

Friday, October 15, 2004

**Scantron Instructions:**

1. Make sure you have a 100 question, GREEN form!!
2. Use a #2 or HB pencil to complete the form.
3. Write in your name, exam #, and I.D. # on BOTH the scantron & the examination.
4. Fill-in the entire rectangle for the answer you choose.

M/C = \_\_\_\_\_ / 54

Fill-in = \_\_\_\_\_ / 19

Essays = \_\_\_\_\_ / 30

**Total = \_\_\_\_\_ /100**

**READ ALL QUESTIONS THOROUGHLY. FOR ALL M/C questions, PICK THE BEST ANSWER.**  
**37 QUESTIONS, 2, 3 or 15 POINTS EACH; 100 points total. (4 total pages = 2, double-sided sheets)**  
**RELAX, CONCENTRATE, AND GOOD LUCK!!**

**\*\*\* IMPORTANT: Turn-in BOTH your signed Scantron and your signed copy of the Exam.**

1. If  $\Delta G$  of a chemical reaction is negative and the change in entropy is positive, what can you conclude about the reaction?
  - a. It will not reach equilibrium
  - b. It requires energy
  - c. It is endergonic
  - d. It is exergonic
  - e. It decreases the order in the system
2. The active site of an enzyme speeds up biochemical reactions by all of the following, EXCEPT....
  - a. Orienting substrates for efficient reactivity
  - b. Straining substrates for efficient reactivity
  - c. Driving the equilibrium of the reaction farther to the "right" of the equation
  - d. Reducing the energy "hump" that must be overcome for a reaction to proceed
  - e. Coupling of an energy-releasing reaction to an energy-absorbing reaction.
3. Which of the following statements is NOT true about branchpoint enzymes that catalyze the committed step in one branch of a metabolic pathway?
  - a. They often have regulatory regions outside of the active site that are bound by non-substrate molecules
  - b. They are often positively regulated by the end product of an alternative metabolic pathway
  - c. They are often negatively regulated by the end product of their own pathway
  - d. They can be negatively regulated by competitive inhibition at the active site.
  - e. They have a rigid, inflexible tertiary structure and bind substrate by a specific "Lock and Key" mechanism
4. Which of the following is an Endergonic process that must be driven by coupling to an Exergonic process?
  - a. The flow of hydrogen protons from the mitochondrial intermembrane space into the matrix
  - b. The passage of electrons from cytochrome oxidase to  $O_2$  to form  $H_2O$ .
  - c. The addition of two phosphate groups to sugar intermediates during the first 5 steps of glycolysis.
  - d.  $ATP \rightarrow ADP + Pi$
  - e. Getting out of bed on a Monday morning. ☺
5. Where is the location of the enzymes and reactions of glycolysis in a eukaryotic cell?
  - a. The plasma membrane
  - b. The cytoplasm
  - c. The mitochondrial matrix
  - d. The mitochondrial inner membrane
  - e. The mitochondrial outer membrane
6. When a molecule loses hydrogen atoms (not hydrogen ions/protons), it becomes
  - a. Reduced
  - b. Oxidized
  - c. Redoxed
  - d. Hydrogenated
  - e. Hydrolyzed
7. During glycolysis, for each mole of glucose oxidized to pyruvate,
  - a. 6 moles of ATP are produced.
  - b. 4 moles of ATP are used, and 2 moles of ATP are produced
  - c. 2 moles of ATP are used, and 4 moles of ATP are produced.
  - d. 2 moles of  $NAD^+$  are produced
  - e. No ATP is produced
8. Which of the following is produced during the citric acid (TCA) cycle?
  - a. FAD
  - b. Pyruvate
  - c. Reduced electron carriers
  - d. Lactic acid
  - e. Really tasty orange juice! ☺

