

Name Last : \_\_\_\_\_ANSWER KEY\_\_\_\_\_ First :\_\_\_\_\_1

**MCB 50  
Midterm I**

**2/21/01**

**Instructions:**

Write your name on **each page** of the exam. There are 100 points total.

**Read each question carefully.** All the questions can be answered **briefly**, in the space allotted.

**Pay attention to point values.** Allocate your effort in proportion to the maximum points that can be awarded for the answer. Points may be deducted for excessive answers.

**I. TRUE/FALSE. 20 points** Please write the entire word "False" or True".

True An alloimmune response is initiated by T cells in response to foreign MHC molecules.

False The redundancy property of cytokines means that cytokines can have different functions on different cells.

False If you have any IgM antibodies to a virus you are currently infected.

False Apoptosis is uncontrolled cell death initiated by inflammation.

False Naive cytotoxic T cells ( $T_c$  cells) are primarily activated by virally infected B cells.

False The tonsils are primary lymphoid organs.

True Hematopoiesis is the process of blood cell maturation.

True Babies are born with maternal antibodies which are IgG isotype because IgG can cross the placental membrane.

True Antibodies of different isotypes provide different effector functions.

True Antibodies can bind to bacteria and activate Complement to lyse the bacteria.

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**II. FILL IN.** Fill in the correct word(s). Be succinct. (10 pts)

During an inflammatory response \_\_\_\_**Neutrophils**\_\_\_\_\_ are polymorphonuclear cells that are the first cells to arrive. These cells are attracted by IL-8 which is a \_\_\_\_**Chemokine**\_\_\_\_\_.

When a mosquito transmits malaria from one person to another person it is considered to be a \_\_\_\_\_**Vector**\_\_\_\_\_.

The antibody isotype primarily found in the saliva and breast milk is \_\_\_\_**secretory IgA**\_\_\_\_\_.

For activation T cells need to recognize peptide antigen in MHC and a 2<sup>o</sup> signal which is provided by \_\_\_\_**B7**\_\_ on the APC binding to \_\_\_\_**CD28**\_\_\_\_\_ on the T cell. In return a T cell can activate a B cell by providing \_\_\_\_**CD40L**\_\_\_\_\_ on the T cell surface which binds to \_\_\_\_**CD40**\_\_\_\_\_ on the B cell. During B cell activation the B cells go through a rapidly dividing stage during which \_\_\_\_**isotype switching**\_\_\_\_\_ can take place. The anti-viral cytokines, \_\_\_\_**IFN-**

$\alpha/\beta$ \_\_\_\_\_, are part of the innate immune response and can be made by many non-immune cells.

**II. SHORT ANSWER.**

1. T cells and B cells both utilize a surface receptor to recognize foreign antigen. What is the major difference in how T cells and B cells recognize foreign antigen with their receptor? (4 pts)

**B cells see 3-D antigen. No antigen processing required.**

**T cells only see processed antigenic peptide when presented on MHC.**

2. **LIST** the two pathways that CTLs use to kill target cells. (4 pts)

**1. Perforin Granzyme B**

**2. Fas- Fas Ligand.**

3. **LIST** two functions of antibodies that require the Fc portion of antibodies to bind to the FcReceptor on macrophages.

**1. Opsonization.**

**2. ADCC Antibody dependent cell cytotoxicity.**

4. A new virus causing *college anxiety illness* (named the CAL virus) was identified in the UCB student population. Approximately 200 students who went to the Tang Center to get medical attention were found to have the CAL virus in their bloodstream.

Are these 200 students the only ones that were infected with CAL virus? Explain (4 pts)

**No, they are the only ones who were sick but many students were most likely infected.**

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5. In the article by Nesse and Williams “Evolution and the Origins of Disease” they discuss how we retain the disease symptoms such as vomiting, fever, diarrhea, which can be a nuisance or sometimes more serious. They also discuss how pathogens can cause more or less disease symptoms.

