Nishant Jindal

| Chapter | Task | Date |
|---|---|---|
| Thermodynamics | Notes | Monday, 1 January 2024 |
| | Jee Main Selected PYQS-2 | Tuesday, 2 January 2024 |
| | **Class** | Wednesday, 3 January 2024 |
| Thermochemistry | Notes + Jee Main Selected PYQS-2 | Thursday, 4 January 2024 |
| Mole concept | Notes + Jee Main Selected PYQS-2 | Friday, 5 January 2024 |
| Concentration Terms | Notes + Jee Main Selected PYQS-2 | Saturday, 6 January 2024 |
| | | Sunday, 7 January 2024 |
| Chemical Kinetics | Notes | Monday, 8 January 2024 |
| | Jee Main Selected PYQS-2 | Tuesday, 9 January 2024 |
| | **Class** | Wednesday, 10 January 2024 |
| Chemical Equilibrium | Notes + Jee Main Selected PYQS-2 | Thursday, 11 January 2024 |
| Ionic Equilibrium | Notes | Friday, 12 January 2024 |
| | Jee Main Selected PYQS-2 | Saturday, 13 January 2024 |
| | | Sunday, 14 January 2024 |
| Redox Reactions | Notes + Jee Main Selected PYQS-2 | Monday, 15 January 2024 |
| Electrochemistry | Notes | Tuesday, 16 January 2024 |
| | **Class** | Wednesday, 17 January 2024 |
| | Jee Main Selected PYQS-2 | Thursday, 18 January 2024 |
| Liquid Solution | Notes + Jee Main Selected PYQS-2 | Friday, 19 January 2024 |
| Atomic structure | Notes + Jee Main Selected PYQS-2 | Saturday, 20 January 2024 |
| | | Sunday, 21 January 2024 |

13.5

Score 0

Score +1

Score −1

akk7007

# Chemical Equilibrium

1. Consider the following reversible chemical reactions :

$$A_2(g) + B_2(g) \underset{}{\overset{K_1}{\rightleftharpoons}} 2AB(g) \; .....(1)$$

[Jee Main, Jan 2019]

$$6AB(g) \underset{}{\overset{K_2}{\rightleftharpoons}} 3A_2(g) + 3B_2(g) \; .....(2)$$

$$\left(\frac{1}{K_1}\right)^3 = K_2$$

(A) $K_1K_2 = 3$ (B) $K_2 = K_1^{-3}$ (C) $K_2 = K_1^{3}$ (D) $K_1K_2 = \frac{1}{2}$

$$K_p = K_c(RT)^{\Delta n_g}$$

$$K_c = \frac{[B]^b}{[A]^a} \qquad K_p = \frac{P_B^{\,b}}{P_A^{\,a}}$$

$K_c^{o}$ $\quad K_p^{o}$ $\quad \underline{K_{pc}}$

# Chemical Equilibrium

2. In a chemical reaction, $A + 2B \overset{K}{\rightleftharpoons} 2C + D$, the initial concentration of B was 1.5 times of the concentration of A, but the equilibrium concentrations of A and B were found to be equal. The equilibrium constant(K) for the aforesaid chemical reaction is : **[Jee Main, Jan 2019]**

(1) $\frac{1}{4}$ (2) 4 (3) 16 (4) 1

$$A + 2B \longrightarrow 2C + D$$

| | | | |
|---|---|---|---|
| $a$ | $1.5a$ | | |
| $a-x$ | $1.5a-2x$ | $2x$ | $x$ |
| $x$ | $x$ | $2x$ | $x$ |

$a - x = 1.5a - 2x$

$x = 0.5a$

$a = 2x$

# Chemical Equilibrium

3. 4.0 moles of argon and 5.0 moles of $PCl_5$ are introduced into an evacuated flask of 100 litre capacity at 610 K. The system is allowed to equilibrate. At equilibrium, the total pressure of mixture was found to be 6.0 atm. The $K_p$ for the reaction is [Given: R = 0.082L atm $K^{-1}$ $mol^{-1}$] **[JEE Main, June 2022]**

(1) 2.25 (2) 6.24 (3) 12.13 (4) 15.24

$$PCl_5 \rightarrow PCl_3 + Cl_2$$

$$5-x \qquad x \qquad x$$

$$K_p = \frac{x \cdot x}{5-x} \times \left(\frac{6}{n}\right)^1$$

$$6 \times 100 = n \times 0.082 \times 610$$

$$n = \underline{5 + x + 4}$$

# Chemical Equilibrium

5. The equilibrium constant for the reaction

$$A(s) \rightleftharpoons M(s) + \frac{1}{2} O_2\ (g)$$

is Kp = 4. At equilibrium, the partial pressure of $O_2$ is _____ atm.

