

**MBIO 2815 – Introduction to Microbiology**

Midterm 1 (125 points) -- Green

February 25, 2002

**Part I: Multiple choice, true-false, and matching (75 points = 3 points each)**

**True-false (mark A for true, B for false):**

1. Viruses and prions are considered Monera in Whittaker's classification system.
2. Enzymes are proteins that bind only to certain molecules in the cell.
3. A substance leaves a cell, although its concentration is already higher outside the cell than inside; the breakdown of ATP is needed for transport to occur. This scenario describes active transport.
4. ATP synthase is located in the inner mitochondrial membrane of eukaryotes, and in the plasma membrane of prokaryotes.
5. Hydrogen bonds are involved in the chemistry of H<sub>2</sub>, CH<sub>4</sub>, and the fatty acid tails of lipids.

**Multiple choice / matching**

6. Which of the following is NOT among the structures found in ALL cells?
  - a. plasma membrane to determine what goes in/out of the cell
  - b. DNA to store genetic information
  - c. mitochondria to make ATP
  - d. enzymes to speed up chemical reactions
  - e. ribosomes to produce proteins
7. Which scientist is most responsible for finally disproving the theory of spontaneous generation?
  - a. Koch
  - b. Spallanzani
  - c. Redi
  - d. Pasteur
  - e. Lister
8. The most hydrophobic molecule would be the one with the most:
  - a. C – O and C – N bonds
  - b. C – C and C – H bonds
  - c. N – H bonds
  - d. O – H bonds
  - e. ionic bonds
9. Which of the following correctly matches the polymer with its monomer?
  - a. amino acid – steroid
  - b. lipid – steroid
  - c. polysaccharide – fatty acid
  - d. nucleotide – nucleic acid
  - e. carbohydrate - protein

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Match the following (answers may be used more than once):

- a. pilus      b. endospore      c. glycocalyx      d. flagellum      e. a and c
10. Structure(s) that may help bacteria attach to solid surfaces.
  11. Structure(s) that help bacteria in genera *Bacillus* and *Clostridium* survive boiling or radiation.
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12. Which of the following statements is FALSE?

- a. A neutral (uncharged) atom has the same number of protons as electrons.
  - b. Bonds in which atoms share electrons are defined as covalent bonds.
  - c. The lower the number on the pH scale, the more acidic the solution.
  - d. A hydrogen bond is an attraction between two adjacent polar molecules.
  - e. Lipids such as fats and steroids are examples of hydrophilic molecules.
13. There are 20 amino acids essential to life. The difference between them is that they each have a different:
    - a. amino group
    - b. carboxyl group
    - c. nitrogenous base
    - d. fatty acid tail
    - e. side (R) group

