MCB102 / Metabolism
Problem Set #3
Spring 2008

These are example problems, which are similar to those you may see on the final exam.

QUESTION 1: TRUE/FALSE. Circle the correct answer, but if the answer is FALSE provide a statement that corrects the one given.

(i) The mitochondrial PMF can be used to drive transport reactions across the membrane, e.g., ADP/ATP exchange.

TRUE **FALSE**

(ii) Ornithine, Arginine, and Aspartate are all amino acids.

TRUE **FALSE**

(iii) Pyruvate makes alanine following transamination in the liver in a parallel reaction to that used in the Cori Cycle to recover glucose from lactate.

TRUE **FALSE**

(iv) The QH2 produced by NADH oxidation in Complex I is equal in energy to the QH2 produced by FADH2 oxidation via Complex II. Explain why this so and what it means for the final ATP yield for the oxidation of each type of reduced co-factor.

TRUE **FALSE**

(v) The heme cofactor in the protein cytochrome *c* can accept two electrons.

TRUE **FALSE**

(vi) The F1 subunit of the F1Fo ATP Synthase is an example of an uncoupler. T/F

TRUE **FALSE**

(vii) The Urea Cycle occurs in the matrix of mitochondrial so that it may couple by-product fumerate to conserve energy during urea production. T/F

TRUE **FALSE**

(viii) The electron transport chain minimizes producing radical intermediate species, like semiquinones, because they cause damage to cellular machinery.

TRUE **FALSE**

(ix) Lipid and sterol biosynthesis are likely regulated since they are energetically costly anabolic pathways.

TRUE **FALSE**

QUESTION 2: FILL IN THE BLANKS.

(i) What is the name of the oxidized form of Coenzyme Q in the electron transport chain?

_____

(ii) What is the name of the reduced form of Coenzyme Q in the electron transport chain?

_____

(iii) What is the name of the Complex that creates water from oxygen?

_____

(iv) The cell can mop up hydroxyl radicals made as by-products of respiration using an enzyme called:

_____

QUESTION 3: SHORT ANSWER.

(i) What essential nutrient is found in both the Acyl Carrier Protein (ACP) used in fatty acid biosynthesis and the CoA cofactor used in fatty acid catabolism?

(ii) How might a rotary mechanism favor ATP release from the F1Fo ATP Synthase of the inner membrane of mitochondria?

(iii) Describe why NADH can release 10 net protons to the intermembrane space. Convert these protons into ATP explaining how you arrived at your final ATP production figure for those protons.

(iv) Describe the regulation of cholesterol biosynthesis.

(v) Why is PLP a great cofactor for the transamination reactions?

(vi) Explain how the uncoupler DNP operates when administered to respiring mitochondria.

(vii) How is the Urea Cycle regulated?

(viii) Draw out the products and reactants of the urea cycle. Circle the steps that require the hydrolysis of ATP.

(ix) Explain the two possible paths electrons may take when flowing from either NADH or succinate to oxygen.

(x) What is malonyl-CoA and where does it belong in metabolism?

QUESTION 4: ENERGETICS CALCULATIONS. Show your work.

(i) How many ATP are consumed in making a C_{16} fatty acid from acetyl-CoAs? In your answer explain what cofactors are used to synthesize fatty acids and why?

(ii) With a basic calculation of PMF, show that for a pH gradient of 1 unit and a membrane potential of 180 mV how much energy (in % yield) would be stored from the original oxidation of NADH if only 8 protons were transferred to the intermembrane space?