Name: _____ Exam 3

1. (3 pts) Draw Threonine.

2. (10 pts) How many grams of powdered threonine would you need to produce 500 mL of 5 mM threonine solution? [C→12.01 g/mole; H→1.008 g/mole; O→16.00 g/mole; N→14.01 g/mole]

3. (16 pts) Threonine catabolism
   a. Convert C3 of threonine from an alcohol to a ketone.

      i. Propose a name for the enzyme that catalyzes this reaction.

      ii. Propose an appropriate cofactor, if needed.

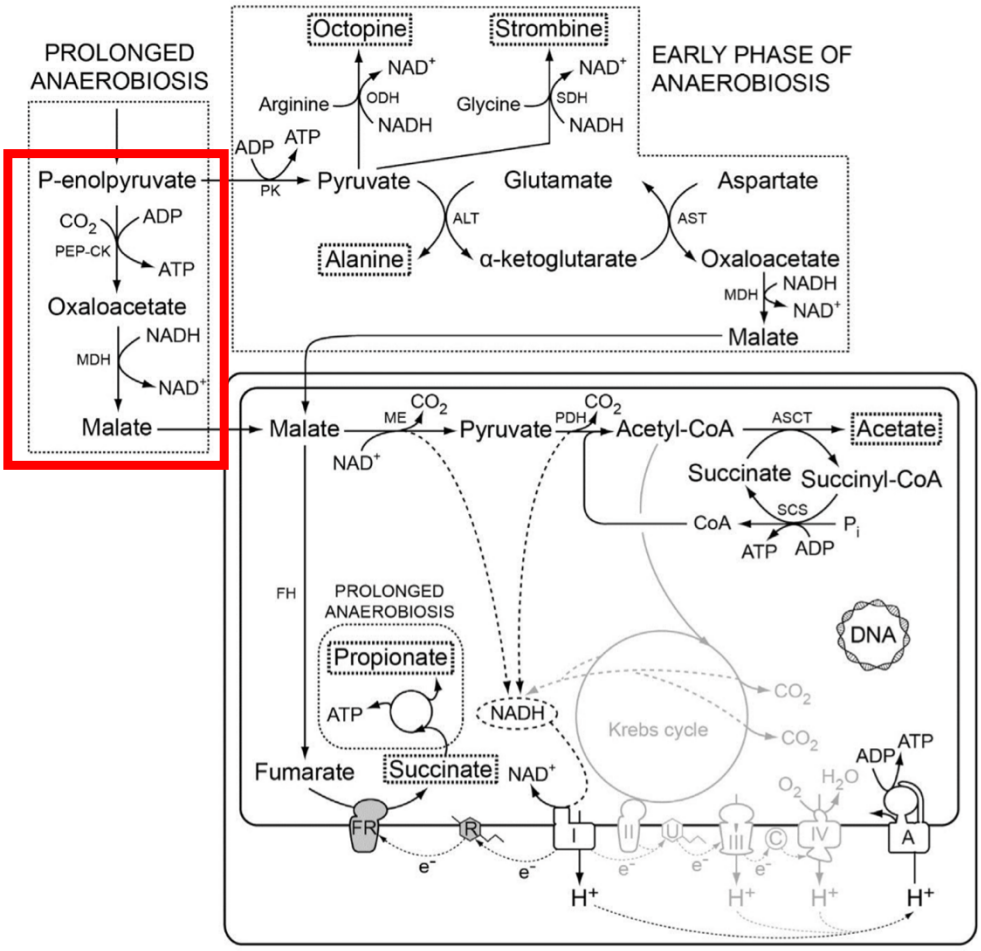
   b. A thiolase catalyzes the nucleophilic addition of CoA-SH on the carbonyl carbon of the ketone. The α-carbon leaves as a carbanion, which is quickly protonated by the solution.

      i. Identify the amino acid product.

      ii. Identify the second, non-amino acid product.

      iii. Circle all that apply for the second, non-amino acid product:

