CHEMISTRY COACHING CIRCLE

+1

GRAND TEST-5

TEST-26

Chemical & Ionic Equilibrium

Date: 07.11.2019 (Thursday)
Time: 10:00 AM to 12:00 NOON

Test Venue:
Lajpat Rai Bhawan, Madhya Marg,
Sector 15-B, Chandigarh.

Empowered By:

TEST SERIES

PCB	PCM
QUANTUM Plus	INTELLIQUEST

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READ THE INSTRUCTIONS CAREFULLY

1. The test is of **2 hour** duration.
2. The maximum marks are **229**.
3. This test consist **55 questions**.

Section – A (Single Correct Choice Type) Negative marking

This Section contains **30 multiple choice questions.** Each question has four choices A), B), C) and D) out of which **ONLY ONE** is correct. (Mark only one choice) **(30 × 4 = 120 Marks)**

1. The aqueous solutions of four sodium salts NaA, NaB, NaC and NaD had pH 7.0, 9.0, 10.0 and 11.0 respectively, when each solution was 0.1 M. The strongest acid is:

a. HA b. HB c. HC d. HD

A

Sol. Aqueous solution of NaA had a pH 7.0 (lowest value). Hence, HA is the strongest acid.

2. In the hydrolytic equilibrium,

$A^- + H_2O \rightleftharpoons HA + OH^-$

$K_a = 1.0 \times 10^{-5}$. The degree of hydrolysis of a 0.001 M solution of the salt is :

a. 10^{-2} b. 10^{-3} c. 10^{-4} d. 10^{-5}

B

Sol. Degree of hydrolysis, $h = \sqrt{\dfrac{K_w}{K_a.C}}$

$$= \sqrt{\frac{1\times10^{-14}}{1\times10^{-5}\times0.001}}$$

$$= \sqrt{\frac{1\times10^{-14}}{1\times10^{-5}\times1\times10^{-3}}} = \sqrt{10^{-6}} = 10^{-3}$$

3. A buffer solutions consists of a mixture of an acid HA and the sodium salt of the acid NaA. The concentration of the acid is 0.2 mol dm^{-3}. What must be the concentration of the sodium salt, so that the pH of the solution is equal to the pK$_a$ of the acid HA?

a. 5.0 mol dm^{-3} b. 0.1 mol dm^{-3} c. 2.0 mol dm^{-3} d. 0.2 mol dm^{-3}

D

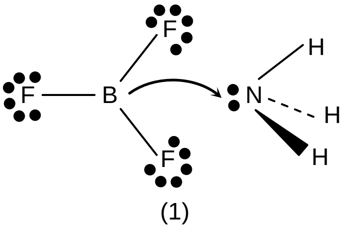
Sol. $pH = pK_a + \log\dfrac{[x^-]}{[HX]}$

If $pH = pK_a$

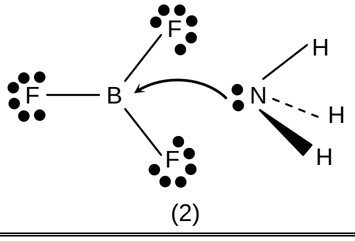
$\log[X^-] = \log[HX]$

$[X^-] = [HX] = 0.2$ mol dm^{-3}

4. BF$_3$ and NH$_3$ undergo a Lewis acid-base reaction forming an adduct. Which picture below correctly represents the curved arrow notation for the initial Lewis acid-Lewis base interaction in this reaction, what is the Lewis acid the Lewis base?



(1)



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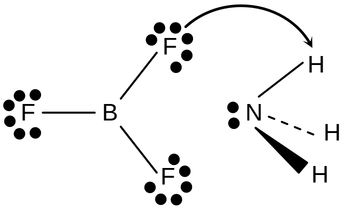

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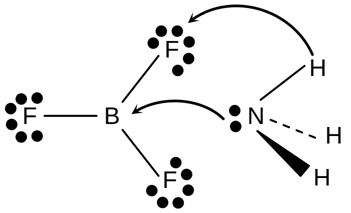


(4)

a. Picture (1) is correct; NH_3 is the Lewis acid and BF_3 is the Lewis base.
b. Picture (2) is correct; BF_3 is the Lewis acid and NH_3 is the Lewis base.
c. Picture (3) is correct; NH_3 is the Lewis acid and BF_3 is the Lewis base.
b. Picture (4) is correct; BF_3 is the Lewis acid and NH_3 is the Lewis base.

