

During Class Invention #

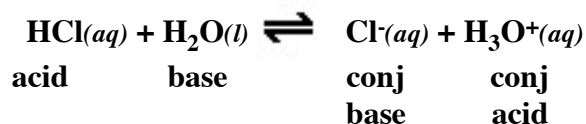
Name(s) with Lab section in Group

*Brønsted-Lowry* acid/base Theory \_\_\_\_\_

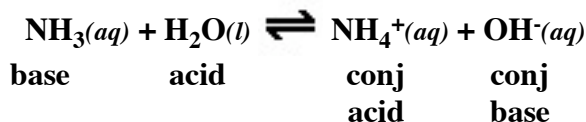
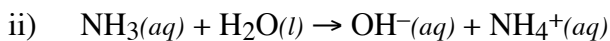
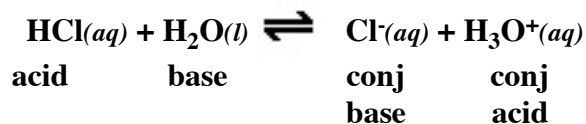
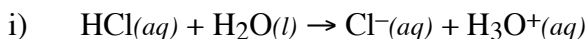
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Define the terms *Brønsted-Lowry acid* and *Brønsted-Lowry base*.

**An acid is defined as a substance that donates a proton and a base as a substance that accepts a proton. In the equation below, HCl is a Brønsted acid because it donates a proton (H<sup>+</sup>) to H<sub>2</sub>O. H<sub>2</sub>O is a Brønsted base because it accepts the proton (H<sup>+</sup>) from HCl. On the right-hand side of the reaction, Cl<sup>-</sup> is a Brønsted base because it accepts the proton (H<sup>+</sup>) from H<sub>3</sub>O<sup>+</sup>. H<sub>3</sub>O<sup>+</sup> is a Brønsted acid because it donates a proton (H<sup>+</sup>) to Cl<sup>-</sup>.**



1. Identify the Brønsted-Lowry acid and Brønsted-Lowry base in each of the following equations.



2. Identify the conjugate bases for each of the following acids.



3. Identify the conjugate acid for each of the following bases.

i)  $\text{Br}^-$             **conjugate acid is HBr**

ii)  $\text{HSO}_4^-$         **conjugate acid is  $\text{H}_2\text{SO}_4$**

iii)  $\text{H}_2\text{O}$             **conjugate acid is  $\text{H}_3\text{O}^+$**

4a. In 1i above which acid is stronger, HCl or  $\text{H}_3\text{O}^+$ ? What experiment could be performed to determine which is stronger?

**HCl is a stronger acid compared to  $\text{H}_3\text{O}^+$ . This can be verified by the observation that an aqueous solution containing HCl is a good conductor of electricity. This indicates the solution is a strong electrolyte, which suggests the presence of a high concentration of ions. This means the position of the equilibrium lies on the product side of the equation. If  $\text{H}_3\text{O}^+$  were the stronger acid, the solution would not conduct electricity at all, or at the most, very poorly.**

b. Describe the difference between a strong acid and a weak acid.

**A strong acid completely dissociates in water producing a high concentration of ions. Strong acids are strong electrolytes. The concentration of ions can easily be measured using a conductivity apparatus. For strong acids, the  $[\text{H}^+]$  is equal to the concentration of the acid. A weak acid does not completely dissociate in water. Weak acids are weak electrolytes. The  $[\text{H}^+]$  is less than the concentration of the acid.**

**Strong acids: HCl,  $\text{HNO}_3$ ,  $\text{H}_2\text{SO}_4$ ,  $\text{HClO}_4$**

**Weak acids:  $\text{HC}_2\text{H}_3\text{O}_2$ , HCN,  $\text{H}_2\text{CO}_3$ , HF**

5a. In Exercise 1ii above, which base is stronger,  $\text{NH}_3$  or  $\text{OH}^-$ ? What experiment could be performed to determine which is stronger?

**$\text{OH}^-$  is a stronger base compared to  $\text{NH}_3$ . This can be verified by the observation that an aqueous solution containing  $\text{NH}_3$  is a poor conductor of electricity. This indicates a low concentration of ions in solution which suggests the position of equilibrium lies on the reactant side of the equation. Therefore,  $\text{OH}^-$  prefers to hold the proton, in the form of  $\text{H}_2\text{O}$ , than does  $\text{NH}_3$  in the form of  $\text{NH}_4^+$ . If  $\text{NH}_3$  were a stronger base, the solution would be a strong conductor of electricity due to the presence of a high concentration of ions.**

- b. Describe the difference between a strong base and a weak base.

**A strong base completely dissociates in water producing a high concentration of ions. Strong bases are strong electrolytes. The concentration of ions can easily be measured using a conductivity apparatus. For strong bases, the  $[\text{OH}^-]$ , is equal to the concentration of the base. A weak base does not completely dissociate in water. Weak bases are weak electrolytes and the  $[\text{OH}^-]$  is less than the concentration of the base.**

**Strong bases: NaOH, Ba(OH)<sub>2</sub>, KOH, Ca(OH)<sub>2</sub>**

**Weak bases: NH<sub>3</sub>, CH<sub>3</sub>NH<sub>2</sub>, CH<sub>3</sub>CH<sub>2</sub>NH<sub>2</sub>, (CH<sub>3</sub>)<sub>3</sub>N**