BCH 4054 **PRE-TEST 2** **GROUP NAME _____**
September 22, 2000

This test is take-home and open book, and it is intended that all members of the group contribute to completing it. Only one copy is to be submitted by the group, and all members who participated should sign their names below. **Test is due at the end of class on Monday, October 2.**

Please use dark pencil or ink and write legibly.

_____ _____

_____ _____

_____ _____

Page	Points
1	_____
2	_____
3	_____
4	_____
5	_____
Total	_____

Points

1. ATP synthesis in chloroplasts is coupled to proton transport as it is in mitochondria, but there are some differences from the mitochondrial system.

(5) (a) The ATP synthase is on the matrix side of the inner mitochondrial membrane. Describe its location and orientation in the chloroplast.

(5) (b) Electron transport pumps protons out of the mitochondrial matrix into the space between the inner and outer membranes. Between what spaces and across what membrane is the gradient formed in chloroplasts?

(5) (c) A cytochrome complex in mitochondria catalyzes transfer of electrons from coenzyme Q, a quinone, to cytochrome c, a protein, and consists of cytochromes b and c_1 and an iron-sulfur protein. The cytochrome complex in photosynthesis catalyzes transfer of electrons from what quinone to what protein, and consists of what cytochromes?

(5) (d) The proton-motive force generated in mitochondria involves both a pH and an electrical potential gradient across the membrane. What is different in the proton-motive force in chloroplasts?

(10) 2. The light reaction of photosynthesis involves two separate pigment systems. For each of the following statements, indicate in the blank whether the statement refers to pigment (or photo) system I (**P.S.I**), pigment (or photo) system II (**P.S.II**), **both**, or **neither**.

_____	Contains a pigment with an absorption maximum of 680 nm.	_____	Is involved in cyclic photophosphorylation.
_____	Absorption of light produces a strong reductant and a weak oxidant.	_____	Is concentrated along the stromal surface of the thylakoid membrane.
_____	Contains antenna chlorophyl.		
_____	Contains a manganese cluster.	_____	Contains bacteriorhodopsin.
_____	Produces a tyrosine radical.	_____	oxidizes reduced plastocyanin.
		_____	contains pheophytin.

3. Following is the overall reaction catalyzed by the Calvin-Benson cycle:

$CO_2 + 3ATP + 2NADPH \rightarrow 1/3$ glyceraldehyde-3-P $+ 3ADP + 2NADP^+$

Give the structures of reactants and products for the **step** or **steps** of the cycle which:

(5) (a) Incorporate CO_2 into an organic form.

(5) (b) Uses ATP as a substrate.

(5) (c) Uses NADPH as a substrate.

(6) 4. Tropical plants have an additional reaction for converting CO_2 into an organic compound. Give the reactants and products of this reaction, and explain what it accomplishes and why it is important.

(4) 5. The Calvin-Benson cycle requires 3 ATP and 2 NADPH for each CO_2 converted to carbohydrate. The Z-scheme generates only about 2 ATP for the four electrons used to reduce 2 NADPH. Where does the additional ATP come from?

(6) 6. Phosphorylase is an allosteric protein, existing in an **R** (active) and a **T** (inactive) conformation. The **T/R** ratio is affected by several allosteric "effectors", which activate or inhibit enzyme activity. For each of the following compounds, indicate whether it primarily affects the **phosphorylated** or **non-phosphorylated** form of the enzyme, whether it shifts the **T/R** ratio toward the **T** form or the **R** form, and whether the effect is an **activation** or **inhibition** of enzyme activity.

Effector	**Phosphorylated or Non-phosphorylated**	**T or R**	**Activation or Inhibition**
ATP	_____	____	_____
AMP	_____	____	_____
Glucose	_____	____	_____
Glucose-6-phosphate	_____	____	_____

(11) 7. Hormonal regulation of glycogen metabolism and glycolysis in liver and muscle is similar in some respects, and different in others. Compare and contrast the two tissues by filling in the blanks of the following table with the requested information.

	Liver	**Muscle**
Hormone stimulating glycogen breakdown:	_____	_____
Phosphorylated form of the following proteins is **active** or **inactive?**		
phosphorylase:	_____	_____
phosphorylase b kinase:	_____	_____
glycogen synthase:	_____	_____
phosphofructokinase-2:	_____	_____
fructose-2,6-bisphosphatase:	_____	_____
phosphoprotein phosphatase inhibitor:	_____	_____
Allosteric activator of the **inactive form** of the following enzyme:		
phosphorylase:	_____	_____
glycogen synthase:	_____	_____
Hormonal stimulation leads to **activation** or **inactivation** of the following:		
phosphofructokinase-1:	_____	_____
fructose-1-6-bisphosphatase:	_____	_____

(8) 8. Describe the Cori cycle.

(20) 9. As an exercise in tracing radioactive labels, use the enzymes of the pentose phosphate pathway, as well as any enzymes you may need from the glycolytic pathway, to show how radioactivity from [2-^{14}C]-glucose (i.e., glucose labeled with carbon-14 in position 2) can be converted to $^{14}CO_2$. Show the structures of the intermediates of your pathway, circling or starring the radioactive atoms in each structure, and give the name of the enzyme catalyzing each step.