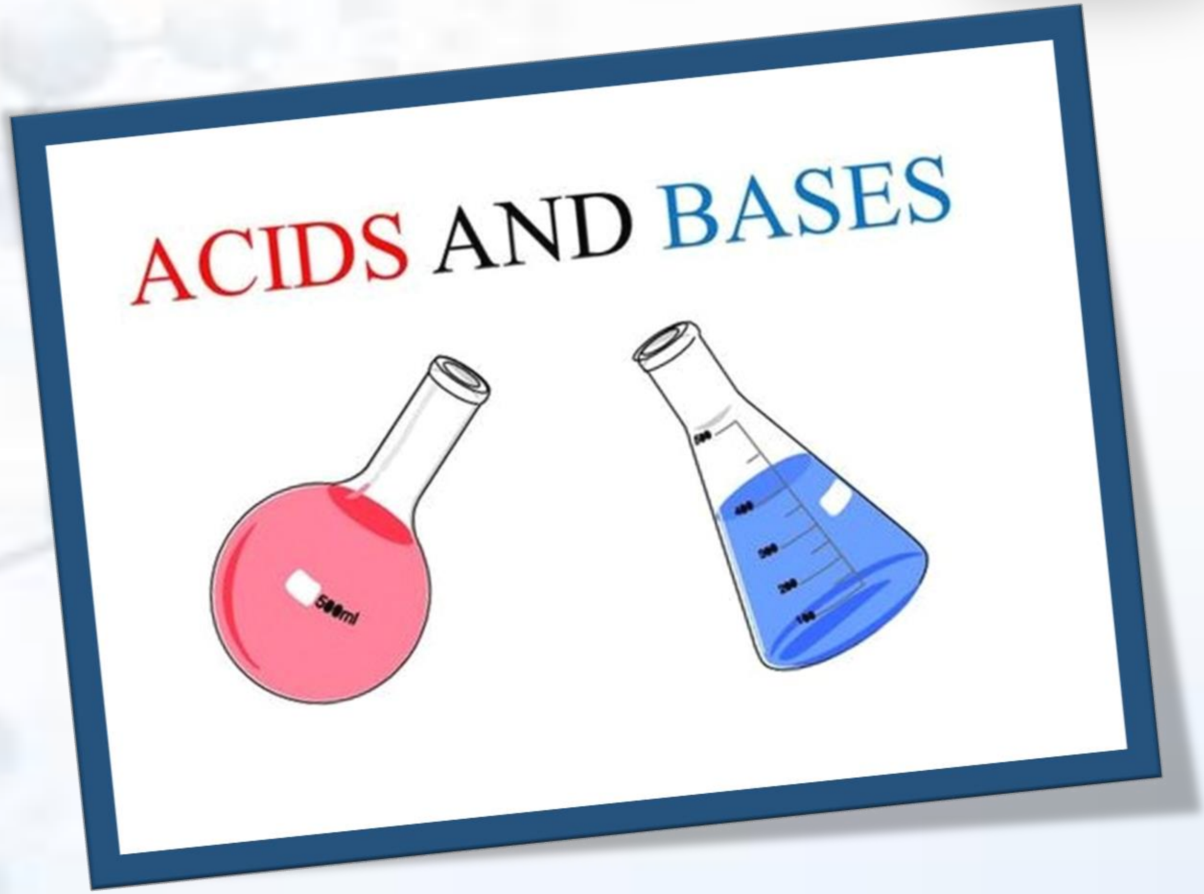
Al-Mustaqbal University College
Department of Radiology Techniques - First Stage

General Chemistry



Fourth Lecture

Asst. Lec.
Alaa Salman Al-Labban

Out line

- ✓ Acids & Bases
- ✓ Arrhenius Concept
- ✓ Brønsted – Lowry Concept
- ✓ Lewis Concept
- ✓ Strength of Acids and Bases
- ✓ Ionization of water
- ✓ Acid or Base Ionization Constant
- ✓ pH of Solution

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Acids and Bases

Acid: The word acid comes from Latin acere meaning sour

Base: is an alkaline, which is derived from Arabic alqali.

