

**Term Test 2: MICR422                      October 26, 2001.**

You have 50 minutes to complete this test. Except where specified, you should answer in complete sentences and/or essay format. Diagrams are acceptable additions to essays, however are NOT a substitute for a coherent, written answer. Try and keep your answers confined to the space provided, but you may use the back of the page if necessary. The TOTAL marks for each question, 1-6, are shown in the margins.

**5 marks**

1. **Enter each immunoglobulin isotype (a-e) next to the description(s) listed below (1-5) that are true about that isotype. Each isotype may be used once, more than once or not at all; some descriptions may apply to more than one isotype, and full marks will require both isotypes.**

a) IgM    b) IgD    c) IgG    d) IgE    e) IgA

- 1). \_\_\_\_\_ Involved in immunity to parasites, and provokes allergic symptoms by binding to Fc receptors on mast cells..
- 2). \_\_\_\_\_ Major antibody in secretions such as saliva, tears, and breast milk.
- 3). \_\_\_\_\_ Present on the surface of naïve B cells.
- 4). \_\_\_\_\_ Secreted form is a pentamer of the basic H<sub>2</sub>L<sub>2</sub> unit.
- 5). \_\_\_\_\_ The most abundant isotype in serum.

**5 marks**

2. **For each incomplete statement below (a-e) circle the number of the correct phrase (1-4) that correctly completes the statement. More than one phrase may be correct.**

a. Recombination of immunoglobulin gene segments serves to

- (1) promote Ig diversification
- (2) assemble a complete Ig coding sequence
- (3) allow changes in coding information during B-cell maturation
- (4) all of the above

b. Somatic mutation of immunoglobulin genes accounts for

- (1) allelic exclusion
- (2) class switching from IgM to IgG
- (3) affinity maturation
- (4) all of the above

- c. Generation of combinatorial diversity among immunoglobulins involves
- (1) mRNA splicing
  - (2) DNA rearrangement
  - (3) recombination signal sequences
  - (4) one-turn/two-turn joining rule (12/23 spacing rule)
- d. A B cell becomes immunocompetent (mature, naïve B cell)
- (1) following productive rearrangement of variable-region heavy-chain and light-chain gene segments in germ-line DNA
  - (2) following class switching
  - (3) during affinity maturation
  - (4) following binding of T<sub>H</sub> cytokines to their receptors on the B cell.
- e. The mechanism that permits immunoglobulins to be synthesized in either a membrane-bound or secreted form is
- (1) allelic exclusion
  - (2) class switching
  - (3) one-turn/two turn joining rule
  - (4) differential RNA processing

**3. Indicate whether each of the following statements is true (T) or false (F).**

**5 marks**

- \_\_\_\_\_ A sandwich ELISA involves immobilizing antigen to the wells of a microtitre plate
- \_\_\_\_\_ A polyclonal antiserum will only contain antibodies directed against a single epitope.
- \_\_\_\_\_ For precipitation to occur, both antigen and antibody must be multivalent.
- \_\_\_\_\_ The Radial Immunodiffusion technique is a quantitative precipitin technique.
- \_\_\_\_\_ Flow cytometry is a technique which is used to measure the concentration of soluble proteins in serum.

5 marks

4. Indicate whether each of the following statements applies to Class I MHC, Class II MHC, or Class III MHC.

- a. \_\_\_\_\_ Genes within the MHC which encode soluble proteins.
- b. \_\_\_\_\_ Expressed exclusively on Professional APCs
- c. \_\_\_\_\_ Binds peptides of 8-10 amino acids in length by anchor amino acids at either end of the peptide.
- d. \_\_\_\_\_ The full protein would be recognized by antibodies which bind 2 microglobulin.
- e. \_\_\_\_\_ The majority of peptides displayed are derived from self proteins.

5 marks

4. Give a SHORT, 1 sentence definition of each of the following terms.

Allelic Exclusion: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Recombination Signal Sequence (RSS): \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Complementarity Determining Region (CDR): \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Name: \_\_\_\_\_

**Opsonization:** \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

**Haplotype:** \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

15 marks
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5. Choose ONE of the following 3 topics, and write a brief (1-2 page) answer in essay format. Diagrams are permissible, but will not be accepted as a substitute for a well-written response. (15 marks).

A. In preparing a demonstration for his immunology class, a lab instructor purified IgG antibodies to sheep red blood cells (SRBCs) and digested some of the antibodies into Fab, Fc, and F(ab')<sub>2</sub> fragments (total of 4 tubes, including the undigested IgG). He placed each preparation in a separate tube, labeled the tubes with a water-soluble marker, and left them in an ice bucket. When the instructor returned for his class period, he discovered that the labels had smeared and were unreadable. Determined to salvage the demonstration, he relabeled the tubes 1,2,3, and 4, and proceeded.

