Chemistry 786
Exam II
February 25, 1998

- Print you name on all sheets of the exam.
- Show all work. Partial credit cannot be given without evidence of work. No credit will be given for incorrect answers without work.
- Do work in the space provided. If additional space is needed, use the opposite side of the page and make note of your additional work in the given space.
- The exam is worth 100 points total. Questions 1-10 are worth 5 points each. Questions 11-15 are worth 10 points each.

1. Describe briefly the chemiosmotic theory for coupling oxidation to phosphorylation in mitochondria.

2. List three (3) ways in which the proton gradient formed by the mitochondrial electron transport system can be put to use.

3. The standard reduction potential, $E^{0'}$, for ubiquinone (Q) is 0.045 V and the standard reduction potential for FAD is -0.219 V. Solve for the standard free-energy change ($\Delta G^{0'}$) for the oxidation of $FADH_2$ by ubiquinone. Faraday's constant, $\mathcal{F}$, is 96.48 kJ/V·mol.

4. Schematically show how glycogen phosphorylase and glycogen synthase are affected by phosphorylation. Explain how this phosphorylation regulates glycogen storage/breakdown.

5. In the biosynthesis of glucose from pyruvate, name all of the enzymes that are not also participants in glycolysis.

6. What are the compounds produced by the pentose phosphate pathway and what is the purpose of these compounds?

7. Draw the hydration step in the β-oxidation of fatty acids if butanoyl-CoA (C_4) was utilized as the initial starting material.

8. Explain the role of the enzymes biotin carboxylase and transcarbamoylase in the process of fatty acid synthesis.

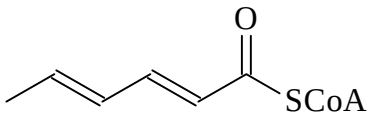
9. Draw out the condensation step of fatty acid biosynthesis using acetyl/malonyl-ACP as your starting material. Include any cofactors and enzyme name in your reaction.

10. Starting with glucose, explain how a monosaccharide unit can be incorporated into a pre-existing polymer of glycogen (structures optional).

11. Write out the reaction catalyzed by the enzyme, β-hydroxybutyrate dehydrogenase (including structures) and explain the conditions under which you expect this reaction to occur.

12. Show the path of electron flow in the Q cycle (starting with the first QH_2) and explain why it is necessary to use 2 molecules of QH_2, which carries 4 electrons, to transport only 2 electrons to cytochrome *c*.

13. For the molecules shown below, complete the degradation pathway until only acetyl-CoA remains. Include all enzymes and cofactors.



14. Write out the reactions leading to the formation of HMG-CoA and list the roles of this intermediate in lipid metabolism.

15. Starting with activated isoprenes, draw out the steps leading to the formation of squalene. Include all enzymes, cofactors, structures and names.