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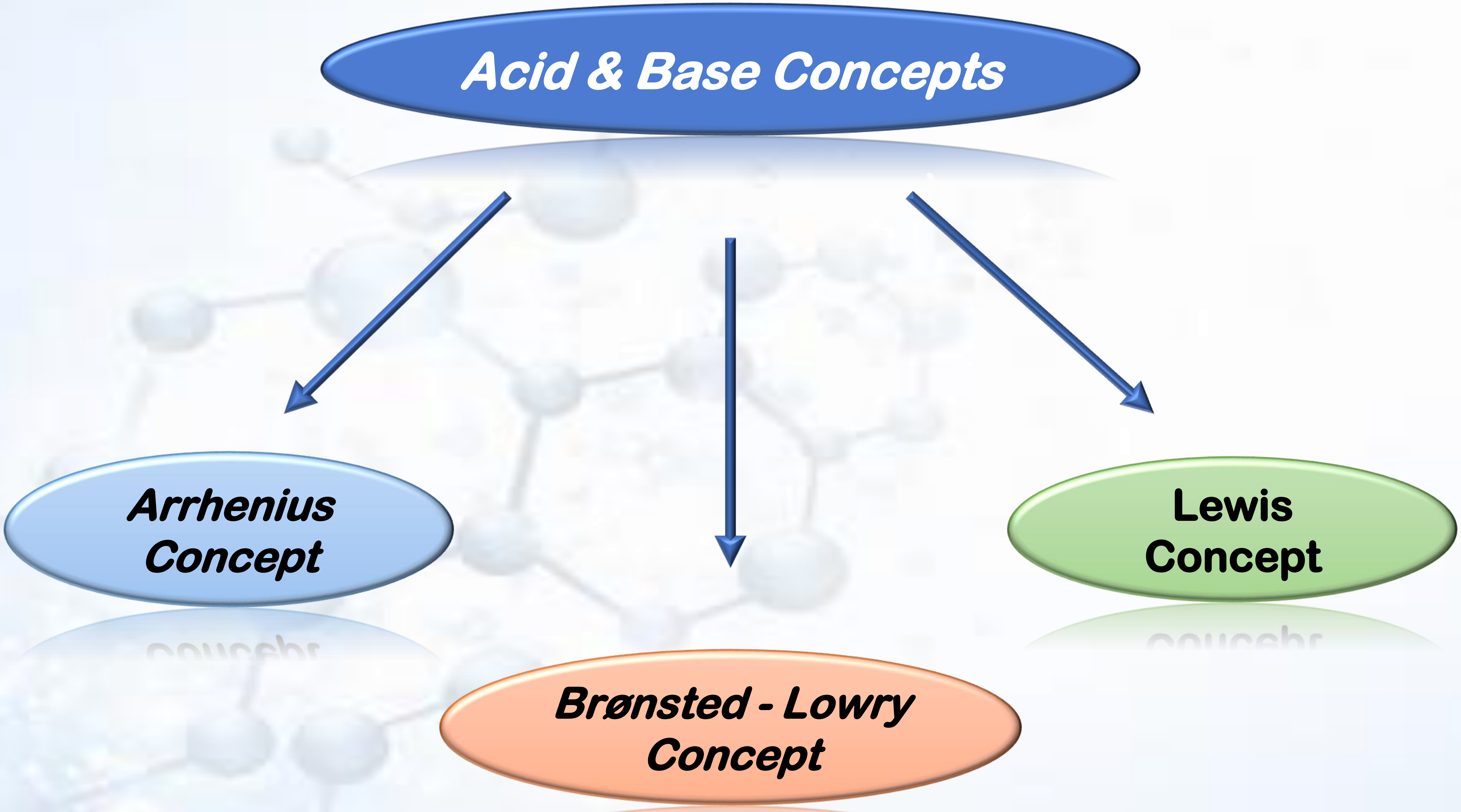
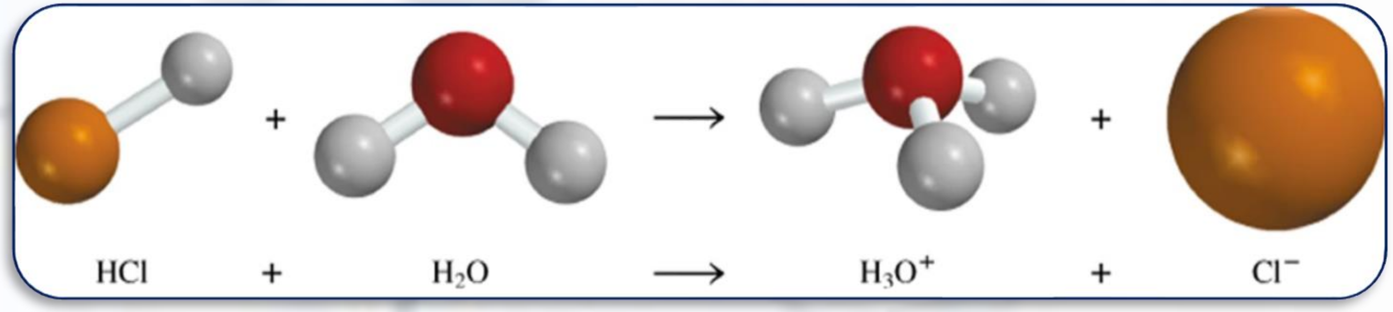
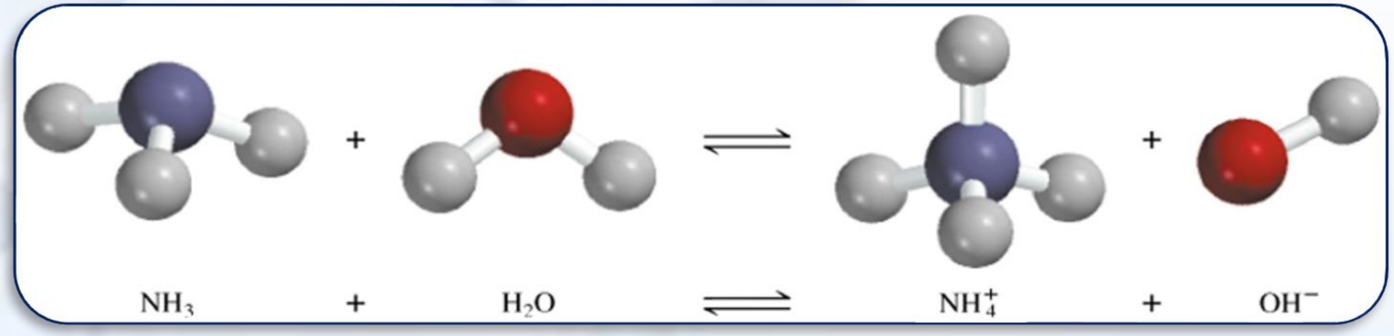