B

5. According to Bronsted concept, the acids in the following reaction
$NH_3 + H_2O \rightleftharpoons NH_4^+ + OH^-$ are

a. NH_3 and NH_4^+ b. H_2O and OH^- c. H_2O and NH_4^+ d. NH_3 and OH^-

C

Sol. H_2O and NH_4^+ donate protons in the given reaction

6. A 0.01 M ammonia solution is 5% ionized, the concentration of OH^- ion is

a. 0.005 M b. 0.0001 M c. 0.0005 M d. 0.05 M

C

Sol. $NH_4OH \rightleftharpoons NH_4^+ + OH^-$

$[OH^-] = C\alpha = 0.01 \times 0.05 = 0.0005$ M

7. The solubility product of $BaCrO_4$ is 2.4×10^{-10} M^2. The maximum concentration of $Ba(NO_3)_2$ possible without precipitation in a 6×10^{-4} M K_2CrO_4 solution is

a. 4×10^{-7} M b. 1.2×10^{10} M c. 6×10^{-4} M d. 3×10^{-4} M

A

Sol. $[Ba^{2+}]\,[CrO_4^{2-}] = K_{sp}$, $[Ba^{2+}]\,[6 \times 10^{-4}] = 2.4 \times 10^{-10}$

or $[Ba^{2+}] = 4 \times 10^{-7}$ M

8. The concentration of $[H^+]$ and concentration of $[OH^-]$ of a 0.1 M aqueous solution of 2% ionized weak acid (HX) is [ionic product of water = 1×10^{-14}]

a. 0.02×10^{-3} M and 5×10^{-11} M b. 2×10^{-3} M and 3×10^{-11} M
c. 2×10^{-3} M and 5×10^{-12} M d. 3×10^{-2} M and 4×10^{-13} M

C

Sol. $[H^+] = C\alpha = 0.1 \times 0.02 = 2 \times 10^{-3}$ M
$\therefore$ $[OH^-] = 10^{-14}/(2 \times 10^{-3}) = 5 \times 10^{-12}$ M

9. For preparing a buffer solution of pH 6 by mixing sodium acetate and acetic acid, the ratio of the concentration of salt and acid should be ($K_a = 10^{-5}$)

a. 1 : 10 b. 10 : 1 c. 100 : 1 d. 1 : 100

B

Sol. $6 = 5 + \log\frac{[Salt]}{[Acid]}$ or $\log\frac{[Salt]}{[Acid]} = 1$ or $\frac{[Salt]}{[Acid]} = 10$

10. A weak acid HX has the dissociation constant 1×10^{-5} M. It forms a salt NaX on reaction with alkali. The degree of hydrolysis of 0.1 M solution of NaX is

a. 0.0001% b. 0.01% c. 0.1% d. 0.15%

B

Sol. Hydrolysis reaction is $X^- + H_2O \rightleftharpoons HX + OH^-$. For a salt of weak acid with strong base,

$$K_h = \frac{K_w}{K_a} = ch^2 \qquad \therefore \quad \frac{10^{-14}}{10^{-5}} = 0.1 \times h^2$$

or $h^2 = 10^{-8}$ or $h = 10^{-4}$

%hydrolysis = $10^{-4} \times 100 = 10^{-2} = 0.01$

11. pH of water is 7.0 at 25°C. If water is heated to 70°C, the

a. pH will decrease and solution becomes acidic
b. pH will increase
c. pH will remain constant as 7
d. pH will decrease but solution will be neutral

D

Sol. On heating water K_w increases and thus pH scale for neutrality changes from 7 to same lower value.

