Biochemistry 694:301
Second Exam, Dr. Deis
Monday Aug. 5, 2002

Name_____
Last 5 digits of SSN _____
Row Letter ____ Seat Number ____

This exam consists of two parts. Part I is multiple choice. Each of these 25 questions is worth two points. Answer the Part I questions on this sheet, below. Answer the Part II questions on the question pages.

Please use BLOCK CAPITAL letters like this --- A, B, C, D, E. Not lowercase!

| | | |
|---|---|---|
| 1. _____ | 10. _____ | 18. _____ |
| 2. _____ | 11. _____ | 19. _____ |
| 3. _____ | 12. _____ | 20. _____ |
| 4. _____ | 13. _____ | 21. _____ |
| 5. _____ | 14. _____ | 22. _____ |
| 6. _____ | 15. _____ | 23. _____ |
| 7. _____ | 16. _____ | 24. _____ |
| 8. _____ | 17. _____ | 25. _____ |
| 9. _____ | | |

GRADE:

Part I Total _____

Part II:

- II-1 _____
- II-2 _____
- II-3 _____
- II-4 _____
- II-5 _____

Part II Total _____

Total, I & II _____

1. Which of the following statements about the sodium channel is *incorrect*?
   A. it is sensitive to voltage
   B. it becomes inactivated spontaneously
   C. it consists of seven hydrophobic transmembrane segments
   D. it is much more permeable to $Na^+$ than to $K^+$
   E. none of the above

2. Acetylcholinesterase has
   A. five subunits
   B. a negatively charged area around the active site
   C. a reactive cysteine at the active site
   D. an ATP Binding Cassette
   E. none of the above

3. For a simple (uncharged) osmotic process, the standard free energy will be
   A. zero
   B. positive
   C. one
   D. negative
   E. you can't tell without specifics

4. Which of the following water soluble vitamins forms part of Coenzyme A?
   A. folate
   B. pyridoxine
   C. riboflavin
   D. thiamine
   E. pantothenate

5. If PEP + ADP --> ATP + Pyruvate has a $\Delta G_o' = -7.5$ kcal /mol, using your knowledge of ATP hydrolysis, what is the standard free energy change for the hydrolysis of PEP --> Pyruvate + $P_i$ ?
   A. –14.8
   B. –10.2
   C. –0.2
   D. +10.2
   E. + 14.8

6. The Citric Acid Cycle is part of which of "stage" of catabolism?
   A. I
   B. II
   C. III
   D. not part of catabolism

7. Protein Kinase A causes phosphorylation of the target sequence RRGSI in such enzymes as Glycogen Synthase and Phosphorylase Kinase. PKA is normally bound to an inhibitor which has the altered sequence:
   A. ARGSI
   B. RAGSI
   C. RRASI
   D. RRGAI
   E. RRGSA

8. One of the second messengers in Protein Kinase C activation is strongly hydrophobic. It is often known by its abbreviation
   A. PIP2
   B. CPU
   C. IP3
   D. SRO
   E. DAG

9. In "standard" conditions, [ATP] = 1 Molar, [ADP] = 1 Molar, and [AMP] = 1 Molar. What's the value of Atkinson's Energy Charge?
   A. 1.0 D. 0.5
   B. 0.9 E. 0.33
   C. 0.67 F. 1.5

10. Glucose labeled with $^{14}C$ at C-1 is incubated with the enzymes and cofactors of Glycolysis. Where does the label appear in Pyruvate?
   A. C-1, the carboxyl C. C-3, the methyl group
   B. C-2, the keto group D. all three carbons

11. How many "high energy" bonds are required to convert 2 OAA into glucose?
   A. 2 D. 5
   B. 3 E. 6
   C. 4

12. When insulin signals ingestion of food, GLUT-4 receptors are
   A. rapidly synthesized D. translocated to outer membrane
   B. rapidly destroyed E. blocked by binding insulin
   C. put into inactive mode

13. Acetyl CoA inhibits ___ but is a required activator for ___
   A. Aconitase, Fumarase D. Citrate Synthase, Hexokinase
   B. Malate DH, G6Pase E. Citrate Synthase, PEPCK
   C. Pyr DH Complex, Pyr Carboxylase

14. The Citric Acid Cycle occurs where in eukaryotic cells?
   A. the cytoplasm D. the mitochondrial matrix
   B. the lumen of the E.R. E. the mito. intermembrane space
   C. the nucleus

15. Unlike other organisms, organisms that have the Glyoxylate Cycle can
   A. make glucose from fatty acids D. run gluconeogenesis
   B. make fatty acids from glucose E. run the Citric Acid Cycle backward
   C. make acetyl CoA from fatty acids

