

Chapter	9 Acid Base Chemistry	Class	1 st Year	Subject	Chemistry
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Give Short Answers of the Following Questions

1. Define the following with an example for each:

- i) Ionization constant
iii) Common ion effect

- ii) Solubility product
iv) Acid-base Indicator

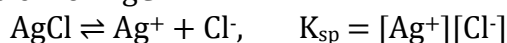
Ans. Ionization Constant: The quantitative measure of the strength of the acid and base is called ionization constant.

Example: we have an acid HA dissolved in water,

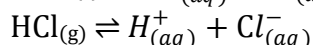
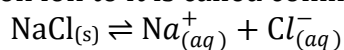


(ii) Solubility product: The solubility product is the product of the concentration of ions raised to an exponent equal to the co-efficient of the balanced equation.

Example: For AgCl



(iii) Common ion Effect: The suppression of ionization of a weak electrolyte by adding a common ion to it is called common ion effect.



(iv) Acid-base Indicator: An indicator is a substance that changes colour to mark a titration's endpoint. Acid-base indicators exhibit one colour in acid and another in base. Most indicators used in acid-base titration are weak organic acids or weak organic bases.

Example:

Phenolphthalein: Colorless (pH < 8.3) to Pink (pH > 10.0)

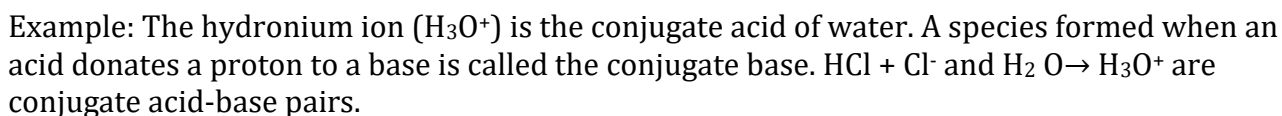
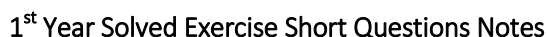
2. Differentiate between:

i) Hydrolysis and dissolution

ii) Acidic and basic buffer solutions

Ans. i) Hydrolysis and dissolution

Feature	Hydrolysis	Dissolution
Definition	A chemical reaction where water breaks bonds in a compound.	A physical process where a solute dissolves in a solvent.
Nature	Chemical process (forms new substances).	Physical process (no new substances formed).
Involves	Reaction with water molecules (H^+ and OH^- may participate).	Mixing of solute and solvent (e.g., salt in water).
Energy Change	May release or absorb energy (exo/endergonic).	Often absorbs energy (endothermic, but not always).
Result	Forms new products (e.g., acids, bases, or ions).	Forms a homogeneous mixture (solution).
Example	$AlCl_3 + 3H_2O \rightleftharpoons Al(OH)_3 + 3H^+ + 3Cl^-$	$NaCl_{(s)} \rightleftharpoons Na^+_{(aq)} + Cl^-_{(aq)}$



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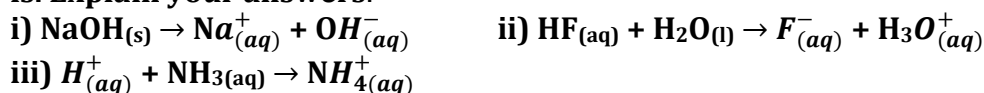
4. What is the relationship between the strength of an acid and the strength of its conjugate base?

Ans. A strong acid has a weak conjugate base because it donates protons easily. A weak acid has a stronger conjugate base as it holds onto protons.

Example: HCl (strong acid) forms Cl⁻ (very weak base).

- **Strong Acid (HCl):** Weak conjugate base (Cl⁻).
- **Weak Acid (CH₃COOH):** Strong conjugate base (CH₃COO⁻).

5. For the following three reactions, identify the reactants that are Arrhenius bases, Bronsted-Lowry bases, and/or Lewis bases. State which type(s) of bases each reactant is. Explain your answers.

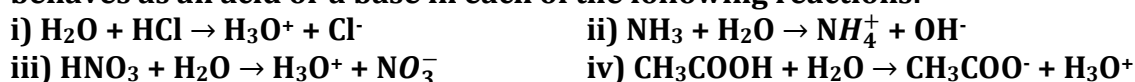


Ans. (i) OH⁻ is Arrhenius and Bronsted-Lowry base (accepts H⁺).

(ii) H₂O is a Bronsted-Lowry base (accepts H⁺) and Lewis base (donates lone pair).

(iii) NH₃ is a Bronsted-Lowry and Lewis base (accepts H⁺ and donates lone pair).