Acid & Base Concepts
Arrhenius Concept
Brønsted - Lowry Concept
Lewis Concept

Arrhenius Concept

Acid: Is a substance that produces H^+ (H_3O^+) in water.



Base: Is a substance that produces OH^- in water.



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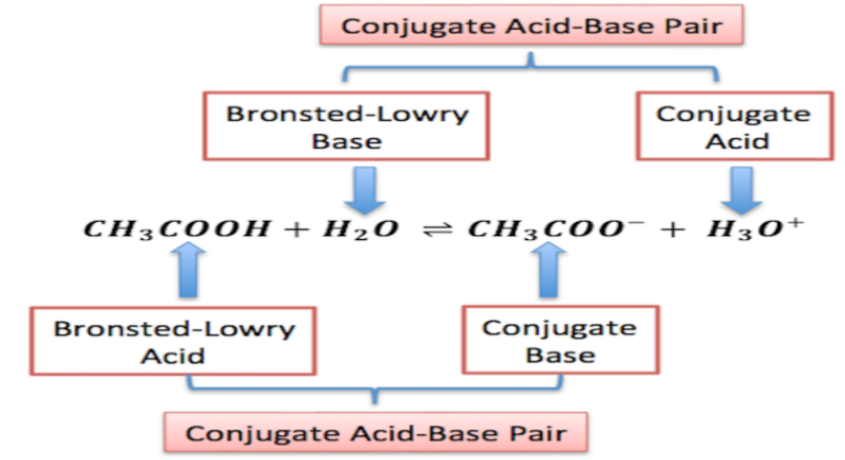
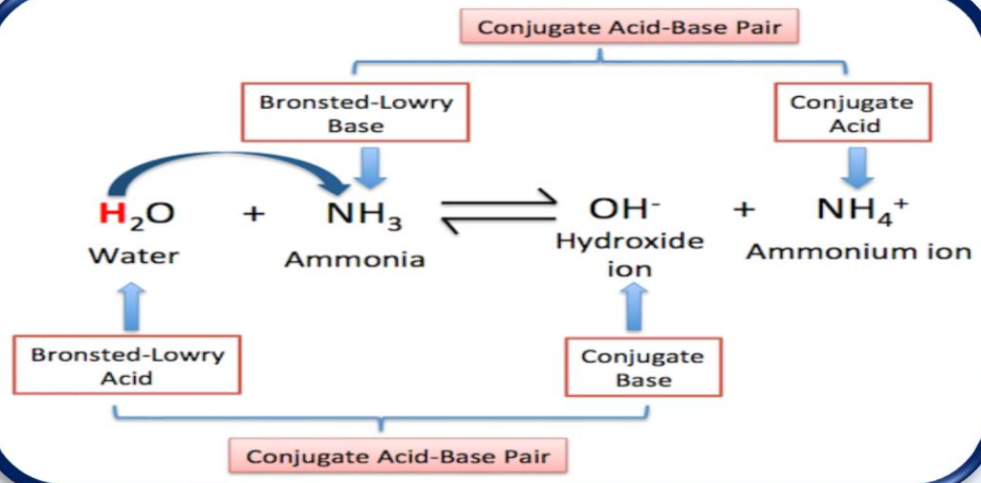
Brønsted - Lowry Concept

Acid: Is a substance capable of donating a proton.



