

VARUN

ADVANCE 2026

PHYSICAL
CHEMISTRY

Lecture - 01

Ionic Equilibrium

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Topics to be covered

1 Questions

QUESTION

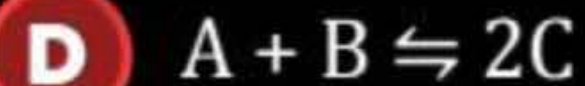
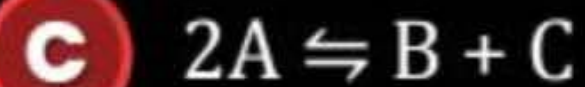
When $\text{N}_2\text{O}_5(\text{g})$ is heated to 600 K, it dissociates as $\text{N}_2\text{O}_5(\text{g}) \rightleftharpoons \text{N}_2\text{O}_3(\text{g}) + \text{O}_2(\text{g})$; $K_c = 2.5$ M. Simultaneously, $\text{N}_2\text{O}_3(\text{g})$ decomposes as $\text{N}_2\text{O}_3(\text{g}) \rightleftharpoons \text{N}_2\text{O}(\text{g}) + \text{O}_2(\text{g})$. When initially 4.0 moles of $\text{N}_2\text{O}_5(\text{g})$ is taken in a 2.0 L flask and allowed to attain equilibrium, the equilibrium concentration of $\text{O}_2(\text{g})$ is found to be 2.5 M. The equilibrium concentration of $\text{N}_2\text{O}(\text{g})$ (in M) is

Ans : 1



QUESTION

A reaction at 300 K with $\Delta G^\circ = -1743$ J consists of 3 moles of A(g), 6 moles of B(g) and 3 moles of C(g). If A, B and C are in equilibrium in 1 L container, then the reaction may be ($\ln 2 = 0.7$, $R = 8.3$ J/K-mol)



Ans : C

QUESTION

If for the equilibria $\text{NH}_2\text{COONH}_4(\text{s}) \rightleftharpoons \text{N}_2 + \text{H}_2 + \text{CO} + \text{O}_2$, the value of K_p at 800 K is $27 \times 2^{\lambda/2}$ and the equilibrium pressure is 22 atm. The value of λ is