9. Animals breathe in air containing oxygen and breathe out air with less oxygen and more carbon dioxide. The carbon dioxide comes from
- The carbon from hydrocarbons and the oxygen from the air
  - The citric acid cycle (TCA) and pyruvate oxidation
  - Glycolysis
  - The Electron Transport Chain
  - All of the above
10. According to the Chemiosmotic Theory, the energy for the synthesis of ATP during the flow of electrons down the respiratory chain (ETC) to  $O_2$  is provided directly by the
- Hydrolysis of GTP
  - Reduction of  $NAD^+$
  - Diffusion of protons
  - Hydrolysis of ATP
  - Reduction of FAD
11. In human cells (muscle cells), the fermentation process produces
- Lactic acid
  - 12 moles of ATP
  - Pyruvic acid
  - An excessive amount of energy
  - Intoxicated partiers at Castro Street. ☺
12. Which of the following molecules carries the most free energy during cellular metabolism?
- ADP
  - ATP
  - $FADH_2$
  - $NADH + H^+$
  - Dilithium crystals ☺
13. Pyruvate oxidation and the TCA cycle together produce 8  $NADH + H^+$  and 2  $FADH_2$  per glucose. How many ATP can be generated from these electron carriers in the ETC and ATP Synthase?
- 10 ATP
  - 20 ATP
  - 30 ATP
  - 28 ATP
  - 22 ATP
14. The light reactions provide the Calvin–Benson cycle with
- protons and electrons.
  - $CO_2$  and glucose.
  - water and photons.
  - light and chlorophyll.
  - ATP and NADPH.
15. The net energy outcome of cyclic electron flow is
- ATP.
  - ATP and NADH.
  - NADPH.
  - ATP and NADPH.
  - Sugar.
16. During  $CO_2$  fixation,  $CO_2$  combines with
- NADPH.
  - 3PG.
  - G3P.
  - water.
  - 1,5-ribulose bisphosphate (RuBP).
17. In  $C_4$  plants, the function of the four-carbon compound that is synthesized in the mesophyll cells is to
- reduce  $NADP^+$ .
  - combine with  $CO_2$  to produce glucose.
  - carry  $CO_2$  to the bundle sheath cells.
  - drive the synthesis of ATP.
  - close the stomata.
18. Which of the following statements about photosynthesis is *false*?
- The water for photosynthesis in land plants comes primarily from the soil.
  - $CO_2$  is taken in, and water and  $O_2$  are released through stomata.
  - Light is absolutely necessary for the production of  $O_2$  and carbohydrates.
  - Photosynthesis is the reverse of cellular respiration.
  - All the  $O_2$  gas produced during photosynthesis comes from water.
19. What happens when a photon is absorbed by chlorophyll?
- Chlorophyll becomes “excited,” or energized.
  - A greater number of light wavelengths can be absorbed.
  - ATP is split into ADP, phosphate, and energy.
  - Hydrogen ions are released.
  - The molecule launches into a rendition of “I Feel Good!”, a la James Brown. ☺
20. Frederick Griffith’s experiments with virulent and avirulent pneumococcus demonstrated that
- DNA is the genetic material
  - Smooth bacteria are avirulent
  - A polysaccharide capsule is not required for virulence
  - Material from dead cells can transform the hereditary characteristics of nearby live cells
  - Mice REALLY need to cover their mouths when they cough! ☺
21. Semiconservative replication of DNA involves
- each of the original strands acting as a template for a new strand.
  - only one of the original strands acting as a template for a new strand.
  - the use of the original double-stranded molecule as a template.
  - None of the above
  - DNA synthesized by a rare collaboration between Democratic and Republican Parties. ☺

