy is positive  
 $2\text{A}(\text{g}) + \text{B}(\text{g}) \rightleftharpoons \text{C}(\text{g}) + \text{D}(\text{g})$   
Which of the following will not affect the equilibrium? **(2017-Gujarat)**  
(a) Presence of catalyst  
(b) Change in concentration of reactants  
(c) Change in pressure  
(d) Change in temperature
28. For the reaction  $\text{CO}(\text{g}) + \text{Cl}_2(\text{g}) \rightleftharpoons \text{COCl}_2(\text{g})$   $\frac{K_p}{K_c}$  is equal to: **(2017-Gujarat)**  
(a)  $(RT)^2$  (b)  $\frac{1}{RT}$   
(c)  $RT$  (d)  $\sqrt{RT}$
29. Which of the following fluoro-compounds is most likely to behave as a Lewis base? **(2016-II)**  
(a)  $\text{CF}_4$  (b)  $\text{SiF}_4$   
(c)  $\text{BF}_3$  (d)  $\text{PF}_3$
30. The solubility of  $\text{AgCl}(\text{s})$  with solubility product  $1.6 \times 10^{-10}$  in 0.1 M NaCl solution would be: **(2016-II)**  
(a)  $1.6 \times 10^{-11} \text{ M}$  (b) Zero  
(c)  $1.26 \times 10^{-5} \text{ M}$  (d)  $1.6 \times 10^{-9} \text{ M}$
31. The percentage of pyridine ( $\text{C}_5\text{H}_5\text{N}$ ) that forms pyridinium ion ( $\text{C}_5\text{H}_5\text{N}^+\text{H}$ ) in a 0.10 M aqueous pyridine solution ( $K_b$  for  $\text{C}_5\text{H}_5\text{N} = 1.7 \times 10^{-9}$ ) is : **(2016-II)**  
(a) 0.77% (b) 1.6%  
(c) 0.0060% (d) 0.013%
32. Consider the nitration of benzene using mixed conc.  $\text{H}_2\text{SO}_4$  and  $\text{HNO}_3$ . If a larger amount of  $\text{KHSO}_4$  is added to the mixture, the rate of nitration will be: **(2016-I)**  
(a) Doubled (b) Increase  
(c) Decrease (d) Unchanged
33. MY and  $\text{NY}_3$ , two nearly insoluble salts, have the same  $K_{sp}$  values of  $6.2 \times 10^{-13}$  at room temperature, which statements would be true in regard to MY and  $\text{NY}_3$ ? **(2016-I)**  
(a) The addition of the salt of KY to solution of MY and  $\text{NY}_3$  will have no effect on their solubilities  
(b) The molar solubilities of MY and  $\text{NY}_3$  in water are identical  
(c) The molar solubility of MY in water is less than of  $\text{NY}_3$   
(d) The salts MY and  $\text{NY}_3$  are more soluble in 0.5 M KY than in pure water
34. If the equilibrium constant for  $\text{N}_2(\text{g}) + \text{O}_2(\text{g}) \rightleftharpoons 2\text{NO}(\text{g})$  is K, the equilibrium constant for  $\frac{1}{2}\text{N}_2(\text{g}) + \frac{1}{2}\text{O}_2(\text{g}) \rightleftharpoons \text{NO}(\text{g})$  will be: **(2015 Re)**  
(a)  $K^2$  (b)  $K^{1/2}$   
(c)  $\frac{1}{2}K$  (d) K
35. Which one of the following pairs of solution is not an acidic buffer? **(2015 Re)**  
(a)  $\text{H}_3\text{PO}_4$  and  $\text{Na}_3\text{PO}_4$   
(b)  $\text{HClO}_4$  and  $\text{NaClO}_4$   
(c)  $\text{CH}_3\text{COOH}$  and  $\text{CH}_3\text{COONa}$   
(d)  $\text{H}_2\text{CO}_3$  and  $\text{Na}_2\text{CO}_3$
36. If the value of an equilibrium constant for a particular reaction is  $1.6 \times 10^{12}$ , then at equilibrium the system will contain: **(2015)**  
(a) Mostly reactants  
(b) Mostly products  
(c) Similar amounts of reactants and products  
(d) All reactants
37. The  $K_{sp}$  of  $\text{Ag}_2\text{CrO}_4$ ,  $\text{AgBr}$  and  $\text{AgI}$  are respectively,  $1.1 \times 10^{-12}$ ,  $1.8 \times 10^{-10}$ , 5.0