A 21

B 22

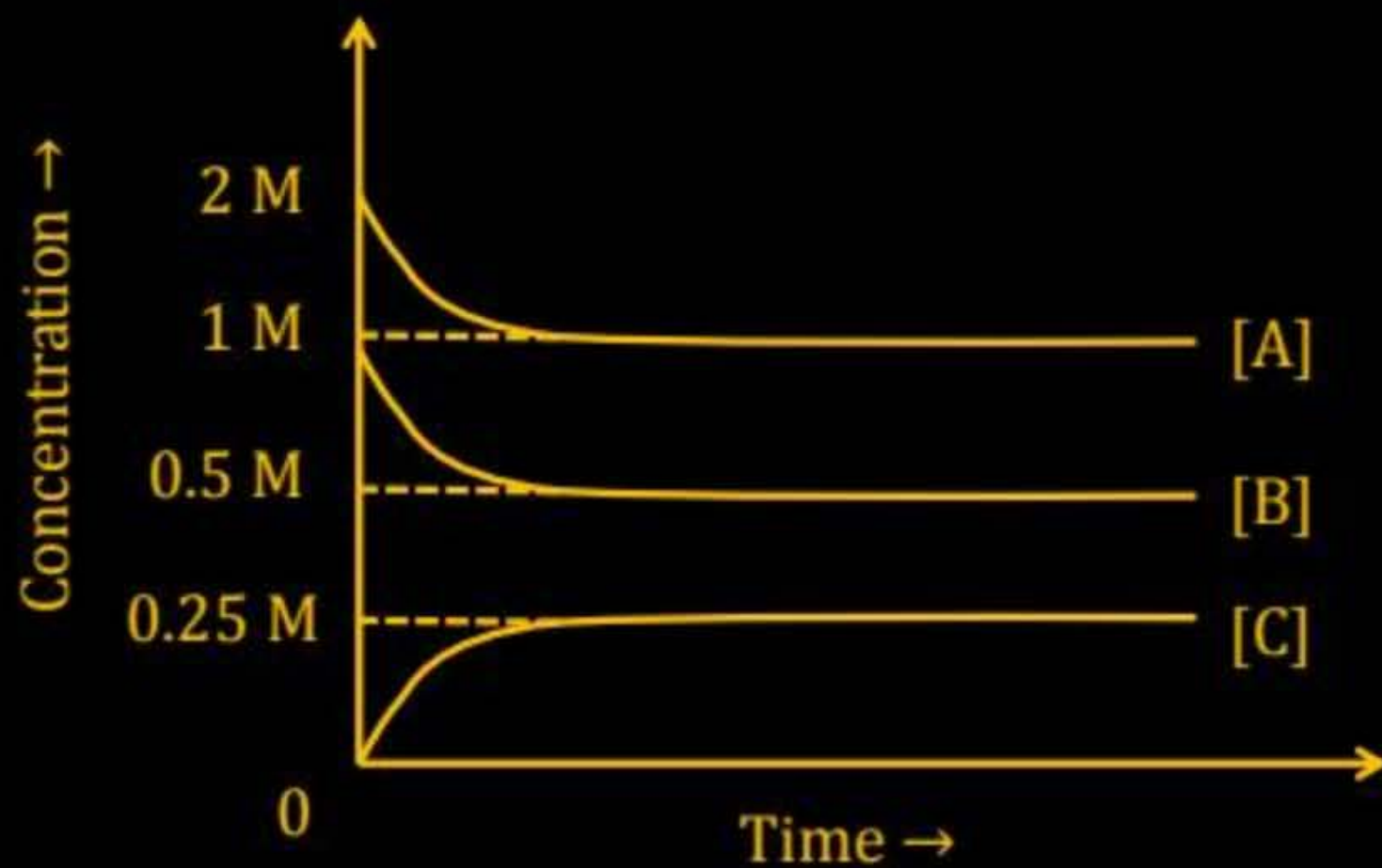
C 11

D 12

Ans : A

QUESTION

From the following graphical representation, what is the value of $(\alpha + \beta + \gamma)$ in following equilibrium reaction?



QUESTION

Dissociation constants of acids HA and HB are 2.0×10^{-4} and 5×10^{-5} , respectively. The $[H^+]$ in the resulting solution obtained by mixing 20 ml of 0.5 M-HA solution and 30 ml of 0.2 M-HB solution is

- A** $1.05 \times 10^{-2} \text{ M}$
- B** $6.78 \times 10^{-3} \text{ M}$
- C** $1.05 \times 10^{-3} \text{ M}$
- D** $6.78 \times 10^{-2} \text{ M}$

Ans: (B)



QUESTION

For a tribasic acid, H_3A . $K_{a1} = 2 \times 10^{-5}$, $K_{a2} = 5 \times 10^{-9}$ and $K_{a3} = 4 \times 10^{-12}$. The value of $\frac{[A^{3-}]}{[H_3A]}$ at equilibrium in an aqueous solution originally having 0.2 M – H_3A is

- A** 5×10^{-17}
- B** 5×10^{-9}
- C** 1×10^{-17}
- D** 2×10^{-22}

Ans : (A)



QUESTION

The buffer capacity (β) for a weak acid (A) – conjugated base (B) buffer is defined as the number of moles of strong acid or base needed to change the pH of strong acid or base needed to change the pH of 1 L of solution by 1pH unit, where $\beta = \frac{2.303 (C_A + C_B) K_a [H^+]}{([H^+] + K_a)^2}$. Under what condition will be buffer best resist a change in pH?

- A** $\text{pH} = 3 \text{ pK}_a$
- B** $2 \text{ pH} = \text{pK}_a$
- C** $\text{pH} = \text{pK}_a$
- D** $\text{pH} = 2 \text{ pK}_a$

Ans: (C)



QUESTION

Calculate the degree of hydrolysis of 0.005 M- K_2CrO_4 . For H_2CrO_4 , $K_{a1} = \text{infinite}$, $K_{a2} = 5 \times 10^{-7}$.

- A** 0.002
- B** 0.02
- C** 0.2
- D** 0.005

Ans: (A)



QUESTION

What is the solubility of MnS in pure water, assuming hydrolysis of S^{2-} ions? K_{sp} of MnS $= 2.5 \times 10^{-10}$, $K_{a1} = 1 \times 10^{-7}$ and $K_{a2} = 1 \times 10^{-14}$ for H_2S .
($0.63^3 = 0.25$)

- A** $6.3 \times 10^{-4} \text{ M}$
- B** $2.5 \times 10^{-4} \text{ M}$
- C** $6.3 \times 10^{-3} \text{ M}$
- D** $1.58 \times 10^{-5} \text{ M}$

Aus: (A)



Comprehension

The first and second dissociation constants of H_2CO_3 are 4.0×10^{-6} and 2.5×10^{-11} , respectively. In a particular titration, 50 ml of 1.0 M- Na_2CO_3 is taken in a flask and 1.0 M-HCl solution is added drop by drop. Determine the pH of the resulting solution on adding the following volume of HCl solution. Assume that volume is additive. ($\log 2 = 0.3$, $\log 3 = 0.48$).

QUESTION

25 ml ?

