17.2: Heat of Reaction

In some reactions, heat is *produced* by the reaction, and such reactions are called *exothermic*. If no heat is allowed to escape from the system, the system will become hot. In other reactions, heat has to be *supplied* to cause the reaction. Such reactions are *endothermic*.

The heat of reaction is the heat required to effect the reaction, or the heat produced by the reaction – some authors use one definition, others use the other. Here we shall define the heat of reaction as the heat required *to effect* the reaction, so that it is positive for endothermic reactions and negative for exothermic reactions. (In your own writing, make sure that your meaning is unambiguous – don't assume that there is some "convention" that everyone uses.) If the reaction is carried out *at constant pressure* (i.e. on an open laboratory bench), the heat required to effect the reaction is the increase of enthalpy of the system. In other words, ΔH is positive for an endothermic reaction. If the reaction produces heat, the enthalpy decreases and ΔH is negative. Heats of reaction are generally quoted as molar quantities at a specific temperature (often 25 ^{o}C) and pressure (often one atmosphere). The usual convention is to write

$$A + B \rightarrow C \; \Delta H = x \text{ J mole}^{-1}$$

One can make it yet clearer by specifying the temperature and pressure at which the enthalpy of reaction is determined, and whether the reactants are solid (s), liquid (l) or gas (g).

If the reaction is carried out *at constant volume* (in a closed vessel), the heat required to effect the reaction is the increase of the *internal energy*, ΔU. In either case, in our convention (which seems to be the most common one) ΔH or ΔU is positive for an endothermic reaction and negative for an exothermic reaction.

The heat of reaction at constant pressure (ΔH) is generally a little larger than at constant volume (ΔU), though if all reactants are liquid or solid the difference is very small indeed and often negligible within the precision to which measurements are made.