**BIOSC 1820, Metabolic Pathways and Regulation**
**Spring, 2012**
**Prof. Jeffrey L. Brodsky**
**Final Exam**
**April 25, 2012**

NAME: ICEY

*Each answer is worth 2 points. GOOD LUCK!!*

**I. Which of the following cofactors/leaving groups is required:**

**for transamination reactions?** C

**for the synthesis of triacylglycerol from glycerol?** A

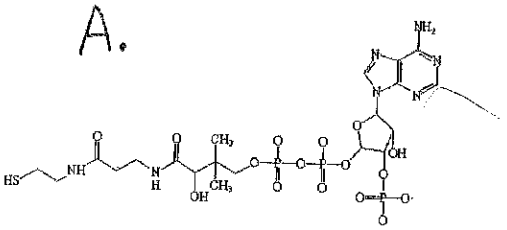
**for sucrose synthesis?** B

**for starch synthesis?** F

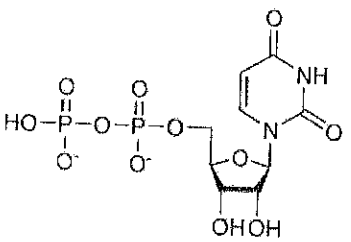
**for fatty acid synthesis?** E

**(choose the best answer—each answer is only used once)**

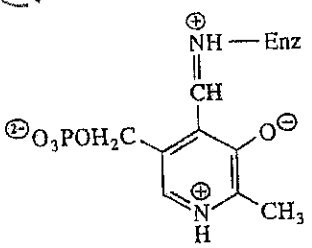
A.



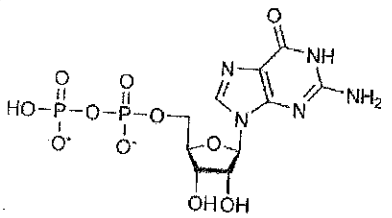
B.



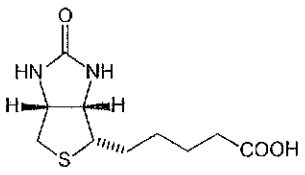
C.



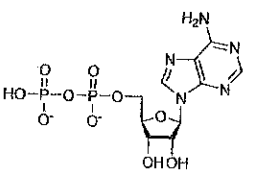
D.



E.



F.



**II. What would be the physiological effect of a defect in N-acetylglutamine synthesis, and in which cell type might this effect be most evident?**

The urea cycle would not be stimulated and $NH_3$ would build-up. The effect would be most evident in liver.

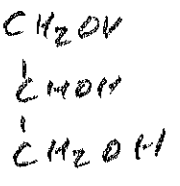
**III. Draw the structures and give the names of three "head groups" that can be appended onto the phosphate in phosphatidic acid (there are several choices). Just draw the structures of the molecules in their free state:**

**A.** Serine $^{+}NH_3-CH(OH)-CO_2^-$

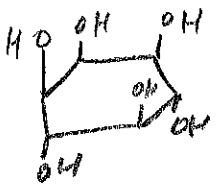
ethanolamine $HO-CH_2CH_2-NH_3^{\oplus}$

choline $HO-CH_2CH_2-N^{\oplus}(CH_3)_3$

**B.** glycerol



inositol

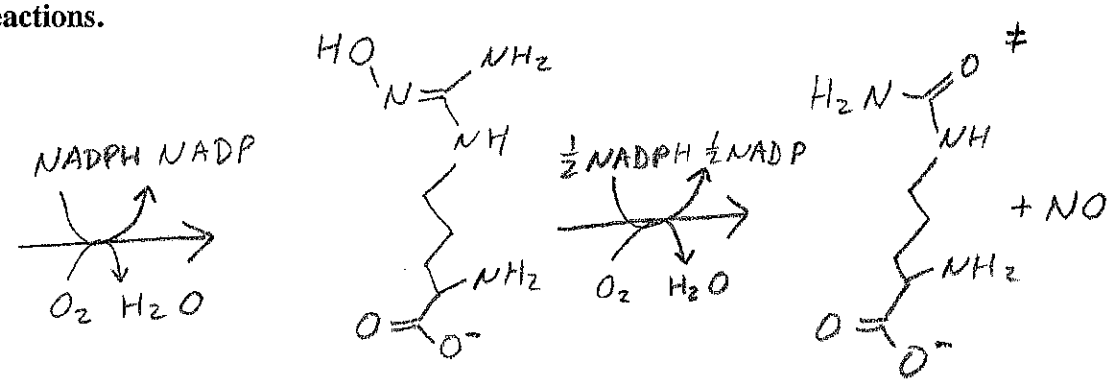


**C.**

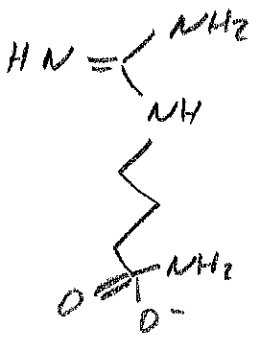
**IV. Is cyclic electron transport during photophosphorylation reductive? Why or why not?**

