2021

MICROBIOLOGY — HONOURS

Paper : CC-13

(Immunology)

Full Marks : 50

The figures in the margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable.

Answer ***Question No. 1*** and ***any three*** from the rest.

1. Answer ***any ten*** questions: 2×10

(a) The T_c cell is said to be class I MHC restricted. What does this mean?

(b) What are the two primary characteristics that distinguish hematopoietic stem cells and progenitor cells?

(c) Differentiate between primary and secondary lymphoid organs with one example of each.

(d) Each MHC molecule binds a unique peptide. Why or why not?

(e) Human red blood cells are not nucleated and do not express any MHC molecules. Why is this property fortuitous for blood transfusions?

(f) Differentiate between peptide binding by Class I and Class II MHC molecules.

(g) Give two examples of nonprofessional APCs. When are these cells most likely to function in antigen presentation?

(h) Explain why serum IgM cannot activate complement by itself.

(i) Some microorganisms produce enzymes that can degrade the Fc portion of antibody molecules. Why would such enzymes be advantageous for the survival of microorganisms that possess them?

(j) Would you expect a C1 or C3 complement deficiency to be more serious clinically? Why?

(k) Most antigens induce a response from more than one clone. Explain the statement.

(l) Write two differences between apoptosis and necrosis.

(m) Write down the importance of hinge region in antibodies. Name the amino acids present in the hinge region.

(n) Hashimoto's thyroiditis is an example of autoimmune disorder. Explain the statement.

(o) Why a v_H segment cannot join directly with a J_H segment in heavy chain gene rearrangement of an antibody?

2. (a) Name three features of a secondary immune response that distinguish it from a primary immune response.

(b) Compare and contrast the four types of antigen-binding molecules used by the immune system—antibodies, T-cell receptors, class I MHC molecules and class II MHC molecules in terms of the following characteristics:

(i) Specificity for antigen

(ii) Cellular expression

(iii) Types of antigen recognized

(c) Innate and adaptive immunity act in cooperative and interdependent ways to protect the host. Discuss briefly about the collaboration of these two forms of immunity. 3+4+3

3. Justify the following statements with proper explanation: 2×5

(a) Infection has no influence on the rate of hematopoiesis.

(b) A hapten can stimulate antibody formation but cannot combine with antibody molecules.

(c) Enveloped viruses cannot be lysed by complement because their outer envelope is resistant to pore formation by the membrane-attack complex.

(d) A papain digest of anti-SRBC antibodies can agglutinate sheep red blood cells (SRBCs).

(e) IgG functions more effectively than IgM in bacterial agglutination.

4. (a) What effect does thymectomy have on a neonatal mouse and on an adult mouse? Explain why these effects differ.

(b) Two vaccines are described below. Would you expect either or both of them to activate T_c cells? Explain your answer.

(i) A UV-inactivated ('killed') viral preparation that has ratained its antigenic properties but cannot replicate.

(ii) An attenuated viral preparation that has low virulence but can still replicate within host cells.

(c) Compare between antigen recognition by T cells and B cells. 3+(2+2)+3

5. (a) You have prepared an immunotoxin by conjugating diphtheria toxin with a monoclonal antibody specific for a tumor antigen.

(i) If this immunotoxin is injected into an animal, will any normal cells be killed? Explain.

(ii) If the antibody part of the immunotoxin is degraded so that the toxin is released, will normal cells be killed? Explain.

(b) According to the clonal selection theory, all the immunoglobulin molecules on a single B cell have the same antigenic specificity. Explain why the presence of both IgM and IgD on the same B cell does not violate the unispecificity implied by clonal selection.

(c) Explain the difference between antibody affinity and antibody avidity. Which of these properties of an antibody better reflects its ability to contribute to the humoral immune response to invading bacteria? Explain. (2+2)+3+(1+2)

6. (a) You are given two solutions, one containing protein X and the other containing antibody to protein X. When you add 1 ml of anti-X antibody to 1 ml of protein X, a precipitate forms. But when you dilute the antibody solution 100-fold and then mix 1 ml of the diluted anti-X antibody with 1 ml of protein X, no precipitate forms.

(i) Explain why no precipitate formed with the diluted antibody.

(ii) Which species (protein X or anti-X antibody) would likely be present in the supernatant of the antibody-antigen mixture in each case?

(b) Explain why the red blood cells of an individual are not normally destroyed as the result of innocent-bystander lysis by complement. Under what conditions might complement cause lysis of an individual's own red blood cells?

(c) What is MHC haplotype? How can you determine if two different inbred mouse strains have identical MHC haplotypes? (2+2)+(1½+1½)+(1+2)

7. (a) What do nude mice and humans with DiGeorge's syndrome have in common?

(b) Write down the properties of T-dependent and T-independent antigens.

(c) How will you detect IL-2 secreting cells by ELISPOT assay?

(d) How the technique of RAST is used to assay sensitivity to an allergen? 2+3+3+2
