



**NAMIBIA UNIVERSITY
OF SCIENCE AND TECHNOLOGY**

FACULTY OF HEALTH, APPLIED SCIENCES AND NATURAL RESOURCES

DEPARTMENT OF HEALTH SCIENCES

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FIRST OPPORTUNITY EXAMINATION PAPER	
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INSTRUCTIONS
<ol style="list-style-type: none">1. Answer ALL the questions.2. Write clearly and neatly.3. Number the answers clearly.

PERMISSIBLE MATERIALS

1. Pen
2. Calculator

THIS QUESTION PAPER CONSISTS OF 8 PAGES (including this front page)

SECTION A [20]

QUESTION 1

[20]

Select the one-lettered answer that fits best in each question. You only need to write down the letter of the correct answer.

- 1.1 Toll-like receptors (TLRs) located in endosomal membranes of cells recognize which of the following? (1)
- (a) Bacterial cell wall lipopolysaacharide
 - (b) Bacterial cell wall lipetechoic acid
 - (c) Diacylglycerides
 - (d) Nucleic acids
 - (e) Mannose
- 1.2 All of the following molecules are opsonins that facilitate efficient phagocytosis of microbes by neutrophils and macrophages except; (1)
- (a) C3b
 - (b) C5a
 - (c) IgG
 - (d) C-reactive protein
 - (e) Mannose-binding lectin
- 1.3 Which of the following is a feature of Natural Killer cells? (1)
- (a) They secrete natural IgM antibodies.
 - (b) Upon activation they secrete abundant IL-4.
 - (c) They kill virally infected cells by a perforin/granzyme-dependent mechanism.
 - (d) They are activated by recognising microbial peptides bound to MHC class I molecules.
 - (e) They express antigen receptors that directly bind to antigens on the surface of microbes.

- 1.4 Activation of the complement cascade plays an important role in host defense by all the following except;
- (a) Working via the classical pathway together with antibody to induce lysis of the pathogen.
 - (b) Mediating bacteriolysis (lysis of bacteria) via the alternative pathway, in the absence of specific antibody.
 - (c) Facilitating phagocytosis through the production of opsonins.
 - (d) Attracting phagocytes to the site of an infection by generating chemotaxins.
 - (e) Enhancing the generation of reactive oxygen intermediates. (1)
- 1.5 Which of the following best describes the differences between the classic and alternate complement pathways?
- (a) The classic pathway results in the lysis of the target cell which is not the case with the alternate pathway.
 - (b) The alternate pathway requires antibody for initiation while the classic pathway is antibody- independent.
 - (c) The classic pathway is more active than the alternate pathway.
 - (d) The alternate pathway typically requires C3b for activation while the classical pathway typically requires antigen-antibody complexes.
 - (e) The classical pathway requires mannose for activation while the alternate pathway is antibody dependent. (1)
- 1.6 All three complement pathways will be severely affected by a deficiency of;
- (a) C1
 - (b) C3
 - (c) C4
 - (d) Factor B
 - (e) Factor D (1)
- 1.7 All of the following are examples of pathogen recognition receptors that are found in the cytoplasm except:
- (a) C reactive protein
 - (b) NALP1
 - (c) RIG-1
 - (d) NOD2
 - (e) MDA (1)

- 1.8 MHC class II molecules present antigen peptides that...
- (a) Have been digested by processing the antigen through a proteasome.
 - (b) Have been transported into the endoplasmic reticulum by the transport-associated proteins (TAP).
 - (c) Have been loaded into the peptide-binding groove with the help of HLA-DM.
 - (d) Are loaded into the peptide-binding groove before the MHC molecule is passed through the Golgi apparatus.
 - (e) Are 9-11 amino acids in length. (1)
- 1.9 Which of the following statements about the innate immune response is correct:
- (a) Natural killer cells possess inhibitory receptors that when bound to their co-receptor prevents the natural killer cell from becoming activated.
 - (b) Type II interferons are able to induce an antiviral state in cells adjacent to an infected cell.
 - (c) Proinflammatory cytokines cause a decrease in the body temperature.
 - (d) IL-1 can trigger apoptosis in infected cells.
 - (e) iNOS reduces oxygen to reactive oxygen molecules which are anti-microbia. (1)
- 1.10 The MHC class I α -chain consists of;
- (a) A half of MHC class 2 molecule.
 - (b) B2- macroglobulin.
 - (c) Three globular chain.
 - (d) Three immunoglobulin-like domains.
 - (e) Two globular domain. (1)
- 1.11 Protection against micro-organisms insides cells is provided by;
- (a) The membrane attack complex.
 - (b) T lymphocytes.
 - (c) Antibody.
 - (d) C4b.
 - (e) Factor H. (1)

1.12 The MHC class 2 processing pathway primarily

- (a) Uses lysosomes packed with hydrolytic enzymes to degrade proteins into peptides.
- (b) Uses TAP proteins to transfer peptides into the endoplasmic reticulum for loading onto MHC class 2 molecules.
- (c) Generates peptides, complexes them with MHC class 2 molecules for presentation to Tc cells.
- (d) Generates peptides, complexes them with MHC class 2 molecules for presentation to NK cells.
- (e) Leads to the lysis of the cell in which the MHC class 2 molecules are synthesised. (1)

1.13 Immune complexes in the blood are normally removed by a mechanism involving the presence on erythrocytes of receptors selective for

- (a) C3
- (b) C4b
- (c) IL-2
- (d) Pentraxin
- (e) NLRs (1)

