As Thanksgiving looms, so do the molecules we consume in those days...

The Malate-Aspartate shuttle is a crazy example of a “catalytic process” that allows a net chemical reaction to occur. Let’s talk about this process to understand several aspects of its nature and function.

1) What do we mean by “catalytic process” in the MA shuttle? What is being consumed, what is being preserved or restored?

2) What is the net process that occurs due to the operation of the Malate-Aspartate shuttle? Write that (amazingly simple) net process that happens when the MA shuttle is operating. Write it in the box to the right, labeling the relevant cellular compartments and components. Keep it simple. JUST THE NET PROCESS.

3) There are two transporter types involved in the operation of the MA shuttle. What types of molecule do they allow to move across the inner membrane? Is there any reason why they must run in only one direction?

4) The two types of molecules involved in the “catalytic” cycle of the MA shuttle are amino acids and alpha-keto acids. These cognate pairs of molecules are found all over the place in biology. What is the cognate pair for the following alpha keto acids: pyruvate, alpha-ketoglutarate, and oxaloacetate. Draw the αKA and the corresponding amino acid in the provided box.

5) The other, more simple way, to restore NAD⁺ in the cytosol involves a simpler catalytic cycle with DHAP as a starting molecule. It is the reason that “3 or 5” is written for the energy from the 2 NADHs derived from glycolysis and fed into the mitochondrion either by the MA shuttle of the glycerol-3P shuttle. So the question is, why do these two catalytic methods of restoring NAD⁺ in the cytosol and moving NADH electrons into the mitochondrion give two different yields of ATP?