Base: Is a substance capable of accepting a proton.



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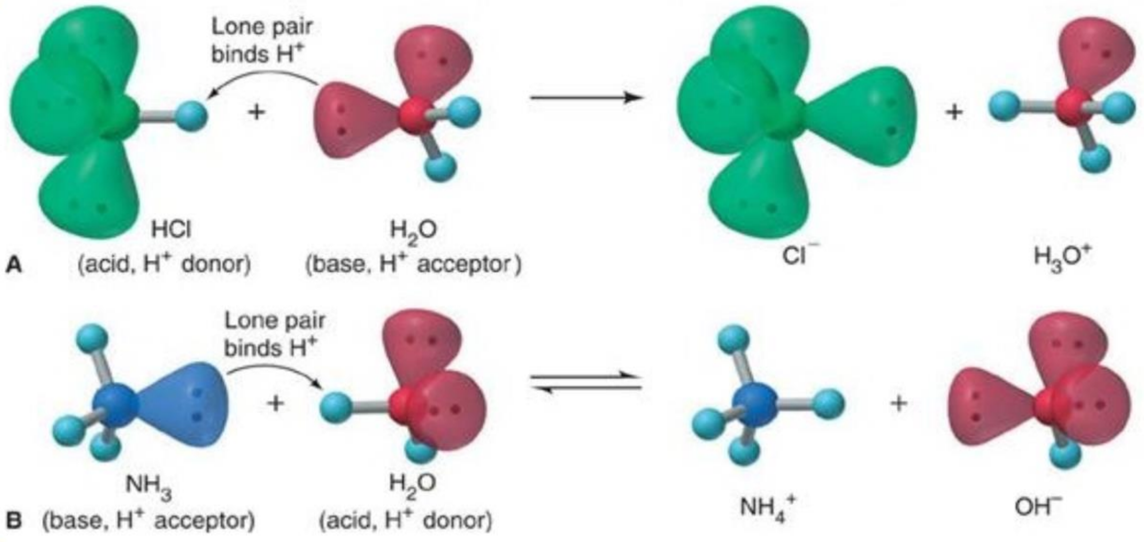
Lewis Concept

Acid: Is as an electron pair acceptor.

Base: Is as an electron pair donor.



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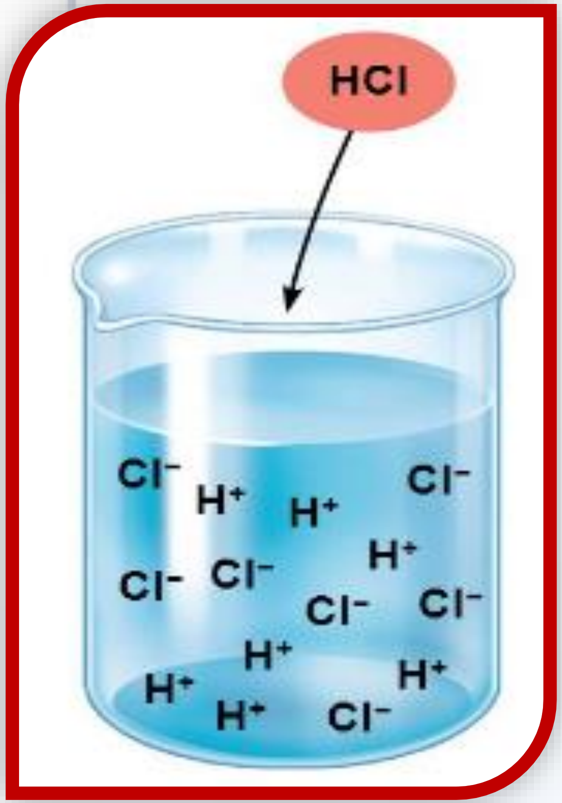
Strength of Acids and Bases

- **Strong Acid:** is an acid that **dissociated completely** in solution and yields hydrogen ions H^+.
- For example, hydrochloric acid **(HCl)** is a **strong acid.**
- Their **conjugate bases** are quite **weak.**



$$HCl \longrightarrow H^{+}_{(aq)} + Cl^{-}_{(aq)}$$

hydrogen chloride molecule ---> hydrogen ion in solution + chloride ion in solution