22. During Hershey and Chase's experiments infecting *E. coli* with bacteriophage T2,
- <sup>15</sup>N was detected in the pelleted bacterial cells
  - <sup>15</sup>N was detected in the culture supernatant.
  - <sup>35</sup>S was detected in the pelleted bacterial cells.
  - <sup>35</sup>S was detected in the culture supernatant.
  - <sup>32</sup>P was detected in the culture supernatant.
23. The various experiments that conclusively proved that DNA was the genetic material depended upon knowledge that
- Hydrolytic (degradative) enzymes are very specific in their choice of substrates
  - Phosphorus is contained in DNA and not in proteins
  - Sulfur is contained in proteins and not in DNA
  - Each class of macromolecule can be chemically separated from the others in a cell-free extract
  - All of the above
24. What is the order of each of the following enzymes' participation in DNA replication (synthesis)?
- |                       |
|-----------------------|
| 1. DNA Ligase         |
| 2. DNA Helicase       |
| 3. DNA Polymerase I   |
| 4. DNA Polymerase III |
| 5. RNA Primase        |
- 1-2-3-4-5
  - 3-4-2-5-1
  - 5-2-4-3-1
  - 2-5-4-3-1
  - 2-5-3-4-1
25. The enzyme DNA ligase is required continuously during DNA replication because
- fragments of the leading strand must be joined together.
  - fragments of the lagging strand must be joined together.
  - the parental strands must be joined back together.
  - 3'-deoxynucleoside triphosphates must be converted to 5'-deoxynucleoside triphosphates.
  - The molecules in the reaction suffer from Severe Codependence Anxiety, and must be kept together. ☺
26. When adding the next monomer to a growing DNA strand, the monomer is added to which carbon of the deoxyribose?
- 1'
  - 2'
  - 3'
  - 4'
  - 5'
27. One strand of DNA has the sequence 5'—ATTCCG—3'. The complementary strand for this is
- 5'—TAAGGC—3'
  - 5'—ATTCCG—3'
  - 5'—ACCTTA—3'
  - 5'—CGGAAT—3'
  - 5'—GCCTTA—3'

Fill-in the blanks with the appropriate terms (2-3 points each):

28. (3 pts.) The huge store of potential energy in the form of a concentration and charge gradient within the mitochondrial inner membrane, is called the \_\_\_\_\_.
29. (2) The regulation of an enzyme's activity by binding of a molecule to a site on the protein, separate from the active site, is called \_\_\_\_\_ regulation.
30. (2) During the light reactions of photosynthesis, protons are concentrated inside the \_\_\_\_\_ space within the chloroplasts.
31. (3) Carbon fixation in the Calvin-Benson cycle begins with the attachment and reduction of CO<sub>2</sub> to a molecule of the five carbon sugar, RuBP, by the enzyme \_\_\_\_\_ (the most abundant enzyme in the world).  
*[FYI: Cellulose, another plant product, is the most abundant biomolecule in the world!!]*
32. (3) The material that changed R strain pneumococcus into the virulent S strain was originally referred to by Griffith as the \_\_\_\_\_.
33. (3) Using Meselson and Stahl's experimental system for studying the mode of replication of DNA, researchers analyze the genetic information from a life-form from Mars. After the first round of replication, they see two distinct bands in the cesium chloride gradient: one close to the top of the tube, and one close to the bottom of the tube. This finding is consistent with \_\_\_\_\_ replication.
34. (3) The site on template DNA where replication begins is called the \_\_\_\_\_.

*Short Essays (30 pts total): Answer ONLY TWO of the following questions BRIEFLY but COMPLETELY. Use diagrams when helpful.*

35. (15 pts) Compare the pathways, and types and quantity of energy inputs and outputs, of aerobic respiration and fermentation in living organisms.

36. (15 pts) Briefly describe or diagram how photon energy is converted into ATP and high energy electron carriers in chloroplasts. Be sure to include cellular/subcellular locations of different reactions, and be specific about photosystems and reaction centers.

37. (15 pts) Describe 3 main pieces of evidence that lead Watson and Crick to solve the structure of DNA. What are 5 main characteristics of the structure of a DNA molecule, as determined by Watson and Crick, and their colleagues?