Name ______________________________________________________

First       Last
(Please Print)

PID Number __________ - __________

HOUR EXAM III

BIOLOGY 422

FALL, 2013

In the spirit of the honor code, I pledge that I have neither given nor received help on this exam.

____________________________
Signature

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2________

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9________

10________
1. (10 points) You are working as a doctor in a clinic in North Carolina. A patient arrives who is a man in his twenties who recently returned from vacation in the Mid-West. The patient presents with sudden, extreme swelling of the lymph nodes in his armpits and groan that began with swelling of a lymph node in his leg. He is also experiencing high fever, chills, headache, and weakness. Upon further questioning, you determine that, while in the Mid-West, he bought a prairie dog as a pet from a man selling them out of the back of his truck.

   A. What disease does the patient have? (2 points) __________________________________________

   B. Which form of the disease is the patient experiencing? (1 points) __________________________

   C. What is the causative agent of this disease? (1 points) _________________________________

   D. How should you treat the patient? (3 points)

   _________________________________________________________________

   E. How did the patient acquire the disease and what steps should be taken to prevent infection of the patient’s family and friends? (3 points)

   How: ____________________________________________________________________________

   Prevention: ________________________________________________________________________
2. (11 points) Another male patient in his twenties arrives at the clinic and presents with single firm, round sore on his penis. Because the sore does not hurt, he let it go for several weeks before coming in. However, he has now developed a fever and a rash on his palms and the soles of his feet. The rash consists of red spots and does not itch. In a patient history, he reports that he has had unprotected sex several times in the last few months.

A. What disease does the patient have? (2 points) __________________________________________________________________________

B. Explain briefly what the consequences would be if the patient does not get treatment. (2 points)

C. How would you treat the patient? (1 point) __________________________________________________________________________

D. As patients often have more than one STD you decide to also test for some other possible infections. You notice that the patient has previously contracted gonorrhea, was treated with antibiotics, and the infection was resolved. (2 points)

Given the patients previous history of gonorrhea, would you test for gonorrhea now? _______

Why or why not? __________________________________________________________________________

E. List two other diseases for which you would also test the patient and briefly state why you would do this testing (4 points)

1. __________________________  2. __________________________

Why? ________________________________________________________________________________

3. (6 points) Your next patient had a prolonged episode of severe bloody diarrhea a few weeks ago which his doctor treated with oral antibiotic. He now has diarrhea again although it is not bloody.

What is a possible cause of his initial episode of diarrhea? ________________________________

What is the likely cause of his current episode of diarrhea? ________________________________

Do you treat him with antibiotics? __________ If so, which ones? __________________________

If he does not respond to treatment (rehydration, antibiotics, if appropriate, etc.) what options for further treatment exist?

____________________________________________________________________________________
4. (8 points) Your last patient before your coffee break has a fever and the whites of her eyes appear yellowish. She reports having recently traveled to Southeast Asia. List three possible different diseases which could be responsible for her symptoms and their causative agents indicating whether the agent is a bacterium (gram negative or positive) or a virus (RNA or DNA).

<table>
<thead>
<tr>
<th>Disease</th>
<th>Causative agent name and type of organism</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td></td>
</tr>
</tbody>
</table>

What treatment could you use for these diseases?

5. (14 points) Fill in the following table by checking 2 boxes in each row: one indicating the effect of the genetic change on transmission and one indicating the effect on virulence.

<table>
<thead>
<tr>
<th>Organism</th>
<th>Mutation or gene acquisition</th>
<th>Effect on transmission</th>
<th>Effect on virulence</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>E. coli</em></td>
<td><em>Ler</em> regulator-minus, can no longer express <em>ler</em> genes</td>
<td>none</td>
<td>decrease</td>
</tr>
<tr>
<td><em>Helicobacter pylori</em></td>
<td>Cannot invade mucous layers</td>
<td>none</td>
<td>decrease</td>
</tr>
<tr>
<td><em>Salmonella enteriditis</em></td>
<td>Acquires cholera toxin</td>
<td>none</td>
<td>decrease</td>
</tr>
<tr>
<td><em>Clostridium tetani</em></td>
<td>Loses plasmid carrying toxin gene</td>
<td>none</td>
<td>decrease</td>
</tr>
<tr>
<td><em>Rickettsia rickettsia</em> (Rocky Mountain spotted fever)</td>
<td>Becomes sensitive to the pH of tick intestinal tract</td>
<td>none</td>
<td>decrease</td>
</tr>
<tr>
<td><em>β-hemolytic Streptococcus</em></td>
<td>Loses erythrogenic toxin gene</td>
<td>none</td>
<td>decrease</td>
</tr>
<tr>
<td>Commensal bacterium living in the gut</td>
<td>Acquires botulinum toxin gene</td>
<td>none</td>
<td>decrease</td>
</tr>
</tbody>
</table>
6. Epidemiology (8 points) You are working as an infectious disease specialist in a hospital in Chapel Hill and have observed the emergence of a new disease in the last 4 years. This disease is characterized by severe encephalitis and you cannot link the disease to any known bacteria, viral, or fungal pathogen. You name this disease Unidentified Encephalitis A (UEA). As the number of cases you observe is worryingly high, you examine the epidemiology of the disease to understand the risk factors and transmission.

