Box 8.1 Units used for the rate constant

The velocity (v) of a reaction is measured in units that represent a change in concentration of the product per unit time (for example, as mol L^{-1} s^{-1}) and the concentration of each reactant [R] has units of mol L^{-1}. So, for a reaction with two reactants:

$$\overbrace{v}^{\text{Rate (velocity) of chemical reaction}} = \overbrace{k_r}^{\text{Rate constant of chemical reaction}}\underbrace{[A]}_{\text{Concentration of reactant A}}\underbrace{[B]}_{\text{Concentration of reactant B}}$$

The units of the rate constant of a reaction depend on the overall order of the reaction. If the velocity of a reaction is directly proportional to the concentration of one of the reactants, it is known as a **first order reaction**, as the rate depends on the concentration of the reactant raised to the power of 1. In first order reactions, k_r has the units:

$$\frac{\text{mol L}^{-1}\ \text{s}^{-1}}{\text{mol L}^{-1}} = \text{s}^{-1}$$

If the rate of a reaction is proportional to the square of the concentration of a reactant (that is, the concentration raised to the power of 2, or to the product of the concentration of two reactants, as in the example above) it is known as a **second order reaction**. In this case, the units for k_r are:

$$\frac{\text{mol L}^{-1}\ \text{s}^{-1}}{(\text{mol L}^{-1})^2} = \text{L mol}^{-1}\ \text{s}^{-1}$$