12. Which of the following species is more soluble in water?

a. $M(OH)_3$, ($K_{sp} = 1 \times 10^{-35}$)
b. $M(OH)_2$, ($K_{sp} = 1 \times 10^{-35}$)
c. MOH, ($K_{sp} = 1 \times 10^{-35}$)
d. All have same solubility

A

Sol. S of M $(OH)_3$ = $\sqrt[4]{\frac{K_{sp}}{27}} = \sqrt[4]{\frac{10^{-35}}{27}}$

S of M $(OH)_2$ = $\sqrt[3]{\frac{K_{sp}}{4}}$; S of MOH $= \sqrt{K_{sp}}$

13. Mark the incorrect solution:

a. KBr : Neutral
b. NH_4NO_3 : Acidic
c. $NaNO_2$: Acidic
d. KF : Basic

C

Sol. $NaNO_2 \longrightarrow \underset{\text{Strong base}}{NaOH} + \underset{\text{Weak acid}}{HNO_2}$

Since NaOH is a strong base so the solution is basic solution

14. The highest pH value is given by:

a. 0.1 M KOH
b. 0.01 M KOH
c. 0.001 M KOH
d. 0.0001 M KOH

A

Sol. 0.1 M KOH has the highest pH value. More the conc. of base, more is its pH value.

15. The molar solubility (in mol L^{-1}) of a sparingly soluble salt MX_4 is 's'. The corresponding solubility product is given by K_{sp}. S is given in terms of K_{sp} by the relation:

a. s = (K_{sp}/128)1/4
b. s = (128 K_{sp})$^{1/4}$
c. s = (256 K_{sp})1/5
d. s = (K_{sp}/256)$^{1/5}$

D

Sol. $MX_4 \rightleftharpoons M^{4+} + 4X^-$

$K_{sp} = [M^{4+}][X^-]^4$

$= (S)(4S)^4 = 256 S^5$ Or $S = \left[\frac{K_{sp}}{256}\right]^{1/5}$

16. The conjugate base of NH_2^- is

a. NH_3
b. NH^{2-}
c. NH_4^+
d. N^{3-}

B

Sol. Conjugate base of $NH_2^- = NH_2^- - H^+ = NH^{2-}$.

17. In a reaction mixture containing H_2, N_2 and NH_3 at partial pressure of 2 atm, 1 atm and 3 atm respectively, the value of K_p at 725 K is 4.28×10^{-5} atm^{-2}. In which direction the net reaction will go?

$$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$$

(a) Forward	(b) Backward
(c) No net reaction	(d) Direction cannot be predicted

B

Sol. $Q = \frac{3^2}{2^3 \times 1} > K$

Hence, reaction is favoured in backward direction

18. The solubility of solid silver chromate, Ag_2CrO_4 is determined in three solvents:

Substance	K_{sp}
Ag_2CrO_4	9×10^{-12}

I. Pure water	II. 0.1 M $AgNO_3$	III. 0.1 M Na_2CrO_4	IV. 0.1 M NH_3

Predict the relative solubility of Ag_2CrO_4, in the three solvents:

a. I = II = III = IV	b. I < II < III < IV	c. II = III < I < IV	d. II < III < I < IV

D

19. Which would increase the partial pressure of $NO_2(g)$ at equilibrium in the following reaction

$$2NO_{(g)} + O_{2(g)} \rightleftharpoons 2NO_{2(g)}$$

(a) Decreasing the volume of the system
(b) Adding a noble gas to increase the pressure of the system
(c) Removing some NO(g) from the system
(d) Adding an appropriate catalyst

A

20. The pH of solution of both ammonium acetate and sodium chloride is 7 due to:

a. Hydrolysis in both cases
b. Equal Cationic & anionic hydrolysis of the former and no hydrolysis in the latter.
c. No hydrolysis in both
d. Hydrolysis of the latter but not the former

B

21. What is the pH of a solution prepared by mixing 100.00 mL of 0.020 M $Ca(OH)_2$ with 50.00 mL of 0.100 M NaOH? Assume that the volumes are additive.

