

Midterm II - 16 May 2005

PART I. Multiple choice questions – (4 points each, 32 points total).

1. Considering the multitude of potential metabolic processes available to prokaryotes, which of the following is used to *best* describe specific types of **chemotrophic** metabolisms?
 - A. Energy source
 - B. Carbon source
 - C. Electron source
 - D. Hydrogen source
 - E. All of the above

2. Microbial **Growth** is best described as an increase in?
 - A. The size of the individual organism.
 - B. The number of colonies present on a plate.
 - C. The life span of individual cells.
 - D. The production of ultramicrocells.
 - E. The number of cells contained in a given habitat.

3. Which of the following structures is NOT found in a typical Gram negative cell wall?
 - A. Peptidoglycan cell wall
 - B. Periplasmic space
 - C. LPS layer
 - D. Teichoic acids
 - E. Core polysaccharides

4. Which of the following **energy and/or electron carriers** contains a nucleotide as part of its molecular structure?
 - A. $\text{NADP}^+ + \text{H}^+$
 - B. FADH_2
 - C. ATP
 - D. Acetyl CoA
 - E. All of the above

5. As prokaryotes are devoid of autonomous organelles, which of the following pathways occur exclusively within the **inner face of the cell membrane** (4 point bonus: name another and/or alternative pathway that occurs here)?
- A. glycolysis
 - B. fermentation
 - C. citric acid cycle aka TCA cycle
 - D. electron transport chain
 - E. none of the above
6. Which of the following environmental forcing functions affect cellular processes relating to the concept of **compatible solutes**?
- A. temperature
 - B. pressure
 - C. water activity
 - D. E_h
 - E. pH
7. Which of the following **electron donors** has the greatest potential to provide the largest amount of free energy?
- A. H_2S
 - B. H_2
 - C. O_2
 - D. Fe^{2+}
 - E. NH_4^+
8. **Two parts:** (A) Which fermentation pathway is using in the production of Swiss cheese? AND (B) Which fermentation pathway is carried out non-exclusively by *Zymomonas mobilis* (as opposed to yeast that do it exclusively)? Make sure to circle two answers!
- A. Butanediol fermentation
 - B. Mixed acid fermentation
 - C. Ethanol fermentation
 - D. Lactic acid fermentation
 - E. Propionic acid fermentation
 - F. Acetone/Butanol fermentation

13. (8 points) Name two of the three key **pigments** used in photosynthesis by cyanobacteria. What is the advantage gained by having an accessory pigment?
14. (8 points) Consider the process of **reverse electron flow** in a phototroph. Explain when this process is necessary AND name a type of phototrophic organism that does not require it.
15. (8 points) What are the **three key features** of fermentation in general and what is the **primary problem** that arises as a result of glycolysis that fermentation attends to?
16. (6 points) Name an alternative pathway for fixing carbon other than the Calvin cycle and name the group of microorganisms that uses this pathway?

17. (18 points) For the following list of key **enzymes and/or molecular structures**. Your job is to name the group of microorganisms that has each characteristic enzyme and/or structure AND briefly describe how each might be used in that group's respective metabolic pathway.

Rusticyanin:

Corrinoids:

Soluble Hydrogenase:

Phosphofructokinase:

Archaeal-Rhodopsin:

Crotonyl-CoA:

18. (8 points) During what metabolic process are the **source of electrons** and the **source of energy** uncoupled, i.e., not the same?
19. (4 points) What is meant by **sulfur disproportionation**?

PART III. Short Essay – (Number of points in parentheses, 30 points total).

- 20.** (15 points) Consider the **Pasteur Effect**. (1) How does this concept apply to the utilization of glucose in terms of what metabolic pathways are possible considering the alternative outcomes? (2) How is the production of ATP numerically impacted and how does ATP get specifically made (name specific process)? (3) How do the possible alternative outcomes impact the accumulation of biomass?

21. (15 points) Consider the metabolic menu of microorganisms. (A) Compare and contrast the primary sources of energy, electrons, and carbon for the metabolic processes collectively known as **aerobic respiration** and **anaerobic respiration**. You should pick a specific pathway for each to make your point. (B) Describe what types of habitats might support each of these types of metabolic processes in nature. (C) In general, when it comes to the physical amounts of substrates that must get processed for a given amount of microbial growth, which of these two mechanisms is more efficient, i.e., requires less substrate?