14. Which of the following statements about the bacterial cell wall is FALSE?
- Gram-positive cells have more peptidoglycan in their cell walls than do Gram-negative cells.
  - Gram-negative cells have a membrane both inside and outside their cell walls.
  - Peptidoglycan consists of long polysaccharide chains cross-linked with amino acids.
  - The cell wall establishes a bacterium's shape as a coccus, bacillus, or spirillum.
  - All of the above statements about the bacterial cell wall are true.
15. Chemically, ATP most resembles a:
- phospholipid
  - cell
  - double helix
  - nucleotide
  - steroid
16. An organism that uses light as an energy source and organic molecules as a carbon source is a:
- chemoautotroph
  - chemoheterotroph
  - photoautotroph
  - photoheterotroph
17. Chloramphenicol is a drug that inhibits protein synthesis on prokaryotic (70s) ribosomes. Which of the following cells (or cell parts) would have protein synthesis inhibited if they were grown in the presence of chloramphenicol?
- bacteria
  - chloroplasts
  - mitochondria
  - a and c
  - a, b, and c
18. Glucose diffuses slowly through artificial phospholipid bilayers. The cells lining the small intestine, however, rapidly move large quantities of glucose from the glucose-rich food into their glucose-poor cytoplasm. Using this information, which mechanism is most probably functioning for the transport of glucose into the intestinal cells?
- simple diffusion
  - active transport
  - exocytosis
  - facilitated diffusion
  - osmosis
19. All of the following statements about glycolysis are true EXCEPT:
- Glycolysis involves oxidation-reduction reactions.
  - The enzymes of glycolysis are located in the cytoplasm of the cell.
  - Glycolysis can operate in the absence of  $O_2$ .
  - The end products of glycolysis are  $CO_2$  and  $H_2O$ .
  - Glycolysis makes ATP exclusively through substrate-level phosphorylation.
20. In chemiosmosis, the most direct source of energy that is used to convert  $ADP + P_i$  to ATP is energy released:
- as electrons flow through the electron transport chain.
  - from substrate-level phosphorylation.
  - from movement of protons through ATP synthase.
  - when  $FADH_2$  is converted to NADH.
  - when NAD is reduced to NADH.
21. Which of the following statements is FALSE?
- Fermenters may reduce pyruvate to ethanol +  $CO_2$ , lactic acid, or propionic acid.
  - The  $CO_2$  produced in respiration comes from the Krebs cycle.
  - The ATP produced in respiration comes mostly from chemiosmosis.
  - NADH and  $FADH_2$  function as electron carriers in metabolism.
  - No organism can carry out respiration in the absence of  $O_2$ .
22. So far, you have seen three student disease presentations, on cholera, hepatitis, and West Nile encephalitis. Which of those diseases is/are caused by a virus?
- cholera
  - hepatitis
  - West Nile encephalitis
  - a and b
  - b and c

23. The primary function of the light reactions in photosynthesis is to:
- produce glucose from carbon dioxide and water.
  - produce ATP and NADPH.
  - produce NADPH for use in respiration.
  - use ATP to make glucose.
  - release the cell's excess energy in the form of short bursts of light.
24. Which of the following best describes the relationship between photosynthesis and respiration?
- Respiration is the exact reversal of all the biochemical pathways of photosynthesis.
  - Photosynthesis stores energy in glucose and respiration releases it.
  - Photosynthesis occurs only in plants and respiration occurs only in animals.
  - ATP molecules are produced in photosynthesis and used up in respiration.
  - Respiration is anabolic and photosynthesis is catabolic.
25. The O<sub>2</sub> liberated from plants during photosynthesis comes from:
- glucose
  - ATP
  - H<sub>2</sub>O
  - CO<sub>2</sub>
  - NADPH
26. **IMPORTANT! Please do not skip this question!** What color is your test form? Sadly enough, this doesn't count for three points, but I do need the information to make sure your test is scored using the correct key.
- green
  - yellow

Name: \_\_\_\_\_ ID#: \_\_\_\_\_

MC _____ / 75
SA _____ / 50
Total = _____ / 125

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Score (this page) \_\_\_\_\_ / 16 points

**Part II: Short answer (50 points)**

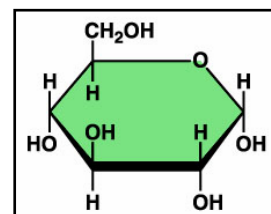
1a. In what way do Whittaker's and Woese's classification schemes treat prokaryotes differently? (2 pts)

b. In what way do the two systems treat eukaryotes differently? (2 pts)

2a. Describe the experiment Spallanzani did to help disprove the theory of spontaneous generation (2 pts).

b. Why were skeptics not convinced that this experiment definitively disproved the theory? (2 points)

3a. What type of molecule appears in the box at right? (1 point)



b. If you link many of these together by a reaction called \_\_\_\_\_, you will get a polymer called a(n) \_\_\_\_\_. Name one example of a *function* performed by such a polymer: \_\_\_\_\_ (3 points total).

4. Name any two functions of proteins in living organisms (2 points).

5. Give one example of a food preservation technique that works by denaturing bacterial proteins (1 pt).

6. Other than 70s ribosomes, give one example of a structural difference between prokaryotic and eukaryotic cells that has been exploited for the development of antibiotics (1 point).