No -- no NADPH is made

**V. Nitric oxide (NO) is critical for controlling smooth muscle cell contraction (e.g., blood pressure), neuronal signaling, and blood vessel growth. In cells, NO is produced by the following reactions.**




**A. What is the structure of the first reactant in this pathway?**



**B. What is the name of the final product?** (*)

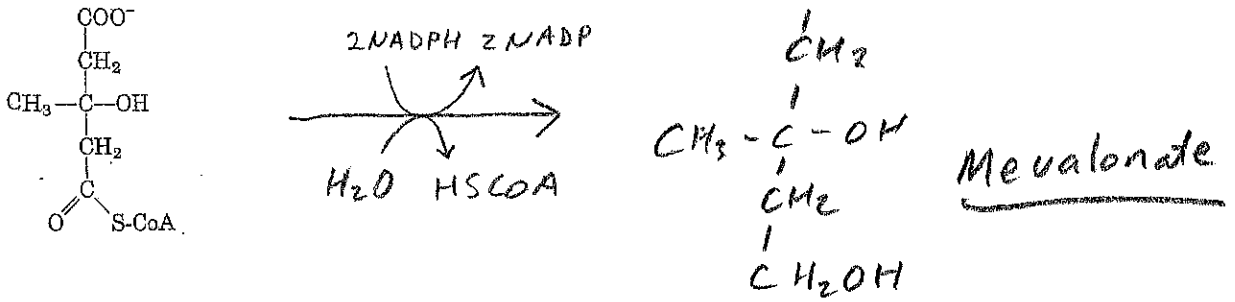
Citrulline

**VI. Assume that you had two different cell types, one that contained mitochondria with the ATP synthase and one without the ATP synthase. In the absence of a proton gradient and in the absence of glucose, in which cell type do you think the cellular levels of ATP might diminish quicker? Why?**

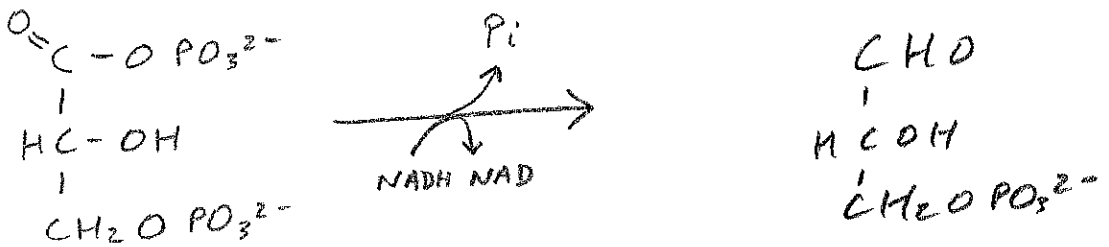
The one with the enzyme would lose ATP quicker -- the synthase would run backwards + chew-up ATP.