a. 11.01	b. 12.78	c. 13.95	d. 1.229

B

Sol. Concentration of OH^- $100 \times 0.02 \times 2 + 50 \times 0.1 = 150 \times M$; M = 0.6;
pOH = - log 6 – log 10^{-2}
= 2 – 0.77
= 1.23
pH = 14 – 1.23
= 12.77

22. $N_2 + O_2 \rightleftharpoons 2NO$ at 10L vessel. When 15 mol N_2 and 5.2 mol of O_2 react then at equilibrium 10 mol NO is obtained calculate K_C.

a. 50	b. 80	c. 60	d. 90

A

Sol. $N_2(g) + O_2(g) \rightleftharpoons 2NO(g)$

	$N_2(g)$	$O_2(g)$	$2NO(g)$
Initial	15 mol	5.2 mol	0
At equilibrium	(15 – x)	(5.2 – x)	2x
At equilibrium	10	0.2	10

2x = 10

x = 5

$$\text{Concentration} = \left(\frac{n}{V}\right) \quad \frac{10}{10}M \quad \frac{0.2}{10} \quad \frac{10}{10}$$

$$K_C = \frac{[NO]^2}{[N_2][O_2]} = \frac{1}{1\times\frac{0.2}{10}} = 50$$

23. For $2SO_2 + O_2 \rightleftharpoons 2SO_3$ which of following is correct temperature at which $2K_P = K_C$ for this reaction

a. 24.36 K b. 28.36 K c. 32.34 K d. 20.23 K

A

Sol. $K_p = K_c\,(RT)^{\Delta ng}$

$K_p = K_c\,(RT)^{-1}$

$K_p = 2K_p(RT)^{-1}$

$1 = 2\left(\frac{1}{RT}\right)$ R = 0.082 lit atm

$RT = 2 \quad T = \frac{2}{R} = 2\times 12.18\,K = 24.36\ K$

24. At constant temperature, the equilibrium constant (K_p) for the decomposition reaction $N_2O_4 \rightleftharpoons 2NO_2$ is express by $K_p = (4x^2p)/(1 - x^2)$, where p = pressure, x = extent of decomposition. Which one of the following statements is true?

a. K_p increases with increase of p

b. K_p increases with increase of x

c. K_p increases with decrease of x

d. K_p remains constant with change in p and x

D

Sol. K_p os an equilibrium reaction depends only on temperature. However, the degree of dissocation will change in accordance with Le-Chatelier's principle.

25. The equilibrium, $SO_2Cl_2(g) \rightleftharpoons SO_2(g) + Cl_2(g)$ is attained at 25°C in a closed container and an inert gas, helium, is introduced. Which of the following statement(s) is/are **correct**?

(a) Concentration of SO_2, Cl_2 and SO_2Cl_2 are changed

(b) No effect on equilibrium

(c) Concentration of SO_2 is reduced

(d) K_P of reaction is increasing

B

Sol. Addition of inert gas at constant volume does not affect the equilibrium.

26. For the reaction $N_2O_4 \rightleftharpoons 2NO_2(g)$, if percentage dissociation of N_2O_4 are 20%, 45%, 65%, 80% then the sequence of observed vapour densities will be:

(a) $d_{20} > d_{45} > d_{65} > d_{80}$ (b) $d_{80} > d_{65} > d_{45} > d_{20}$

(c) $d_{20} = d_{45} = d_{65} = d_{80}$ (d) $(d_{20} = d_{45}) > (d_{65} = d_{80})$

A

Sol. As % dissociation ↑, % NO_2 ↑, Thus, decreasing the V.D.