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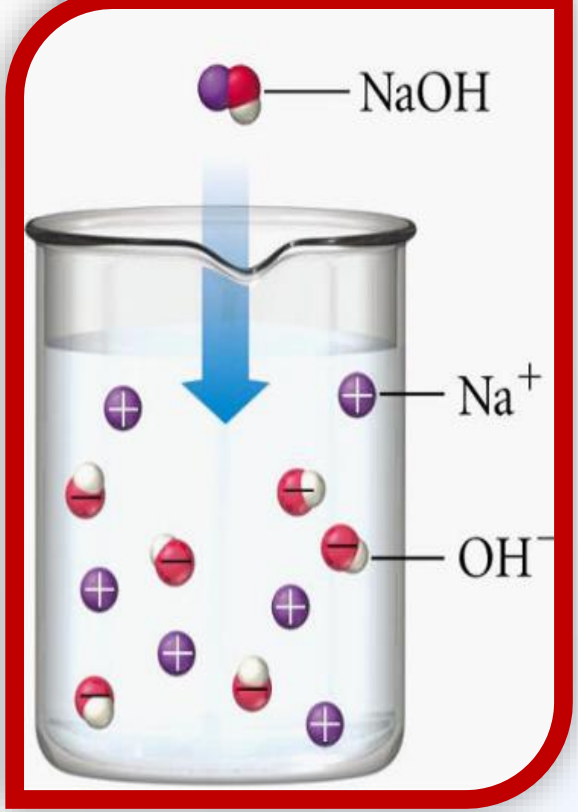
Strength of Acids and Bases

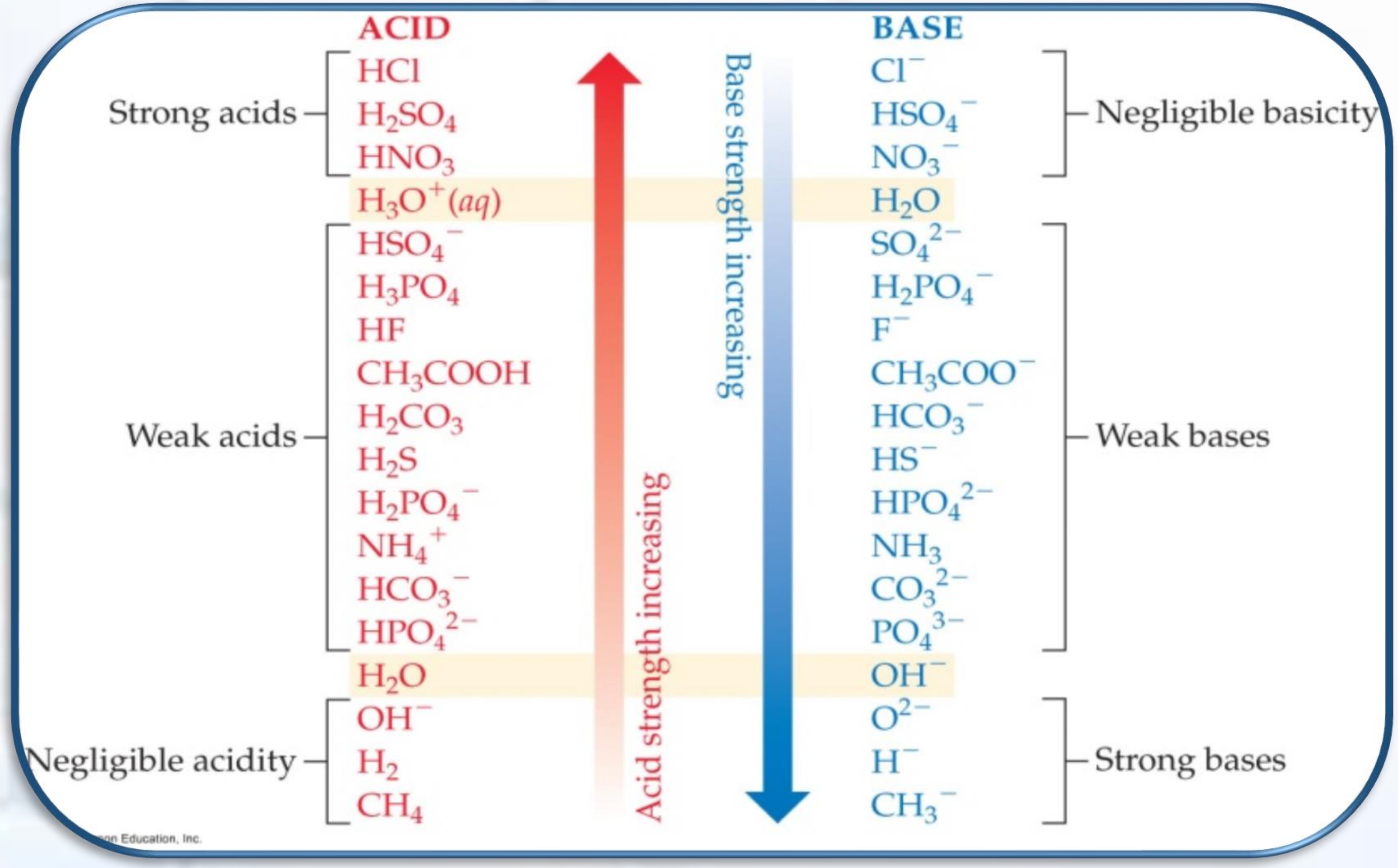
- **Strong Base:** a base that **dissociated completely** in solution and yield hydroxide ions **OH^-**.
- For example, sodium hydroxide **(NaOH)** is a strong base.
- Their **conjugate acids** are **weak acids.**