**VII. Draw the structures AND give the names of the products of the following reactions:**

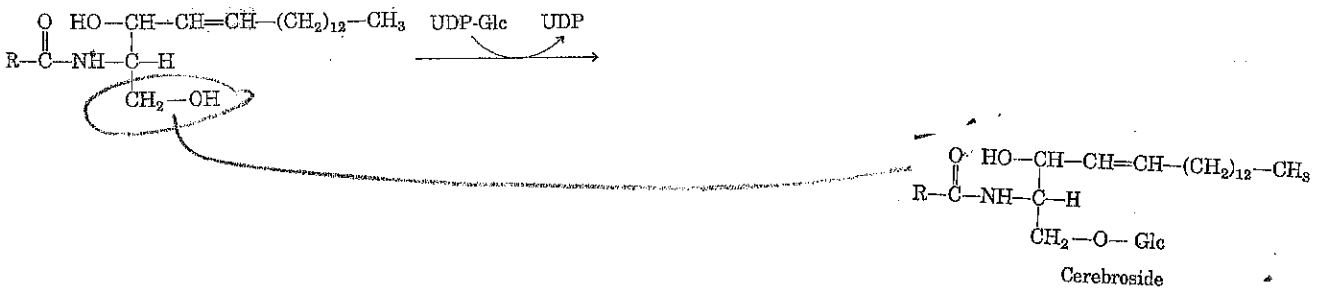
**A.**



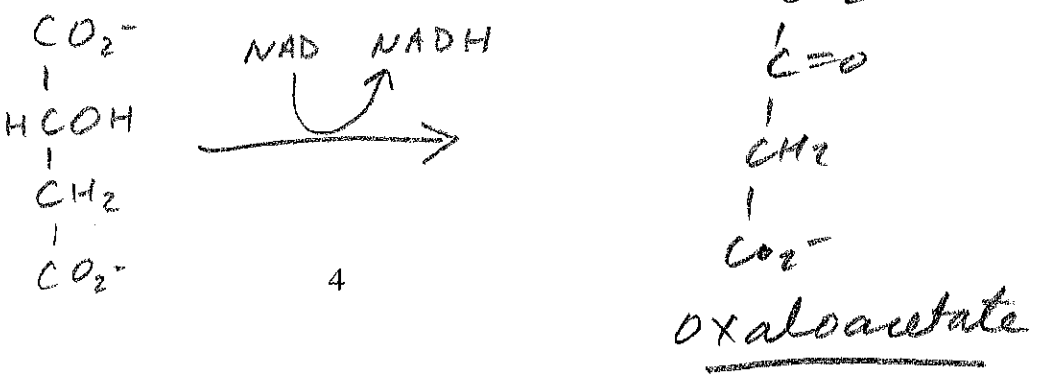

**B.**




**C.**




**D.**



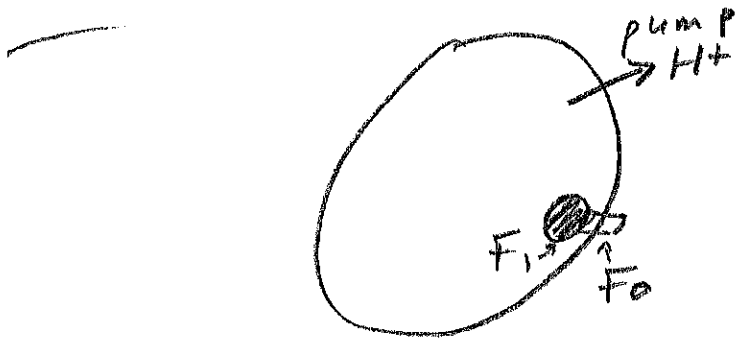
**VIII. Does the following reaction, as catalyzed by the ATP synthase, directly require the proton gradient?**

$ADP + P_i \longrightarrow ATP$

No -- it occurs due to a conformation change which is needed to release Bound ATP.

**IX. A *Halobacterium* that lives in high salt lakes (>3 M NaCl) normally carries out oxidative phosphorylation but one problem is that these lakes are often oxygen depleted. Therefore, these ancient microbes contain a plasma membrane light sensitive transporter, bacteriorhodopsin (Brh). When light is absorbed by Brh, the transporter is able to directly pump protons against their concentration gradient.**

**Draw a picture of a halobacterium and indicate: (1) in which direction the protons are pumped, (2) the placement of the F1 and the Fo portions of its ATP synthase (double credit).**

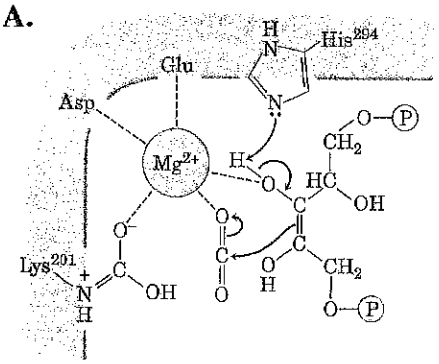



H+ H+ ) +1

) +1

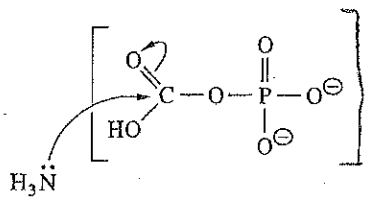
**X. The following are intermediates in the reactions catalyzed by which enzymes?**