      Glucogenic Ketogenic Lipogenic

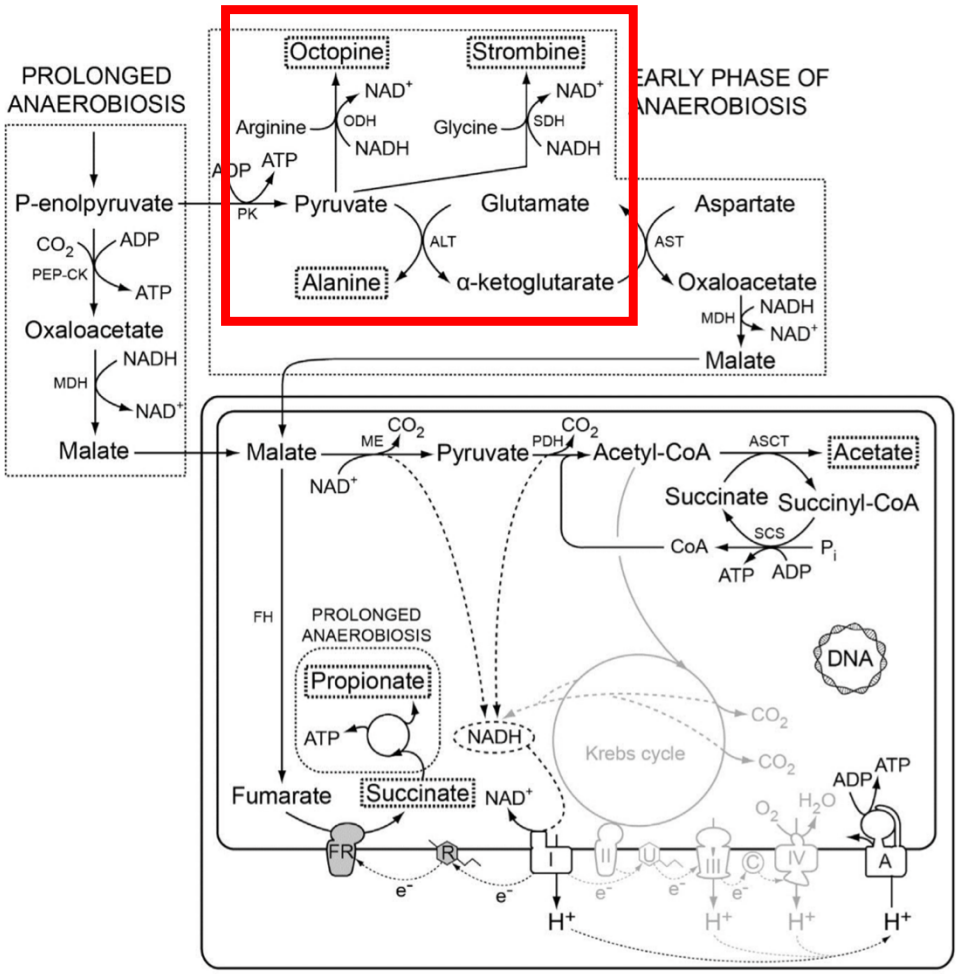


*Zimorski *et al.* (2019)

Modern, obligate-aerobic animals use the enzymes of prolonged anaerobiosis differently from that of our ancestors.

4. (6 pts) What is the metabolic role of interconversion between phosphoenolpyruvate and oxaloacetate as catalyzed by phosphoenolpyruvate carboxykinase in modern, obligate-aerobic animals (i.e., humans)? [Only the first two sentences will be read and graded. Write legibly; I will not guess.]

5. (6 pts) What is the metabolic role of <u>cytoplasmic</u> interconversion between oxaloacetate and malate as catalyzed by malate dehydrogenase in modern, obligate-aerobic animals (i.e., humans)? [Only the first two sentences will be read and graded. Write legibly; I will not guess.]



*Zimorski *et al.* (2019)

In early-phase anaerobic growth, the mussel *Mytilius edulis* accumulates alanine, octopine, and strombine.

6. (6 pts) Draw alanine. Name the type of reaction the mussel uses to produce alanine?

7. (14 pts) Octopine is a derivative of arginine and pyruvate via octopine dehydrogenase.
    a. Draw arginine and pyruvate.

b. React the backbone amine of arginine with the carbonyl carbon of the ketone of pyruvate to form an imine. The carbonyl oxygen on the ketone leaves as water.

