BCH 4054 **PRE-TEST 3** **GROUP NAME ___________________**
October 15, 1999

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 25.**

Page	Points
1	______
2	______
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Total	______

Please use dark pencil or ink and write legibly.

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Points

(8) 1. 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.

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

(a) oleic acid

(b) palmitoleic acid

(c) linoleic acid

(d) arachidonic acid

(5) 3. Compare eukaryotic fatty acid oxidation with fatty acid synthesis, giving at least five ways in which the two pathways **differ** from each other.

(8) 4. Describe briefly the role of each of the following vitamins in lipid metabolism:

(a) biotin (vitamin H)

(b) carnitine (vitamin Bt)

(c) vitamin B-12

(d) pantothenic acid

(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-ß(1-4)-glc ß(1-1)-ceramide**).

(a) Gaucher's disease

(b) Fabry's disease

(c) Niemann-Pick disease

(d) Tay-Sach's disease

(8) 6. 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

(6) 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.

(8) 8. Carbon-carbon bond formation in fatty acid synthesis and in sterol synthesis both require an activated intermediate to make the bond formation energetically favorable. In the former case the bond formation joins two-carbon units. In the latter case the bond formation joins five-carbon units. For each case, give the structure of the activated intermediate, and describe the mechanism for forming the carbon-carbon bond.

(8) 9. Biosynthetic reactions often require the investment of energy, either in the form of coupling a reaction to the hydrolysis of **ATP** or its equivalent, or to a reduction step involving oxidation of **NADPH**. Identify the following steps by giving the **name of the enzyme** and both the **reactants** and **products** (names or structures okay).

(a) ATP requiring reaction of palmitic acid biosynthesis from acetyl-CoA.

(b) NADPH requiring reactions of lanosterol biosynthesis from acetyl-CoA.

(12) 10. Diagram the intermediates and enzymes of the urea cycle, showing the cellular location of each enzyme and intermediate. (Names or structures okay for intermediates.)

(5) 11. Give the structure of the **prosthetic group** of the enzyme **aspartate aminotransferase** (also known as glutamate-oxaloacetate transaminase) in which the prosthetic group is covalently attached to aspartate as an enzyme-bound intermediate during the catalytic cycle of the reaction. Describe how the prosthetic group is covalently bound to the enzyme at the beginning and end of the catalytic cycle..

(6) 12 Lysine is a ketogenic amino acid and alanine is a glucogenic amino acid. What do these terms mean, and what is different about the catabolism of these two amino acids that leads to this classification?

(8) 13. The alanine cycle is similar to the Cori cycle, except that alanine instead of lactate is transported from muscle to liver for further metabolism. In addition to providing fuel for synthesis of more glucose in muscle, alanine also serves as a carrier of nitrogen from muscle to liver in times of muscle protein degradation. The following conversion must occur in liver:

alanine ---> pyruvate + NH_3

Give the reaction steps accomplishing this conversion, including the name of the enzyme catalyzing each step, the **structure** of the **reactants** and **products** of each step, and the name of any coenzyme cosubstrates or coenzyme prosthetic groups involved.

(6) 14. Arachidonic acid is a precursor of both prostaglandins and leukotrienes. The initial step in each pathway is catalyzed by an enzyme requiring oxygen. Give the name of each enzyme, and the structure of the first oxygenated intermediate in the two pathways.