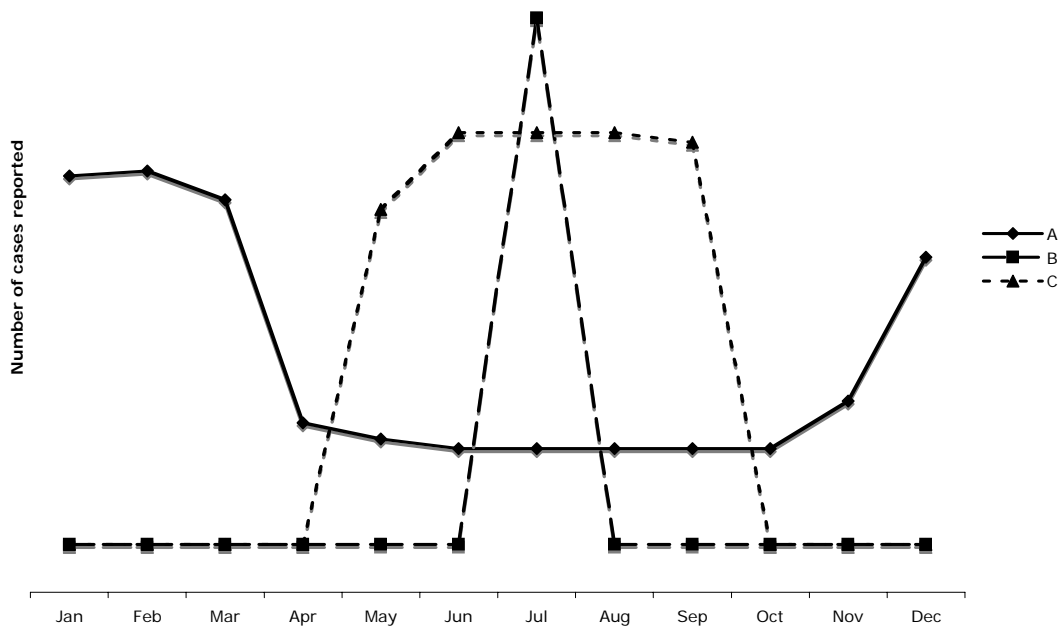


I. (9 points)



1. What is the mechanism for the transmission of disease represented by the different curves in the above graph:

A _____

B _____

C _____

2. Provide an example of a disease that corresponds to the different curves in the above graph:

A _____

B _____

C _____

List a potential containment plan for the diseases you listed in part 2 above:

A _____

B _____

C _____

II. (10 points) You are a doctor at an HMO in North Carolina. Your first patient is a young man with a painful lesion on his penis. You take a sample for microscopic examination and find a lot of spiral shaped bacteria. What disease is this likely to be?

How do you treat it?

What other diseases do you test him for?

- 1.
- 2.
- 3.
- 4.

As well as the original disease he also turns out to be positive for the most common bacterial infection for which you tested him.

Describe the life cycle of this organism.

III. (9 points) Your next patient is a young woman who has just returned from two years with the peace corps in Central America. She complains of nausea and being tired. She has a fever and her skin and whites of her eyes appear yellow. Name two **different** diseases which she might have and state the causative agent, the nature of the causative agent (e.g. Gram negative bacterium, ssRNA virus +strand segmented genome, etc.), and route of transmission for each.

disease	causative agent	nature of causative agent	route of transmission

How do you treat this disease?

IV. (10 points) Your third patient is an elderly man who is suffering from persistent watery diarrhea. He recently moved here from Montreal, Canada where he was hospitalized after a traffic accident. He got out of the hospital about 3 months ago. He has been treated with antibiotics for the diarrhea but they have only provided temporary relief from the disease. What organism do you suspect as the cause of this disease?

How do you determine if this is the organism responsible?

What are the principle virulence factors for this organism?

What are the conditions which favor a patient contracting this disease?

V. (7 points) Your next patient is a construction worker. While he was working he tripped over some loose building material and used his hands to try to break his fall. Unfortunately, he punctured his hand on some nails left on the ground where he was working. He has a headache, difficulty speaking and swallowing, and rigid abdominal muscles. What is this disease likely to be?

