8.3: Conjugate Acid-Base Pairs

Acid dissociation reactions are often described in terms of the concepts of conjugate acids and their corresponding conjugate bases. The description of "acids and bases" that we will deal with in this text will be limited to simple dissociation reactions, like those shown above, where a hydronium ion is produced. This description is referred to as the **Brønsted-Lowery Acid-Base Theory**, and in the Brønsted theory, the **conjugate acid** is defined as the species that *donates* a hydrogen in the forward reaction, and the **conjugate base** is the species that *accepts* a hydrogen the reverse reaction. Thus for the ionization of HCl, HCl is the conjugate acid and Cl^- is the conjugate base.

$$\mathbf{HCl}\ \textit{(aq)} + \mathbf{H_2O} \rightleftarrows \mathbf{H_3O^+}\ \textit{(aq)} + \mathbf{Cl^-}\ \textit{(aq)}$$

In the discussion of Brønsted acid-base behavior, the hydrogen atom that is transferred is generally referred to as a **proton**, because it is transferred as a hydrogen atom without its electron. Thus for the ionization of HCl, HCl (the conjugate acid) is a *proton donor* and Cl^- (the conjugate base) is a *proton acceptor.* In General Chemistry you will learn that acid-base behavior can also be described in terms of electron donors and electron acceptors (the **Lewis Acid-Base Theory** in which an *acid* is an electron acceptor and a *base* is an electron donor), but here we will limit our discussion to simple, strong, Brønsted acids and bases.

? Exercise 8.3.1

For each of the reactions given below, identify the conjugate acid and the conjugate base. For example (d), also identify the conjugate acid and the conjugate base in the reverse reaction.

a. $HClO_4\ (aq) + H_2O \rightleftarrows H_3O^+\ (aq) + ClO_4^-\ (aq)$
b. $H_2SO_4\ (aq) + H_2O \rightleftarrows H_3O^+\ (aq) + HSO_4^-\ (aq)$
c. $HSO_4^-\ (aq) + H_2O \rightleftarrows H_3O^+\ (aq) + SO_2^{2-}\ (aq)$
d. $HNO_3\ (aq) + NH_3 \rightleftarrows NH_4^+\ (aq) + NO_3^-\ (aq)$
e. $H_2PO_4^- + H_3O^+ \rightleftarrows H_2O + H_3PO_4$
f. $NH_3(g) + H_2O \rightleftarrows NH_4^+(aq) + OH^-(aq)$
g. $H_2O(l) + HNO_2(aq) \rightleftarrows H_3O^+(aq) + NO_2^-(aq)$

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