Professor Brown Practice Set 3

Remember, some of these problems will take you outrageous amounts of time. Do NOT waste your time with this packet if you have not yet understood your notes and made your charts. Your big chart is key.

Take your old chart and add to it

- Pentose/Calvin Cycle
- Fatty Acid Biosynthesis
- Fatty Acid Oxidation
- Urea Cycle
- All those pesky Amino Acids that I have listed on my handout
- ANY and ALL reactions that you can connect.

Trust me when I say it will save you hours and hours of time while studying and prolly just enough time on an exam to make a difference between you finishing all the questions correctly or not.

Solutions will be distributed next week.

Lastly, I shouldn't even have to tell yall at this point - don't even try and bring this into an exam.

GOOD LUCK
-Ali

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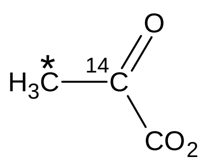
1. (Q1, Pset 8, 1998) Supposing you fed pyruvate, labeled with carbon-14 at the second carbon, to a cell culture. Name three amino acids that you would expect to show significant amounts of carbon-14 label in these cells. Where would the label be in each of these amino acids? Please answer by tracing the label through a series of enzymatic reactions covered in class. You do not need to show any mechanisms, but please show enough intermediate structures so that it is clear where the label is going.

Supposing you repeated the experiment, this time labeling the third carbon. Where would the label end up on methionine?

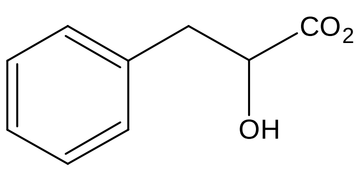
(Trace *'d carbon to Met and ^{14}C to 3 amino acids.)

2. (Q2, Pset 8, 1998) (Old exam question) Show how all the carbons (except one) of a purine can be derived enzymatically from serine. Although no mechanism of individual enzymatic reactions are required, please indicate which coenzymes and cosubstrates, if any, may be needed for individual enzymatic reactions. No structural formula are

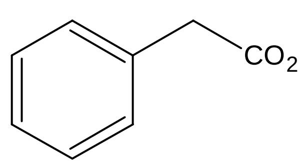


required.

3. (Q3, Pset 8, 1998) (Old exam question) The aromatic compounds show below can be produced enzymatically from phenylalanine in individuals suffering from the metabolic phenlyketonuria. With the use of structural formulas show how these compounds could be produced from phenylalanine. No need to include mechanisms, but please indicate which co-enzymes and co-substrates may be needed. Assume the availability to any thioesterase that may be needed.



A



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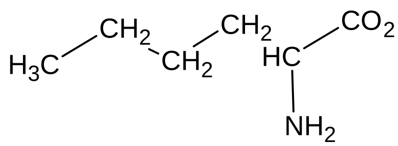
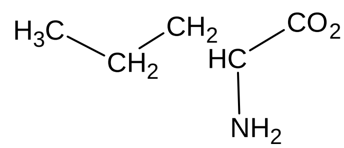
4. (Q4, Pset 8, 1998) The microbes that live in the craters on Mars turn out to have identical biochemistry to us terrestrial mammals, except that somewhere in their evolution they picked up two extra amino acids in their proteins, endearingly called marsbar and milkyway, shown below. Would you expect each of these amino acids to be ketogenic, glycogenic, neither, or both? Please answer with a reaction pathway. (You don't need to trace it all the way to glucose or ketone bodies, but rather to known precursors. Hint: think about isoleucine.)



milkyway



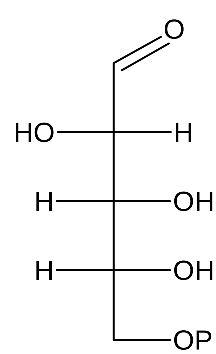
marsbar

5. (Q1, Exam 3, 1994; 30 points) Assume that an organism capable of engaging in photosynthesis has been mutagenized so that lysine residues present at active sites of enzymes have been replaced by other amino acids (i.e., these enzymes are inactive.) During photosynthesis, this organism was observed to be able to carry out the follwoing overall transformation:

CO_2+3ATP+2NADPH+2H^++2 fructose-6-P –> 3ADP+2 Pi+2$NADP^+$+ribose-5-P + ?

