Skills to Develop

- Define Lewis acids and Lewis bases

Previously we said that an acid produces $H^+$ when dissolved in water, and a base produces $OH^-$ when dissolved in water. Then the acid and base (meaning $H^+$ and $OH^-$) can react (without redox) to make water. This is a pretty good definition, but it is kind of small.

Lewis explained that in many reactions that form new bonds, both electrons in the new bond come from 1 atom (or 1 reactant) only, instead of 1 electron coming from each. He called all these reactions acid-base reactions. The picture shows water forming from the elements, in a redox process, and water forming from hydrogen ion and hydroxide ion, in an acid base process. It also shows how the tetrafluoroborate ion, $BF_4^-$ can form from boron trifluoride and fluoride ion.

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\begin{align*}
H^+ & : \overset{\delta^-}{\text{O}}-H \\
H & : \overset{\delta^-}{\text{O}} : -H
\end{align*}
\]

Left top, water forming by an acid-base reaction. Left bottom, water forming by a redox reaction. Right, a Lewis acid-base reaction.

In general, if we can draw a good Lewis structure by making two molecules or ions share an electron pair, it's likely that the reaction can happen. For instance, $BH_3$ can react with $NH_3$, because N has an extra lone pair, and B only has 6 electrons and 3 connected atoms. So a Lewis acid is something than can fit 2 more electrons from a different molecule. It can share another molecule's lone pair. A Lewis base is any molecule or ion with a lone pair to share. It's easy to see what can be a Lewis base just by drawing a Lewis structure. Lewis acids are usually cations, like $H^+$ or $Al^{3+}$. Boron is a famous Lewis base because it often makes electron-deficient compounds, like $BH_3$, in which it only has 6 electrons. Try drawing Lewis structures for an acid-forming anhydride combination reaction. Is the anhydride a Lewis acid or base?

Contributors and Attributions

- Emily V Eames (City College of San Francisco)