BCHM 463 **Your Name:** _____

Biochemistry and Physiology **ID #:** _____

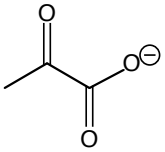
Makeup exam, May 16, 2003 **Prof. Jason Kahn**

You have 55 minutes for this exam.

Exams written in pencil or erasable ink will not be re-graded under any circumstances.

You may use a calculator for this exam. No other study aids or materials are permitted.

Generous partial credit will be given, *i.e.*, if you don't know, guess.



Glucose, G6P, F6P, FBP, GAP(+DHAP), 1,3-BPG, 3PG, 2PG, PEP, Pyruvate

OAA, citrate, isocitrate, KG, succinyl-CoA, succinate, fumarate, malate, OAA

Hill equation: $Y_{O_2} = \frac{(pO_2)^n}{(p50)^n + (pO_2)^n}$

Explanations should be concise and clear. I have given you more space than you should need.

Honor Pledge: Please write out the following sentence and sign it, or talk to me about it:

"I pledge on my honor that I have not given or received any unauthorized assistance on this examination."

1. Carbohydrates and living without them (25 pts):

(a; 10 pts) Draw the disaccharide composed of two a-D-glucopyranosides linked by an -1,4 linkage. What macromolecule that we've spent time on is made of long chains of -1,4 linked glucose? What is the other type of linkage in that molecule?

(b; 6 pts) How many CO_2 molecules are generated for each Acetyl-CoA metabolized through the TCA cycle? Explain why protein is consumed during starvation even when there is enough fat stored in the body to provide lots of ATP.

(c; 9 pts) How does the process of ketone body formation in the liver spare protein from being degraded, and why is this good for the owner of the liver? Why is it advantageous that the liver lacks the enzyme needed for consuming ketone bodies? (Hint: what would we call it if glycolysis and gluconeogenesis were ever active at the same time within one cell?)

2. Prions and other ills (25 pts):

The idea of "balancing selection" is that there are situations in which heterozygotes have a selective advantage over homozygotes, or in which a defective protein confers a selective advantage, so that two or more alleles are maintained in the population at high frequencies. We have seen at least two examples.

(a; 12 pts) What is the pentose phosphate pathway enzyme that is defective in the most common genetic disease? What are the two main functions of the pentose phosphate pathway? What is the disease that is responsible for positive selection of both this defect and sickle-cell anemia?

It has recently been discovered that there appears to have been widespread selection pressure in the past for being heterozygous in the gene for PrP, the prion protein, even though apparently the only difference among alleles is that heterozygotes are resistant to kuru.

(b; 13 pts) Where was kuru discovered, and how did it spread? Thus, what is the rather unsettling likely origin of a selection pressure for resistance to kuru? Speculate on why mixtures of different PrP proteins might aggregate less readily than uniform samples.

3. Ox-phos and fat (25 pts):

(a; 12 pts) Uncouplers allow the dissipation of the mitochondrial proton gradient without the concomitant synthesis of ATP. What is the metabolic consequence of uncoupling? Why do babies have an uncoupler protein? Name another example of an apparently futile cycle with the same purpose.

(b; 13 pts) Briefly describe the changes in fuel consumption upon exertion in skeletal muscle, on the second/minute/hour time scale.

4. Enzyme Kinetics and Regulation (25 pts):

(a; 8 pts) Draw the v_o versus [S] plot for a simple Michaelis-Menten enzyme, and identify V_{max} and K_m on your graph.

(b; 6 pts) Given your answer to part a, how can it be possible for increasing substrate concentration to slow down an enzymatic reaction? Can this occur if there is only one binding site for the substrate? Give an example of an enzyme that uses ATP as a substrate and is also inhibited by ATP.

(c; 11 pts) Circle the three good nucleophiles from the following set of amino acids

Lysine Serine Valine Cysteine Tryptophan Glycine

Draw a Schiff's base between acetone and a lysine □-NH_2 group. Why is it that enzymes that act through an intermediate Schiff's base are often inhibited at low pH? What kind of catalysis is this?