University of British Columbia
Mid-term I – February 2nd, 2009
Biochemistry 300 – Winter semester, Term 2

Time: 1.0 hours
Total Marks: 60

Candidate's Name: _____
(Please print **family name first.**)

Student Number: _____

Candidate's Signature: _____

This examination consists of 3 parts A, B, and C. Part B has 9 questions and part C has 4 questions. The exam has a total of 6 pages. Please check to ensure that this paper is complete.

Answer all questions on this examination paper in the space provided.

Read and observe the following rules:

1. Each candidate should be prepared to produce, upon request, his/her library/AMS card.
2. No candidate shall be permitted to enter the examination after the expiration of ½ hour, or to leave during the first ½ hour of the examination.
3. Candidates are not permitted to ask questions of the invigilators, except in cases of supposed errors or ambiguities in examination questions. CAUTION - Candidates guilty of any of the following, or similar, dishonest practices shall be immediately dismissed from the examination and shall be liable to disciplinary action:
   a) making use of any books, electronic storage devices, papers or memoranda, or cassette recorders other than those authorized by the examiners;
   b) speaking or communicating with other candidates;
   c) purposely exposing written papers to the view of other candidates.
   d) The plea of accident or forgetfulness shall not be received.
4. Smoking is not permitted during examinations.
5. Cellular telephones must be fully turned **off**.

Mark Obtained: _____ /60

Part A. Matching terms. Chose from the following list below and assign a number. Not all terms will be used. (12 marks)

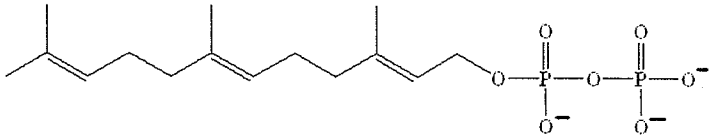
1. Farnesyl pyrophosphate
2. Low density lipoprotein
3. Chylomicron
4. Intermediate density lipoprotein
5. Geranyl pyrophosphate
6. Endopeptidase
7. Exopeptidase
8. Malonyl CoA
9. Excipeptidase
10. Malate
11. Citrate
12. Propionyl CoA
13. Carnitine
14. Isopentenyl pyrophosphate
15. Albumin
16. Acetyl CoA
17. Oxaloacetate
18. Very low density lipoprotein

A. _____ Acetyl groups are transported from the mitochondrial matrix to the cytosol as this molecule.

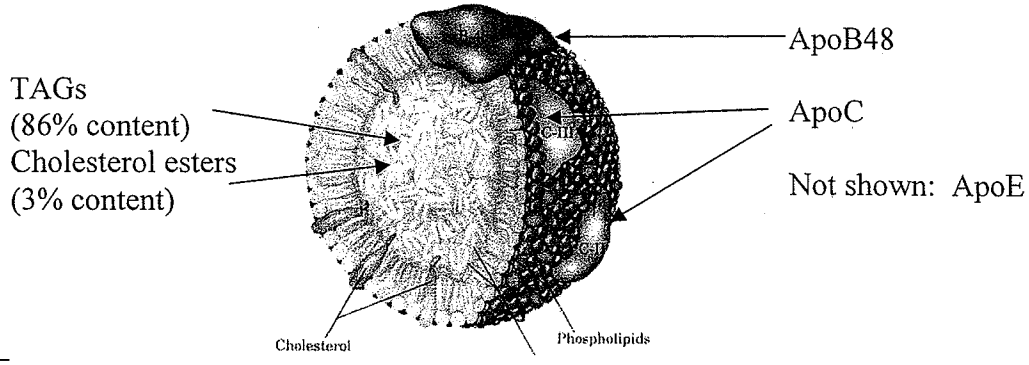
B. _____ An enzyme that digests proteins from the ends of the molecule, rather than at an internal site.

C. _____ Free fatty acids produced by adipocytes are transported on this molecule.

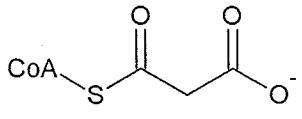
D. _____



E. _____



F. _____



Part B. Multiple Choice. Circle the best answer. (18 marks)

1. Which of the following is **NOT** true of the reaction producing Malonyl CoA during fatty acid synthesis?
   a. It requires acyl carrier protein.
   b. It is stimulated by citrate.
   c. One molecule of ATP is converted to ADP + Pi for each Malonyl CoA made.
   d. The cofactor is biotin.

2. High density lipoprotein particles:
    a. Contain a large amount of triacylglycerides.
    b. Contain lecithin-cholesterol acyltransferase.
    c. Are the largest of the lipoprotein particles.
    d. Are synthesized by peripheral tissues such as muscle to carry cholesterol back to the liver.