(Round off to the nearest integer) [JEE Main, July 2021]

$$K_P = \left(P_{O_2}\right)^{1/2} = 4$$

$$P_{O_2} = 16$$

# Chemical Equilibrium

6. Value of $K_p$ for the equilibrium reaction $N_2O_4(g) \rightleftharpoons 2NO_2(g)$ at 288 K is 47.9. The $K_C$ for this reaction at same temperature is_______. (Nearest integer)
($R = 0.083$ L bar $K^{-1}$ $mol^{-1}$) **[JEE Main, July 2021]**

$$K_p = K_c (RT)^{\Delta n_g}$$

$$47.9 = K_c (0.083 \times 288)^1$$

# Chemical Equilibrium

7. For the reaction $A(g) \rightleftharpoons B(g)$ at 495 K, $D_rG^0 = -9.478$ kJ mol$^{-1}$. If we start the reaction in a closed container at 495 K with 22 millimoles of A, the amount of B is the equilibrium mixture is _______ millimoles. (Round off to the Nearest Integer). [R = 8.314 J mol$^{-1}$ K$^{-1}$; $\ell n10 = 2.303$] **[JEE Main, March 2021]**

$$\Delta G^0 = -RT\ln K$$

$$-9.478 \times 10^3 = -2.303 \times 8.314 \times 495 \times \log K$$

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$$A \longrightarrow B$$

$$\boxed{\begin{aligned} &\ln \frac{K_2}{K_1} = \frac{\Delta H}{R}\left[\frac{1}{T_1} - \frac{1}{T_2}\right] \\ &\Delta G^\circ = -RT\ln K \\ &\Delta H^\circ - T\Delta S^\circ = -RT\ln K \end{aligned}}$$

$A(s) \rightarrow A(l)$

$P\uparrow$ backward

$H_2O(s) \rightarrow H_2O(l)$

$P\uparrow$ forward

graphite $\rightarrow$ diamond

$P\uparrow$ forward

# IONIC EQUILIBRIUM

1. A student needs to prepare a buffer solution of propanoic acid and its sodium salt with pH 4. The ratio of $\frac{[CH_3CH_2COO^-]}{[CH_3CH_2COOH]}$ required to make buffer is .......... **[JEE Main, June 2022]**

Given: $K_a(CH_3CH_2COOH) = 1.3 \times 10^{-5}$

(1) 0.03 (2) 0.13 (3) 0.23 (4) 0.33

SA

WA →

$HA \longrightarrow H^+ + A^-$

$c-x \quad x \quad x$

$K_a = \frac{x^2}{c-x} = \frac{c\alpha^2}{1-\alpha}$

SA + WA

WA + WA $\quad [H^+] = \sqrt{K_{a_1}C_1 + K_{a_2}C_2}$

$4 = 5 - \log 1.3 + \log \frac{S}{a}$

$H_3PO_4$

$K_{a_1} = \frac{x^2}{c-x}$

$K_{a_2} = y$

$K_{a_3} = \frac{xz}{y}$

HA $\quad$ $A^-$

$K_a \times K_b = K_w$

$pH = \frac{1}{2}(pK_w + pK_a - pK_b)$

WB

$NH_4OH$

$C_6H_5-NH_2$

$C_6H_5N$

$CH_3COO^-$

$HCOO^-$

$CN^-$

$$CH_3COOH + NaOH \rightarrow CH_3COONa + H_2O$$

1 1

---

1 2

---

2 1

2. Given below are two statements: one is labelled as Assertion A and the other is labelled as **[JEE Main, July 2022]**
Reason R.

T Assertion (A): Phenolphthalein is a pH dependent indicator, remains colourless in acidic solution and gives pink colour in basic medium

Reason (R): Phenolphthalein is a weak acid. It doesn't dissociate in basic medium. F

In the light of the above statements, choose the most appropriate answer from the options given below:

(1) Both A and R are true and R is the correct explanation of A
(2) Both A and Rare true but R is NOT the correct I explanation of A.
(3) A is true but R is false
(4) A is false but R is true