1.14 Which of the following best describes the differences between the classical and alternative complement pathways?

- (a) The alternative pathway requires antibody for initiation and the classical is antibody- independent.
- (b) The classical pathway results in the lysis of the target cell which is not the case with the alternative pathway.
- (c) The classical pathway is more active than the alternative pathway.
- (d) The alternative pathway is only activated on bacterial cells while the classical pathway can also be activated on self-cells.
- (e) The alternative pathway typically requires C3b for activation while the classical pathway typically requires antigen-antibody complexes. (1)

- 1.15 Which one of the following statements about the alternative pathway is false?
- (a) Properdin forms part of the C3 convertase.
 - (b) The alternative pathway can be activated by bacterial cell walls.
 - (c) In order to check whether one has a defect in the alternative pathway, one would assay a patient's serum for C4 proteins.
 - (d) The Alternative pathway can be activated on the host cells (self) if there is a deficiency of Factors H and I.
 - (e) There is a positive feedback loop. (1)
- 1.16 The role of the invariant protein in the MHC class II molecules is
- (a) To display self-peptides on the surface of the antigen-presenting cells.
 - (b) To target the MHC molecule to the Golgi apparatus.
 - (c) To provide targeting to lysosomes and a substrate for lysosomal enzymes.
 - (d) To prevent the MHC from binding endogenous peptides before it encounters an antigen fragment.
 - (e) To activate B cells. (1)
- 1.17 One principle function of complement is to
- (a) Bind antibodies attached to cell surfaces to lyse these cells.
 - (b) Cross-link antigens.
 - (c) Inactivate perforin.
 - (d) Mediate the release of histamine
 - (e) Phagocytose antigen. (1)
- 1.18 Which of the following cells is primarily a professional antigen-presenting cell?
- (a) Basophils
 - (b) Platelets
 - (c) Eosinophils
 - (d) Interdigitating dendritic cells
 - (e) Neutrophils (1)
- 1.19 Which of the following markers in T lymphocytes is responsible for signal transduction to the nucleus?
- (a) CD2
 - (b) CD3
 - (c) CD4
 - (d) IgG
 - (e) IgM (1)

- 1.20 The function of IgE receptors on eosinophils is to:
- (a) Bind epitopes of parasites to activate the eosinophils.
 - (b) Bind histamine to activate the eosinophils.
 - (c) Bind IgE which can then bind the corresponding epitope resulting in the activation of the eosinophils.
 - (d) Bind IL-4 which will trigger the activation of the eosinophils.
 - (e) Bind selectin molecules so that the eosinophils can migrate to the site of infection. (1)

SECTION B [80]

QUESTION 2

[55]

A 35-year-old woman with severe pre-eclampsia gave birth to a normal girl, Kate, by caesarean section in her 30th week of pregnancy. The neonate (newborn) weighed 750g and had no obvious congenital abnormalities. As a result of her premature birth, cord blood was sent to the laboratory to establish the immunoglobulin concentration. Her serum IgG was 0.1g/liter. The normal range for IgG in a neonate is normally the same as that of the mother, that is 7.2 – 19g/liter. A diagnosis of hypogammaglobulinaemia of prematurity was made.

- 2.1 Why does a neonate normally have the same concentration of IgG as that of the mother at birth? (6)
- 2.2 If Kate were to develop an infection within her first week of life, passive immunity could be administered.
- 2.2.1 What would passive immunity entail? (2)
 - 2.2.2 Why would passive immunity be administered? (3)
 - 2.2.3 Would the passive immunity give her life-long protection? Motivate your answer. (3)
- 2.3 On day 10, the infant was diagnosed with a Staphylococcal infection. *Staph aureus* is a bacterial species that causes extracellular infections.
- 2.3.1 Describe how the bacteria would be processed into peptides which are then presented to T lymphocytes (12)
 - 2.3.2 Name the type of adaptive immune response that would predominate. Motivate your answer. (2)

- 2.3.3 Describe how memory cells that recognise *Staphylococcus aureus* remained behind after this infection. (6)
- 2.4 Name the class of antibody that would be initially produced after a lymphocyte's first encounter with *Staphylococcus aureus*. (1)
- 2.5 Sketch and label a molecule of the antibody named in 2.4 (½ mark per label). (10)
- 2.6 By means of a table, compare the class of antibody named in 2.4 with respect to the following features: *Type of heavy chain; Structure of the antibody; Crosses the placenta; Subclasses; and Percentage of the class of antibody in the body* (10)

QUESTION 3

[25]

A 11-year-old male developed pneumonia and was placed on penicillin. He developed puffy eyes, urticaria, swollen face and wheezing. This was not the first time he had been placed on penicillin for the treatment of bacterial infections. CH50 test to determine the presence of complement proteins revealed that the levels were below normal. He was diagnosed with drug-induced serum sickness. Serum sickness results from the formation of small immune complexes in the presence of excess antigen. These small immune complexes are not removed from the circulation and instead are deposited in the tissue. The immune system tries to rid the body of these deposited immune complexes by activating complement proteins. Anaphylatoxins which are released during the activation of complement contribute to the inflammatory responses which manifested in the symptoms the boy exhibited.

- 3.1 Define complement and list the 4 major functions of complement (5)
- 3.2 Name the complement pathway that is activated in this scenario where immune complexes are deposited in tissues. (2)
- 3.3 With the aid of a diagram, describe the formation of the C5 convertases in the pathway named in 3.2. In your answer indicate which are the opsonins that are produced in the process and to which the phagocytes can attach to the immune complexes which have settled in the tissues. (12)
- 3.4 In the scenario above anaphylatoxins are produced and cause the inflammatory response. What are these anaphylatoxins and describe their role in inflammation? (6)

End of Examination

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