CHEM 450/450G HW #9 — Hand-in Concept Solutions

Q19.4

The pre-equilibrium approximation is a method of simplifying a reaction mechanism to express the overall rate of the reaction in terms of rate constants and the concentrations/pressures of reactants only (no intermediates). It is valid when a rapid equilibrium (one which has fast k values in either direction) precedes the next slower step. To use it, the concentration of intermediate I (which we assume is the product side of the equilibrium reaction) is solved for, assuming that the rates of the forward and reverse reaction are equal. In the event that this reaction looks like:

$$2A \underset{k_r}{\overset{k_f}{\rightleftharpoons}} I \,,$$

the rates set equal to one another yield

$$k_f \left[A\right]^2 = 2k_r \left[I\right],$$

such that

$$\left[I\right] = \frac{k_f}{2k_r}\left[A\right]^2 .$$

Q19.7

An enzyme is a protein which catalyses a particular reaction. The general mechanism (lock-and-key) suggests that the reactants (substrate) binds to the enzyme at the "active site" to form a complex, which can either dissociate, or react, releasing products from the active site:

$$E + S \underset{k_{-1}}{\overset{k_1}{\rightleftharpoons}} ES$$

$$ES \xrightarrow{k_2} P$$