Colourless 8.3 — 10 Pink

Pinkish Red $\longrightarrow$ yellow

Red $\longrightarrow$ yellow

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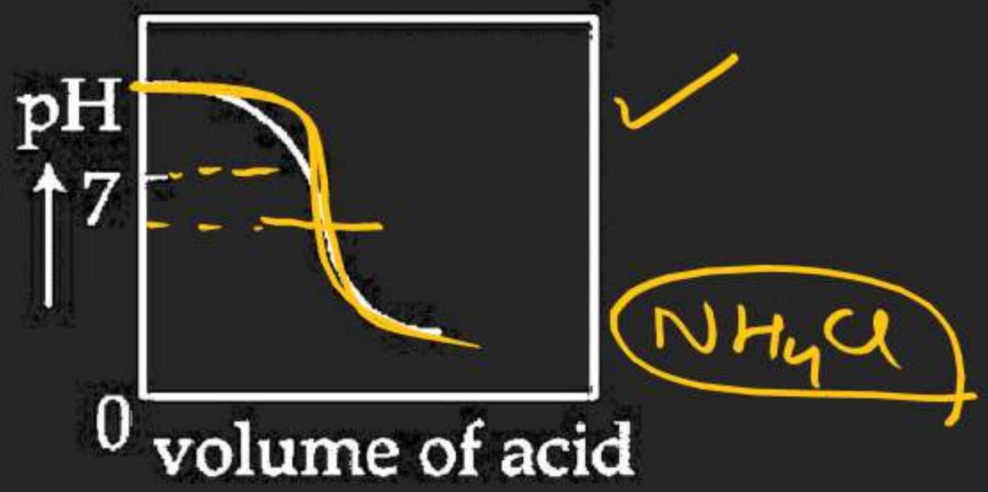
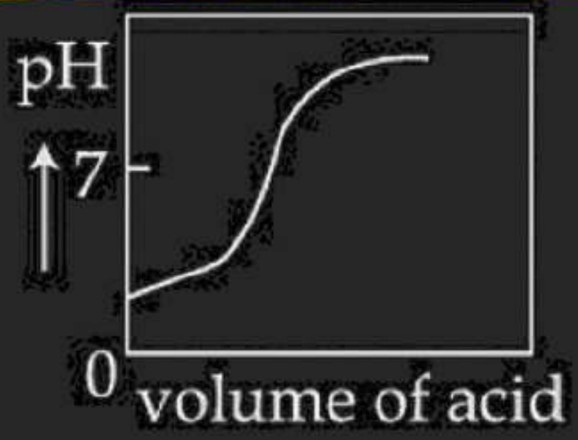
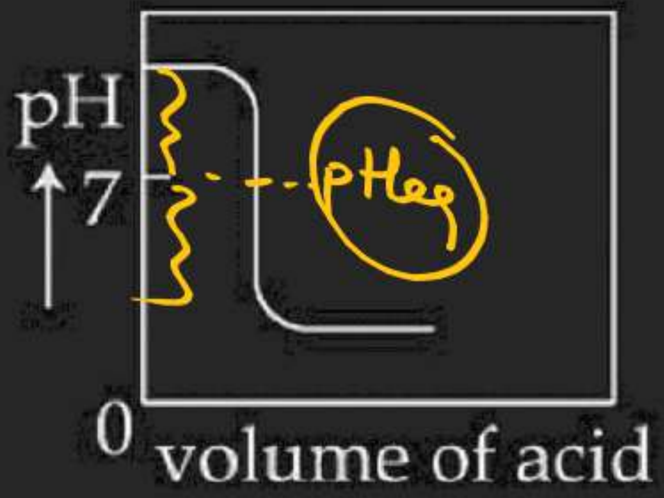
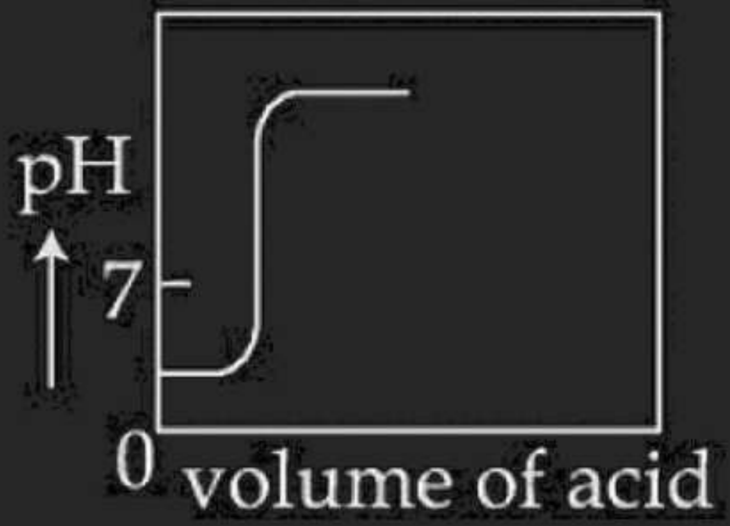
# IONIC EQUILIBRIUM