Propose a set of enzymatic reactions, known to occur in organisms capable of photosynthesis, to account for this overall transformation and identify the product (and how much) designated as a question mark in the equation.

6. (Q2, Exam 3, 1994; 20 points) Suppose you have an organism that is capable of converting one mol of fructose-6-P and one mol of the sugar whose structure is shown on the right to one mol of xylulose-5-P and one mol of glucose-6-P and that it is known that <u>two enzymes</u> similar to those that operate in the "pentose cycle" are needed to allow this overall transformation. What is the nature of these enzymatic reactions? Please include any proposed enzyme-bound intermediates and write the structures of the products formed by the action of these <u>two enzymes</u>.



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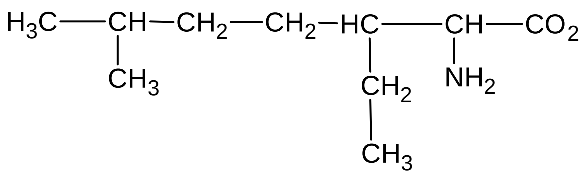
7. (Q3, Exam 3, 1994; 30 points) How many net moles of ATP could be produced by the conversion of the carbon chain of the compound shown below to CO_2? Please show how your answer was obtained. Note: assume the presence of an enzyme that can convert acetoacetate to acetoacetylCoA.



8. (Q4, Exam 3, 1994; 20 points) Show how the amino group of isoleucine could be used to provide all of the N atoms present in cytidine triphosphate "CTP." Be sure to indicate how many mols of isoleucine are required to generate 1 mol of CTP.

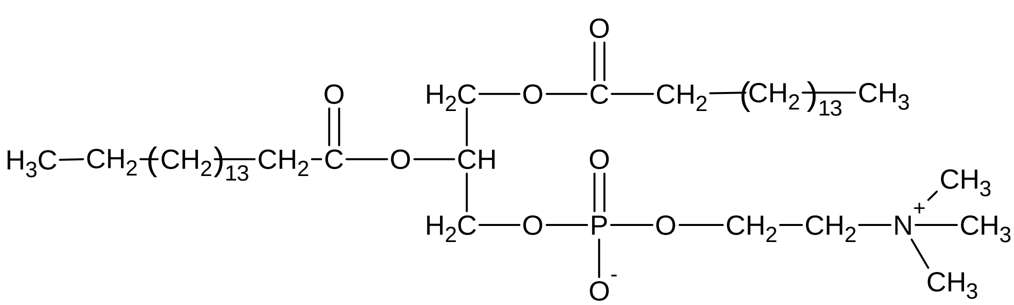
9. (Q1, Exam 3, 1995; 15 points) Indicate the enzymatic reaction sequence that could account for the overall transformation summarized in the equation shown below. There is no need to include structural formulas in your answer, but please name the enzyme that catalyzes each of the proposed reactions. Note that $NADP^+$ is not involved.

3 Glucose-6-P + ATP –> 2 Ribose-5-P + 2 Erythrose-4-P + ADP

10. (Q2, Exam 3, 1995; 15 points) (Same as Q3 on this set of practice problems)

11. (Q3, Exam 3, 1995; 20 points) (Same as Q2 on this set of practice problems)

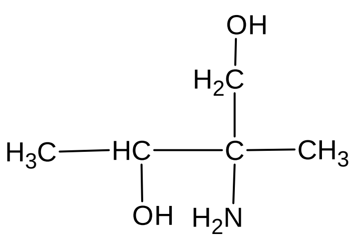
12. (Q4, Exam 3, 1995; 50 points) Show how glyceraldehyde-3-P could be used to provide all of the carbons in the biosynthesis of the species of phosphatidyl choline shown below. Please indicate which, if any, coenzymes and cosubstrates may be needed for individual enzymatic steps. In presenting your answer, there is no need to use structural formulas, except for the final assembly of the compound from its component parts.