**A.**




Rubisco

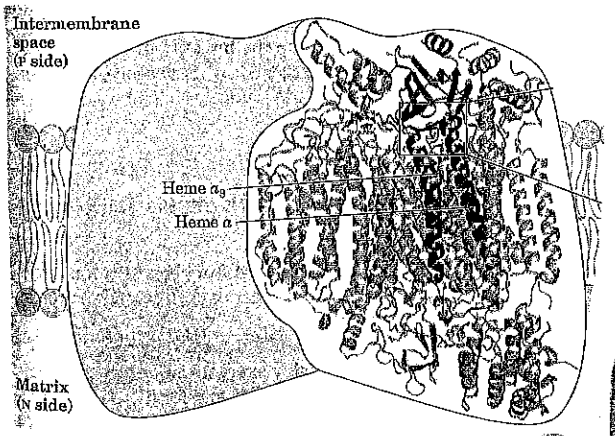
**B.**




carbamoyl phosphate Synthetase

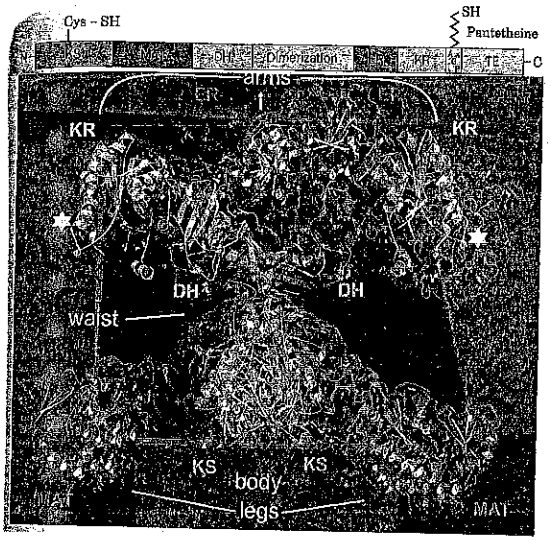
**XI. What are the full names of the enzyme complexes that are depicted in the following images?**

**A.**




cytochrome oxidase

**B.**




fatty acid synthase

**XII. In plants, electrons from ferrodoxin have three fates that we have discussed this term. State the names of two of the factors or complexes that can receive these electrons:**

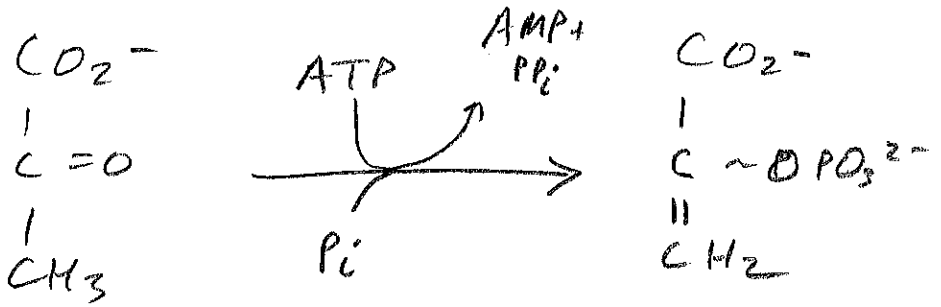
**A.** NADP

Fd – NADP oxidoreductase

**B.** cyt $b_6$f complex

thioredoxin

**XIII. During the cycle for the fixation of carbon in a C4 plant, there is an energy-requiring, anapleurotic reaction. Draw the structures of the reactants and products for this reaction (adenosine derivatives can be abbreviated):**



**XIV. Not only is the expression of a mitochondrial inner membrane uncoupling protein (UCP1) controlled, but in humans UCP1 is a $H^+$ channel that is regulated. Based on when and where this physiologically critical protein is needed, which cellular metabolite do you think activates UCP1? Explain your reasoning...**

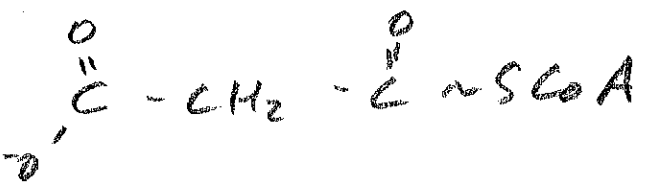
Fatty acids -- these are liberated from triacylglycerol in "brown fat" when it is critical to generate heat.

**XV. Why might the presence of a proton gradient across the mitochondrial inner membrane favor the synthesis of fatty acids?**

- Citrate "wants" to leave the mitochondria due to a favorable energy

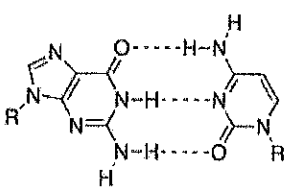
- pyruvate entry (with a proton) is more favorable into mito: needed to make Ac CoA.