3. The Plot of pH-metric titration of weak base $NH_4OH$ vs strong acid HCl looks like:

(A)



(B)



(C)



(D)


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4. What is the molar solubility of $Al(OH)_3$ in 0.2 M NaOH solution? Given that, solubility product of $Al(OH)_3 = 2.4\times10^{-24}$: **[Jee Main, April 2019]**

(1) $12 \times 10^{-23}$
(2) $3 \times 10^{-22}$
(3) $12 \times 10^{-21}$
(4) $3 \times 10^{-19}$

$$Al(OH)_3 \longrightarrow Al^{3+} + 3OH^-$$

$$(S) \times (0.2 + \cancel{3S})^3 = K_{sp}$$

# IONIC EQUILIBRIUM

5. For the following Assertion and Reason, the correct option is [Jee Main, 2020]

Assertion (A) : When Cu (II) and sulphide ions are mixed, they react together extremely quickly to give a solid.

Reason (R) :The equilibrium constant of $Cu^{2+}(aq) + S^{2-}(aq) \longrightarrow CuS(s)$ is high because the solubility product is low.

$\frac{1}{K_{sp}}$

(1) (A) is false and (R) is true.

(2) Both (A) and (R) are true but (R) is not explanation for (A).

(3) Both (A) and (R) are false.

(4) Both (A) and (R) are true and (R) is the explanation for (A)

# IONIC EQUILIBRIUM

$1.7 \times 10^{-9}$

6. A solution is 0.1 M in $Cl^-$ and 0.001 M in $CrO_4^{2-}$. Solid $AgNO_3$ is gradually added to it Assuming that the addition does not change in volume and

$K_{sp}(AgCl) = 1.7 \times 10^{-10}\ M^2$ and

$[Ag^+]$

$K_{sp}(Ag_2CrO_4) = 1.9 \times 10^{-12}\ M^3$.

Select correct statement from the following : **[JEE Main, July 2021]**

(1) AgCl precipitates first because its $K_{sp}$ is high.

(2) $Ag_2CrO_4$ precipitates first as its $K_{sp}$ is low.

(3) $Ag_2CrO_4$ precipitates first because the amount of $Ag^+$ needed is low.

(4) AgCl will precipitate first as the amount of $Ag^+$ needed to precipitate is low.

7. The strength of an aqueous NaOH solution is most accurately determined by titrating: [Jee Main, 2020]

(Note : consider that an appropriate indicator is used)

(1) Aq. NaOH in a pipette and aqueous oxalic acid in a burette

(2) Aq. NaOH in a volumetric flask and concentrated $H_2SO_4$ in a conical flask

(3) Aq. NaOH in a burette and concentrated $H_2SO_4$ in a conical flask

(4) Aq. NaOH in a burette and aqueous oxalic acid in a conical flask

# IONIC EQUILIBRIUM

8. Assuming that $Ba(OH)_2$ is completely ionised in aqueous solution under the given conditions the concentration of $H_3O^+$ ions in 0.005 M aqueous solution of Ba $(OH)_2$ at 298 K is _____ $\times 10^{-12}$ mol $L^{-1}$. (Nearest integer) **[JEE Main, July 2021]**

# IONIC EQUILIBRIUM

9. 0.01 moles of a weak acid HA($K_a = 2.0 \times 10^{-6}$) is dissolved in 1.0 L of 0.1 M HCl solution. The degree of dissociation of HA is ________ $\times$ $10^{-5}$. [Neglect volume change on adding HA. Assume degree of dissociation <<1]

[JEE Main, March 2021]

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# IONIC EQUILIBRIUM

10. 3 g of acetic acid is added to 250 mL of 0.1 M HCl and the solution made up to 500 mL. To 20 mL of this solution $\frac{1}{2}$ mL of 5 M NaOH is added. The pH of the solution is ________.

