1. Consider the thermodynamic cycle

$$\mathrm{A} \underset{k_{-1}}{\overset{k_1}{\rightleftharpoons}} B$$

$$\mathrm{B} \underset{k_{-2}}{\overset{k_2}{\rightleftharpoons}} C$$

$$\mathrm{C} \underset{k_{-3}}{\overset{k_3}{\rightleftharpoons}} D$$

$$\mathrm{D} \underset{k_{-4}}{\overset{k_4}{\rightleftharpoons}} A$$

   If this system is able to reach equilibrium, what conditions must the rate constants obey?

2. Show that the sensitivity of the Hill function, defined as

$$\text{sensitivity} = \frac{d\log y}{d\log x} = \frac{x}{y} \cdot \frac{dy}{dx}$$

   is equal to the Hill number n divided by two when $x = K$, with K being the EC_{50}. Thinking about how the sensitivity relates a small change in x, Δx, to a small change in y, Δy,

$$\frac{\Delta y}{y} = \text{sensitivity} \times \frac{\Delta x}{x}$$

   why are Hill functions with a higher n steeper at $x = K$?