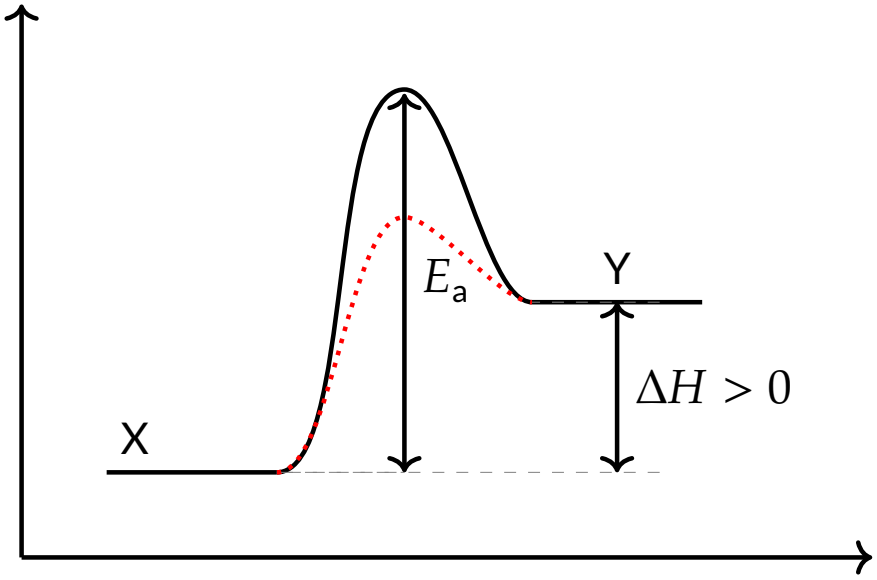
Physical Chemistry



$$\Delta G = \Delta H - T \times \Delta S$$

Chapters 5 to 7

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Part I

Acid-Base Equilibrium

1 Theory of Acids and Bases

1.1 Brønsted-Lowry

Fundamental to understanding this chapter is the Brønsted-Lowry theory of acids and bases... as the section header would lead you to conclude.

- Brønsted acids *donate* a proton (H^+) to a base
- Brønsted bases correspondingly *accept* a proton (H^+) from an acid.

Thus, there are some restrictions placed on each — acids must contain one or more atoms of H to donate, and bases must have one or more lone pairs in order to accept the H^+ ion.

As such, acid-base reactions in the context of this theory involves the transfer of a proton from a Brønsted acid to a Brønsted base.

1.2 Lewis

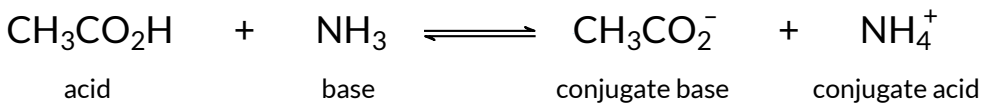
While Brønsted acids and bases are defined in terms of the transfer of protons, Lewis acids and bases are defined in terms of the transfer of electron pairs. Thus:

- Lewis acids *accept* an electron pair from a Lewis base donor.
- Lewis bases correspondingly *donate* an electron pair to a Lewis acid.

Further references to acids or bases implicitly refer to the *Brønsted* definition.

1.3 Conjugate Acid-Base Pairs

When a acid loses the H^+ ion, an anion is naturally left — this is the conjugate base of the acid. Conversely, when a base accepts a proton, it forms the conjugate acid of the base.



It should be immediately clear that this is an *equilibrium* reaction.

In the forward reaction, CH_3CO_2H acts as the acid, donating a proton to the base, NH_3. In the reverse direction, NH_4^+ is the acid, donating a proton to the base $CH_3CO_2^-$.

Furthermore, CH_3CO_2H and $CH_3CO_2^-$ are *conjugate pairs*, as are NH_3 and NH_4^+. Conjugate pairs always differ by a proton, and in any given acid-base reaction, there are two such pairs.

1.4 Strength of Acids and Bases

The strength of an acid or base is given as the degree of dissociation from the acid or base into ions, in solution. A strong acid or base is one that ionises *completely* in solution to give H^+ or OH^- respectively.