BIOLOGY 311C - Brand Spring 2008

NAME (printed very legibly) _____ Key ____ UT-EID _____

EXAMINATION 3

Before beginning, check to be sure that this exam contains 7 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 (not your social security number) on the front of the Answer Sheet in the spaces provided. The first 36 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 37 - 39 directly on this exam, in the spaces provided with the questions. Write in complete sentences if an explanation or a description is required. Print neatly if your handwriting is likely to be difficult to read. Turn in both this exam and the Answer Sheet after checking to be sure that your name is clearly written on both, 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 kind of bond in ATP that can be hydrolyzed to produce useful energy for the cell is a(n):
 - a. ester bond.
 - b. phosphodiester bond.
 - **c.** acid anhydride bond.
 - d. glycosidic bond.
- 2. Which one of the following molecules functions as a second messenger in eukaryotic cells?
 - a Insulin
 - b. DNA polymerase
 - c. cyclic AMP
 - d. ATP synthase
- 3. Which one of the following is a modification of normal photosynthesis that allows desert plants to take up carbon dioxide only at night, and then perform normal photosynthesis during the following Day?
 - a. CAM
 - b. C₃ photosynthesis
 - c. C₄ photosynthesis
 - d. Photorespiration
- Which one of the following is a process that results from the fact that RUBISCO can use O₂ as a substrate? 4.
 - a. CAM
 - **b.** Photorespiration
 - c. C₃ photosynthesis
 - d. C₄ photosynthesis
- 5. Which one of the following possible fates of the pyruvate is best described as an anabolic process?
 - a. Fermentation to a final product that is discarded from the cell
 - b. Further metabolism by aerobic respiration to a C₂ alcohol
 - c. Further metabolism by anaerobic respiration to CO₂
 - d. Conversion to an amino acid and incorporation into a protein

Consider a metabolic pathway: $A \xrightarrow{E_1} B \xrightarrow{E_2} C \xrightarrow{E_3} D$

- $\Delta G^{\circ} = +5 \text{ kJ/mole for the reaction catalyzed by } E_1$
- $\Delta G^\circ = -15 \text{ kJ/mole}$ for the reaction catalyzed by E_2
- $\Delta G^{\circ} = +5 \text{ kJ/mole for the reaction catalyzed by } E_3$

The following two questions pertain to this pathway.

- 6. Which one of the following statements must be true according to ΔG° values of the individual reactions? a. This pathway is endergonic under standard conditions.
 - **b.** This pathway is exergonic under standard conditions.
 - c. This pathway is anabolic under standard conditions.
 - d. This pathway is catabolic under standard conditions.
- 7. Which one of the substrates is most likely to serve as an allosteric inhibitor in feed-back inhibition?
 - a. A
 - b. B
 - c. C
 - <u>d.</u> D
- 8. Which one of the following is a hydrogen-atom (electron) carrier in all kinds of cells?
 - <u>**a.**</u> NAD^+
 - b. GDP
 - c. RNA
 - d. PS 1
- 9. A metabolic reaction with K_{eq} of 100:
 - **<u>a.</u>** is spontaneous.
 - b. is endergonic.
 - c. has a positive ΔG° value.
 - d. would not be expected to require an enzyme in order to proceed rapidly in the forward direction.

10. The double hydrolysis of ATP to yield AMP + 2 P_i would have a ΔG° value of:

- a. 0.
- b. +30 Kj/mole.
- c. -30 Kj/mole.
- <u>**d.</u>** -60 kJ/mole.</u>
- 11. Consider a molecule of DNA that is undergoing replication in a eukaryotic cell. If eighty (80) "origin of replication" sites are formed along the DNA, then how many replication forks (replication Ys) will be generated during replication of that molecule of DNA?
 - a. 1
 - b. 20
 - c. 80
 - <u>d.</u> 160
- 12. Which one of the following is the function of topoisomerase during DNA replication?
 - a. It keeps recently separated strands from coming back together and re-forming the double helix.
 - **b.** It prevents excessive supercoiling in front of the replication fork.
 - c. It identifies an origin of replication and initiates the process of separating the two polynucleotide chains of DNA.
 - d. It catalyzes the synthesis of a short segment of RNA complementary to a strand of DNA.

