

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 5.**

Please use dark pencil or ink and write legibly.

Page Points

1 _____

2 _____

3 _____

4 _____

5 _____

Total _____

Points

(10) 1. ATP synthesis in mitochondria and in chloroplasts is carried out by similar enzymes and coupled to electron transport in similar ways, but there are differences in the identity, cellular location, and orientation of the membrane components. Compare and contrast the two organelles by identifying the following for each organelle:

(a) Membrane location and orientation of the ATP synthase:

Mitochondria

Chloroplasts

(b) Direction protons are pumped during electron transport through cytochromes, and the nature of the electrochemical "proton motive force" produced::

Mitochondria

Chloroplasts

(c) Quinone donor of electrons to cytochrome chain:

Mitochondria

Chloroplasts

(d) Protein components of cytochrome chain:

Mitochondria

Chloroplasts

(e) Protein acceptor of components of cytochrome chain:

Mitochondria

Chloroplasts

- (10) 2. In the Z scheme for the light reaction of photosynthesis two pigment systems are responsible for the transfer of electrons from water (forming oxygen) to NADP^+ (forming NADPH). Outline the scheme, placing the following components in their proper location along the path of the electrons: plastoquinone, plastocyanin, manganese, ferredoxin, cytochrome b/f complex, P_{700} , P_{680} , pheophytin.

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



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

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

(b) Use(s) ATP as a substrate.

(c) Use(s) NADPH as a substrate.

- (18) 4. Under some conditions the liver oxidizes fatty acids to acetoacetate, which is secreted into the blood and then oxidized in peripheral tissues (such as heart muscle) to produce energy.
- Give the overall pathway, indicating by name or structure all intermediates, by which palmitic acid ($C_{16:0}$) is oxidized completely to CO_2 in this fashion, distinguishing which reactions occur in liver and which in heart muscle.
 - Identify the steps at which ATP, NADH, and $CoQH_2$ are utilized or produced.
 - Assuming reoxidation of NADH and $CoQH_2$ by the electron transport chain, calculate the net yield of ATP in liver and in heart muscle from this overall reaction.

(8) 5. Identify the **missing enzyme** and the **structural composition** of the accumulated lipid in the following sphingolipidoses. (for example, structural composition of **lactosyl ceramide** would be **gal-β(1-4)-glc β(1-1)-ceramide**).

(a) Gaucher's disease

(b) Fabry's disease

(c) Niemann-Pick disease

(d) Tay-Sach's disease

(12) 6. For the four plasma lipoproteins, (a) chylomicrons, (b) VLDL, (c) LDL, and (d) HDL, put the letter or letters corresponding to the lipoprotein(s) for which the following statements are true in the blank to the left of the statement:

_____	Contains apoprotein B-100.	_____	Transports endogenous (made in liver) triacylglycerols.
_____	Contains apoprotein B-48.	_____	Is degraded by lipoprotein lipase.
_____	Contains apoprotein A-1.	_____	Is taken up by cells via receptor-mediated mechanisms.
_____	Contains apoprotein C-1.	_____	Is a precursor of LDL.
_____	Source of cholesterol for tissues.	_____	May remove cholesterol from cells.
_____	Transports dietary triacylglycerols.	_____	Is acted on by the enzyme LCAT.

(8) 7. HMG-CoA is an intermediate in synthesis of both ketone bodies and synthesis of isoprenoid compounds such as cholesterol. Give the reaction product of HMG-CoA in each case, the name of the enzyme catalyzing the reaction, and the cellular location of the two pathways.

(10) 8. Compare and contrast the structural organization of the **fatty acid synthase** from **yeast** and from **animals**. Identify the catalytic domains that participate in the overall reaction (name or abbreviation), and explain in each case how the domains are organized to provide an active enzyme.

(8) 9. Radioactive acetate labeled in the carboxyl carbon ($[1-C^{14}]$ -acetate) was injected in a rat and subsequently several radioactive products were isolated. For each of the following compounds, draw the structure and **circle** the carbon atoms of the compound you would expect to contain radioactivity.

(a) mevalonic acid

(b) squalene

(c) palmitic acid

(d) arachidonic acid

(4) 10. To which **omega** class do the following fatty acids belong?

(a) oleic acid

(b) palmitoleic acid

(c) linoleic acid

(d) arachidonic acid