03-390 Immunology  
Exam III – 2015S  
Name:______________________

Instructions: This exam consists of 160 points. On questions with choices, all of your attempts will be graded and you will receive the highest grade. You may answer any question with a diagram, just be sure that it is adequately labeled. Use the space provided, or the back of the preceding page.

1. (6 pts) Pick any two (2) of the following proteins and describe the consequence of a deficiency in this protein on the function of the innate or acquired immune system.
   a) C3  
   b) C4 or C1q  
   c) TLR3  
   d) TLR4  
   e) INFα or INFβ  
   f) INFγ  
   g) histamine receptor  
   h) Fas/FasL  
   i) Perforin  
   j) Invariant chain

2. (6 pts) What is the function of the Rag1/Rag2 proteins in a normal individual, and how would a deficiency of these proteins affect the function of the humoral (Ab) and cellular immune system?

3. (6 pts) Please do one of the following choices:
   Choice A: An individual appears to have normal levels of IgM and what appears to be fully functional B and T cells, yet they cannot produce high affinity antibodies of other classes. What is the most likely immunodeficiency that would cause this condition? Briefly justify your answer.
   Choice B: An individual cannot mount an effective immune response against viruses, yet they appear to have normal T-cells. What is the most likely immunodeficiency that would cause this condition? Briefly justify your answer.
4. (10 pts) The response to parasitic infections is very similar to an allergic response. Briefly discuss the common features of the two processes and then indicate the differences between the two. Your answer should discuss T-cell subsets and what other cells and molecules are involved. You should also clearly define the events that occur during each phase (sensitization, activation, response).

5. (10 pts) Please do one of the following choices:

**Choice A:** Many drug allergies result in the destruction of red blood cells.

i) Briefly describe how the immune system becomes sensitized to the drug.

ii) Provide one mechanism that leads to the destruction of red blood cells.

iii) Why does the process stop when the drug is no longer given to the patient.

**Choice B:** A patient is being treated with a mouse monoclonal antibody as part of their anti-cancer therapy and they develop serum sickness. What is serum sickness and how could it have been avoided?
6. (10 pts) Rejection of solid transplanted tissue occurs by the same mechanism as type IV hypersensitivity.
   i) Briefly discuss differences in sensitization, including the nature of the antigen.
   ii) How does the immune response lead to rejection of the transplanted tissue?

7. (2 pts) In transplantation of solid tissues it is important to ensure that ABO blood groups are correctly matched. Why?

8. (8 pts) Your friend is getting a kidney transplant. Serotyping indicates that a donor kidney is a perfect match for transplantation. However, the mixed lymphocyte assay shows a high level of radioactive counts when the donor cells are mixed with the recipient cells.
   i) Is the data from serotyping consistent with the data from the mixed lymphocyte assay? Briefly justify your answer.
   ii) Should the transplant proceed? Why or why not?
9. (4 pts) Your friend’s (previous question) new kidney transplant is showing signs of rejection, what could the transplant surgeon do to stop this process – give one possible treatment.

10. (6 pts) In bone marrow transplants, it is necessary to have a good match between the donor and the recipient, even though the recipient cannot mount an immune response because their immune system is destroyed prior to the transplant. Why?

11. (6 pts) Please do one of the following choices.

   Choice A: Some individuals are resistant to infection by HIV. What is different about their genotype and how does deficiency interfere with the progression of the disease.

   Choice B: What types of retroviral inhibitors are currently used to treat HIV infected individuals and why are these inhibitors generally effective.

   Choice C: An individual discovers that they are HIV positive and begins treatment with retroviral inhibitors. Unfortunately, even though they were compliant with respect to the drug treatment, they still develop AIDS. Provide one reason why this might occur.

   Choice D: What cells are infected by the HIV virus in the lymph node? List three ways by which these infected cells are killed.
12. (4 pts) Please do one of the following choices:
   
   **Choice A:** Why are vaccines relatively ineffective against pathogens that show disease symptoms quickly, say within 2-3 days?
   
   **Choice B:** How does an adjuvant increase the effectiveness of a vaccine – give one reason.

13. (4 pts) There have been recent outbreaks of measles, in spite of the fact that there is an effective vaccine for this disease. What is the cause of these outbreaks?

