Multiple choice 20 points (2 points each)

1. Transformation does not involve
   A. uptake of DNA
   B. competent cells
   C. the restriction-modification system
   D. cell to cell contact
   E. physical substitution of part of the recipient DNA by donor DNA

2. For full expression of the trp operon, the cell needs to have
   A. a leader sequence with two or more trp codons
   B. a high level or tryptophane
   C. a low level of tryptophane
   D. A and B
   E. A and C

3. The mutagen nitrosoguanidine is an example of:
   A. An alkylating and/or intercalating agent
   B. An radiation agent
   C. An amino analogue
   D. A base analogue
   E. A haloquine

4. The formation of antigen-antibody complexes that lead to acute glomerulonephritis can occur after infection with:
   A. Streptococcus pyogenes
   B. Staphylococcus aureus
   C. Bordetella pertussis
   D. Chlamydia trachomatis
   E. Helicobacter pylori

T  F  20 points (2 points each)

1. The hisA gene produces a protein designated HisA.
2. The ability of a organism such as Streptococcus pneumonia to cause disease requires a large number of microbes in the initial infection.
3. Listeria and Shigella each produce a protein that polymerizes actin within the human host cell, enabling these organisms to move from cell to cell.
4. Sebaceous glands on the skin secrete fatty acids and lactic acid which lower the pH of the skin, encouraging the growth of many pathogens.
5. Yeast infections in the vaginal tract can result if antibiotic treatment kills the bacterium Lactobacillus acidophilus.
6. All insertions result in a frameshift mutation.
7. People acquired Lassa virus from ingestion of cooked rat meat in restaurants in Sierra Leone.
8. Whooping cough is caused by Borrelia recurrensis.
9. Enzymes subject to allosteric inhibition have one binding site which is occupied by the substrate, but if product builds up, this site is occupied by the allosteric inhibitor.
10. The scarlet fever rash results from infection with strains of Streptococcus pyogenes infected with a bacteriophage.
5. Which of the following is **not** a host resistance factor?
   A. macrophages
   B. skin
   C. inflammation
   D. peptidoglycan cell wall layer
   E. interferon

6. Invasion of host tissue by pathogens is facilitated by the production of enzymes which destroy tissue components. Which of the following correlates highly with the virulence of *Staphylococcus aureus*?
   A. necrotizing fasciitis
   B. streptokinase
   C. oxidase
   D. hepatolyase
   E. coagulase

7. *Clostridium botulinum* produces a toxin which:
   A. causes flaccid paralysis
   B. is composed of seven related toxins
   C. blocks release of acetylcholine
   D. A and B
   E. A, B, and C

8. In which of the following infectious diseases caused by bacteria does invasiveness play essentially no major role?
   A. diphtheria
   B. listeriosis
   C. bacterial pneumonia
   D. tuberculosis
   E. syphilis

9. Which of the following infections result after transmission by an arthropod or insect vector?
   1. legionellosis (Legionnaire’s disease)
   2. pertussis
   3. the plague
   4. Rocky Mountain spotted fever
   5. lyme disease

   A. 1,2,3,4,5
   B. 2,3,4,5
   C. 3,4,5
   D. 1,2,3,4
   E. 1,2,5

10. The organism implicated in ulcers and stomach cancer is:
    A. *Listeria pyogenes*
    B. *Legionella amophila*
    C. *Helicobacter pylori*
    D. *Hansenella ulurei*
    E. *Hemophilus aegypticus*

**Short answer (30 points)**

1. (3 pts) Name or draw three different structural motifs found in most DNA binding proteins.
   1. 
   2. 
   3. 

2. (3 pts) Name three factors that contribute to the spread of disease. In other words, why are we seeing an increase in the spread of certain diseases?
   1. 

3. (5 pts) These questions deal with sexually-transmitted diseases. The Gram-negative diplococcus (kidney-bean shaped) that shows tropism for urogenital tissues is ____________________  ____________________.

An infection that cannot be cured, but can be treated with acyclovir, is caused by the __________________ virus.

Aside from death, name two serious complications that can result from sexually-transmitted disease.
1. 
2. 

4. (3 pts) Compare endotoxin and exotoxin

<table>
<thead>
<tr>
<th></th>
<th>Endotoxin</th>
<th>Exotoxin</th>
</tr>
</thead>
<tbody>
<tr>
<td>sensitivity to heat</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ability to activate the immune response</td>
<td></td>
<td></td>
</tr>
<tr>
<td>give the genus and species name of an organism that produces this type of toxin</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

5. (3 pts) The organism that causes the disease known as BLACK DEATH (bubonic plague) is ____________________  ____________________.

(genus)                        (species)

How is the pneumonic form of the plague transmitted to humans? __________________________

6. (4 pts) Name two types of obligate intracellular parasites and give an example of a disease caused by each.

<table>
<thead>
<tr>
<th>Type of parasite:</th>
<th>disease caused:</th>
</tr>
</thead>
</table>

7. (8 points) What is food infection and how is it different than food poisoning?