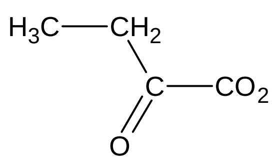


13. (Q1, Exam 3, 1998; 20 points)
a) Give the probable mechanism of the reaction catalyzed by the epimerase involved in the “pentose cycle.” Please use structural formulas and include any proposed enzyme-bound intermediates.
b) In the overall enzymatic transformation of ornithine to arginino-succinate and other end products, where would ^{18}O be found in the final products when bicarbonate labeled with ^{18}O is provided during this transformation. Assume the presence of (and identify) any other compounds that may be needed and please show how your answer was obtained.

14. (Q2, Exam 3, 1998; 15 points) How much ATP and NADPH would be needed to convert palmitic acid to oleoyl CoA by an enzyme system present in the cytosol of animal cells. Assume the presence in the cytosol of any acetyl CoA that may be needed. Please show how your answer was obtained.

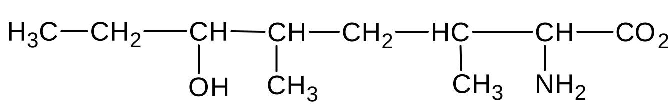
15. (Q3, Exam 3, 1998; 20 points) Assume that the metabolism of the compound shown below results in the production of α-ketobutyrate and also allows the conversion of norepinephrine to epinephrine. Present a set of enzymatic reactions that would allow these end products to be produced. Please give the mechanisms of each enzymatic reaction that you present which requires the participation of the coenzyme form of vitamin B_6. Note: no transamination takes place.





alpha Ketobutyrate

16. (Q4, Exam 3, 1998; 20 points) Assume that the hypothetical compound shown below is glycogenic (and not at all ketogentic). Propose a set of enzymatic reactions, of the type discussed in class, that could account for this statement. Note that CO_2 can be produced and/or utilized. Please use structural formulas and name any coenzymes that may be needed in presenting your answer.



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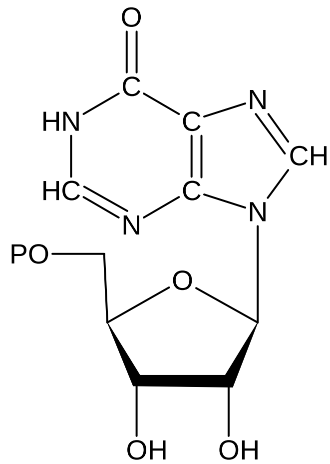
17. (Q5, Exam 3, 1998; 25 points) Present a sequence (or sequences) of enzymatic reactions that indicate how all of the carbon atoms (except for the one derived from CO_2) of IMP can be derived metabolically from glucose-6-P. No need to use structural formulas or to present the full biosynthetic pathway for the formation of IMP, but please identify any coenzymes that may be needed in individual enzymatic reactions.

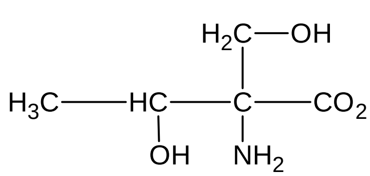


IMP

18. (Q1, Exam 3, 1999; 20 points) How many net mols of ATP could be generated by the complete oxidation (to CO_2) of one mol of the following fatty acid. Please use structural formulas to show how the acid is metabolized and give a complete explanation to indicate how much ATP can be produced. Note: if you believe the TCA cycle is involved, there is no need to show the individual reactions of this cycle.
19. (Q2, Exam 3, 1999; 23 points) Based on principles presented in class, propose a

$$H_3C-CH_2-CH\overset{cis}{=}CH-CH_2-CH_2-CH_2-CO_2$$

method for the enzymatic conversion of the compound shown below to succinyl CoA as one of the resulting products. In presenting your answer, use structural formulas and identify all reactants and products as well as coenzymes that may be needed. If you believe that pyridoxal-P is involved, please present the mechanisms for any proposed reactions and include any proposed enzyme-bound intermediates.



