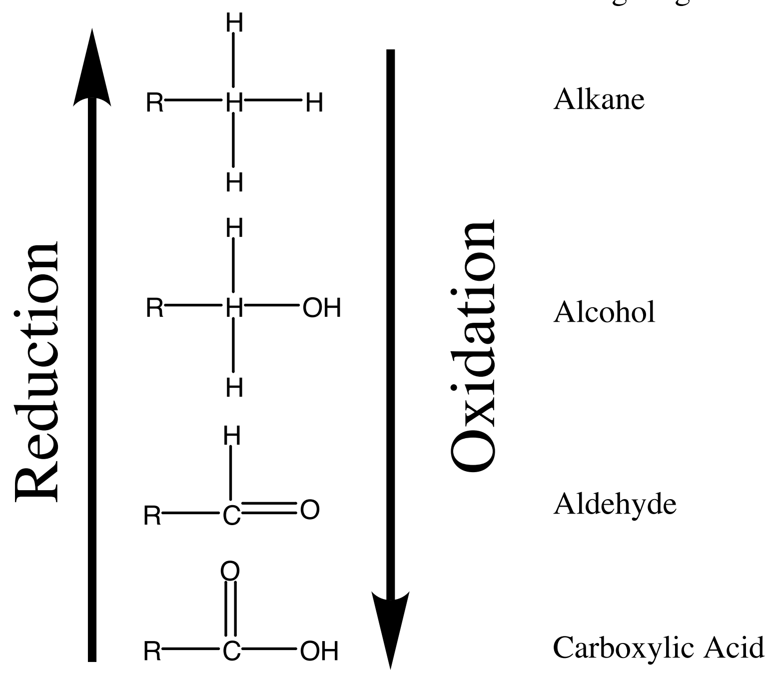
NESA Biochemistry Fall 2001
Answer page for Exam 2 review sheet

Updated version as of 11/19/01. Changed entries are underlined.

Overview of Metabolism

Concept check questions:
1. linear sequence 2. cytosol 3. T 4. F 5. F 6. T 7. C 8. C 9. D

7. A. when a metal atom with a charge gains an electron (reduced) it is reduced in charge
B. With these types of reactions it is difficult to track the gain and loss of electrons if the oxidizing or reducing agent is not specified in the reaction. On can though think about Oxidation as the addition of oxygen (source of the name) to a compound and reduction the removal. As seen the following diagram:

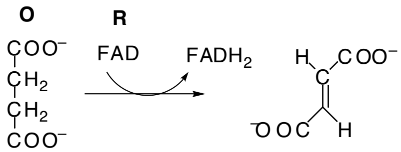


The compound starts out with no oxygen (the alkane) and progressively obtains more oxygens and has increased bonding in-between carbon and oxygen.
C. This is the correct answer. Note that two hydrogens (and two electrons) are removed from the middle carbonds.
D. This is a hydrolysis and is not a redox reaction.

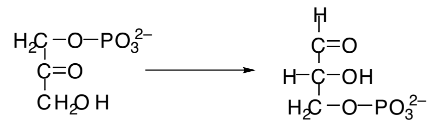
Problems

1. This question was miswritten. I should have asked for the energy of each reaction (–7.5 and –4.5 kcal/mol respectively). These reactions would not be “added” together in one reaction. But, they could be “coupled” together by the conversion of ATP to ADP and vice versa.

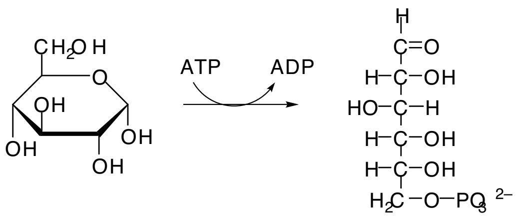
2.



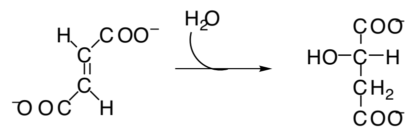
Oxidation



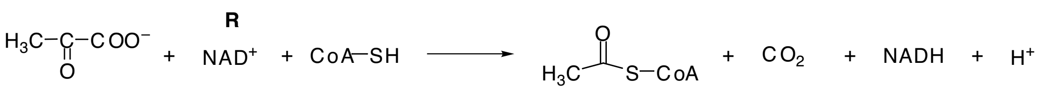
Isomerization



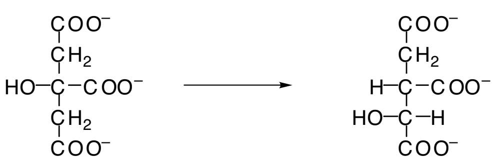
Phosphorylation



Hydration

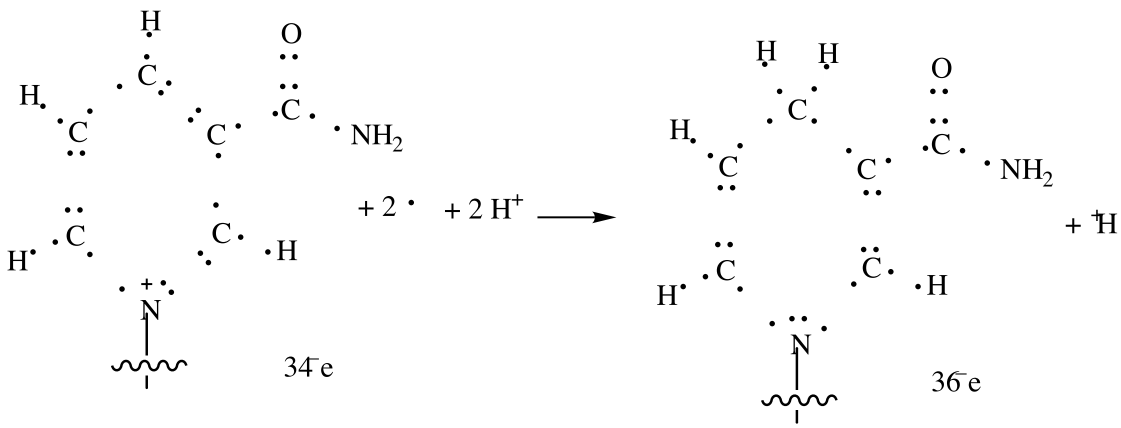


Oxidative decarboxylation



Isomerization

3.