Give the genus name of a bacterium that can cause food infection and the specific type of food most often associated with this organism.

Give the genus name of a bacterium that can cause food poisoning and the specific type of food most often associated with this organism.

Name a virus that causes food infection and the type of food that can be contaminated with this virus.

8. (1 pt) Give an example of a fungal infection that affects the skin.
Fill-in (20 points, 2 points each)
The uptake of DNA as a free molecule is called __________________________which was first demonstrated by Avery, McCleod and McCarty who were working with *Streptococcus pneumoniae*.

When DNA is transferred from cell to cell using a **bacteriophage**, this process is called ________________.

*Pseudomonas aeruginosa* is an opportunistic pathogen that produces a _______________ that helps it to adhere to medical devices and to resist antibiotics.

Infection with Group A streptococcus can result in an autoimmune disease called ________________.

A close relative of this organism is an alpha hemolytic streptococcus that causes lung and ear infections. The name of this organism is ________________ and it can evade host defenses because it produces a _______________ which can be seen after staining with India ink.

If someone is bitten by a wild animal, it is necessary to try to capture and kill the animal, then examine brain tissue for ________________, which indicate infection with the rabies virus.

A mutation that changes the DNA sequence of a gene but does not change the amino acid sequence of the gene product is called a ________________ mutation.

A toxin that acts specifically on the cells of the intestine is called a ________________.

The ________________ is the word that describes the physical characteristics that result from the genotype.

**ESSAY (35 pts)**

1. (4 pts) You are doing fall cleaning in your outdoor shed which is used to store wood and garden tools. While you are furiously sweeping out the mouse droppings, you cut your foot on a piece of glass. A few days later, you find you are having a difficult time breathing and you find that your foot is red and large sections of skin are being destroyed at a rate of 1 cm per hour. Then you die. The coroner finds some Gram positive organisms in your foot, and your lungs are full of fluid, but there are no signs of microbes in your lungs.

What infectious agent caused your lungs to fill with fluid and where did it come from?

What agent likely caused the infection in your foot and how could it cause such damage?

2. (4 pts) What are superantigens and how do they affect the body?

Give an example of an organism that produces a superantigen.

3. (2 pts) For several months, an IV-drug user from the City has had an infection and a nasty cough. Chest X-rays show that she has dark lesions in the lungs. Although the lab has waited for 2 weeks, it is unable to grow the organism that is seen in microscopic samples of sputum. The physician prescribes isonicotinic acid hydrazide. Based on these data, what organism you think is causing the infection?
4. (6 pts) In the 250 lab, four students isolated *Corynebacterium diphtheriae* from their throats in October, but they were not sick. During finals, all four of these students were very stressed and were skipping meals. Two of the students became ill with diphtheria.

Based on your knowledge of *C. diphtheria* and its virulence mechanism, what factor or factors caused the illness to appear and why did only two of the students come down with the disease? (For full credit, you need to explain how the organism causes the disease)

What did the physician see in the throats of the ill students that suggested that the infectious agent was *C. diphtheria*?

5. (8) You are growing *Bordetella pertussis* at 30°C and find that the virulence factors associated with the disease are not produced at this temperature, but are produced at 37°C. [How can activities inside the cell detect external changes?] What type of regulatory system is controlling the production of these virulence factors and explain how it works.

6. (6 pts) You are working with several *E. coli* mutants that are Lac". Here are the results you have obtained for four of these mutants. Using these results, indicate what is wrong with each mutant. For full credit, you must justify your answer.

Mutant A makes a protein that is exactly the same size as ß-galactosidase (116 kilodaltons) and this protein only appears on protein gels when the cells are grown without glucose and in the presence of lactose. When you perform the ß-galactosidase assay but the enzyme has no activity. What is going on?
You have grown Mutants B, C, and D on glucose, lactose and glucose + lactose and you obtain the following results after growing the cells for 24 hrs. For comparison, the results for the wild-type strain are shown also.

<table>
<thead>
<tr>
<th></th>
<th>cells grown on 1% glucose</th>
<th>cells grown on 1% lactose</th>
<th>cells grown on 1% glucose + 1% lactose</th>
<th>What gene has been mutated?</th>
</tr>
</thead>
<tbody>
<tr>
<td>wild-type</td>
<td>50</td>
<td>5000</td>
<td>3000</td>
<td>none</td>
</tr>
<tr>
<td>B</td>
<td>0</td>
<td>5</td>
<td>0</td>
<td>none</td>
</tr>
<tr>
<td>C</td>
<td>1000</td>
<td>5000</td>
<td>4000</td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>50</td>
<td>2500</td>
<td>2500</td>
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</tbody>
</table>

4. (5 pts) You are working in Nicaragua helping clean up after hurricane Mitch. There has been massive flooding. You drink water in the local restaurant and subsequently develop a severe diarrhea.

What organism might be causing this disease? ______________________ ______________________ (genus) (species)

What does this organism produce that causes the diarrhea and how does it work?

Describe the reaction that occurs in your body.