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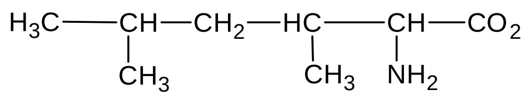
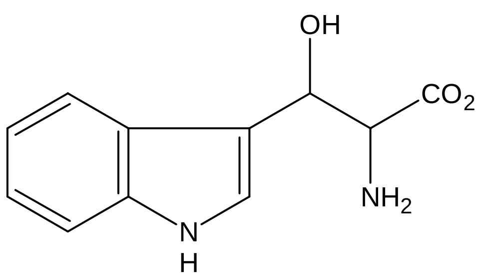
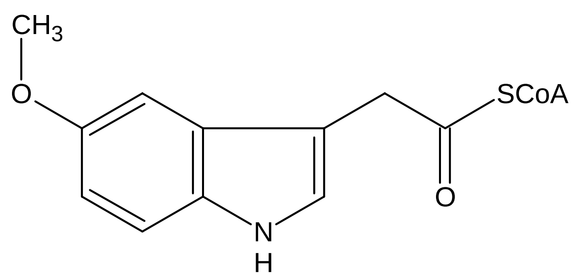
20. (Q3, Exam 3, 1999; 23 points) The compound shown below can be metabolized to yield glycogenic substances (no keotgenic materials are produced). Propose a set of enzymatic reactions of the type presented in class to account for this. In presenting your answer, please use structural formulas and indicate any coenzymes that may be needed in specific reactions.



21. (Q4, Exam 3, 1999; 23 points) Show how Compound A could be converted to Compound B with the use of enzymatic reactions of the type presented in class. In presenting your answer, please use structural formulas to show intermediates and identify any coenzymes that may be needed. If you use a pyridoxal-P-containing enzyme or enzymes, give the mechanisms of the reactions.



A



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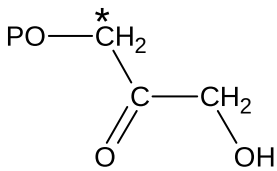
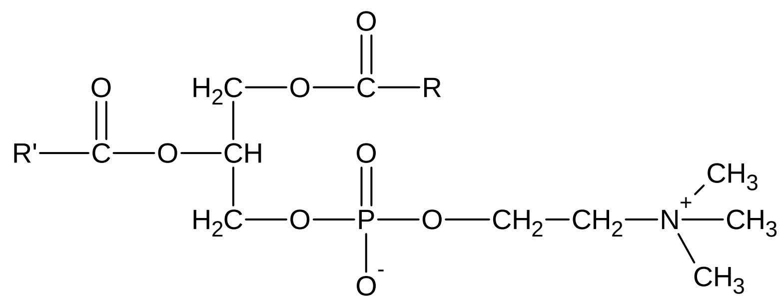
22. During the metabolism of each of the following compounds labeled with ^{14}C as shown with an asterisk, which carbons would be labeled in the indicated products in each case? Indicate with asterisks where the ^{14}C would be found.

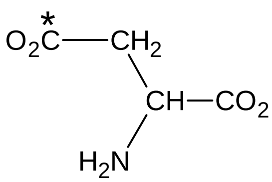
<u>Labeled Compound</u> | <u>Product</u>

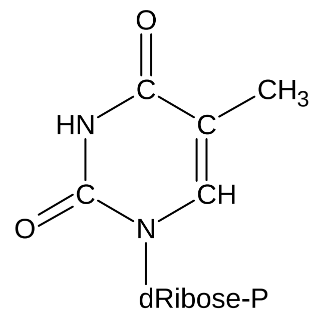
a.



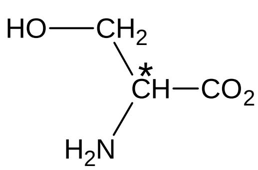


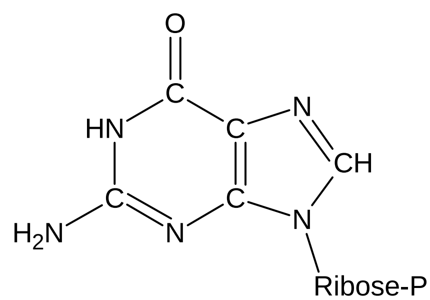
b.





c.





d.