

$$\text{system} + \text{R}_1 + \cdots \overset{r_{\text{f}}}{\underset{r_{\text{b}}}{\rightleftharpoons}} \text{changed system} + \text{P}_1 + \cdots$$

$$\frac{r_{\text{f}}}{r_{\text{b}}} = \exp((\Delta\epsilon + \mu_{\text{R}_1} + \cdots - \mu_{\text{P}_1} - \cdots)/kT)$$

$$\text{ATP} \rightleftharpoons \text{ADP}$$

$$\text{P} \rightleftharpoons \emptyset$$

$$0 \quad \epsilon_{\text{t}} \quad \Delta \epsilon_{\text{r}} \quad \epsilon_{\text{t}} - \Delta \epsilon_{\text{r}} \quad \epsilon_{\text{p}}$$

$$r_{\text{square phosphorylation}} = r_1 \frac{c_{\text{P}} e^{\frac{\Delta \epsilon}{kT}}}{c_{\text{P}} e^{\frac{\Delta \epsilon}{kT}} + 1} + r_2 \frac{c_{\text{R}} e^{\frac{\Delta \epsilon}{kT}}}{c_{\text{R}} e^{\frac{\Delta \epsilon}{kT}} + 1} \quad \text{with} \quad c_{\text{R}} = \frac{c_{\text{ATP}}}{c_{\text{ADP}}}$$

$$c_{\text{P}} = c_{\text{R}}$$

$$\text{enzyme E} + \overline{\cdots \text{i}0\text{j} \cdots} \overset{r_{\text{E},0\rightarrow 1,ij}}{\underset{r_{\text{E},1\rightarrow 0,ij}}{\rightleftharpoons}} \text{changed E} + \overline{\cdots \text{i}1\text{j} \cdots}$$

$$r_{\mathrm{E},0\rightarrow 1,ij}=K_{\mathrm{E},ij}\frac{\exp(\beta\mu_{\mathrm{E}})}{\exp(\beta\mu_{\mathrm{E}})+1}$$

$$r_{\mathrm{E},1\rightarrow 0,ij}=K_{\mathrm{E},ij}\frac{1}{\exp(\beta\mu_{\mathrm{E}})+1}$$

$$\mu \quad +\infty \quad -\infty \quad \mu_{\mathrm{E}} \rightarrow \pm \infty$$

$$\underline{\underline{K}}$$

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