Carbohydrate Metabolism

Concept check questions

1. C 2. C 3. C 4. CO_2 5. F 6. F 7. F

Problems

<u>1.</u> Ribulose-5-P would be converted back into glucose-6-phosphate and glycolysis would continue on from that point. After complete aerobic metabolism of the carbohydrate 33 ATPs would be yielded (ideal conversion). The cofactors used should have been NADP and NADHP

2. 2 ATPs

3. Under anaerobic conditions, NADH can't enter the respiratory chain. Instead, in order to replenish the body's supply NAD^+, NADH reacts with pyruvate to form lactate and NAD^+

Citric Acid Cycle, Electron-Transport Chain and ATP Production

Concept check questions

1. F 2. B 3. Kerbs and Tri-carboxylic acid cycle 4. 1 5. Electron carriers (NADH and $FADH_2$)

Problems

1. Ideally 18 ATPs are produced.

2. It enters on coenzyme A (CoA). During the citric acid cycle the two carbons of the acetyl group are released as CO_2 during a series of oxidation reactions.

3. Oxygen (and 2 hydrogens, making water) is the ultimate destination for the electrons oxidized from NADH and $FADH_2$ in the electron transport chain.

4. If $FADH_2$ and NADH were not reoxidized, the body's supply of the oxidized forms of their coenzymes would be depleted, and the citric acid cycle would stop.

5. Oxidative phosphorylation refers to formation of ATP from the reactions of reduced coenzymes as they are oxidized in the electron-transport chain. *Substrate-level phosphorylation* is the formation of ATP directly as a result of a biochemical reaction.

Lipid Metabolism

Concept check questions

1. B 2. NAD^+ and FAD 3. emulsify 4. T 5. T 6. F 7. T

Problems

<u>1.</u> The lipid pictured has 18 carbons. First the fatty acid is attached to HS-CoA and an equivalent of 2 ATPs are used. β-oxidation it will result in 9 Ac-SCoA molecules. Eight cycles of β-oxidation (last time through the cycle yields 2 Ac- SCoA and the fatty acid can not be broken down further), produces 8 NADH and 8 $FADH_2$. The citric acid cycle is completed 9 times (one for each Ac-SCoA) yielding 27 NADH, 9 $FADH_2$, and 9 ATP molecules. Going into the electron transport chain we have 35 NADH and 17 $FADH_2$. Using ideal conversion this yields 139 ATPs for a total of 146 ATPs

2. Entry of succinyl-CoA in to the citric acid cycle yields 1 ATP, 1 $FADH_2$, and 1 NADH. Passing on to the electron transport chain the electron carriers would ideally yield 5 ATP molecules. Giving at total of 6 ATPs yielded.

3. You might find the carbon atoms from the glycerol portion of the triacylglycerol molecules in glycogen. Glycerol can be converted into glyceraldehyde-3-phosphate, which can participate in gluconeogenesis. Ultimately yielding glucose, which is the monomer of glycogen. Alternately, the glycerol could be used to synthesis other triacylglycerols. The other carbon atoms in the tricacylglycerol are located in the three fatty acids. These carbons are transferred in twos by β-oxidation to Ac-SCoA. If the Ac-SCoA is used in the citric acid cycle, the carbons are released as carbon dioxide and could not participate in gluconeogenesis. Acetyl-SCoA could also be used to synthesize fatty acids.

Protein and amino Acid Metabolism

Concept check questions

1. D 2. B, D 3. acetyl-SCoA or acetoacelyl-SCoA 4. protease 5. F (they can not be synthesized, but they can be broken down). 6. F (Furmarate is a product of the urea cycle and an intermediate in the citric acid cycle). 7. F (only on does).

Problems

1. a. C b. A c. D d. B e. C

<u>c</u>. Two major choices would be A and D. D is the best answer since ammonium ions are used to synthesize part of urea in the urea cycle.

<u>d</u>. This answer is correct, but do not expect this type of question on a quiz.

<u>e.</u> Of the compounds only C and B have compounds that are both in citric acid cycle. C is the right choice because the total number of oxaloacetate and fumarate is 8 carbons, the same number is the end compound in the synthesis pathway. The compound could not be synthesized to both Succinate and citrate because it does not have enough carbons.

2. In the body, tyrosine is biosynthesized from phenylalanine. Tyrosine is an essential amino acids for phenylketonurics, who are unable to synthesize tyrosine from phenylalanine.

3. Amino acids can be both glucogenic and ketogenic. After catabolism, certain amino acids yield products that can enter the citric acid cycle and products that can be intermediates of fatty acid metabolism.

4. Ketosis is the major hazard of a high-protein, low carbohydrate diet. Ketosis occurs when the body produces a large amount of acetyl-SCoA that can't enter the citric acid cycle because of a shortage of citric acid cycle intermediates (due to the low level of carbohydrates in the diet). Instead, acetyl-S-CoA undergoes ketogenesis, which results in production of keytone bodies and a lowering of the blood pH. With the increase of keytone the levels of acetone can increase in the blood. A similar condition can result from unregulated diabetes.