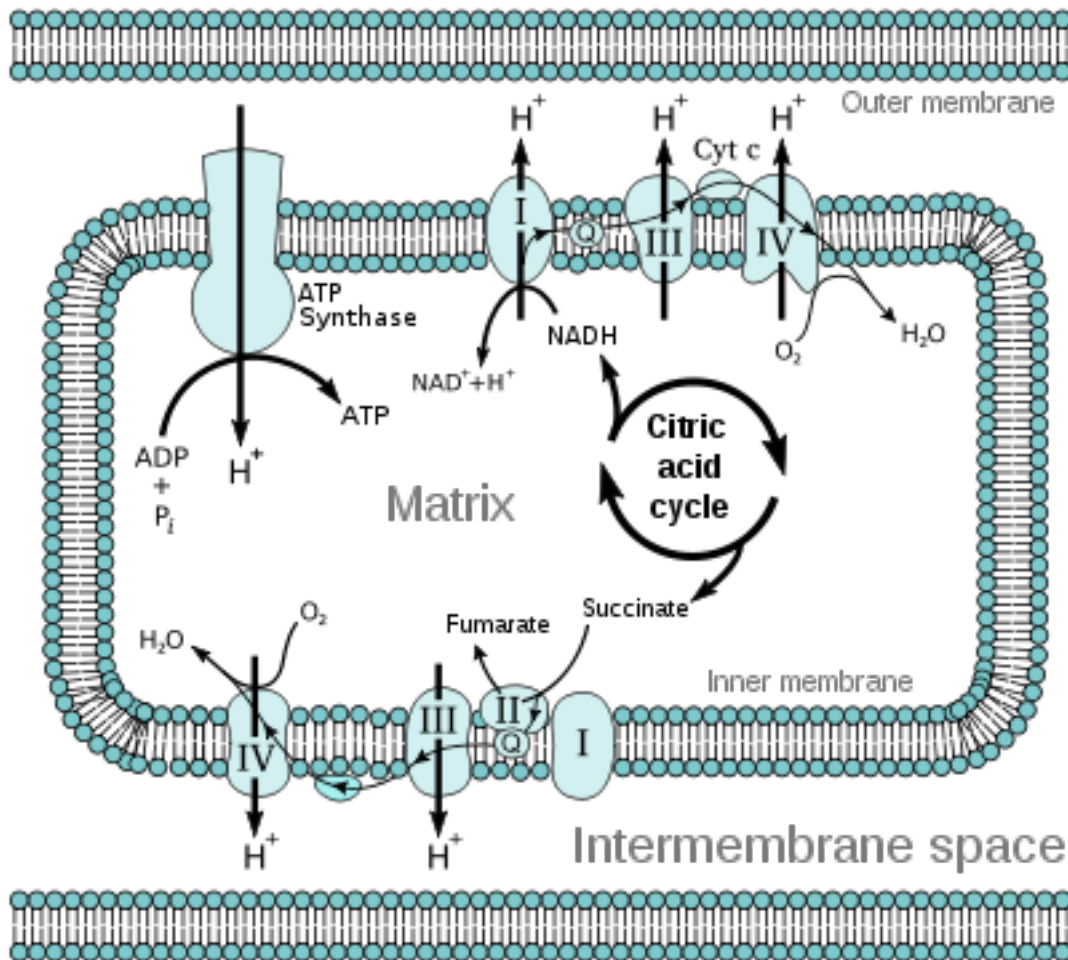


21.28, 21.30, 21.31 & 21.32 (exergonic mean $\Delta G < 0$, endergonic mean $\Delta G > 0$), 21.35, 21.38,

21.39 **Adapted** What are the functions of the multiple membrane folds in the mitochondria and why is there a double layer of cell membranes in this organelle?

21.40, 21.42, 21.43, 21.44-21.49, 21.53, 21.54, 21.55, 21.57, 21.59 21.62 (You do not need to memorize these steps, just be able to look at a diagram of the Citric Acid Cycle and find them.), 21.63-21.66, 21.72-21.76, 21.88, 21.96

1. ATP is produced in mitochondria. When this happen O_2 is consumed, at which point during the synthesis on ATP is O_2 consumed?
2. In the diagram shown below the part of the Citric Acid Cycle that converts Succinate to Fumarate is shown outside the cycle, even though the product Fumarate is used in the next step in the Citric Acid Cycle, why do you think this is?