A 10.6

B 10.3

C 10.9

D 3.4

Ans: (A)



Comprehension

The first and second dissociation constants of H_2CO_3 are 4.0×10^{-6} and 2.5×10^{-11} , respectively. In a particular titration, 50 ml of 1.0 M- Na_2CO_3 is taken in a flask and 1.0 M-HCl solution is added drop by drop. Determine the pH of the resulting solution on adding the following volume of HCl solution. Assume that volume is additive. ($\log 2 = 0.3$, $\log 3 = 0.48$).

QUESTION

50 ml ?

A 10.6

B 5.4

C 8.0

D 6.0

Ans: (C)



Comprehension

The first and second dissociation constants of H_2CO_3 are 4.0×10^{-6} and 2.5×10^{-11} , respectively. In a particular titration, 50 ml of 1.0 M- Na_2CO_3 is taken in a flask and 1.0 M-HCl solution is added drop by drop. Determine the pH of the resulting solution on adding the following volume of HCl solution. Assume that volume is additive. ($\log 2 = 0.3$, $\log 3 = 0.48$).

QUESTION

75 ml ?

A 10.6

B 8.6

C 8.0

D 5.4

Ans: (D)



Comprehension

The first and second dissociation constants of H_2CO_3 are 4.0×10^{-6} and 2.5×10^{-11} , respectively. In a particular titration, 50 ml of 1.0 M- Na_2CO_3 is taken in a flask and 1.0 M-HCl solution is added drop by drop. Determine the pH of the resulting solution on adding the following volume of HCl solution. Assume that volume is additive. ($\log 2 = 0.3$, $\log 3 = 0.48$).

QUESTION

100 ml ?

A 2.94

B 11.06

C 5.4

D 5.88

Ans: (A)



The K_{sp} of Ag_2CrO_4 is 1.1×10^{-12} at 298 K. The solubility (in mol/L) of Ag_2CrO_4 in a 0.1 M AgNO_3 solution is

- A** 1.1×10^{-11}
- B** 1.1×10^{-10}
- C** 1.1×10^{-12}
- D** 1.1×10^{-9}

[Ans : B]



A solution is prepared by mixing 0.01 mol each of H_2CO_3 , NaHCO_3 , Na_2CO_3 and NaOH in 100 mL of water. pH of the resulting solution is _____.

[Given : pK_{a_1} and pK_{a_2} of H_2CO_3 are 6.37 and 10.32, respectively; $\log 2 = 0.30$]

[Ans : 10.02]

An acidified solution of 0.05 M Zn^{2+} is saturated with $0.1 \text{ M H}_2\text{S}$. What is the minimum molar concentration (M) of H^+ required to prevent the precipitation of ZnS ?

Use $K_{\text{sp}} (\text{ZnS}) = 1.25 \times 10^{-22}$ and overall dissociation constant of H_2S , $K_{\text{net}} = K_1 K_2 = 1 \times 10^{-21}$.

Ans : 0.2 M



Concentration of H_2SO_4 and Na_2SO_4 in a solution is 1 M and 1.8×10^{-2} M, respectively. Molar solubility of PbSO_4 in the same solution is $X \times 10^{-Y}$ M (expressed in scientific notation). The value of Y is _____. [Given : Solubility product of PbSO_4 (K_{sp}) = 1.6×10^{-8} . For H_2SO_4 , K_{a_1} is very larger and $K_{a_2} = 1.2 \times 10^{-2}$]

QUESTION



Calculate the pH of the following solutions.



- (A) 50 mL of 0.12 M H_3PO_4 + 20 mL of 0.15 M NaOH;
- (B) 50 mL of 0.12 M H_3PO_4 + 40 mL of 0.15 M NaOH;
- (C) 40 mL of 0.12 M H_3PO_4 + 40 mL of 0.18 M NaOH;
- (D) 40 mL of 0.10 M H_3PO_4 + 40 mL of 0.25 M NaOH;

Comprehension



The solubility product of AgCN is 1.0×10^{-16} and the formation constant of $\text{Ag}(\text{CN})_2^-$ is 1.5×10^{17} .

QUESTION

The solubility of AgCN in 0.02 M-KCN solution, assuming no complex formation, is

A $1.0 \times 10^{-8} \text{ M}$

B $5.0 \times 10^{-15} \text{ M}$

C 0.02 M

D $5.0 \times 10^{-14} \text{ M}$

[Ans : B]



QUESTION



The solubility of AgCN in 0.02 M-KCN solution, assuming complex formation, is

- A** 0.3 M
- B** 0.02 M
- C** 1.33×10^{-19} M
- D** 1.87×10^{-2} M

[Ans : D]



QUESTION

The solubility product (K_{sp}) of Ca(OH)_2 at 25°C is 3.2×10^{-5} . A 500 ml of saturated solution of Ca(OH)_2 is mixed with equal volume of 1.6 M-NaOH. How much Ca(OH)_2 (in milligrams) is precipitated?

Ans: 740 mg





THANK
YOU