Biochemistry Homework 3

1. Amphibolic pathways can serve either in energy-yielding catabolic or in energyrequiring biosynthetic processes, depending on the cellular circumstances. For example, the citric acid cycle generates NADH and FADH2 when functioning catabolically. But it can also provide precursors for the synthesis of such products as glutamate and aspartate (from α-ketoglutarate and oxaloacetate, respectively), which in turn serve as precursors for other products, such as glutamine, proline, and asparagine

2. The citric acid cycle is so central to metabolism that a serious defect in any cycle enzyme would probably be lethal to the embryo.

3. **Answer** From the difference in standard reduction potential ($\Delta E'^\circ$) for each pair of half-reactions, we can calculate the $\Delta G'^\circ$ values for the oxidation of succinate using NAD^+ and oxidation using E-FAD.

For NAD^+:

$$\begin{aligned}\Delta G'^\circ &= -n\mathcal{F}\Delta E'^\circ \\ &= -2(96.5\ \text{kJ/V}\cdot\text{mol})(-0.32\ \text{V} - 0.031\ \text{V}) \\ &= \ \ 68\ \text{kJ/mol}\end{aligned}$$

For E-FAD:

$$\begin{aligned}\Delta G'^\circ &= -2(96.5\ \text{kJ/V}\cdot\text{mol})(0.050\ \text{V} - 0.031\ \text{V}) \\ &= -3.7\ \text{kJ/mol}\end{aligned}$$

The oxidation of succinate by E-FAD is favored by the negative standard free-energy change, which is consistent with a K'_{eq} of >1. Oxidation by NAD^+ would require a large, positive, standard free-energy change and have a K'_{eq} favoring the synthesis of succinate.