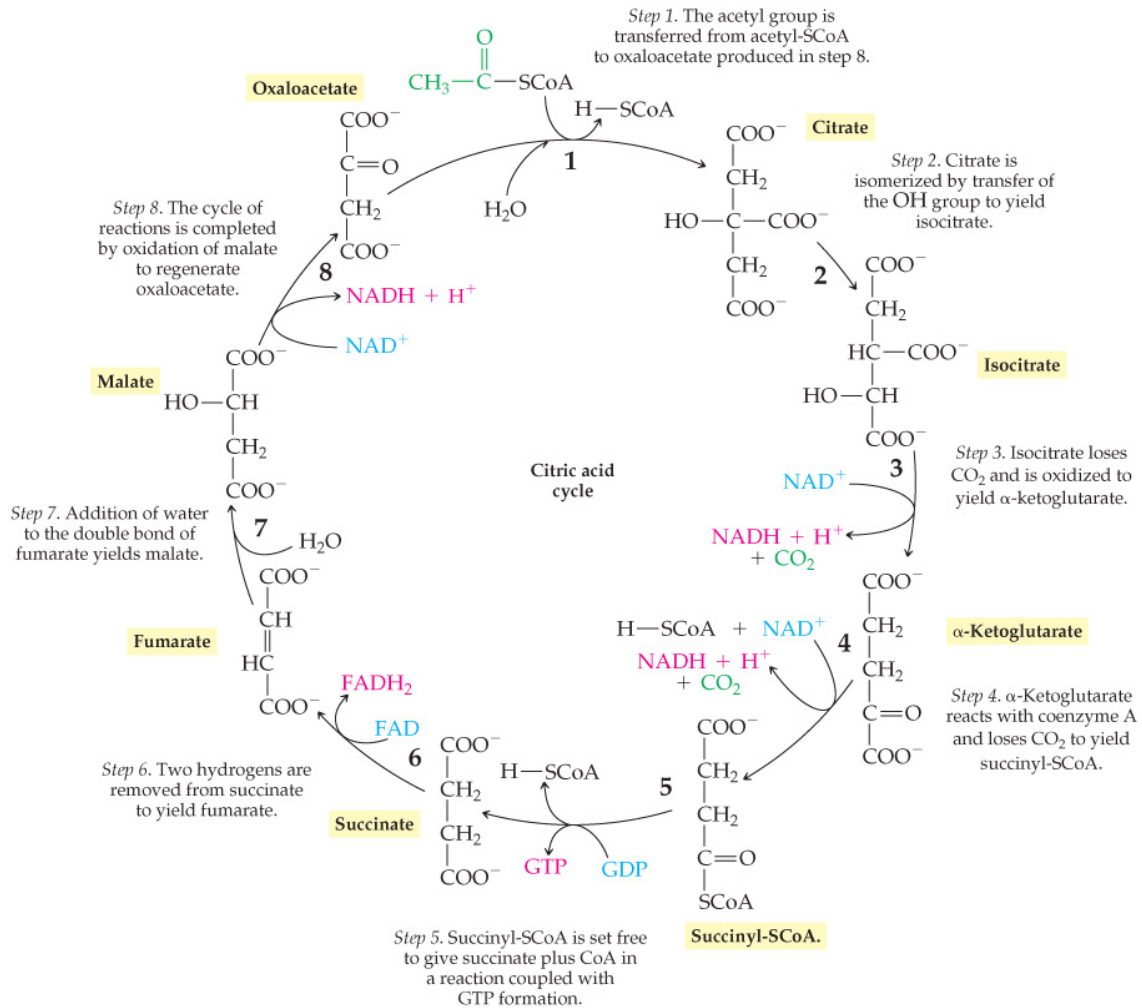
3. In the first step of the citric acid cycle joins the 4 carbon molecule by the use of 8 enzyme, or enzyme complexes, oxaloacetate is reformed. In this cycle 5 products are formed that have a higher free energy than their starting material. Why is this possible when the starting material is the same as the ending material? Is this a way of producing energy without adding energy to the system. If energy is added to the system at some point where does it come from?
4. The overall reaction in the Krebs cycle is



In this overall reaction, NAD is reduced to NADH, FAD⁺ is reduced to FADH₂, and GDP + HPO₃²⁻ react to form GTP. Producing all of these products is not spontaneous by itself. How are these reactions able to occur?

5. The presence of ADP in the mitochondria increases the rate at which for the isocitrate dehydrogenase complex produces α-Ketoglutarate from Isocitrate. What is this type of interaction and could it be due to competition between ADP and α-Ketoglutarate for the active site on this enzyme?
6. When NADH is abundant NADH slows the reaction of isocitrate dehydrogenase, what type of enzyme regulation is this?
7. When ADP is converted to ATP it requires 7.3 kcal/mole, what is the amount of energy liberated when ATP is converted to ADP?
8. Acetyl-S-Co enters the Citric Acid Cycle as one of the reactants in the first reaction, succinyl-S-CoA is a reactant for the 5th enzyme in this series. What does this tell you about the relative free energy of acetyl-S-CoA and succinyl-S-CoA?

The information that you will be provided with that will help you during this part of the Exam is given on the next page. (Be aware that though I will provide this diagram with the best printer quality available to me, it will not have the quality of the image that is given on the next page. Having access to this diagram is meant to help you, but it cannot take the place of understanding the Citric Acid Cycle.)



Enzymes of the Citric Acid Cycle

STEP NO.	ENZYME NAME	REACTION PRODUCT
1	Citrate synthase	Citrate
2	Aconitase	Isocitrate
3	Isocitrate dehydrogenase complex	α-Ketoglutarate
4	α-Ketoglutarate dehydrogenase complex	Succinyl-SCoA
5	Succinyl CoA synthetase	Succinate
6	Succinate dehydrogenase	Fumarate
7	Fumarase	Malate
8	Malate dehydrogenase	Oxaloacetate