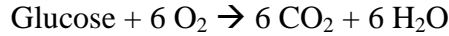


### 1) Thermodynamics vs Kinetics.

Living systems make use of energy from the environment. Many humans consume glucose, and the conversion of glucose to  $\text{CO}_2$  and  $\text{H}_2\text{O}$  in the presence of  $\text{O}_2$  is a highly exergonic process, releasing free energy ( $\Delta G$ ) that can be used to think, move, etc.

The  $\Delta G'^0$  for the reaction :

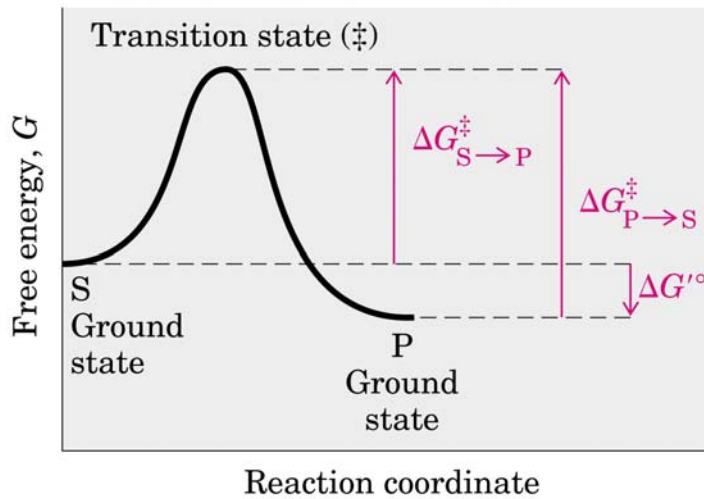


is  $-2840 \text{ kJ/mol}$ . This chemical process is thermodynamically favorable (spontaneous). However, under sterile conditions a solution of glucose can be stored for years without any obvious conversion to  $\text{CO}_2$  and  $\text{O}_2$ . This process is very slow.

When glucose is consumed by a human, it releases its chemical energy in seconds.

Is the  $\Delta G'^0$  the same outside and inside the organism? What does it make the difference?

2) Base on the following **reaction coordinate diagram** for the  $\text{S} \rightarrow \text{P}$  reaction,



How is  $k_1 (\text{S} \rightarrow \text{P})$  compared to  $k_{-1} (\text{P} \rightarrow \text{S})$ ? Bigger, equal, or smaller? Justify.

3) How does a **catalyst** change the rate of a reaction? Sketch the reaction coordinate diagram in the presence of a catalyst for the figure showed above. Will the catalyst/enzyme change only  $k_1$  or both,  $k_1$  and  $k_{-1}$ ?

4) Can the presence of an **enzyme** transform a non-spontaneous reaction into a spontaneous one? Why?

5) Is the **transition state** a reaction intermediate?

6) Define **activation energy** and **rate limiting step**.

7) Enzymes active sites are complementary to the transition states through which substrates pass as they are converted into products during the course of an enzymatic reaction. If you want to prepare a **catalytic antibody** to catalyze a particular reaction, what kind of compound would you use as an hapten to produce the antibody?

**8)** If you want to quantify the amount of a particular enzyme by measuring its **enzymatic activity**, will you use a  $[S] \gg K_M$  or a  $[S] \ll K_M$ . Why?

What if you want to use an enzyme to quantify how much substrate is present in a sample? (Tip: examine the Michaelis-Menten equation).

**9)** Under what conditions  $K_M$  represents a measure of the affinity of an enzyme for its substrate?

Reference: Lehninger Principles of Biochemistry, 3<sup>rd</sup> Ed. Chapter 8.