$$NaOH_{(s)} \rightarrow Na^{+}_{(aq)} + OH^{-}_{(aq)}$$

sodium hydroxide unit cell | sodium ion in solution | hydroxide ion in solution

Strength of Acids and Bases



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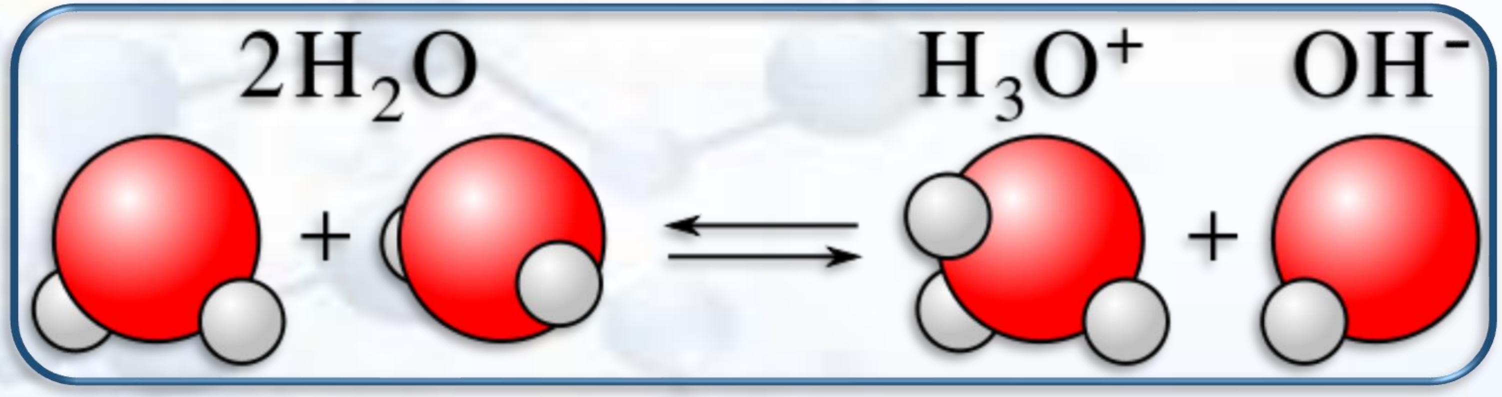
Ionization of water

- Water acts either as an acid or a base.
- When one molecule react with another to form hydronium ion H_3O^+ and hydroxyl ion OH^- ion this process called autoionization or self-ionization.



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Ionization of water

$$K_w = [H_3O^+] \times [OH^-]$$

- Where K_w Ionization constant for water.
- In pure water at 25 ℃, The concentration of hydronium ion and hydroxyl ion is equal at equilibrium between water and (hydronium, hydroxyl) ions.
- $[H_3O^+] = 1\times 10^{-7}$ mol/L and $[OH^-] = 1\times 10^{-7}$ mol/L

$$[H_3O^+] = [OH^-] \text{ at } 25°C$$

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Ionization of water

- K_w is a constant at 25 ℃:

$$K_w = [H_3O^+] \times [OH^-]$$

$$K_w = (1\times 10^{-7}) \times (1\times 10^{-7})$$

$$K_w = 1\times 10^{-14}$$

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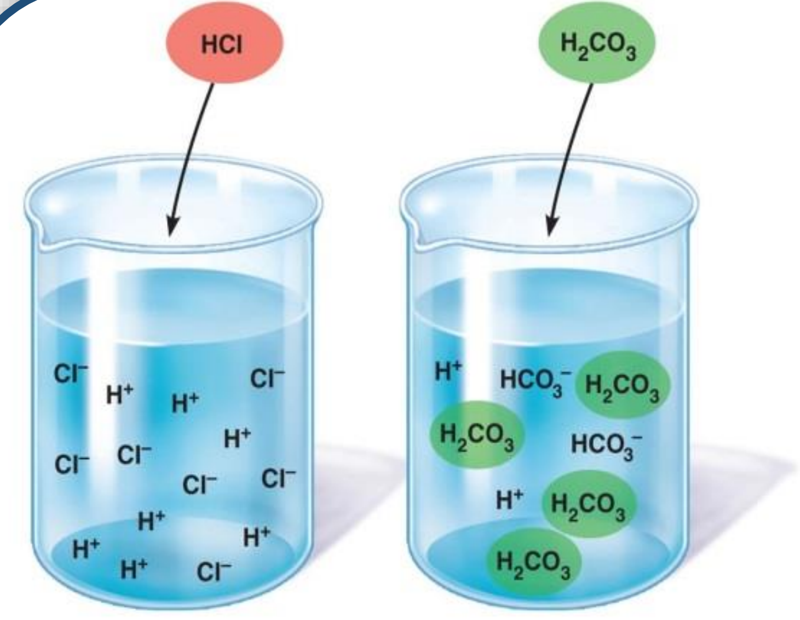
Acid or Base Ionization Constant

