

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 is true about the sorting pathway for proteins destined for incorporation into lysosomes or the plasma membrane of eukaryotic cells?
  - A) Binding of the signal recognition particle (SRP) to the signal peptide and the ribosome temporarily accelerates protein synthesis.
  - B) The newly synthesized polypeptides include a signal peptide at their carboxyl termini.
  - C) The signal peptide is cleaved off inside the mitochondrion by signal peptidase.
  - D) The SRP binds to the signal peptide soon after it appears outside the ribosome.
  - E) The signal sequence is added to the polypeptide in a posttranslational modification reaction.
  
2. Which of the following is involved in ensuring the *specificity* of a signal transduction process?
  - A) Specific interactions between the receptor and signal molecules.
  - B) Release of the G $\alpha$  protein from the nucleus.
  - C) Release of inositol 1,4,5-triphosphate from phosphatidylinositol.
  - D) Activation of ATP-dependent protein kinase.
  - E) Transmembrane transport of signal molecules by receptor molecules.
  
3. Inositol 1,4,5-triphosphate activates protein kinase C by:
  - A) Stimulating the release of G $\alpha$ .
  - B) Inhibition of diacylglycerol release by phospholipase A<sub>1</sub>.
  - C) Stimulating Ca<sup>2+</sup> release from the endoplasmic reticulum.
  - D) Acting as a substrate for target proteins.
  - E) None of the above.
  
4. The following are involved in the termination of signal transduction responses:
  - A) cAMP degradation by cyclic nucleotide phosphodiesterase.
  - B) G protein self-inactivation by hydrolysis of bound GTP to GDP.
  - C) Desensitization of hormone receptors by phosphorylation when hormonal stimulus is present for extended periods.
  - D) Dephosphorylation of phosphorylated target proteins.
  - E) All of the above.
  
5. Which enzyme catalyzes a substrate-level phosphorylation?
 

A. Pyruvate DH	D. Succ CoA Synthetase
B. Hexokinase	E. Fumarase
C. Citrate Synthase	
  
6. What two compounds inhibit the  $\alpha$ -Ketoglutarate DH Complex?
 

A. NAD <sup>+</sup> and citrate	D. Fru-2,6-BP and CoA
B. ADP and pyruvate	E. Biotin and lipoic acid
C. NADH and succ-coA	
  
7. The Citric Acid Cycle occurs where in eukaryotic cells?
 

A. the cytoplasm	D. the nucleus
B. the mitochondrial matrix	E. the mito. inner membrane
C. the lumen of the E.R.	

8. People with beri-beri, a disease caused by a dietary deficiency of Thiamine (TPP) have high blood levels of what metabolites?
 

A. niacin and riboflavine	D. pyruvate and $\alpha$ -KG
B. glucose and lactate	E. none of the above
C. succinate and fumarate	
  
9. The ATP yield from oxidation of Pyruvate to CO<sub>2</sub> and water by respiring mitochondria is
 

A. 2.5 ATP	D. 12.5 ATP
B. 7.5 ATP	E. 15 ATP
C. 10 ATP	
  
10. In an experiment with *Drosophila*, scientists found out that they could lengthen life by transfecting a gene which allowed flies to make more:
 

A. Catalase	D. Fumarase
B. Vitamin C	E. Lipoic acid
C. Folic acid	
  
11. Which inhibitor of the mitochondrial electron transport chain would *not* block the flow of electrons from Succinate DH to oxygen?
 

A. cyanide	D. 2,4 DNP
B. antimycin A	E. atractyloside
C. rotenone	
  
12. In mitochondria, cytochrome c is oxidized by direct interaction with
 

A. cyto c <sub>1</sub>	D. Cu <sub>A</sub>
B. Rieske FeS	E. Oxygen
C. cyto a <sub>3</sub>	
  
13. "Tightly Coupled" mitochondria have a Respiratory Control Ratio of about
 

A. 25	D. 1
B. 10	E. 0.5
C. 3	
  
14. Heart and liver cells can get 2.5 (not 1.5) ATP for each cytoplasmic NADH because they utilize
 

A. black magic	D. the malate-aspartate shuttle
B. quantum tunneling	E. the Busch-College Ave. shuttle
C. the glycerol phosphate shuttle	
  
15. If a doctor asks for an "SGOT" test, which shows transamination of Aspartate by enzymes in the serum, (recall "Supersize Me") he probably suspects
 