What causes the symptoms of this disease, i.e. what type of tissue does it affect and how?

How would you treat this disease?

VI. A. (4 points) Crown gall is a plant disease caused by a bacteria. The most notable symptom of the disease is the formation of tumors. Fill in the table with a yes or no if tumors will appear when the plants in the second column are exposed to the bacteria in the first column.

Bacterial Strain	Plant	Tumor Growth (Y or N)
Wild-type	Wild-type unwounded	
Mutant VirB which can no longer be phosphorylated	wild-type wounded	
Mutant VirB which is locked in the phosphorylated configuration	wild-type wounded on its root	
Has no functional <i>virA</i>	wild-type wounded on its root	
Has no functional <i>virA</i> and a VirB which is locked in the phosphorylated configuration	wild-type wounded on its root	

B.(4 points) The rotting of vegetables in refrigerators and on countertops is caused by a plant disease. What is this disease?

What are some of the major virulence factors involved in the disease?

You discover a mutant of the causative agent that is incapable of transporting proteins out of the organism. What effect will this mutation have on the virulence of this organism?

VII. (7 points) Many fruit crops that are grown in areas that experience all four seasons can be damaged by early spring freezes. This damage is caused by bacteria. Answer the following questions about this phenomenon.

Name one species of bacterium involved: _____

Describe its mechanism of infection.

Suggest a method that an orchard grower could use to protect his peach crop. Explain why your method would work.

VIII. (9 points) Fill in the following table.

	Initial electron donor	Final electron acceptor	Subcellular reaction location	Likely carbon source for bacteria using this reaction
Cyclic photophosphorylation				
Non-cyclic Anaerobic Photosynthesis				
Oxygenic Photosynthesis				

IX. (7 points) Fill in the following table describing the expected phenotypes resulting from the interactions of the indicated bacteria and plants. Answer yes or no.

bacterium and genotype	plant and genotype	Are nodules formed?	Is nitrogen fixed?
<i>Rhizobium leguminosarum</i> (wild type pea strain)	wild type peas		
<i>R. leguminosarum</i> wild type	wild type alfalfa		
<i>Sinorhizobium meliloti</i> (wild type alfalfa strain)	alfalfa legume hemoglobin minus		
<i>S. meliloti eps</i> ⁻ mutant which can not make proper polysaccharide to make an infection thread	wild type alfalfa		
<i>S. meliloti nifHDK</i> ⁻	wild type alfalfa		
<i>S. meliloti nodABC</i> ⁻	wild type alfalfa		
<i>S. meliloti eps</i> ⁻ and <i>S. meliloti nifHDK</i> ⁻ mixed	wild type alfalfa		

X. (15 points) Complete the table with the major reason why prokaryotes carry out the following reactions, and provide an example of a prokaryote that performs the reaction.

Reaction	Major reason for the reaction	Example of a prokaryote that performs the reaction
Fermentation		
$O_2 \rightarrow H_2O$		
$NO_3^- \rightarrow NO_2^-$		
Anaerobic photosynthesis (noncyclic)		
$CO_2 \rightarrow C(H_2O)$		
Cyclic photophosphorylation		
$NO_2^- \rightarrow NO_3^-$		XXXXXXXXXX
Nitrogen fixation		

XI. (9 points) The EPA has asked you to look into the microorganisms found in a lake which appears to be polluted. How would you determine each of the following for the bottom layer in the lake? (Give the method but not all of the details or procedure, for example it is adequate to say that to determine whether *E. coli* was able to break down lactose you could measure β -galactosidase activity using ONPG or X-gal).

a. The diversity of eubacteria and archaea living there.

b. Whether any of the organisms living there were capable of nitrogen fixation using a *nifHDK* type system.

c. Whether any of the organisms living there were actually fixing CO₂.

d. Whether an unusual organic compound found only at the lake bottom was produced by living organisms or was a pollutant from a chemical industrial process.

True or False (circle one) Although it may be difficult, you can grow most bacteria found in nature in the laboratory.