- It is a **measure of the strength of acid or base.** The ionization constant has the same equilibrium expression.
- **Weak Acid:** like strong acid gives hydrogen ions but its dissociated partly in solution.
- The dissociation of a weak acid can be described by an equilibrium reaction:



(a) A strong acid such as HCl dissociates completely into its ions.

(b) A weak acid such as H_2CO_3 does *not* dissociate completely.

$$HA\,(aq) + H_2O\,(l) \rightleftharpoons A^-\,(aq) + H_3O^+\,(aq)$$

Acid or Base Ionization Constant

- The expression for the **equilibrium constant** is:

$$K_a = \frac{\text{Products}}{\text{Reactants}} = \frac{[A^-][H_3O^+]}{[HA]}$$

$$pK_a = -\log K_a$$

- *Example of weak acid is acetic acid:*

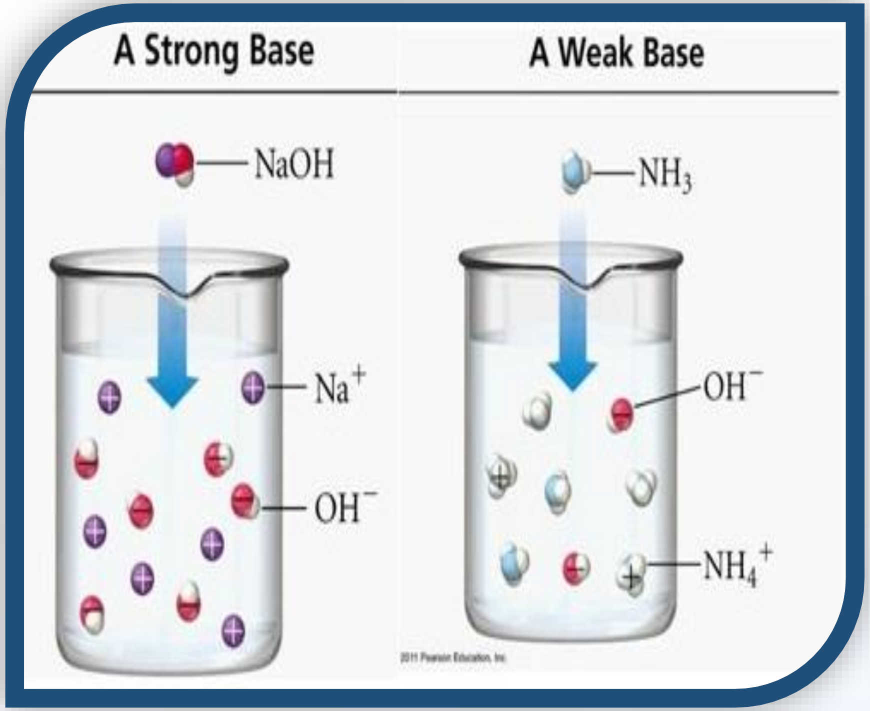
$$CH_3COOH \rightleftharpoons CH_3COO^- + H^+$$

- K_a for acetic acid is:

$$K_a = \frac{[CH_3COO^-][H^+]}{[CH_3COOH]}$$

Acid or Base Ionization Constant

- **Weak Base:** like strong base gives hydroxyl ions but its dissociated partly in solution.
- The dissociation of a weak base can be described by an equilibrium reaction:



$$B + H_2O \rightleftarrows BH^+ + OH^-$$

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Acid or Base Ionization Constant

- **The expression for the equilibrium constant is:**

$$K_b = \frac{[B\,H^+]\,[OH^-]}{[B\,]}$$

$$pK_b = -\log K_b$$

- ***Example for weak base is Ammoina:***

$$NH_{3(aq)} + H_2O_{(l)} \rightleftharpoons NH_4^+{}_{(aq)} + OH^-{}_{(aq)}$$

- **K_b for *Ammoina* is:**

$$K_b = \frac{[NH_4^+][OH^-]}{[NH_3]}$$

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pH of Solution

- Is a measure of the acidity or basicity of a solution.
- pH of solution is defined as the negative logarithm of the molar hydrogen-ion concentration.
- Expressed as a – log [H+]

$$pH = -\log [H^+]$$

- For example, a solution of HCl with a pH of 3.0 has a concentration of hydronium ions (hydrogen ions) of 1×10^{-3} M.

