#### BIOLOGY 311C - Brand Spring 2010

NAME (printed very legibly)	KEY	UT-EID

### **EXAMINATION III**

Before beginning, check to be sure that this exam contains 8 pages (including front and back) numbered consecutively, and that you have been provided with a clean Answer Sheet. Then immediately print your name and UT-EID legibly at the top of this page. Also print and bubble in your name and your UT-EID (<u>not</u> your social security number) on the front of the Answer Sheet in the spaces provided. The first 45 questions are "multiple choice", with only one correct answer. Mark the letter corresponding to the correct answer to each of these questions in the appropriate location on the Answer Sheet, using a No. 2 pencil. Write answers to Questions 46 - 48 directly on this exam, in the spaces provided with the questions. Write in complete sentences if an explanation is required and <u>print</u> neatly if your handwriting is likely to be difficult to read. Turn in <u>both</u> this exam and the Answer Sheet after checking to be sure that your name is clearly written in both places and all questions have been answered in the appropriate locations. You must turn in your exam on or before 9:55 a.m.

- 1. The metabolism of a living cell refers to:
  - a. its ability to maintain a state of homeostasis.
  - b. its black-box properties.
  - c. the energy level of its molecular components.
  - **<u>d.</u>** the sum of its chemical reactions.

The next three questions refer to the reaction  $X \iff Y$ , which has a  $\Delta G^{\circ}$  value of 0.

- 2. The  $K_{eq}$  of this reaction is:
  - a. 0
  - **b.** 1
  - c. 5.7
  - d. 10
- 3. When allowed to proceed under standard conditions, this reaction is:
  - a. spontaneous.
  - b. exergonic.
  - c. endergonic.
  - **<u>d.</u>** neither exergonic nor endergonic.
- 4. The  $\Delta G^{\circ}$  of the reverse reaction ( Y = X ) is:
  - a. + 5.7 kJ/mole.
  - b. 5.7 kJ/mole.
  - <u>c.</u> 0.
  - d -1.
- 5. Which one of the following hydrolysis reactions would you expect to release the largest amount energy?

a. ATP 
$$\longrightarrow$$
 ADP + P<sub>i</sub>  
b. ATP  $\longrightarrow$  A + P  $-$  P  
c. ATP  $\longrightarrow$  AMP + 2 P<sub>i</sub>  
d. ATP  $\longrightarrow$  AMP + P  $-$  P

- 6. Which one of the following is <u>not</u> true of enzymes?
  - a. They are proteins.
  - **<u>b.</u>** They increase the  $E_A$  (energy of activation) of chemical reactions.
  - c. They have a domain that is called an active site.
  - d. Hundreds of different kinds occur in the same living cell.
- 7. Which one of the following is true of a monomeric enzyme that is heated just to a temperature such that it barely becomes denatured?
  - a. Only its primary structure is altered.
  - b. Its primary and secondary structures are altered, but not its tertiary structure.
  - **<u>c.</u>** Only its tertiary structure is altered.
  - d. Its primary and tertiary structures are altered, but not its secondary structure.
- 8. Hexokinase (the enzyme that catalyzes the first reaction of glycolysis) couples the phosphorylation of glucose with the:
  - **<u>a.</u>** hydrolysis of ATP.
  - b. reduction of  $NAD^+$ .
  - c. uptake of  $O_2$ .
  - d. capture of light energy.
- 9. An allosteric domain on an enzyme binds to a:
  - a. substrate.
  - b. cofactor.
  - **<u>c.</u>** regulatory molecule.
  - d. membrane surface.
- 10. A typical <u>competitive</u> inhibitor of an enzyme-catalyzed reaction becomes inhibitory when it binds to:
  - a. a substrate for the reaction.
  - b. an allosteric domain of the enzyme.
  - c. a membrane surface.
  - **<u>d.</u>** the active site of the enzyme.

11. An organic molecule that loses a pair of hydrogen atoms is said to be:

- a. oxidized.
- b. reduced.
- c. protonated.
- d. de-protonated.
- 12. The saturation of an unsaturated fatty acid is an example of a(n):
  - a. hydrolysis.
  - b. dehydration.
  - <u>c.</u> reduction.
  - d. isomerization.
- 13. The molecules  $NADP^+$  and FAD serve in cells as:
  - **<u>a.</u>** hydrogen-atom carriers.
  - b. "high energy" compounds.
  - c. information molecules.
  - d. enzymes.
- 14. Which one of the following metabolic pathways/processes occurs in the cytoplasmic matrix of eukaryotic cells?