A. glycogen storage disease	D. gout
B. PKU	E. sickle cell anemia
C. heart or liver damage	

16. Which amino acid is Ketogenic?  
 A. Alanine  
 B. Asparagine  
 C. Leucine  
 D. Threonine  
 E. Glycine
17. The amino acid Cystathionine contains a total of how many carbons?  
 A. 11  
 B. 7  
 C. 5  
 D. 4  
 E. 3
18. Mitochondrial CPS-I uses ammonia as its nitrogen source, but cytoplasmic CPS-II uses what?  
 A. carbamoyl phosphate  
 B. arginine  
 C. asparagine  
 D. glutamine  
 E. glutamate
19. Cytosine plus Ribose is called  
 A. Cytidylate  
 B. Ribocytosine  
 C. Polyuridine  
 D. Cytidine  
 E. Cytosine
20. The oxidation of IMP to XMP is inhibited by  
 A. GMP  
 B. Azaserine  
 C. AMP  
 D. Cyclic AMP  
 E. GTP
21. Glutamine Synthetase is subject to cumulative regulation by several compounds. Which of the following is *not* an inhibitor of Glutamine Synthetase?  
 A. Alanine  
 B. Glycine  
 C. AMP  
 D. Proline  
 E. Histidine
22. If Glutamate is reduced, it enters the Proline synthetic pathway. But if it is first acetylated, it enters a pathway that leads to Ornithine instead. Thus it is logical that N-Acetyl Glutamate should stimulate what enzyme?  
 A. CPS-II  
 B. Ornithine decarboxylase  
 C. Arginase  
 D. Ornithine  $\delta$ -amino-transferase  
 E. none of the above
23. The Pyrimidine Ring is made out of  
 A. Serine and Threonine  
 B. Histidine and Valine  
 C. Aspartate and Carbamoyl Phosphate  
 D. Asparagine and Ammonia  
 E. a Purine ring
24. Lack of Phenylalanine Mono-oxygenase ("Phe Hydroxylase") can cause  
 A. Gout  
 B. Leukemia  
 C. Phenylketonuria  
 D. Lesch-Nyhan Syndrome  
 E. none of the above
25. Two free points, want them?  
 A. yes  
 B. no

1. a. What are the functions of the following components of the ATP-dependent eukaryotic protein degradation pathway?  
(5 points)

a.) E<sub>2</sub> - ubiquitin carrier protein

b.) E<sub>3</sub> - ubiquitin-protein ligase

c.)  $\alpha$ -subunits of proteasome

d.)  $\beta$ -subunits of proteasome

b. On the THF Worksheet handout, two drugs were depicted, Sulfanilamide and Methotrexate. Both have an effect on the use of Folate, but they are used in very different contexts for very different purposes. Briefly describe what each does, what the target for each drug would be, and how each affects folate.

(5 points)

2. a. Show how Oxaloacetate would be converted into Succinyl CoA by the enzymes of the Citric Acid Cycle. Draw all reactants and products, name all enzymes, and indicate all cofactors. Go "forward" around the cycle and do not reverse any irreversible reactions. About 1/2 point per fact.

(8)

- b. Draw Thiamine and Pyruvate and show how they would react to decarboxylate the Pyruvate.

(2)

3. a. Show the cyclic portion of the Urea Cycle. Draw all reactants and products, show cofactors, and name enzymes.

(7)

- b. Show how Phenylalanine can be converted into L-DOPA. Draw reactants and products, indicate cofactors. (From assigned Epinephrine biosynthesis)

(3)

4. a. Show the synthesis of Phosphoribosyl aminoimidazole (sometimes called PRAI or AIR) the first five-membered-ring in the Purine *de novo* Pathway. Start with PRPP. You do not have to name enzymes or compounds but you should show all structures (sticks are OK for Ribose) for reactants and products. You should also mention all cofactors. About 1 point per fact.

(7)

- b. Show how free Adenine would be "salvaged" by the Salvage Pathway – draw reactants and products (sticks are OK) and name enzyme. Explain briefly what ailments can result from a lack of recovery of purines.

(3)

5. a Show how dUMP is converted into dTMP, including the regeneration of cofactors. Draw reactants and products (using sticks for sugar) and indicate all cofactors.

(5)

- b.\* Complete the structures shown below:

N<sub>5</sub> Methyl THF

N<sub>5</sub>, N<sub>10</sub> Methylene THF

(2)

- c. How are nucleotides converted into 2'deoxy-ribonucleotides? Show an example of this reaction, name the enzyme and any cofactors. What does the universality of this reaction imply?

(3)