國立臺灣大學 109 學年度碩士班招生考試試題

一、選擇題 ※ 本大題請於試卷內之「選擇題作答區」依序作答。

單選題: 每題 2 分，共 12 分

1. Immature B cells develop into B cells in the
   a. bone marrow
   b. thymus
   c. blood
   d. secondary lymphoid organs.

2. Negative selection of developing B cells ensures that
   a. there is enough space for B cells to proliferate
   b. only antigen-activated B cells leave the bone marrow
   c. clonal expansion of B cells does not occur in the absence of infection
   d. B-cell receptors that bind to normal constituents of the body do not emerge

3. Identify the mismatched pair of chemokine or cytokine and the cells that secrete it.
   a. CCL19: lymph-node dendritic cells
   b. CXCL13: follicular dendritic cells
   c. IL-2: activated B cells
   d. IFN-γ (Gamma interferon): activated $CD4^+$ T cell subset

4. Recombinant DNA technology has been especially useful for the production of _____ that are used in subunit vaccines.
   a. viral nucleic acids
   b. viral proteins
   c. mutated viruses
   d. infectious particles.

5. The reason that vaccines against influenza must be administered annually, unlike vaccines against measles, is
   a. the antigens that stimulate protection against influenza virus are buried inside the virion
   b. influenza is an RNA virus with a higher mutation rate
   c. influenza stimulates T-independent responses that fail to generate memory cells
   d. human immune system responds poorly against influenza virus.

6. The function of negative selection of thymocytes in the thymus is to eliminate
   a. single-positive thymocytes
   b. double-positive thymocytes
   c. alloreactive thymocytes
   d. autoreactive thymocytes.

複選題: 每題 2 分, 共 10 分 ※ 本大題請於試卷內之「選擇題作答區」依序作答。

7. Which of the following events occur within germinal centers (Select all that apply.):
   a. isotype switching

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b. B cells are activated by CD4 helper T cells
c. affinity maturation
d. somatic hypermutation

8. A plasma cell is characterized by which of the following features? (Select all that apply.)
   a. It dedicates 10–20% of total protein synthesis to antibody production.
   b. Levels of MHC class II molecules are elevated.
   c. It undergoes extensive proliferation in germinal centers.
   d. It produces secreted immunoglobulin instead of the membrane-bound form.

9. Which of the following statements are true for both α:β (alpha:beta) T cells differ and B cells during development? (Select all that apply.)
   a. Their antigen receptors are derived from gene rearrangement processes.
   b. MHC molecules are required to facilitate progression through the developmental pathway.
   c When the first chain of the antigen receptor is produced it combines with a surrogate chain.
   d. Cells bearing self-reactive antigen receptors undergo apoptosis.

10. Which of the following processes is not dependent on an interaction involving MHC class I or class II molecules? (Select all that apply.)
   a. positive selection of α:β T cells
   b. intracellular signaling by pre-T-cell receptors
   c. peripheral activation of mature naive T cells
   d. positive selection of γ:δ T cells.

11. Identify which of the following describes how antigen processing and presentation of self antigens by thymic epithelial cells differs from that of antigen-presenting cells in peripheral tissues. (Select all that apply.)
   a. Thymic epithelium expresses MHC class I molecules but not MHC class II molecules.
   b. Thymic epithelium uses cathepsin L for proteolytic degradation of self proteins.
   c. Thymic epithelium expresses MHC class II molecules but not MHC class I molecules.
   d. Thymic epithelium uses the transcription factor AIRE to activate thymic expression of tissue-specific genes.

二、是非題　※ 本大題請於試卷內之「非選擇題作答區」標明題號依序作答。

1. Indicate which of the following statements concerning memory B cells are true (T) and which are false (F): (每格 0.5 分，共 3 分)
   a. Memory B cells are derived from germinal center B cells as immune responses subside.
   b. Memory B cells have long life spans.
   c Memory B cells die after encountering the recall antigen.
   d. Memory B cells possess high-affinity antigen receptors as a consequence of affinity maturation.
   e. Memory B cells have more stringent requirements for activation than naive B cells do.
   f. Memory B cells express only IgM and retain the capacity to switch to the most beneficial isotype during secondary responses.

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2. Indicate whether the following statement are **true (T) or false (F). <u>If it is false, explain why</u>.** (每格 1 分)

a. Host-pathogen interactions determine the infection outcome.
b. Protective immunity persists for the same period regardless of the type of pathogen.
c. Antigenic shift describes the mechanism in which Influenza virus accumulates point mutations in the gene encoding hemagglutinin and neuraminidase to alter the binding sites of protective antibodies.
d. Inherited genetic defect in T cell development can result in defects in other components of the immune system and cause severe combined immunodeficiency (SCID).
e. The effector mechanisms that are recruited to clear an infection are always the same, regardless of the type of pathogens.

三、解釋名詞(每題 3 分)

1. Immunotherapy
2. Monoclonal antibody
3. siRNA
4. Innate immunity
5. BALB/c
6. Antigen
7. Pathogen
8. Immunogen

四、問答題

1. Anti-CLTA4 and anti-PD-1 antibody has been successfully used to treat cancer patients. Why these two treatments are also called immune checkpoint blockade therapy? (4 分) Please describe the mechanisms of each treatment to explain why these drugs are working? (6 分)
2. A graduate student has recently identified a soluble factor secreted by dendritic cells that have been stimulated with a TLR ligand. He believes that this factor is a novel cytokine. Please design two experiments, including a cellular and a molecular approach to support his hypothesis. (8 分)
3. The complement system is an important arm of the humoral immunity. Once activated, the complement system is able to modulate the immune response. Please describe 2 examples of how activated complement components may regulate the immune response. (8 分)
4. You are jogging in the neighborhood in a sunny beautiful day. All of a sudden you trip over a brick, fall on the ground and scratch your knees. You notice that your knees are bleeding and covered with dirt. Bacteria on the ground are about to break through the abrasion and begin to grow in the skin tissue. Describe in a stepwise manner the events mediated by the immune responses which result in the removal of the bacteria (10 分).
5. Describe **<u>two ways</u>** in which antibody diversity is generated. One example **<u>must</u>** come from B cell development and one example **<u>must</u>** come from after the naïve B cell has become activated. Please give details of how the diversity is generated. (10 分)

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