- a. Pyruvate dehydrogenase
- **<u>b.</u>** Glycolysis
- c. The Krebs cycle
- d. Oxidative phosphorylation
- 15. A metabolic pathway may be defined as:
  - a. a set of distinct reactions, all of which use the same starting reactant.
  - b. a set of reactions that are incapable of occurring outside of a living cell.
  - **<u>c.</u>** a set of sequentially connected reactions in the same cellular compartment.
  - d. the sum of all reactions that occur within the same cellular compartment.
- 16. Which one of the following is <u>not</u> a substrate in the complete metabolic process of aerobic respiration?
  - **<u>a.</u>** Lactate
  - b. H<sub>2</sub>O
  - $c. \quad O_2$
  - d. P<sub>i</sub>
- 17. Which one of the following is oxidized in the complete metabolic process of aerobic respiration?
  - a. Oxygen
  - **b.** Sugar
  - c. Water
  - d. Carbon dioxide
- 18. Which one of the following is true of the investment phase (the first phase) of glycolysis?
  - a. Pyruvate is a product.
  - b. Pyruvate is a reactant.
  - c. ATP is synthesized.
  - **<u>d.</u>** ATP is hydrolyzed.
- 19. A final product of glycolysis is:
  - **<u>a.</u>**  $C_3$  molecules.
  - b. hexose phosphate.
  - c.  $Fe^{++}$ .
  - d. acetyl-CoA.
- 20. What feature of the cytoplasm of living cells causes a product of glycolysis to be pyruvate instead of pyruvic acid?
  - a. A specific enzyme in the cytoplasm catalyzes the synthesis of pyruvate instead of pyruvic acid.
  - b. The cytoplasm is a large compartment relative to other cellular compartments.
  - c. The cytoplasmic contents are exposed to the plasma membrane.
  - **<u>d.</u>** The cytoplasm is maintained at a pH near 7.
- 21. Phosphofructokinase (PFK) is an enzyme that catalyzes one of the intermediate reactions of glycolysis. It has to be an allosteric enzyme because:
  - a. its allosteric control lowers the  $\Delta G$  of the PFK-catalyzed reaction, so it can proceed in the forward direction.
  - **<u>b.</u>** glycolysis is a part of a metabolic pathway that branches just before the PFK-catalyzed reaction.
  - c. PFK is present at much lower concentration than the substrates to which it binds.
  - d. PFK is not very specific in the substrates it recognizes or the kind of reaction it catalyzes.
- 22. Which one of the following is a difference between fermentation and respiration of glucose?
  - a. fermentation does not include glycolysis.

- **<u>b.</u>** fermentation generates less ATP per glucose molecule.
- c. fermentation does not utilize glycolysis.
- d. fermentation occurs in the mitochondrial matrix.
- 23. A final product of ethanolic fermentation is:
  - <u>a.</u> CO<sub>2</sub>.
  - b. sugar phosphate.
  - c. H<sub>2</sub>O<sub>2</sub>.
  - d. Coenzyme A.
- 24. How many ATP molecules are synthesized and made available to the cell per molecule of fermented glucose?
  - a. 0
  - <u>b.</u> 2
  - c. 4
  - d. 36
- 25. Which one of the following is <u>not</u> a reactant of the pyruvate dehydrogenase pathway?
  - a. Co-A
  - b. Pyruvate
  - <u>c.</u> Citric acid
  - d.  $NAD^+$

26. Which one of the following is not a product of the Krebs cycle?

- a. ATP
- b. FADH<sub>2</sub>
- c. Carbon dioxide
- <u>**d.</u> NADP^+</u>**
- 27. How many carbon atoms are completely oxidized during each complete rotation of the Krebs cycle?
  - a. 0
  - <u>b.</u> 2
  - c. 6
  - d. 34

28. Mitochondrial electron transport and chemiosmosis together are called:

- a. cyclic electron flow.
- b. anaerobic respiration.
- **<u>c.</u>** oxidative phosphorylation.
- d. CAM metabolism.
- 29. Which one of the following mitochondrial compartments/components is <u>not</u> essential to ATP synthesis in mitochondria?
  - a. The inner membrane
  - **b.** The outer membrane
  - c. The intermembrane space
  - d. The matrix

- 30. Synthesis of ATP by chemiosmosis requires the capture of energy that is stored as:
  - a, an imbalance of hydrogen atom concentration on the two sides of a membrane.
  - **<u>b.</u>** an imbalance of proton concentration across a membrane.
  - c. GTP accumulated to a high concentration in the matrix of mitochondria or stroma of chloroplasts.
  - d. Cyclic ATP accumulated in the mitochondrias intermembrane space or in the chloroplast thylakoid lumen.
- 31. Chloroplast ATP synthase occurs:
  - a. in the stroma.
  - b. in the lumen of thylakoids.
  - **<u>c.</u>** within thylakoid membranes.
  - d. in the intermembrane space of the envelope.
- 32. The number of ATP molecules produced during the complete respiration of a molecule of glucose is approximately:
  - a. 2.
  - b. 8.
  - c. 24.
  - <u>**d.**</u> 38.
- 33. The only difference between aerobic respiration and anaerobic respiration is in the:
  - **<u>a.</u>** final reaction of the electron transport chain.
  - b. metabolic pathway that uses pyruvate as a reactant.
  - c. organelle within which these two processes occur (mitochondria vs. the cytoplasm).
  - d. initial substrate (glucose vs. triglycerides).
- 34. Which one of the following is <u>not</u> a product of the light reactions of photosynthesis?
  - a. NADPH
  - b. ATP
  - <u>c.</u> Sugar
  - $d. \quad O_2$
- 35. In serving as a solar collector, chlorophyll molecules are attached to transmembrane proteins by:
  - a. their  $Mg^{++}$  ions.
  - b. their polar ring structure.
  - **<u>c.</u>** their nonpolar tails.
  - d. attaching to the enzyme rubisco.
- 36. What is transferred among chlorophyll molecules immediately after a quantum of light is captured by a chlorophyll molecule, but before energy is trapped at the special chlorophyll pair?
  - a. Electrons
  - b. Protons
  - c. Neutrons
  - **<u>d.</u>** None of the above
- 37. During photosynthesis, the "special pair" reaction center chlorophyll causes energy to be briefly stored in the form of:
  - **<u>a.</u>** electrical charge separation.
  - b. a proton gradient.
  - c. ATP.
  - d. a reduced carbon compound.