**XVI. After it is first synthesized in the cell, neither the fatty acid synthase nor the associated acyl carrier protein is conjugated to a fatty acid precursor. Draw the structure of the molecule that you think is used to "charge" the enzyme so it can start working (you can abbreviate the names/structures of any added cofactors):**

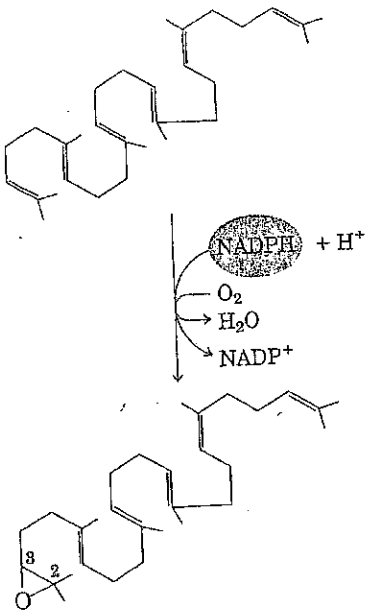



**XVII. Draw a G – C base pair:**

**(Just draw the bases...)**



**XVIII. The following is a member of which class of enzymes?**




Mixed Function oxidase

**XIX. Which of the following statements about ribonucleotide reductase is incorrect?**

A. The enzyme contains a stable tyrosine free radical
B. The enzyme is highly regulated
C. The enzyme creates a pool of substrates that may be limiting for DNA synthesis
D. One of the products is dTMP
E. The enzyme contains iron

**XX. Which of the following statements about LDL particles is incorrect?**

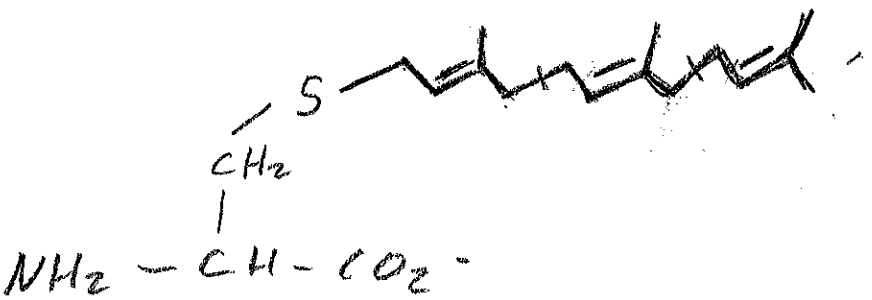
A. The major protein component is apolipoprotein B
B. The particle contains both esterified and unesterified cholesterol
C. The particle is more dense than a chylomicron
D. The particle is surrounded by a lipid bilayer
E. The particle can be endocytosed and most of the components are degraded in the lysosome

**XXI. In brief, why is ATP required for the proteolysis of a poly-ubiquitinated protein?**

The proteasome cap (19S) needs ATP to unfold and drive the ubiquitinated protein into the proteolytic core.

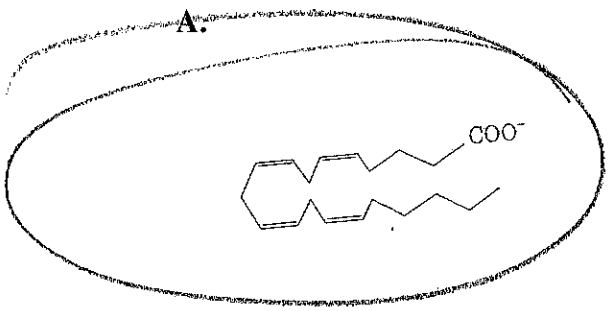
**XXII. A series of farnesyl transferase inhibitors have entered clinical trials based on their ability to inhibit the membrane association (and thus activation) of the *ras* oncogene. Farnesylation occurs on *ras* at a Cys near the C-terminus.**

**Based on what we discussed, try to draw the structure of a Cys residue with an attached farnesyl group:**

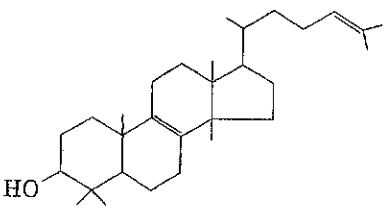


**XXIII. Which of the following is NOT a building block or intermediate for cholesterol biosynthesis?**

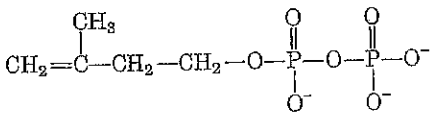
**A.**



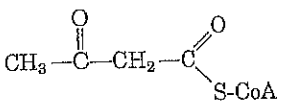

**B.**




**C.**




**D.**




37 - _____ (number incorrect)

***HAVE A WONDERFUL SUMMER! You were a terrific group--***



×2 = _____