A. You begin by tracking the occurrence of cases in the Mid-Atlantic States over the last 4 years to try to understand if UEA occurrence varies throughout the year. You generate the graph shown below.

How do you think UAE is transmitted and why do you think this? (3 points)

B. In examining surveys completed by patients and their families, you determine that 34% of patients lived near a stagnant body of water and 73% had spent significant time outdoors (hiking, boating, camping, etc.) in the weeks prior to getting sick. You also notice the spike in cases in July of Year 3 and determine that this month had 5 inches more rainfall than average. This data leads you to a more specific conclusion about the transmission of UEA. What is this conclusion? (2 points)

C. Should you suggest quarantining the infected patients to prevent spread (circle correct answer)? (1 point)
   Yes          No          Only from children, elderly, immunocompromised, etc.

D. What are two things that public health officials could encourage people to do to decrease their risk of contracting UEA? (2 points)

1.

2.
7. (9 points) You are working for the UN refugee agency and are responsible for the public health in a refugee camp in the mountains in northern Pakistan. List 3 major potentially life-threatening diseases you are worried about spreading in the camp, why you are worried about them and what control measures you can take.

<table>
<thead>
<tr>
<th>Disease</th>
<th>Reason for concern</th>
<th>Control measures</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

8. Disease Eradication (12 points)

A. It has been several years since the emergence of Unknown Encephalitis A (UEA) and you have determined that the pathogen which causes this disease is a virus and named it UEA virus. You developed a vaccine that is very effective at preventing UEA and you are excited by the possibility of eradicating it. What are three factors of UEA virus that you need to determine before deciding whether UEA can be eradicated? (3 points)

1. ____________________________________________
2. ____________________________________________
3. ____________________________________________

B. Fill in the table below by determining whether a disease could be eradicated and stating the major reasons why or why not. If you believe the disease can be eradicated list 3 major reasons. (9 points)

<table>
<thead>
<tr>
<th>Disease</th>
<th>Can it be eradicated?</th>
<th>Why or why not?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Syphilis</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Polio</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rubella</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
9. (10 points) You are an agricultural expert (animal diseases) working in Africa. You discover some new diseases in local wildebeests. One of them, M disease, is caused by a picorna virus. Another, Y disease, is caused by a bacterium belonging to the proteobacteria. There are related bacteria and viruses found in zebras, gnus, and other animals. You are concerned about the health of cattle in your area. At the present time the cattle have neither of these diseases. Answer each of the following questions for both diseases.

Do you want to develop an immunization for this disease? Why or why not?

M ________________________________________________________________

Y ___________________________________________________________________

How likely do you think it is that the causative agent will undergo genetic change and become a significant cause of disease in cattle? Why?

M ___________________________________________________________________

Y ___________________________________________________________________

On further examination of current infections of cattle in your area you find that they often have a bacterium in their gut which causes no symptoms but is related to Y. Does this observation change your thinking about disease Y? If so, how?

_____________________________________________________________________

10. (12 points) Fill in the following table.

<table>
<thead>
<tr>
<th>organism</th>
<th>Medium and conditions</th>
<th>Growth rate fast, slow, or none</th>
<th>Initial electron donor</th>
<th>Final electron acceptor</th>
</tr>
</thead>
<tbody>
<tr>
<td>E. coli</td>
<td>Minimal medium, NO₃⁻, glucose, aerobic</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>E. coli</td>
<td>Minimal medium, NO₃⁻, glucose, anaerobic</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thiobacillus species</td>
<td>Minimal medium, H₂S₂O₃, CO₂, aerobic,</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thiobacillus species</td>
<td>Minimal medium, H₂SO₄, CO₂, Fe³⁺, NO₃⁻, aerobic,</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>