3. If malonyl CoA is synthesized from radiolabeled $^{14}CO_2$ and unlabeled acetyl CoA, and the resulting labeled malonyl CoA is then used for fatty acid synthesis, the final product (fatty acid) will have radioactive carbon in:
    a. Every carbon.
    b. No part of the molecule.
    c. Every odd numbered carbon.
    d. Every even numbered carbon.
    e. Only the ω (omega) carbon.

4. Which of the following is **NOT** true of transport of acetyl units from the mitochondrial matrix to the cytosol via option II (malic enzyme):
    a. Citrate lyase is required.
    b. As part of the over net process, NADH is converted to NADPH.
    c. ATP is required.
    d. The carbon skeleton is transported back to the mitochondrial matrix as malate.

5. Which reaction sequence best represents the synthesis of cholesterol?
    a. $C_5 \rightarrow C_{10} \rightarrow C_{15} \rightarrow C_{25} \rightarrow \rightarrow C_{27}$
    b. $C_5 \rightarrow C_{10} \rightarrow C_{15} \rightarrow \rightarrow C_{30}$
    c. $C_5 \rightarrow C_{10} \rightarrow C_{15} \rightarrow C_{30} \rightarrow \rightarrow C_{27}$
    d. $C_5 \rightarrow C_{10} \rightarrow C_{20} \rightarrow C_{30} \rightarrow \rightarrow C_{27}$
    e. $C_5 \rightarrow C_{10} \rightarrow C_{15} \rightarrow C_{20} \rightarrow C_{25} \rightarrow C_{30} \rightarrow \rightarrow C_{27}$

6. Which of the following is **NOT** true of mammalian fatty acid synthase?
    a. It is found exclusively in the cytosol.
    b. It requires phosphopantetheine (a derivative of vitamin B5) to function.
    c. Acetyl groups are attached to a cysteine residue on acetyl/malonyl CoA transferase.
    d. It is one large polypeptide with many different functional domains.

7. In regards to acetyl unit transport (for fatty acid synthesis), Malic enzyme:
    a. Produces CO_2.
    b. Requires ATP.
    c. Requires $NADP^+$.
    d. Is highly active in the matrix of the mitochondria.
    e. a and c.

8. This molecule **directly** cleaves chymotrypsinogen to chymotrypsin.
    a. Enteropeptidase.
    b. Trypsin.
    c. Trypsinogen.
    d. Cholescystokinin.

9. If carnitine acyl transferase I could no longer allosterically bind malonyl CoA:
    a. β-oxidation would not occur (or occur much more slowly).
    b. Fatty acid synthesis would not occur (or occur much more slowly).
    c. β-oxidation would occur.
    d. Fatty acid synthesis would occur.
    e. Both c and d.
    f. Both a and d.

Part C: Short Answer Questions:

1a. Draw the structure of cholesterol. (4 marks)

1b. In the spaces below, list three **specific** and **different** examples of cholesterol derivatives. Include a brief (one sentence or less) description of the derivative's function in the body. A cholesterol ester has been provided as an example. (3 marks)

Enzyme	**Function**
Example: Cholesteryl palmitate	Storage and transport of cholesterol
1._____	_____
2._____	_____
3._____	_____

2. Draw out the reaction catalyzed by the β-ketoacyl ACP reductase domain of fatty acid synthase. Make sure to include the structures of the reactants and products, their names, and list any required co-factors. (4 marks)

3. Provide a detailed explanation on how each of the following mutations in mammalian liver cells has affected the cellular metabolism. What long term effect would this have?

3a. The allosteric regulatory site of AMP dependent protein kinase (AMPK) is modified such that ATP can bind but can never leave. (4 marks)

3b. The Sterol Regulatory Element Binding Protein (SREBP) is never cleaved, such that SREBP always remains bound to the Endoplasmic Reticulum (ER). (4 marks)

3c. The Apo-B100 protein is mutated such that it can no longer bind to LDL-receptor protein. (5 marks)

4. You have been asked to consult in a case of a young child presenting with abdominal pain, swollen liver and spleen. **Lab** results indicate an extremely high concentration of circulating chylomicrons and very low density lipoproteins (VLDLs) in the blood. Conversely, the levels of circulating intermediate density lipoproteins (IDLs) and low density lipoproteins (LDLs) are very low. Based on your knowledge in this course, provide a detailed biochemical explanation for the **Lab** results. DO NOT try to explain the patient's physical symptoms! (6 marks)