27. At temperature T, a compound $AB_2(g)$ dissociates according to the reaction $2AB_2(g) \Leftrightarrow 2AB(g) + B_2(g)$ with a degree of dissociation, x, which is small compared with unity. Deduce the expression for K_P, in terms of x and the total pressure, P

(a) $\frac{Px^3}{2}$ (b) $\frac{Px^2}{3}$ (c) $\frac{Px^3}{3}$ (d) $\frac{Px^2}{2}$

A

Sol. $2AB_2(g) \rightleftharpoons 2AB(g) + B_2(g)$

1 mol

$(1-x)$ x $\frac{x}{2}$

$$K_p = \frac{n_{B_2}\cdot n_{AB}^2}{n_{AB_2}^2}\times\left(\frac{P_t}{n_t}\right)^{\Delta ng}$$

$n_T = 1+\frac{x}{2}\approx 1$ $K_p = \frac{x^2\times\frac{x}{2}}{1-x}\times\frac{P_t}{1+\frac{x}{2}}$

$K_P = x^2\times P\times\frac{x}{2}=\frac{Px^3}{2}$ $K_p = \frac{x^3}{2}\times P_t$

28. The effect of temperature on equilibrium constant is expressed as,

$$\log\left[\frac{K_2}{K_1}\right]=\frac{\Delta H}{2.303}\left[\frac{1}{T_1}-\frac{1}{T_2}\right];\ (T_2 > T_1)$$

For endothermic reaction **false** statement is :

(a) $K_2 < K_1$ (b) ΔH = positive (c) $\log K_2 > \log K_1$ (d) $K_2 > K_1$

A

Sol. In endothermic reaction K increases with increase in temperature

29. $\log\frac{K_p}{K_c}+\log RT = 0$ is a relationship for the reaction

(a) $PCl_5 \rightleftharpoons PCl_3 + Cl_2$ (b) $2SO_2 + O_2 \rightleftharpoons 2SO_3$

(c) $H_2 + I_2 \rightleftharpoons 2HI$ (d) $N_2 + 3H_2 \rightleftharpoons 2NH_3$

B

Sol. $\log\frac{K_p}{K_c}=\log\frac{1}{RT}$; $\frac{K_p}{K_c}=\frac{1}{RT}$

$\Rightarrow$ $K_p = K_c\,(RT)^{-1}$

$\Rightarrow$ $\Delta n_g = -1$

30. XY_2 dissociates as:

$XY_2(g) \rightleftharpoons XY(g) + Y(g)$

When the initial pressure of XY_2 is 600 mm Hg, the total equilibrium pressure is 800 mm Hg. Calculate K for the reaction assuming that the volume of the system remains unchanged:

a. 50 b. 100 c. 166.6 d. 400

B

Sol.

$$\begin{array}{lccc} & XY_2(g) & \rightleftharpoons XY(g) + & Y(g) \\ \text{Initial} & 600 & 0 & 0 \\ \text{At eqbm} & 600-P & p & P \end{array}$$

Total pressure = 600 – p + p + p = 800

$\therefore$ $p = 200\text{ nm}$

$\therefore$ $K_p = \frac{p\times p}{600-p}=\frac{200\times 200}{400}=100$

Section – B (ASSERTION & REASON) Negative marking

This Section contains **6 multiple choice questions.** Each question has four choices A), B), C) and D) out of which **ONLY ONE** is correct. (Mark only one choice). **6 × 4 = 24 Marks**

(A) If both assertion and reason are true and reason is a correct explanation of assertion.

(B) If both assertion and reason are true but reason is not a correct explanation of assertion.

(C) If assertion is true but reason is false.

(D) If assertion and reason are false.

1. **Assertion:** pH of boiling water is nearly 6.6. This means that boiling water is not neutral.
Reason: H^+ ion concentration in boiling water decreases because some water boils off.

a. (A) b. (B) c. (C) d. (D)

D

Sol. **Correct A:** pH of boiling water is nearly 6.6. This does not mean that the boiling water is not neutral.
Correct R: On heating, dissociation of H_2O molecules increases and hence H^+ ion concentration also increases but $[H^+] = [OH^-]$ always in water.