- 38. Consider the terminology presented in lectures, where A<sub>1</sub>, A<sub>2</sub>, D<sub>1</sub> and D<sub>2</sub> represent the electron acceptors and donors of the reaction centers of Photosytem 1 and Photosystem 2, respectively. Then electron transport between the two photosystems occurs because electrons flow:
  - a. from  $A_1$  to  $A_2$ .
  - b. from  $D_1$  to  $D_2$ .
  - c. from  $D_1$  to  $A_2$ .
  - **<u>d.</u>** from  $A_2$  to  $D_1$ .

## 39. The strongest oxidizing agent generated in photosynthesis is:

- <u>**a.**</u>  $D_2^+$ .
- $\overline{b}$ .  $A_1^{-}$ .
- c. NADPH.
- d.  $H_3O^+$ .
- 40. NADP<sup>+</sup> reduction in chloroplasts occurs in:
  - **<u>a.</u>** Photosystem 1.
  - b. Photosystem 2.
  - c. cyclic electron transport.
  - d. the Calvin cycle.

# 41. ATP and NADPH are required for the dark reactions of photosynthesis in the ratio of:

- a. 1:1
- b. 2:1
- c. 3:1
- <u>**d.**</u> 3:2

42. A reactant of the carbon-fixation phase of the Calvin cycle is:

- <u>a.</u> CO<sub>2</sub>.
- b. hexose phosphate.
- c. ATP.
- d. chlorophyll.
- 43. Which one of the following is <u>not</u> true of the enzyme called rubisco?
  - a. It is the most abundant enzyme on earth.
  - b. It can use  $O_2$  as a substrate.
  - **<u>c.</u>** It is a highly efficient enzyme.
  - d. Its synthesis requires shared genetic information from two different cellular compartments.
- 44. Photosynthesis of  $C_4$  plants is expected to be more effective than photosynthesis of  $C_3$  plants under conditions of.
  - a. high carbon dioxide availability.
  - **<u>b.</u>** high light intensity.
  - c. low O<sub>2</sub> availability.
  - d. excess water availability.

## 45. CAM plants are adapted especially to conditions of:

- a. low carbon dioxide concentrations.
- **b.** low water availability.
- c. high light intensity.
- d. poor nutrient availability.

- 46. In the spaces provided below, list three characteristics that are typical of catabolic pathways, but are not typical of anabolic pathways.
- a.

Catabolic pathways result in the conversion of relatively large and/or complex initial reactants into smaller and/or simpler final products.

b.

Individual reactions of catabolic pathways often result in a substrate becoming more oxidized as hydrogen atoms are removed.

c.

Individual reactions of catabolic pathways pathway often release enough energy that a portion of the energy can be captured by the synthesis of ATP or can be stored in another form.

Also: The final products of catabolic pathways are generally of less potential value to the cell than was the starting reactant.

- 47. For each of the statements below, select the <u>one</u> best answer from the list at right and write the corresponding letter in the space provided.
  - i. \_\_**D**\_\_ Lactate is a product.
  - ii. A Produces  $O_2$  as a product.
  - iii. **B** Is catabolic.
  - iv. \_\_C\_\_ Is exergonic.
  - v. \_\_C\_\_ Utilizes an electron transport chain.
  - vi. \_\_C\_\_ Includes a cyclic metabolic pathway.

- A Characteristic of photosynthesis only
- **B** Characteristic of aerobic respiration only
- C Characteristic of both photosynthesis and aerobic respiration
- D Characteristic of neither photosynthesis nor aerobic respiration

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- 48.For each reaction or half-reaction shown below, select from the list at right the one best answer, and write the corresponding letter in the space provided.
  - i. <u>E</u> aldehyde  $\longrightarrow$  carboxylic acid
  - ii.  $_G_{\_}$  aldehyde  $\longrightarrow$  ketone
  - iii. \_\_D\_\_\_\_ ionization of a carboxylic acid to a carboxylate ion.
  - iv.  $\mathbf{F}$  Fe<sup>+++</sup>  $\longrightarrow$  Fe<sup>++</sup>
  - v. \_\_A\_\_\_ the reaction shown at right.

- **A** Dehydration
- **B** Hydrolysis
- **C** Protonation
- **D** Deprotonation
- **E** Oxidation
- **F** Reduction
- **G** Isomerization