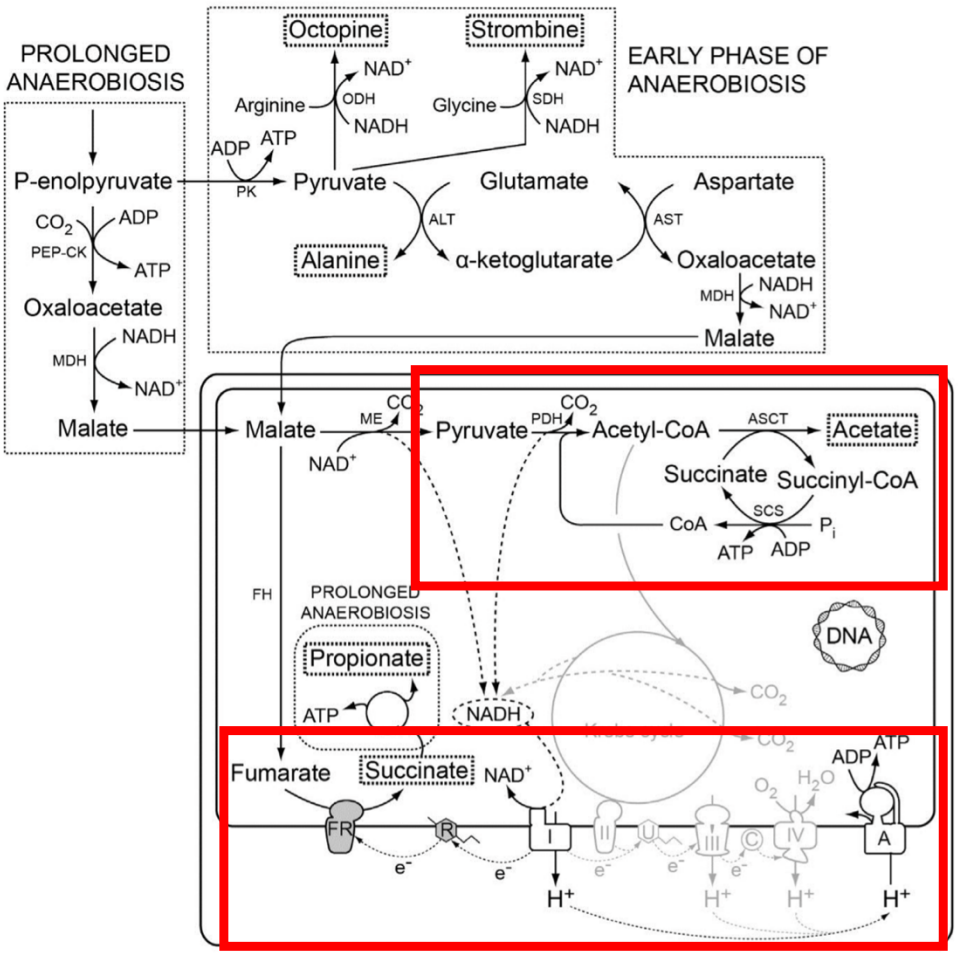
c. Convert the imine to a secondary amine.

i. Is this an oxidation or reduction reaction?

ii. Suggest a cofactor required for this reaction to proceed.

8. (9 pts) Strombine is a derivative of glycine and pyruvate via strombine dehydrogenase in a nearly identical reaction scheme as the synthesis of octopine.
   a. Draw glycine and pyruvate.

   b. Draw strombine.



*Zimorski *et al.* (2019)

In early-phase anaerobic growth, the mussel *Mytilius edulis* converts pyruvate to acetate which accumulates. This is coupled to the reaction catalyzed by succinyl-CoA synthetase which generates GTP (an ATP equivalent as shown in the figure above). NADH is processed by Complex I of the electron transport chain; however, Complexes II, III, and IV do not function (... there's no O_2). To allow complex one to continue to function, the electrons are passed unto fumarate to reduce it to succinate which accumulates. ATP synthase functions with the protons pumped by Complex I.

9. (6 pts) How many ATP equivalents will the mussel *Mytilius edulis* produce from one pyruvate under <u>anaerobic</u> conditions?

10. (6 pts) How many ATP equivalents do you produce from one pyruvate under <u>aerobic</u> conditions?

11. (18 pts) Complete the following table for the fed state with respect to a cardiac myocyte.

	Increasing	Decreasing	N/A
Blood glucose			
Blood [Insulin]			
Insulin Receptor Signal			
Blood [Glucagon]			
Glucagon Receptor Signal			
Flux through GLUT2			
Flux through GLUT4			
Flux through glycolysis			
Flux through gluconeogenesis			
Phosphorylation-Phosphofructokinase-2			
Activity-Phosphofructokinase-2			
Phosphorylation-Fructose-2,6,-bisphosphatase			
Activity-Fructose-2,6,-bisphosphatase			
[fructose-2,6-bisphosphate]			
Flux through glycogenesis			
Flux through glycogenolysis			
Phosphorylation-glycogen synthase			
Activity-glycogen synthase			
Phosphorylation-glycogen phosphorylase			
Activity-glycogen phosphorylase			
Flux through the Pentose Phosphate Pathway			
Transport of acyl-CoA into mitochondria			
Transport of citrate into cytoplasm			
Phosphorylation of acetyl-CoA carboxylase			
Activity of acetyl-CoA carboxylase			
[malonyl-CoA]			
fatty acid synthesis			
ketone body synthesis			
flux of alanine to pyruvate			