14. (10 pts) Vaccines can be divided into two broad classes, those that consist of non-living material and those that consist of living material. Give one example of each of these classes and briefly discuss why one form of vaccine may be better than another.
15. (8 pts) State the steps in T-cell development starting with where cells originate, migrate to, and the requisite four checkpoints they undergo before migrating to lymph nodes. What might be the end result if a T-cell escapes the last checkpoint?

16. (2pts) Briefly describe the role of **AIRE** (autoimmune regulator) in negative selection of T-cell development. What might happen if someone was missing AIRE due to an inactivating mutation?

17. (2pts) Why is CTLA-4 such an important possible therapeutic target in cancer? What biological therapy are researchers developing to target CTLA-4 in the clinic?
18. (6 pts) List at least two examples for each of the following innate mechanisms of immune defense against extracellular bacteria:

Physical:

Physiological / Chemical:

Cellular:

19. (6 pts) Briefly describe some of the key characteristics and attributes of gut-associated lymphoid tissue (GALT), and how these play a role in immune defense?

20. (2pts) Briefly describe the consequences of when your doctor, although well intentioned, gives you antibiotics for your viral GI infection?

21. (8 pts) Describe the concepts of Antigenic Shift vs. Antigenic Drift. In doing so, provide an example for each and briefly describe the possible impact on human health.
22. (6 pts) Answer one of the following (do not give antigenic shift or drift as a possible answer to this question)

**Choice A:** List at least three mechanisms that bacteria employ to invade host cells or evade host immune detection or destruction.

**Choice B:** List at least three mechanisms that viruses employ to evade host immune detection or destruction.

23 (6 pts) In general terms, briefly compare and contrast central versus peripheral tolerance in lymphocytes. Also, what is anergy and what role does it play in tolerance?

24. (6 pts) Of the following three activating mechanisms for autoimmunity, select and describe two, providing details of what happens and how reaction to self occurs. 1) Molecular mimicry; 2) Release of normally sequestered antigens; 3) Bystander activation.
25. (5pts) Pick ONE of the following and briefly describe how the autoimmune disease presents (1-2 symptoms) and the underlying immunological mechanism of the disease:

a) Graves disease  
c) Myasthenia gravis  
e) Hashimoto’s thyroiditis  
b) Diabetes mellitus  
d) Multiple sclerosis  
f) Sympathetic ophthalmia

26. (5 pts) Answer ONE of the following questions:
Choice A:
i) Briefly describe at least two of the four categories for cancer antigens discussed in class.
ii) List at least one example of an actual cancer antigen.
Choice B: List at least three examples of reasons for failed immune response to tumors.

27. Questions Based on Presentations (6 pts). You can answer up to 3 questions, 2pts each. Two additional choices can be answered for bonus points. Please indicate the five that you would like graded, otherwise the first five of your answers will be graded. Please answer on the back of the previous page.

1. How does childbirth by Cesarean section affect the immune system?  
2. Briefly describe how cancer immunotherapy using antibodies results in killing of the tumor cells.  
3. Discuss a genetic origin of rheumatoid arthritis, or the most likely auto-antigen.  
4. Why is the blood cell stage of the malarial life cycle a better target for vaccine development?  
5. Why is the rabies virus undetectable during the early stages of incubation?  
6. Henipavirus infects horses. What is the basis of vaccine development for this virus?  
7. What is the relationship between and high fat diet and insulin sensitivity?  
8. Antibodies against hCG provide a means of establishing contraception. How is the hCG made to be immunogenic?  
9. What type of vaccine is most effective for individuals with IgA deficiencies?  
10. How are chimeric antigen receptors used to treat cancers?  
11. What cancer can be effectively controlled by vaccination?  
13. What do Ebola and Dengue have in common?  
14. How is the vaccine against anthrax made?  
15. Discuss one way to generate a catalytic antibody.  
16. How is the vaccine against TB made?  
17. How do cancerous lymphocytes evade the immune system?  
18. Genetic resistance against the HIV virus also provides resistance against what other pathogen?  
19. What are the two types of polio vaccines?