6. An amphoteric substance can behave as either an acid or a base. Identify whether water behaves as an acid or a base in each of the following reactions.



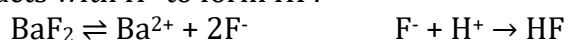
Ans.

Reaction	H ₂ O Role	Reason
i) $\text{H}_2\text{O} + \text{HCl} \rightarrow \text{H}_3\text{O}^+ + \text{Cl}^-$	Base	Accepts H ⁺ from HCl.
ii) $\text{NH}_3 + \text{H}_2\text{O} \rightarrow \text{NH}_4^+ + \text{OH}^-$	Acid	Donates H ⁺ to NH ₃ .
iii) $\text{HNO}_3 + \text{H}_2\text{O} \rightarrow \text{H}_3\text{O}^+ + \text{NO}_3^-$	Base	Accepts H ⁺ from HNO ₃ .
iv) $\text{CH}_3\text{COOH} + \text{H}_2\text{O} \rightarrow \text{CH}_3\text{COO}^- + \text{H}_3\text{O}^+$	Base	Accepts H ⁺ from CH ₃ COOH.

7. Which salt would you expect to dissolve more readily in acidic solution: Barium sulfate or Barium fluoride? Explain. $K_{sp}(\text{BaSO}_4) = 1.1 \times 10^{-10}$, $K_{sp}(\text{BaF}_2) = 8 \times 10^{-10}$

Ans. Barium fluoride (BaF₂) dissolves more acid.

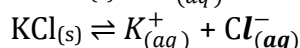
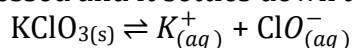
Reason: F⁻ reacts with H⁺ to form HF:



BaSO₄ is unaffected because SO₄²⁻ doesn't react with H⁺.

8. Why does common ion effect decrease solubility of a less soluble salt?

Ans. The solubility of less soluble salts KClO₃ in water is suppressed by the addition of a more soluble salt KCl by common ion effect. K⁺ is a common ion. The ionization of KClO₃ is suppressed and it settles down as precipitate.



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9. State the basic principle of solubility product. Mention factors affecting solubility product.

Ans. It is the product of molar solubilities of two ions at equilibrium stage.

For example: sparingly soluble salt, PbCl_2 . $K_{sp} = [\text{Pb}^{2+}][\text{Cl}^-]^2$

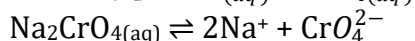
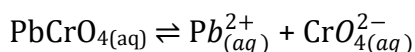
K_{sp} is usually a very small quantity at room temperature. The value of K_{sp} is temperature dependent.

Factors Affecting K_{sp} :

- Temperature
- Presence of common ions
- pH (if salt has basic/acidic ions)

10. Prove by equations what happens when Na_2CrO_4 is added to saturated solution of PbCrO_4 .

Ans. When Na_2CrO_4 is added to a saturated PbCrO_4 solution, it increases the concentration of CrO_4^{2-} ions. According to Le Chatelier's Principle, the equilibrium shifts left to reduce the added CrO_4^{2-} ions:



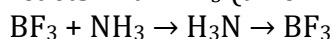
- **Result:** More PbCrO_4 precipitates out, decreasing its solubility.
- **Reason:** The common ion CrO_4^{2-} suppresses the dissociation of PbCrO_4 . This is an example of the common ion effect reducing solubility.

11. According to the Lewis acid-base concept, Boron trifluoride (BF_3) can act as an acid. Is this statement correct?

Ans. Correct, BF_3 is a Lewis acid.

Reason: Boron in BF_3 has an empty p-orbital and can accept an electron pair (Lewis acid).

Example: When BF_3 reacts with NH_3 (a Lewis base), it forms a coordinate covalent bond.



Here, BF_3 accepts the lone pair NH_3 .

12. If the concentration of hydrogen ions in a solution is $1 \times 10^{-5} \text{ M}$, what is the pH of the solution?

Ans. Given Data:

Concentration of hydrogen ions, $[\text{H}^+] = 1 \times 10^{-5} \text{ M}$

To Find:

pH of the solution = ?

Solution:

Step 1: pH formula:

$$\text{pH} = -\log [\text{H}^+]$$

Step 2: Substitute the given $[\text{H}^+]$ into the formula:

$$\text{pH} = -\log (1 \times 10^{-5})$$

Step 3: Simplify the logarithm:

$$\text{pH} = -(-5) = 5$$

Answer: The pH of the solution is 5.