PH scale: from 0–14

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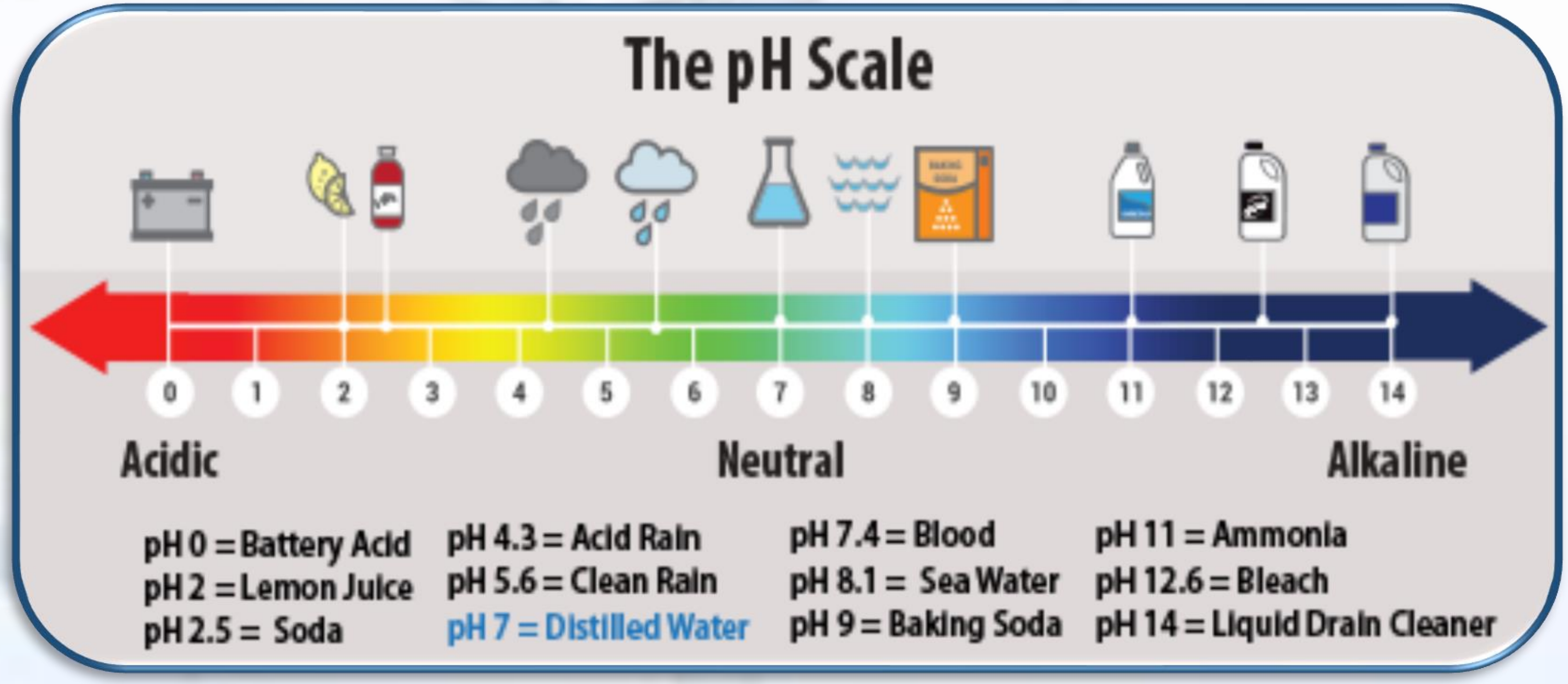
pH of Solution

- Pure water (natural solution) has $[H^+] = 10^{-7}$ and thus pH = 7.
- Acid have a high $[H^+]$ and thus a low pH < 7.
- Bases have a low $[H^+]$ and thus a high pH > 7.



pH of Solution

- POH is the opposite of PH, and a measure of alkalinity and expressed as – log [OH⁻]

$$pOH = -\log [OH^-]$$

- Natural solution has $[OH^-] = 10^{-7}$ thus POH = 7.
- Basic solution has a high $[OH^-]$ and thus POH < 7.
- Acidic solution has a low $[OH^-]$ and thus POH > 7.
- The relationship between pH and pOH:

$$pH + pOH = 14$$

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THANK YOU