- 13. The function of the enzyme primase during DNA replication is to:
 - a. add the first deoxyribonucleotide to the new polypeptide chain.
 - b. separate the two strands of a molecule of DNA.
 - **<u>c.</u>** synthesize a short segment of RNA.
 - d. unwind the two strands of DNA.
- 14. In addition to its DNA polymerase function, the DNA replication complex:
 - **a.** replaces incorrectly inserted nucleotides.
 - b. catalyzes the synthesis of m-RNA.
 - c. catalyzes the synthesis of double-stranded RNA.
 - d. ligates (covalently bonds) segments of DNA together along the lagging strand.
- 15. Which one of the following is <u>not</u> true of telomers found at the ends the DNA molecules in eukaryotic chromatin?
 - a. They get shorter with each DNA replication cycle.
 - **b.** They contain code for useful genetic information..
 - c. They may account for why many eukaryotic cells can replicate only a relatively few times.
 - d. They consist of multiple repetitions of short repeated sequences of DNA.
- 16. The hydrogen bonding between the nitrogen bases of an "A-T pair" require less energy to separate than the hydrogen bonding between the nitrogen bases of a "G-C pair" because the G-C pair:
 - a. has more bond energy per hydrogen bond than does an A-T pair.
 - b. is more hydrophobic than is an A-T pair.
 - c. is bulkier (larger in physical size) than is an A-T pair.
 - **<u>d.</u>** is held together by more hydrogen bonds than is an A-T pair.
- 17: Which one of the following is a <u>catabolic</u> pathway or process?
 - a. The synthesis of a polynucleotide from nucleotides
 - b. The Calvin Cycle
 - **<u>c.</u>** The Krebs cycle
 - d. The active transport of a a sugar across the plasma membrane
- 18. Which one of the following is <u>not</u> true of enzymes?
 - a. They are catalysts of metabolic reactions.
 - b. They speed up the rates of metabolic reactions.
 - **<u>c.</u>** They alter the ΔG° values of metabolic reactions.
 - d. They lower the energy of activation (E_A) of metabolic reactions.
- 19. Which one of the following is most often altered when an enzyme is denatured by placing it in a solution of too high a temperature or at an incorrect pH value?
 - a. The covalent bonding of atoms in the R groups of its amino acids
 - b. Its primary structure
 - c. Its secondary structure
 - <u>**d.**</u> Its tertiary structure
- 20. If two metabolic reactions occur in the same compartment of a cell and a product of one reaction is a reactant of the other reaction, then the two reactions are said to be:
 - **<u>a.</u>** loosely coupled together.
 - b. at equilibrium.
 - c. in homeostasis.
 - d. exergonic.
- 21. An allosteric domain of an enzyme:

- a. binds to a substrate molecule in preparation for a metabolic reaction.
- b. attaches the enzyme to a surface such as a membrane.
- **<u>c.</u>** is a regulatory site.
- d. is a binding site for a cofactor.
- 22. A competitive inhibitor of an enzyme:
 - **a.** binds to the enzyme's active site.
 - b. binds to an allosteric site of the enzyme.
 - c. binds to a cofactor during the enzymatic reaction.
 - d. does not bind to the enzyme.
- 23. Which one of the following is most reduced (in chemical sense)?
 - a. An aldehyde
 - b. An alcohol
 - c. A carboxylic acid
 - **<u>d.</u>** A saturated hydrocarbon
- 24. Which one of the following is a final <u>signal response</u> of a signal transduction pathway initiated by a signal received from outside the cell?
 - a. Binding of insulin to a receptor on the plasma membrane
 - b. Synthesis of cyclic AMP
 - **<u>c.</u>** Activation of an allosteric enzyme
 - d. Replacement of GDP by GTP on a G protein
- 25. When the overall process of respiration is written as a single equation, it demonstrates that glucose is:
 - a. phosphorylated.
 - **<u>b.</u>** oxidized.
 - c. hydrolyzed.
 - d.. esterified.
- 26. During the investment phase (the first 5 metabolic reactions) of glycolysis:
 - **a.** ATP is hydrolyzed to ADP.
 - b. ATP is synthesized.
 - c. NAD^+ is reduced.
 - d, NADH is oxidized.
- 27. Substrate enters the Krebs cycle as:
 - a. pyruvate.
 - **<u>b.</u>** C₂-CoA.
 - c. glucose-6-phosphate.
 - d. ethanol.

28. The number of ATP generated per glucose molecule utilized during respiration in prokaryotic cells is:

- a. 12.
- b. 18.
- c. 30.
- <u>**d.**</u> 38.