- i) Draw a stick diagram of IgG, labeling the heavy and light chains and showing any intrachain disulfide bonds (location is important, number isn't). Show the digestion/break points which will generate the various fragments, and label the Fab, Fc, and F(ab')<sub>2</sub> regions.
- ii) Based on the test results described below, indicate which preparation (whole IgG, Fab, Fc, or F(ab')<sub>2</sub>) was contained in each tube and explain why you so identified the contents.
  - a) The preparation in tube 1 agglutinated SRBCs but did not lyse them in the presence of complement.
  - b) The preparation in tube 2 did not agglutinate SRBCs or lyse them in the presence of complement. However, when this preparation was added to SRBCs before the addition of whole anti-SRBC, it prevented agglutination of the cells by the whole anti-SRBC antiserum.
  - c) The preparation in tube 3 agglutinated SRBCs and also lysed the cells in the presence of complement.
  - d) The preparation in tube 4 did not agglutinate or lyse SRBCs and did not inhibit agglutination of SRBCs by whole anti-SRBC antiserum.

OR

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**B. Discuss the structure and function of proteins encoded by the human MHC. You may use appropriate diagrams and/or charts to add to your answer, which should address the following points:**

- a) Structure/nature of the Class I, Class II, Class III proteins (what does each region of the MHC encode? Examples?)
- b) Surface structure of the membrane-bound MHC Class I and Class II proteins, including appropriate names for the component proteins.
- c) Differences in the cellular expression of the Class I and Class II proteins.
- d) Differences in the size and binding characteristics of peptide to Class I and Class II proteins
- e) Types of antigen which would be presented by Class I and Class II proteins.

**OR**

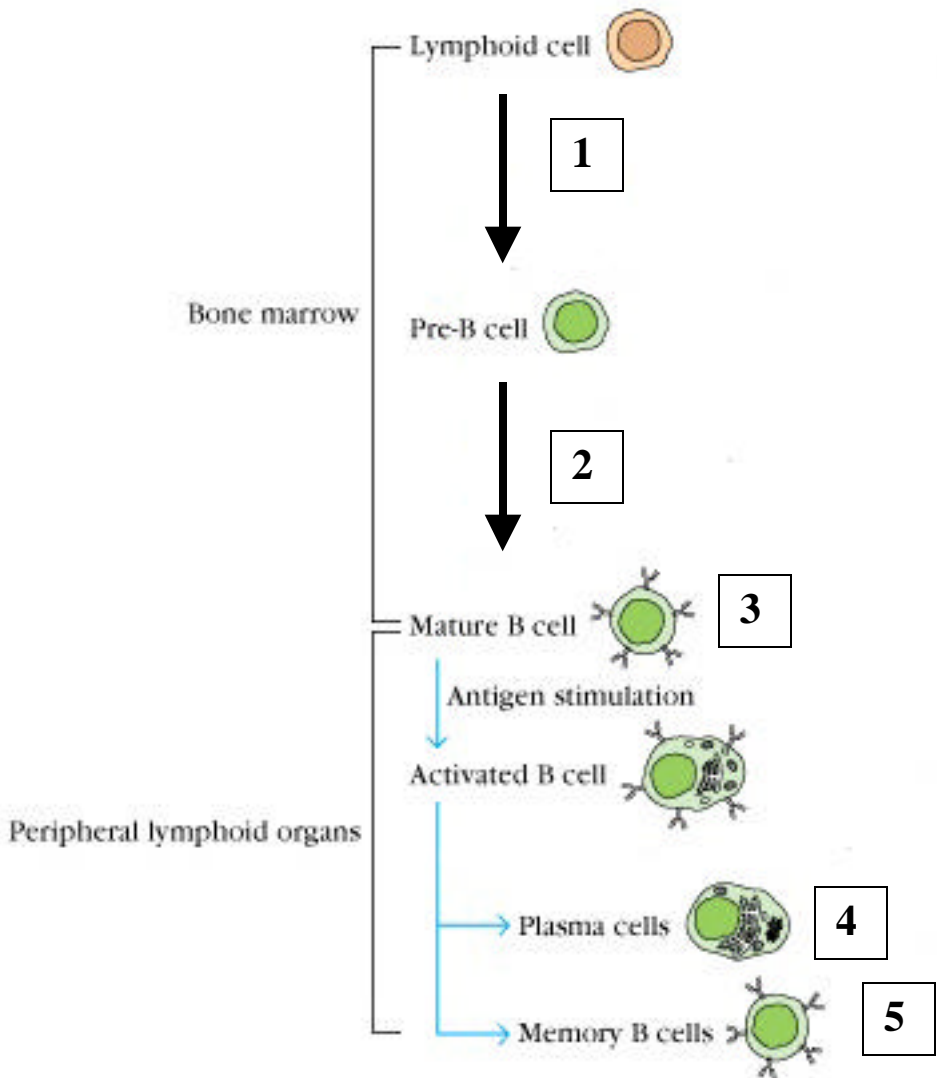
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**C. A principal characteristic of the immune system is antibody diversity. Diversity is generated at several points during the development of B cells from progenitor cells in the bone marrow through to memory cell differentiation following antigen stimulation. With reference to the following figure, discuss the mechanisms which induce diversity during development. Make reference to the molecular mechanisms which generate diversity, and the form and isotype of immunoglobulin expressed at each stage.**

**In your answer, you should make use of the following terms:**

**Somatic Hypermutation  
Differential splicing of mRNA  
Heavy chain recombination  
Light chain recombination  
Combinatorial Diversity  
Junctional Diversity  
Affinity Maturation  
Class Switching  
Non-functional Rearrangement  
Complementarity Determining Region 3 (CDR3)**

Figure for Question 5C



Name: \_\_\_\_\_

Name: \_\_\_\_\_