16. Anaplerotic reactions produce what intermediate for the CAC?
   A. L-Malate D. Aconitate
   B. Succinate E. Oxaloacetate
   C. Fumarate

17. During the Q cycle, outward-facing $QH_2$ gives its first electron directly to
   A. $b_H$ D. Rieske FeS
   B. $b_L$ E. cyto c
   C. cyto $c_1$

18. The ATP yield, after oxidative phosphorylation, for oxidation of pyruvate from to $CO_2$ in respiring mitochondria is
    A. 2
    B. 5
    C. 10
    D. 12.5
    E. 30

19. Compared with cytochromes, iron sulfur clusters are
    A. higher in energy, evolutionarily older
    B. higher in energy, evolutionarily younger
    C. lower in energy, evolutionarily older
    D. lower in energy, evolutionarily younger
    E. none of the above

20. Cytochrome c is located where?
    A. intermembrane space
    B. inner mito membrane
    C. outer mito membrane
    D. mito matrix
    E. cytoplasm

21. In the laboratory, Ribose-5-P and Fructose-6-P can be reacted with the enzyme Transketolase. What would the products of this reaction be?
    A. glyoxylate-2-P and a 9 carbon ketose
    B. Glyceraldehyde-3-P and an 8 carbon ketose
    C. Erythrose-4-P and Sedoheptulose-7-P
    D. Ribose-5-P and Fructose-6-P
    E. Allose-6-P and Ribulose-5-P

22. A deficiency of G6PDH can lead to
    A. Pamaquine induced hemolytic anemia
    B. Wernicke-Korsakoff Syndrome
    C. Diabetes
    D. a selenium deficiency
    E. all of the above

23. Transaldolase and Transketolase have which similarity?
    A. both require thiamine pyrophosphate
    B. both form a Schiff base with substrate
    C. both use an aldose as a group donor
    D. both use a ketose as a group donor

24. The Calvin Cycle
    A. requires light to function
    B. includes parts of PPP and Gluconeo
    C. occurs in mitochondria
    D. all of the above

25. August 1 is a national holiday in (two free points)
    A. Ukraine
    B. Botswana
    C. Switzerland
    D. Brazil
    E. North Korea
    F. all of the above

1. Give specific answers to each question:

a1. Where is Acetylcholinesterase located?

(2)

a2. Why is it such a fast-acting enzyme?

(2)

a3. What happens to an animal exposed to an *inhibitor* of ACHase.

(2)

b. Compare and contrast the Calcium pump (Ca2+ ATPase) and the Multidrug Resistance Protein. Which is a P-type ATPase? What does each do in the cell? Be as specific as you can.

(4)

2.* a. What cofactors are represented below?

(6)

b. Show how Glucose-6-Phosphate can be converted to Ribulose-5-P by the oxidative branch of the Pentose Phosphate Pathway. Draw all reactants and products, indicate all cofactors, and name all enzymes. Roughly 1/2 point per fact. Hint, start with G6P drawn in the Haworth ring form.

(4)

3. a. Show how Fructose-1,6-BP would be converted into Phosphoenolpyruvate by the enzymes of Glycolysis. Draw all reactants and products, name all enzymes, and indicate all cofactors. 1/2 point per fact. Note, you may simply write out the entire pathway if that is easier for you.

(8)

b. Galactose is converted into Glucose by a 3-epimerase discussed in class. Show the reaction, being careful to represent the correct reactant and product. You may use "sticks" where appropriate but do show the epimerization.

(2)

4. a. Show the Citric Acid Cycle starting with Succinate (as in class) and ending with Citrate. Draw all reactants and products, name all enzymes, and indicate all cofactors. Do not "back up" through irreversible reactions. 1/2 point per fact.

(6)

b. Starting with Isocitrate, show the two reactions which are unique to the Glyoxylate Cycle (i.e. not part of the Citric Acid Cycle). Name enzymes, draw reactants and products.

(4)

5. a. For the following reaction, catalyzed by Alcohol Dehydrogenase, calculate the $\Delta E^{o'}$ and the $\Delta G_o'$. The value of a Faraday is 23.06 kcal/volt/mol. State equations, show work, and circle both answers.

Ethanol + $NAD^+$ → Acetaldehyde + NADH

Reduction Potentials:

| | | | |
|---|---|---|---|
| $NAD^+$ → NADH | | 2 | -0.32 v |
| Acetald. → Ethanol | | 2 | -0.20 v |

(4)

b. Diagram the structure of a "Racker's Knob" ($F_o$-$F_1$). What rotates? How does this rotation cause ATP formation? (Hint, for partial credit show OLT mechanism.)

(6)