Why would a pathogen evolve to potentially increase the amount of diarrhea caused by infection? (4 pts)

**A pathogen will increase in virulence if it was beneficial for transmission or survival in host. If increasing diarrhea aids in the virulence of the pathogen by helping with replication, survival, and/or transmission. The pathogen will favor genetic mutations that enhance its survival as a process of natural selection.**

6. A. What is MHC polymorphism? (2 pts)

**Genetic diversity at a locus which allows for the presence of multiple forms of the same gene which provide the same function.**

B. Keeping in mind the article by Nesse and Williams.

How is it that human MHC polymorphism has been selected for through evolution? (4 pts)

**The ability to have various MHC has been a selective advantage because it allows for a broader spectrum of antigens to be presented. Therefore, as a population when there is more MHC diversity there is an increased ability to fight off disease.**

7. Your skin has been punctured with a needle containing numerous *Staphylococcus aureus* (a common pathogenic bacteria) which causes the surrounding skin tissue to become inflamed and swollen.

A. Why do you get reddened swollen tissue around the site of infection or tissue injury?

(In other words: What are the three steps that initiate the inflammatory process which is activated during Acute Inflammation?) (6 pts)

- 1. Vasodilation. Increase in diameter of blood vessels.**
- 2. Increased capillary permeability.**
- 3. Increased cells. (Extravasation of Neutrophils).**

B. What **innate** cytokines are present at the site of infection to activate this cascade of events? (2 pts)

**(2 of the following) IL-1, IL-6, TNF- $\alpha$ . Chemokines IL-8.**

C. If the bacteria start to replicate at the site of infection, will there be T helper cell activation specific for the *S. aureus* bacteria at the site of inflammation? How long after the needle stick would T cell activation occur and what cells and events would control the activation? **Explain your answer in detail.(8 pts)**

**Yes, there will be T cell activation but when depends on if this was a primary or secondary exposure. Because this a common bacteria chances are this is a secondary exposure. You will need activation of naive T cells in the lymph node by APCs which have taken up the bacteria. The activated effector T cells will then need to travel to the inflamed tissue where they will be activated by macrophages (takes 5-7 days). If there are memory T cells present they would be activated more quickly in the tissue by macrophages (within 2-4 days).**

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8. *Trypanosoma brucei* are unicellular protozoan parasites which live extracellularly in your bloodstream and can cause the disease sleeping sickness. Infection with *T. brucei* is transmitted by tsetse flies.

A. If you have a systemic infection with Trypanosomes, in which **lymphoid organ** will these parasites be filtered out by phagocytic cells to get activation of the adaptive immune response? (4 pts)

### Spleen

B. What are **two factors** that will help determine if *T. brucei* will make a good immunogen (in other words that it will be seen by the adaptive immune response)? (4 pts)

1. **Complexity based on amino acid composition (Foreignness)**
2. **Size**
3. **Dose**

C. What type of adaptive immune response will be **most effective** for eliminating these parasites and **why**? (4 pts).

**Antibodies (requiring Th2 and B cells activation) are most effective against eliminating extracellular parasites.**

D. Will an infection with *T. brucei* elicit more Th1 cytokine or Thelper 2 cytokines? Explain. (4 pts)

**Th2 because you need to make antibodies and this is an extracellular pathogen.  
(2 pts for Th11 to activate macrophages for enhanced opsonization/phagocytosis).**

E. **Name 2** cytokines that will be produced by the Thelper subset that was activated in your answer to part D. (4 pts)

**Th2 IL-4, IL-6, IL-10.**

**(if Th1 answer given then credit for correct Th1 cytokines IL-2, IFN- $\gamma$ , TNF- $\alpha$ ).**

F. Will the *T. brucei* antigens be presented by dendritic cells through the exogenous antigen processing pathway or the endogenous antigen processing pathway? **Explain your answer.** (4 pts)

**Exogenous ag processing pathway because they live extracellularly and therefore must be taken up by APCs through phagocytosis or receptor mediated endocytosis.**

G. How could you determine if a person has previously been infected with *T. brucei*? (4 pts)

**Measure your specific antibody levels against *T. brucei* especially IgG.**

**IgM levels will only be relevant for current infection.**