2. **Assertion:** Dissociation of H_2S will be suppressed in presence of HCl.
Reason: This is used to separate gp II basic radical from gp IV.

a. (A) b. (B) c. (C) d. (D)

B

3. **Assertion:** In dilute aqueous solution, water is present in such large excess such that its concentration remains essentially constant during any reaction involving water.
Reason: The term $[H_2O]$ does not appear in any equilibrium constant expression for a reaction taking place in dilute aqueous solution.

a. (A) b. (B) c. (C) d. (D)

A

4. **Assertion:** A catalyst does not influence the values of equilibrium constant.
Reason: Catalyst influence the rate of both forward and backward reaction equally.

a. (A) b. (B) c. (C) d. (D)

A

Sol. Catalyst decreases E_{af} and E_{ab} by the same amount

5. **Assertion:** $NaNO_3 \rightleftharpoons NaNO_2 + O_2$, addition of $NaNO_2$ will shift the equilibrium to backward direction.
Reason: Addition of product donot change state of equilibrium

a. (A) b. (B) c. (C) d. (D)

D

6. **Assertion:** In decomposition of $CaSO_{4(s)} \rightleftharpoons CaO_{(s)} + SO_{2(g)} + O_{2(g)}$ change in volume does not change pressure of O_2.
Reason: Total pressure will be increased on increasing temperature

a. (A) b. (B) c. (C) d. (D)

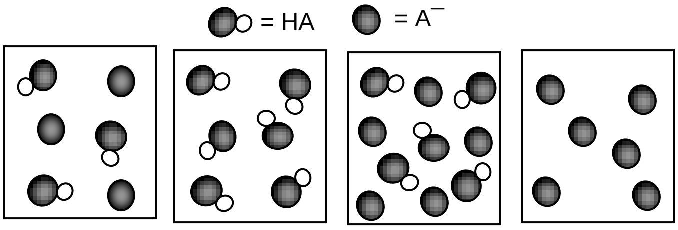
B

SECTION – C (Comprehension Type) Negative Marking

This Section contains **3 paragraphs.** Each of these questions has four choices A), B), C) and D) out of which **ONLY ONE** is correct. (Mark only one) **(10 × 4 = 40 Marks)**

Passage -1

The following pictures represent solutions that contain a weak acid HA and/or its potassium salt KA. Unshaded spheres represent H atoms and shaded represent A^- ions. (K^+, H_3O^+, OH^-, and solvent H_2O molecules have been omitted for clarity.)



1. Which solution has the highest pH?

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

D

2. Which of the solutions are buffer solutions?

a. (1) and (2) b. (1) and (3) c. (2) and (3) d. (2) and (4)

B

3. For which solution(s) pH = pK_a?

a. only solution (1) b. only solution (2) c. only solution (3) d. solution (1) and (3)

D

Sol. If $[HA] = [A^-]$; $pH = pK_a$

Passage-2

Consider an aqueous 0.01 M sodium acetate solution. Given: log 1.85 = 0.27, Ka of acetic acid = 1.85×10^{-5} at 298 K.

4. pH of the solution is:

a. 7.0 b. 8.36 c. 9.2 d. 6.0

B

Sol. $pH = \frac{1}{2}pK_w + \frac{1}{2}pK_a + \frac{1}{2}\log c$

$= \frac{1}{2}(14) + \frac{1}{2}(4.73) + \frac{1}{2}\log(10^{-2})$

$= 7 + 2.365 - 1 = \mathbf{8.365}$

5. The hydrolysis constant is:

a. 5.45×10^{-10} b. 5.45×10^{10} c. 54.5×10^{8} d. 54.5×10^{-10}

A

Sol. $\frac{K_w}{K_a} = \frac{10^{-14}}{1.85 \times 10^{-5}} \simeq 5.45 \times 10^{-10}$

6. Degree of hydrolysis is:

a. 23.4×10^{4} b. 23.4×10^{-4} c. 2.34×10^{-4} d. 2.34×10^{4}

C

Sol. $h = \sqrt{\frac{K_h}{c}} = \sqrt{\frac{5.45 \times 10^{-10}}{10^{-2}}} = 2.34 \times 10^{-4}$

7. What is the conjugate acid of the Bronsted-Lowry base $HAsO_4^{2-}$?

a. $H_2AsO_4^{-}$ b. AsO_4^{3-} c. H_2O d. H_3O^{+}

A

Passage – 3

Le Chatelier's Principle

If a system at equilibrium is subjected to a change of any one of the factors such as concentration, pressure or temperature, the system adjusts itself in such a way as to nullify the effect of that change.

