BIOLOGY 345 **Name _____**
FINAL EXAM - 9 June 2005

PART I. Multiple choice questions – (4 points each, 32 points total). Single best answer!

1. Which following enzyme causes a modification to the original theory regarding the flow of information as it relates to the central dogma?

A. DNA directed RNA polymerase
B. reverse transcriptase
C. Aminoacyl-tRNA synthetase
D. DNA gyrase
E. restriction endonuclease

2. Which of these following microorganisms is a member of the domain *Archaea*?

A. *Escherichia coli*
B. *Bacteroides vulgatus*
C. *Lactobacillus acidophilus*
D. *Streptococcus mutans*
E. *Methanococcus vanneilii*

3. Which of the following is the most common population of microorganisms found in throughout the entire gastrointestinal tract of humans (lower numbers in stomach)?

A. *Escherichia coli*
B. *Bacteroides vulgatus*
C. *Lactobacillus acidophilus*
D. *Streptococcus mutans*
E. *Methanococcus vanneilii*

4. An organism that is capable of fixing carbon using only CO_2, using H_2 as its sole electron donor (an energy source), and O_2 as its sole electron acceptor, would be best described as which of the following:

A. photoautotroph
B. chemoautotroph
C. photoheterotroph
D. chemoheterotroph
E. mixotroph

5. Consider the unidirectional exchange of genetic information in microorganisms. Which of the following does not fit this general model of transmission?

A. transformation
B. specialized transduction
C. generalized transduction
D. conjugation
E. transcription

6. A deadly viral disease that has been completely eradicated (except for a couple of top-secret freezers) is which of the following?

A. lyme disease
B. plague
C. anthrax
D. chicken pox
E. small pox

7. High energy thioester bonds such as that used in acetyl-CoA are also known as sulfoanhydride bonds, which of the following metabolic processes are capable using this type of bond inside the cell?

A. Reduction reactions
B. Generation of amino acid charged tRNAs
C. Production of ATP
D. Peptide bond formation
E. All of the above

8. An organism that is capable of using acetate as a carbon source, using light as its primary energy source, sulfide and/or thiosulfide as an electron donor, and SO_4^{2-} as its electron acceptor, would be best described as which of the following:

A. photoautotroph
B. chemoautotroph
C. photoheterotroph
D. chemoheterotroph
E. mixotroph

PART II. Matching – (90 points total).

9. (3 points each) Considering the phases involved with bacterial **growth** within a population of cells in batch culture, match the characteristics and/or features in the left column with the appropriate phase in the right column by choosing letters A through D (pick a **single** best answer for each).

_____	Balanced Growth	**A. Lag Phase**
_____	Cryptic Growth	**B. Log Phase**
_____	Retooling with new enzymes	**C. Stationary Phase**
_____	Autolysins are abundant	**D. Death phase**
_____	Doubling times are shortest	
_____	Viable counts (CFUs) > Turbidity counts (OD_{600})	
_____	Turbidity counts (OD_{600}) > Viable counts (CFUs)	
_____	I left my plate of *E. coli* in the 37°C incubator for over a week.	
_____	A chemostat at equilibrium with high "μ" is most like?	

10. (3 points each) Indicate if the following characteristics describe exotoxins only (**e<u>X</u>o**), endotoxins only (**en<u>D</u>o**), or both exotoxins and endotoxins (**<u>B</u>oth**).

_____ Toxins that are more easily inactivated by heat.

_____ Toxins that are comprised of the lipid A component of the LPS layer.

_____ Toxins that are among the most lethal substances known.

_____ Toxins is capable of producing general systemic effects including fever.

_____ AB toxins are an example of these.

_____ True enterotoxins are an example of these.

11. (3 points each) Consider the following types of control mechanisms used for gene regulation in prokaryotes: **Quorum Sensing, Signal Transduction & Attenuation**. Name the specific type of control that is associated with the following set of characteristics (pick a **single** best answer for each, i.e., **QS, ST or Att**).

_____ Uses diffusible autoinducers like homoserine lactones.

_____ Uses three components to regulate porins in *Escherichia coli*.

_____ Uses a leader sequence downstream from the operator.

_____ Used to control the lux operon in *Vibrio fisheri*.

_____ Uses feedback from translation to control transcription.

_____ Uses a sensor kinase to transmit environmental cues.

12. (3 points each) Considering key enzymes associated with **metabolic pathways**, match the pathway in the right column with a key enzyme in the left column (pick a **single** best answer for each).

_____	ATP synthase	A. Glycolysis
_____	PFK (phosphofructokinase)	B. TCA or Krebs cycle
_____	Succinate dehydrogenase	C. Electron Transport System
_____	Cytochrome oxidase	D. Calvin cycle
_____	Pyruvate kinase	E. Fermentation
_____	Alcohol dehydrogenase	F. Ox/photo phosphorylation
_____	Rubisco (Ribulose bisphosphate carboxylase)	
_____	Methylmalonyl-CoA mutase	
_____	Membrane-bound hydrogenase	

PART III. Short answer questions – (Number of points in parentheses, 48 points total).

13. (6 points) Name two different enzymes that help **detoxify** when using O_2 as a terminal electron acceptor (make sure to include which **reactants AND products** that are used for each enzyme you choose)?

14. (6 points) If you were a phototrophic bacteria with **ferrodoxin** in your membrane, what special feature does this indicate that you are capable of doing?

15. Give a specific example of a **virulence factor** that represents **invasiveness** AND another that represents **toxigenicity**. Also, what is it that "in the end makes you sick" (i.e., causes disease)?

16. (6 points) What are two very different metabolic pathways that use **reverse electron flow** and ultimately what is the metabolic goal each is used for?

17. (6 points) The evolutionary advancement of the **porphyrin ring** was paramount to the development of what three major metabolic pathways AND what was the resulting molecular structure and corresponding metal is used in each?

18. (6 points) Briefly, what is the mode of action for the **cholera** enterotoxin. What type of therapy is most effective in treating this disease?

19. (6 points) Name and briefly describe three different **mechanisms** of antibiotic resistence used among bacteria.

20. (6 points) Name and briefly describe the mechanism of antibiotic mode of action that occurs when a bacterium is sensitive to **penicillin**. Briefly, how is growth affected?

PART IV. Short Essay – (30 points total).

21. (15 points) Consider the **global carbon cycle** in terms of the amount of CO_2 that exists within the atmosphere. **(A)** Describe why, on an annual basis, atmospheric CO_2 is cyclic in terms of what seasons correspond to the maximal and minimal levels, AND **(B)** why there is a greater deviation of atmospheric CO_2 in the northern hemisphere, AND **(C)** what microbial metabolisms are of primary importance to relative levels of atmospheric CO_2 in terms of contributing the annual highs and lows?

22. (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 (heterotrophic)** and **chemolithotrophic metabolism(s)**. You should pick a specific pathway for each to make your point. **(B)** Describe which of these pathways are considered to be the "best" in terms of efficiency and ATP production AND **(C)** which of these pathway(s) preceded the other in terms of evolutionary occurrence regarding free-living bacteria and what evidence can you use to support your claim?