

Ionic Equilibrium

Question1

Solubility product of CaC_2O_4 at a given temperature in pure water is $4 \times 10^{-9} \left(\text{mol L}^{-1} \right)^2$. Solubility of CaC_2O_4 at the same temperature is

KCET 2024

Options:

A. $6.3 \times 10^{-5} \text{ mol L}^{-1}$

B. $2 \times 10^{-5} \text{ mol L}^{-1}$

C. $2 \times 10^{-4} \text{ mol L}^{-1}$

D. $6.3 \times 10^{-4} \text{ mol L}^{-1}$

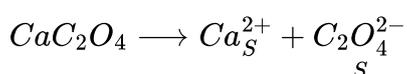
Answer: A

Solution:

Given,

$$K_{\text{sp}} = 4 \times 10^{-9} \left(\text{mol L}^{-1} \right)^2$$

$$S = ?$$



$$4 \times 10^{-9} = S^2$$

$$\Rightarrow S = \sqrt{4 \times 10^{-9}}$$

$$= 6.3 \times 10^{-5} \text{ mol/L}$$

Thus, the solubility of CaC_2O_4 is $6.3 \times 10^{-5} \text{ mol/L}$.



Question2

A weak acid with pK_a 5.9 and weak base with pK_b 5.8 are mixed in equal proportions. pH of the resulting solution is

KCET 2023

Options:

A. 7.005

B. 7.5

C. 7

D. 7.05

Answer: D

Solution:

pH of the resultant solution is given by,

$$pH = 7 + \frac{1}{2}(pK_a - pK_b) = 7 + \frac{1}{2}(5.9 - 5.8)$$

$$pH = 7.05$$

Question3

Which among the following has highest pH ?

KCET 2022

Options:

A. 1 M NaOH



B. 1 M H_2SO_4

C. 0.1 M NaOH

D. 1 M HCl

Answer: A

Solution:

For acidic medium, we know that pH values range is between 0 – 6, 9, for neutral it is 7 and for bases it is 7.1 – 14. So, HCl is acidic and NaOH is basic. Thus, we can straight forward infer that NaOH has a higher pH value.

Now, 1 mole of sodium hydroxide produces 1 mole of Na^+ and 1 mole of OH^- ions. This means that the concentration of the hydroxide ions will be equal to $[\text{OH}^-] = [\text{NaOH}] = 1\text{M}$

For case A,

$$\begin{aligned} \text{pOH} &= -\log [\text{OH}^-] = -\log[1] = 0 \\ \therefore \text{pH} &= 14 - \text{pOH} = 14 - 0 = 14 \end{aligned}$$

For case B,

$$\begin{aligned} [\text{OH}^-] &= [\text{NaOH}] = 0.1 \text{ M} \\ \text{pOH} &= -\log[0.1] = 1 \\ \therefore \text{pH} &= 14 - 1 = 13 \end{aligned}$$

So, pH of 1 M NaOH is highest among the given solution.

Question4

K_a values for acids H_2SO_3 , HNO_2 , CH_3COOH and HCN are respectively 13×10^{-2} , 4×10^{-4} , 1.8×10^{-5} and 4×10^{-10} , which of the above acids produces stronger conjugate base in aqueous solution?

KCET 2021

Options:

A. H_2SO_3

B. HNO_2



C. CH_3COOH

D. HCN

Answer: D

Solution:

Lower the value of K_a , lower will be the acidic strength and stronger will be the conjugate base. Therefore, among the given acids, HCN has the lowest K_a value (i.e. 4×10^{-10}).

Hence, it is the strongest conjugate base.

Question 5

The conjugate base of NH_3 is

KCET 2020

Options:

A. NH_4^+

B. NH_4OH

C. NH_2OH

D. NH_2^-

Answer: D

Solution:

The conjugate base of NH_3 can be obtained after removal of one hydrogen ion.



So, NH_2^- is the conjugate base of NH_3 .



Question6

In the reaction



functions as

KCET 2019

Options:

- A. Protonic acid
- B. Lewis base
- C. Bronsted acid
- D. Lewis acid

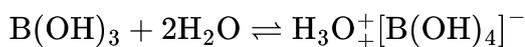
Answer: D

Solution:

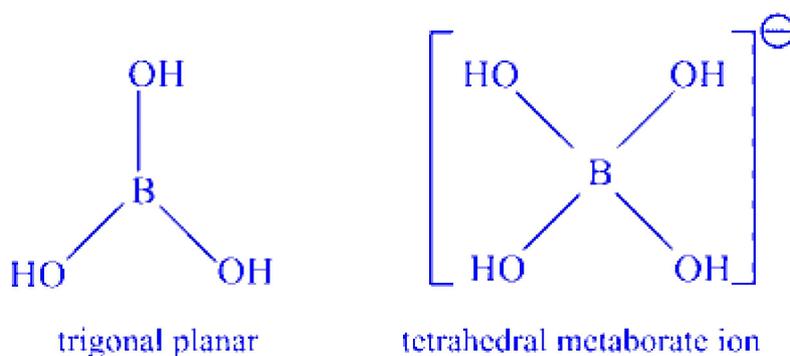
In the reaction



functions as a Lewis acid. It readily accepts OH^- . It is readily soluble in water and behaves as a weak monobasic acid. It does not donate protons like most acids.



The respective structures of $B(OH)_3$ and $[B(OH)_4]^-$ are as follows



Question 7

Solubility of AgCl is least in

KCET 2019

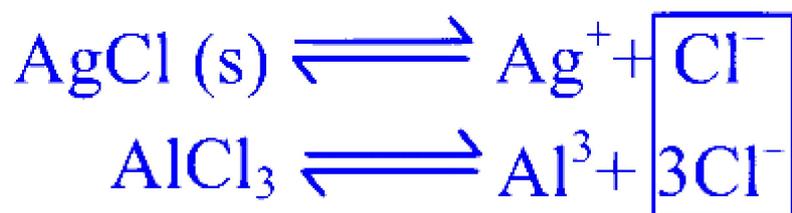
Options:

- A. 0.1 M NaCl
- B. pure water
- C. 0.1 M BaCl₂
- D. 0.1 M AlCl₃

Answer: D

Solution:

Solubility of AgCl is least in 0.1 M AlCl₃ reaction



Addition of AlCl₃ in AgCl solution results in decreasing the concentration of Cl⁻ ion. Due to the presence of common ion, the equilibrium shifts in the backward direction. Hence, the solubility decreases.