Change of pressure. If a system in equilibrium consists of gases, then the concentrations of all the components can be altered by changing the pressure. To increase the pressure on the system, the volume has to be decreased proportionally. The total number of moles per unit volume will now be more and the equilibrium will shift in the direction in which there is a decrease in number of moles i.e., towards the direction in which there can be decrease in pressure.

Effect of pressure on melting point: There are two types solids:

(a) Solids whose volume decreases on melting, e.g., ice, diamond, carborundum, magnesium nitride and quartz.
Solid (higher volume) $\rightleftharpoons$ Liquid (lower volume)
The process of melting is facilitated at high pressure, thus, melting point is lowered.

(b) Solids whose volume increase on melting, e.g., Fe, Cu, Ag, Au etc.
Solid (lower volume) $\rightleftharpoons$ Liquid (higher volume)
In this case, the process of melting become difficult at high pressure; thus melting point becomes high.

(c) **Solubility of substances:** When solid substance are dissolved in water, either heat is evolved (exothermic) or heat is absorbed (endothermic).
$KCl + aq \rightleftharpoons KCl(aq) - heat$
In such cases, solubility increase with increase in temperature. Consider the case of KOH; when this is dissolved, heat is evolved.
$KOH + aq \rightleftharpoons KOH(aq) + heat$
In such cases, solubility decrease with increase in temperature.

(d) **Solubility of gases in liquids:** When a gas dissolves in liquid, there is decrease in volume. Thus, increase of pressure will favour the dissolution of gas in liquid.

8. A gas 'X' when dissolved in water, heat is evolved. Then solubility of 'X' will increase:

(a) low pressure, high temperature (b) low pressure, low temperature
(c) high pressure, high temperature (d) high pressure, low temperature

D

9. $Au(s) \rightleftharpoons Au(\ell)$

Above equilibrium is favoured at :

(a) high pressure, low temperature (b) high pressure, high temperature
(c) low pressure, high temperature (d) low pressure, low temperature

C

10. For the reaction, $N_2(g) + O_2(g) \rightleftharpoons 2NO(g)$

If pressure is increased by reducing the volume of the container then:
(i) total pressure at equilibrium will change
(ii) concentration of all the component at equilibrium will change
(iii) concentration of all the component at equilibrium will remain same
(iv) equilibrium will shift in the forward direction
Correct statements are

a. i & ii b. i, ii, iv c. only iii d. i, ii, iii

A

Sol. As $\Delta n_g = 0$

SECTION – D More than One Answer (No Negative Marking)

This Section contains **4 multiple choice questions.** Each question has four choices A), B), C) and D) out of which **ONE OR MORE** may be correct. **4 × 5 = 20 Marks**

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1. The salts whose aqueous solutions have pH more than 7 are

a. $CuSO_4$ b. KCN c. Na_2CO_3 d. Na_2SO_4

B,C

Sol. $CuSO_4$ and LiCl are salts of strong acid and weak base. Their solutions are acidic with pH < 7.

2. The degree of dissociation of an electrolyte:

a. depends on the nature of solute and solvent
b. increases with increase in dilution
c. increases with increase in temperature
d. Depend on its Dissociation constant

A, B, C, D

3. Pick out the correct statement about hydrolysis of HCOONa if h is degree of hydrolysis of salt.

a. Hydrolysis constant, $K_H = Ch^2$ if h is less than 10%
b. Dissociation constant for base $HCOO^-$ in water is, $K_{HCOO} = Ch^2/1\text{-}h$
c. The solution is alkaline due to hydrolysis of $HCOO^-$ ion
d. The product of degree of dissociation (α) of HCOOH and degree of hydrolysis of (h) of $HCOO^-$ is equal to $\frac{\sqrt{K_w}}{C}$; where, C is concentration of salt [$1 - \alpha \approx 1$ & $1 - h \approx 1$]