- 29. The number of molecules of ATP required to produce one molecule of hexose during the operation of the Calvin Cycle is:
 - a. 12.
 - <u>b.</u> 18.
 - c. 30.
 - d. 38.

30. Which one of the following is most closely associated with Photosystem 2 of photosynthesis?

- a. The reduction of $NADP^+$
- **<u>b.</u>** The oxidation of H_2O
- c. The reduction of Carbon Dioxide
- d. Photorespiration
- 31. Which one of the following is most closely associated with Photosystem 1 of photosynthesis?
 - **<u>a.</u>** The reduction of $NADP^+$
 - b. The oxidation of H_2O
 - c. The fixation of CO₂
 - d. Photophosphorylation
- 32. Which one of the following processes of photosynthesis is <u>not</u> also a process of respiration? <u>a.</u> Primary electrical charge separation
 - b. Electron transport
 - c. ATP synthesis via a rotating ATP synthase
 - d. Generation of a difference in proton concentration across a membrane
- 33. During which phase of the cell cycle must a eukaryotic cell make the irreversible decision whether to prepare to divide again or else to mature?
 - <u>a.</u> G₁
 - b. G₂
 - c. S
 - d. M
- 34. The term cytokinesis (as used in cell biology) refers to:
 - a. mitosis.
 - b. meiosis.
 - c. DNA synthesis.
 - <u>d.</u> cell division.
- 35. Which one of the following events is not a part of the central dogma of molecular biology?
 - a. DNA replication
 - b. Transcription
 - <u>c.</u> Translocation
 - d. Translation

36. The net number of NADH generated during the lactate fermentation of one molecule of glucose is:

- <u>a.</u> 0.
- b. 1.
- c. 2.
- d. 6.

37. For each of the reactions or half-reactions shown below, determine which category from the list best describes it, and write the corresponding letter in the space provided.



- 38. For each word or expression below, select the <u>one</u> best answer from the list at right and place the corresponding letter in the space provided. Items at right may be used more than once.
 - i. A_Hexokinase
 - ii. <u>I</u> RUBISCO
 - iii. <u>I</u> Produces sugar as its final product.
 - iv. __A__ Uses sugar as its initial reactant.
 - v. **__G**_ Oxidizes water to O₂.
 - vi. $_F_$ Utilizes chlorophyll.
 - vii. **___G__** Generates NADPH as a final product.
- viii. __A_ Phase 1 requires ATP; Phase 2 generates ATP.
- ix. __H_ Spinning ATP synthase in thylakoids generates ATP
- x. __C_Products are CO₂, NADH and FADH₂.
- xi. \mathbf{B} A cluster of several enzymes bound together (multienzyme complex) in the mitochondrion
- xii. <u>**H**</u> ATP synthesis resulting from cyclic electron transport

- A. oxidation
- B. reduction
- C. hydrolysis
- D. dehydration
- E. protonation
- F. deprotonation
- G. isomerization
- H. none of the above

- A. Glycolysis
- B. Pyruvate dehydrogenase
- C. Krebs cycle (Citric acid cycle)
- D. Mitochondrial electron transport
- E. Oxidative phosphorylation
- F. Photosynthetic light harvesting
- G. Photosynthetic electron transport
- **H**. Photophosphorylation
- I. Calvin Cycle

39. In each space provided, print the name that best fits the description.

- a. **Hexokinase** The name of the enzyme that catalyzes the first reaction of glycolysis
- b. **NADP⁺** The abbreviated name name of the hydrogen-atom-carrier molecule that transfers reducing units from the light reactions of photosynthesis to the Calvin cycle
- c. **pol III** The name of the major enzyme that catalyzes the incorporation of deoxyribonucleotides into a new strand of DNA during replication
- d. **Oxidative phosphorylation** The name of the process that uses the energy of oxidation/reduction reactions in the inner membrane of mitochondrial to produce ATP
- e. **Protein kinase (PK)** The name of a class of enzymes used in many signal transduction pathways that transfers a phosphate functional group from ATP to a protein
- f. *Histone* The name of the kind of protein which eukaryotic nuclear DNA binds to and wraps around in order to organize the DNA
- g. **Hormone** The name of a type of molecule that is produced in one kind of cell of a multicellular organism, and elicits a response in another kind of cell of that same organism
- h. *Helicase* The name of the enzyme that separates the two strands of DNA at the replication fork during replication