$\times 10^{-13}$ ,  $8.3 \times 10^{-17}$ . Which one of the following salts will precipitate last if  $\text{AgNO}_3$  solution is added to the solution containing equal moles of  $\text{NaCl}$ ,  $\text{NaBr}$ ,  $\text{NaI}$  and  $\text{Na}_2\text{CrO}_4$  ? **(2015)**

- (a)  $\text{AgCl}$  (b)  $\text{AgBr}$   
(c)  $\text{Ag}_2\text{CrO}_4$  (d)  $\text{AgI}$

**38.** What is the pH of the resulting solution when equal volumes of 0.1 M  $\text{NaOH}$  and 0.01 M  $\text{HCl}$  are mixed? **(2015 Re)**

- (a) 2.0 (b) 7.0  
(c) 1.04 (d) 12.65

**39.** Aqueous solution of which of the following compounds is the best conductor of electric current? **(2015 Re)**

- (a) Hydrochloric acid,  $\text{HCl}$   
(b) Ammonia,  $\text{NH}_3$   
(c) Fructose,  $\text{C}_6\text{H}_{12}\text{O}_6$   
(d) Acetic acid,  $\text{C}_2\text{H}_4\text{O}_2$

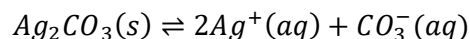
**40.** Which of the following statements is correct for a reversible process in a state of equilibrium? **(2015)**

- (a)  $\Delta G^\circ = -2.303 RT \log K$   
(b)  $\Delta G^\circ = 2.303 RT \log K$   
(c)  $\Delta G = -2.303 RT \log K$   
(d)  $\Delta G = 2.303 RT \log K$

**41.** Which of the following salts will give highest pH in water? **(2014)**

- (a)  $\text{NaCl}$  (b)  $\text{Na}_2\text{CO}_3$   
(c)  $\text{CuSO}_4$  (d)  $4\text{KCl}$

**42.** Using the Gibb's energy change,  $\Delta G^\circ = +63.3 \text{ kJ}$ , for the following reaction,



The  $K_{sp}$  of  $\text{Ag}_2\text{CO}_3(s)$  in water at  $25^\circ\text{C}$  is ( $R = 5.314 \text{ JK}^{-1} \text{ mol}^{-1}$ ) **(2014)**

- (a)  $3.2 \times 10^{-26}$   
(b)  $8.0 \times 10^{-12}$   
(c)  $2.9 \times 10^{-3}$   
(d)  $7.9 \times 10^{-2}$

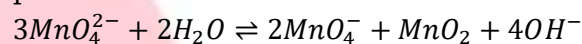
**43.** For the reversible reaction,  
 $\text{N}_2(g) + 3\text{H}_2(g) \rightleftharpoons 2\text{NH}_3(g) + \text{Heat}$ .  
The equilibrium shifts in forward direction: **(2014)**

- (a) By decreasing the pressure  
(b) By decreasing the concentration of  $\text{N}_2(g)$  and  $\text{H}_2(g)$   
(c) By Increasing pressure and decreasing temperature  
(d) By increasing the concentration of  $\text{NH}_3(g)$

**44.** Which of these is least likely to act as a Lewis base? **(2013)**

- (a)  $\text{CO}$  (b)  $\text{F}^-$   
(c)  $\text{BF}_3$  (d)  $\text{PF}_3$

**45.**  $\text{KMnO}_4$  can be prepared from  $\text{K}_2\text{MnO}_4$  as per the reaction:



The reaction can go to completion by removing  $\text{OH}^-$  ions by adding: **(2013)**

- (a)  $\text{HCl}$   
(b)  $\text{KOH}$   
(c)  $\text{CO}_2$   
(d)  $\text{SO}_2$