A, B, C, D

Sol. $\alpha = \sqrt{\frac{K_a}{C}}$ (b) $\underset{C(1-h)}{HCOO^-} + H_2O \rightleftharpoons \underset{Ch}{HCOOH} + \underset{Ch}{\bar{O}H}$

$h = \sqrt{\frac{K_w}{K_a.C}}$ $K_h = \frac{Ch^2}{(1-h)}$

$$\alpha.h = \sqrt{\frac{K_a}{C}.\frac{K_w}{K_a.C}} = \sqrt{\frac{K_w}{C^2}} = \frac{\sqrt{K_w}}{C}$$

4. The thermal dissociation equilibrium of $CaCO_3(s)$ is studied under different conditions.

$$CaCO_3(s) \rightleftharpoons CaO(s) + CO_2(g)$$

For this equilibrium, the correct statement(s) is (are)

a. K increases with temperature
b. K is independent of the initial amount of $CaCO_3$
c. K is dependent on amount of CaO
d. K is independent of the catalyst

A,B,D

Sol. K is independent of pressure & catalyst

SECTION – F (Integer Type) No Negative Marking

This Section contains **5 questions**. The answer to each question is a **single digit integer** ranging from 0 to 10. **5 × 5 = 25 Marks**

1. The approximate pH of a solution formed by mixing equal volumes of solution of 0.1 M sodium propanoate and 0.1 M propanoic acid is) will be (K_a of propionic acid = 10^{-5})

Sol. **5** ; It is an acidic Buffer

$$pH = pK_a + \log \frac{[\text{Salt}]}{[\text{Acid}]}$$

$$= -\log(0^{-5}) + \log\frac{0.1}{0.1} = (5) + 0 = \mathbf{5}$$

2. The K_{sp} of $Mg(OH)_2$ is 1×10^{-12}. 0.01 M Mg^{2+} will precipitate after the limiting pH of

Sol. **9**

K_{sp} for $Mg(OH)_2 = [Mg^{2+}][OH^-]^2$

$\therefore$ $10^{-12} = (0.01)[OH^-]^2$

or $[OH^-]^2 = 10^{-10}$ M or $[OH^-] = 10^{-5}$ M

$\therefore$ $[H^+] = 10^{-9}$ M or pH = **9**

3. The pOH of a solution formed by mixing 40 mL of 0.1 M HCl with 10 mL of 0.45 M of NaOH is:

Sol. **2;** Meq. of HCl = 4; Meq. of NaOH = 4.5

$\therefore$ Meq. of NaOH left = 0.5

$\therefore$ $[NaOH] = \frac{0.5}{50} = 1 \times 10^{-2}$

$\therefore$ pOH = **2**

4. 0.63 g of HNO_3 was reacted with 100 cm^3 of 0.2 M NaOH solution. The POH of the resulting solution would be:

Sol. **1**

No. of moles of HNO_3 in 0.63 g = $\frac{0.63}{63}$ = 0.01 mole

No. of moles of NaOH is 100 cc. of 0.2 M

NaOH= $\frac{0.2}{1000} \times 100 = 0.02$ mole

NaOH left unneutralized = 0.02 – 0.01 = 0.01 mole

Volume of solution = 100 cm^3

M (NaOH) = $\frac{0.01}{100} \times 1000 = 0.1M$

pOH = $-\log(OH^-) = -\log(0.1)$ = **1**

5. For dissociation of PCl_5 into PCl_3 and Cl_2 if observed vapour density is 100. Then what will be percent dissociation of PCl_5 (Mw of PCl_5 is 208)

Sol. **4%**

$$D_T = \frac{Mw}{2} = \frac{208}{2} = 104$$

$D_O = 100$

$$PCl_5 \rightleftharpoons PCl_3 + Cl_2$$

1 mol

At equilibrium $1 - \alpha$ α α

$n_t = 1 + \alpha$

$(1+\alpha)V.D_{mix} = V.D_{PCl_5}$

$$(1+\alpha) = \frac{104}{100}$$

α = 4%