[Given: $pK_a$ of acetic acid = 4.75, molar mass of acetic acid = 60 g/mol, log3 = 0.4771]

Neglect any changes in volume. **[Jee Main, 2020]**

$1000 \times \frac{3}{60} = \frac{1}{20} \times \cancel{1000}$ 50 mmol $CH_3COOH$

25 mmol HCl

In 20 ml soln

2 mmol $CH_3COOH$

~~1 mmol~~ HCl

~~2.5~~ mmol NaOH

1.5 mmol

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# IONIC EQUILIBRIUM

$x$ $y$

11. 0.4g mixture of $\cancel{NaOH}$, $Na_2CO_3$ and some inert impurities was first titrated with $\frac{N}{10}$ HCl using phenolphthalein as an indicator, 17.5 mL of HCl was required at the end point. After this methyl orange was added and titrated. 1.5 mL of same HCl was required for the next end point. The weight percentage of $Na_2CO_3$ in the mixture is ........... (Rounded-off to the nearest integer)

[JEE Main, Feb 2021]

NaOH

$Na_2CO_3 \rightarrow NaHCO_3 \xrightarrow{\text{Methyl}} H_2CO_3$

$x + y = 1.75$

$y = \frac{1}{10} \times 1.5 = 0.15$

# REDOX

2. In polythionic acid, $H_2S_xO_6$($x = 3$ to $5$) the oxidation state(s) of Sulphur is/are :

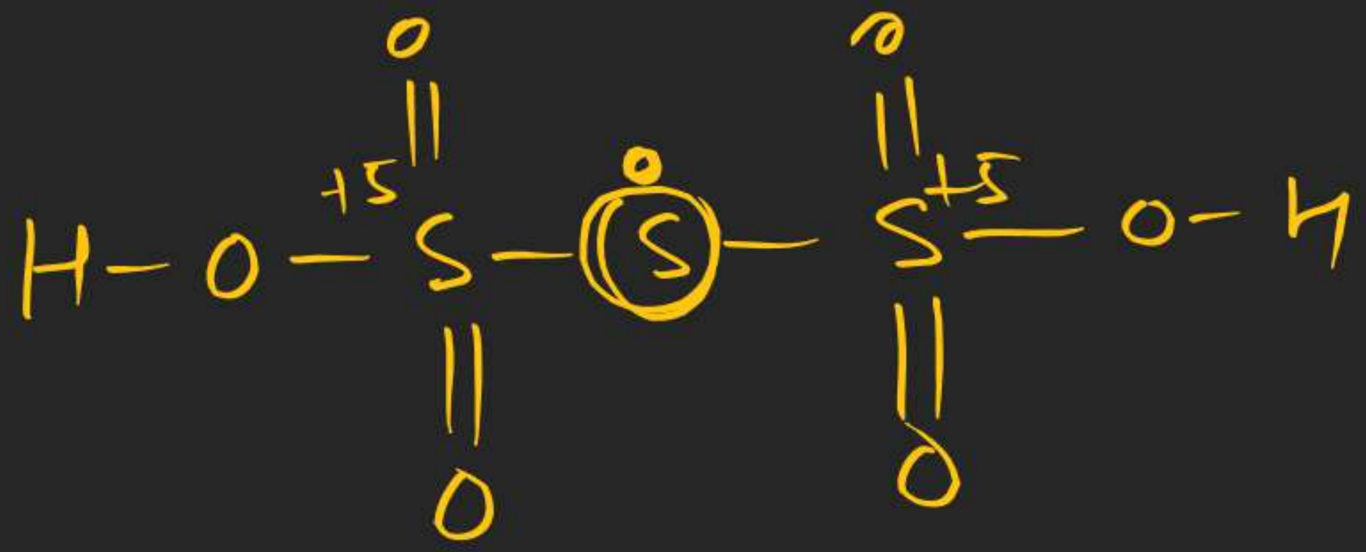
**[JEE Main, August 2021]**

(A) + 5 only

(B) + 6 only

(C) + 3 and + 5 only

(D) 0 and + 5 only



# REDOX

3. Which one of the following reactions indicates the reducing ability of hydrogen peroxide in basic medium ? [JEE Main, June 2022]

(A) $HOCl + H_2O_2 \rightarrow H_3O^+ + Cl^- + O_2$

(B) $PbS + 4H_2O_2 \rightarrow PbSO_4 + 4H_2O$

(C) $2MnO_4^- + 3H_2O_2 \rightarrow 2MnO_2 + 3O_2 + 2H_2O + 2OH^-$

(D) $Mn^{2+} + H_2O_2 \rightarrow Mn^{4+} + 2OH^-$

# REDOX

4. In neutral or faintly alkaline medium, $KMnO_4$ being a powerful oxidant can oxidize, thiosulphate almost quantitatively, to sulphate. In this reaction overall change in oxidation state of manganese will be: **[JEE Main, July 2022]**

(A) 5 (B) 1 (C) 0 (D) 3