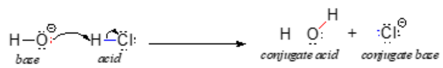
2.2: Reactions of Brønsted–Lowry Acids and Bases

The Brønsted-Lowry definition of acidity

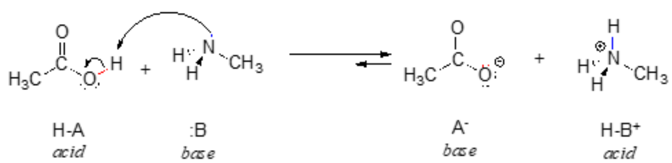
We'll begin our discussion of acid-base chemistry with a couple of essential definitions. The first of these definitions was proposed in 1923 by the Danish chemist Johannes Brønsted and the English chemist Thomas Lowry, and has come to be known as the Brønsted-Lowry definition of acids and bases. An acid, by the Brønsted-Lowry definition, is a species which is able to donate a proton (H^+), while a base is a proton acceptor. We have already discussed in the previous chapter one of the most familiar examples of a Brønsted-Lowry acid-base reaction, between hydrochloric acid and hydroxide ion:



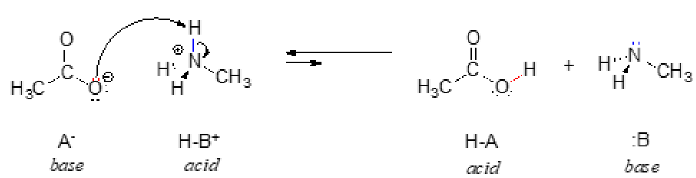
In this reaction, a proton is transferred from HCl (the acid, or proton *donor*) to hydroxide (the base, or proton *acceptor*). As we learned in the previous chapter, curved arrows depict the movement of electrons in this bond-breaking and bond-forming process.

After a Brønsted-Lowry acid donates a proton, what remains – in this case, a chloride ion – is called the **conjugate base**. Chloride is thus the conjugate base of hydrochloric acid. Conversely, when a Brønsted-Lowry base accepts a proton it is converted into its **conjugate acid** form: water is thus the conjugate acid of hydroxide.

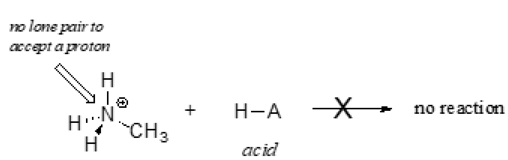
We can also talk about conjugate acid/base pairs: the two acid/base pairs involved in our first reaction are hydrochloric acid/chloride and hydroxide/water. In this next acid-base reaction, the two pairs involved are acetate/acetic acid and methyl ammonium/methylamine:



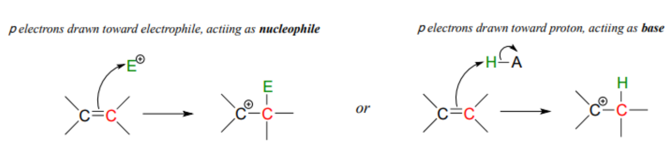
Throughout this text, we will often use the abbreviations HA and :B in order to refer in a general way to acidic and basic reactants:



In order to act as a proton acceptor, a base must have a reactive pair of electrons. In all of the examples we shall see in this chapter, this pair of electrons is a non-bonding lone pair, usually (but not always) on an oxygen, nitrogen, sulfur, or halogen atom. When acetate acts as a base in the reaction shown above, for example, one of its oxygen lone pairs is used to form a new bond to a proton. The same can be said for an amine acting as a base. Clearly, methyl ammonium ion cannot act as a base – it does not have a reactive pair of electrons with which to accept a new bond to a proton.



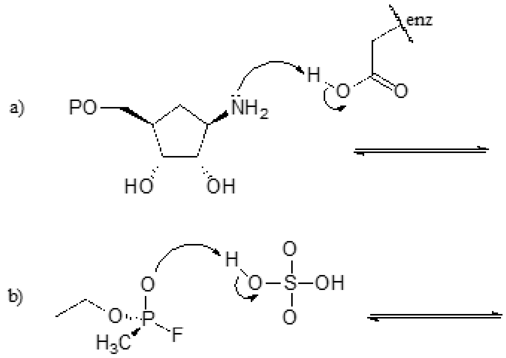
Later, in chapter 15, we will see several examples where the (relatively) reactive pair of electrons in a π bond act in a basic fashion.



In this chapter, we will concentrate on those bases with non-bonding (lone pair) electrons.

Example

Exercise 7.1: Draw structures for the missing conjugate acids or conjugate bases in the reactions below.



Solution

Contributors

- **Organic Chemistry With a Biological Emphasis** by Tim Soderberg (University of Minnesota, Morris)