Name: \_\_\_\_\_ ID#: \_\_\_\_\_

Score (this page) \_\_\_\_\_ / 17 points

7. Many types of disorders such as migraines and epilepsy have been traced to faulty ion channels in the patient's plasma membrane. Somehow, the inability to take in or expel certain ions triggers the disorders.

a. What type of molecule are the ion channels in a membrane made of? (1 point) \_\_\_\_\_

b. In the space below, sketch the overall structure (the "bilayer") of the plasma membrane -- you don't need to draw the individual atoms, just the overall layout of the molecules in a patch of membrane. Label the hydrophilic and hydrophobic areas of the membrane (3 points).

c. Why do ions need channels to cross the membrane, instead of just crossing over on their own? (2 pts).

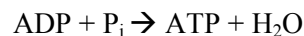
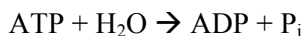
8. What is the endosymbiont theory, and what are three lines of evidence for the theory? (4 points)

9. If placed for too long in pure water, an animal cell will burst, although most bacterial cells will not.

a. Explain why pure water will force the animal cell to burst (2 points).

b. Explain why most bacterial cells will not burst (2 points)

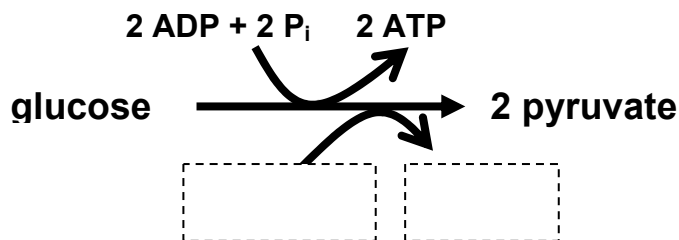
10a. Below are two chemical reactions involving ATP. Circle the reaction that represents hydrolysis (1 pt):



b. Give an example of a cell activity that would *require* ATP: \_\_\_\_\_ (1 pt)

c. Give an example of a cell activity that would *generate* ATP: \_\_\_\_\_ (1 pt)

11. Below is a figure that summarizes a particular process that is critical to metabolism in all living organisms. Look at the figure and answer the questions below:



a. Fill in the contents of the dashed boxes to show the other reactants and products (1 point total).

b. What is the name of the overall process depicted in the figure? (1 point)  
 \_\_\_\_\_

c. If this organism is a prokaryote using respiration, what will happen to the pyruvate next? (2 pts)

d. If this organism is a prokaryote using fermentation, what will happen to the pyruvate next? (2 pts)

12. What is the function of O<sub>2</sub> in aerobic respiration? (2 points)

13. In the light reactions of oxygenic photosynthesis, A is the electron source. At the end of the light reactions, the electrons end up in the molecule called B, which ends up reducing C to form glucose in the dark reactions (3 points total).

A = \_\_\_\_\_     B = \_\_\_\_\_     C = \_\_\_\_\_

14. In yesterday's *Norman Transcript* (really!) was an article about a "smart bandage", a product that would indicate whether the bacteria infecting a wound are gram-positive or gram-negative. According to the article, the adhesive's pores contain a synthetic chemical that changes color upon binding to a certain molecule that is characteristic of gram-positive or gram-negative bacteria.

What is a molecule that could be diagnostic for gram-negative bacteria? \_\_\_\_\_ (1 pt)

What is a molecule that could be diagnostic for gram-positive bacteria? \_\_\_\_\_ (1 pt)

15. So far, you have seen three student disease presentations, on cholera, hepatitis, and West Nile encephalitis. Choose any ONE of those diseases (if you were among the students presenting, you may NOT pick your own disease). For your chosen disease, briefly explain any TWO of the following: how the disease is transmitted, how the pathogen causes disease, disease symptoms, disease diagnosis, treatment options, or prevention (4 points)