



**NAMIBIA UNIVERSITY
OF SCIENCE AND TECHNOLOGY**

FACULTY OF HEALTH AND APPLIED SCIENCES

DEPARTMENT OF HEALTH SCIENCES

QUALIFICATION: BACHELOR OF MEDICAL LABORATORY SCIENCES	
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SESSION: JANUARY 2020	PAPER: THEORY
DURATION: 3 HOURS	MARKS: 100

SUPPLEMENTARY / SECOND 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 [50]

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?
- (a) Bacterial cell wall lipopolysaacharide
 - (b) Bacterial cell wall lipetechoic acid
 - (c) Diacylglycerides
 - (d) Nucleic acids
 - (e) Mannose
- (1)
- 1.2 All of the following molecules are opsonins that facilitate efficient phagocytosis of microbes by neutrophils and macrophages except;
- (a) C3b
 - (b) C5a
 - (c) IgG
 - (d) C-reactive protein
 - (e) Mannose-binding lectin
- (1)
- 1.3 Which of the following is a feature of Natural Killer cells?
- (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)
- 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 alterative 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 function primarily as a professional antigen-presenting cell?
- (a) Basophils
 - (b) Platelets
 - (c) Eosinophils
 - (d) Interdigitating dendritic cells
 - (e) Neutrophils (1)
- 1.19 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)
- 1.20 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)

QUESTION 2**[15]**

In the Chediak-Higashi disease the functions of phagocytes as well as natural killer cells is impaired.

- 2.1 From which lineage does natural killer cells develop? (2)
- 2.2 Describe natural killer T-cells and discuss their functions and markers that are found on their surface. (7)
- 2.3 Define cluster differentiation and its uses in immunology. (6)

QUESTION 3**[15]**

- 3.1 What is C-reactive protein (1)
- 3.2 CRP can trigger the complement pathway when it binds to C1q.
- 3.2.1 Name the pathway that is triggered when CRP binds to C1q. (1)
- 3.2.2 Describe the functions of complement. (10)
- 3.3 What is the function of perforin? (1)
- 3.4 The function of which 2 cells are affected by the absence of perforin. (2)

SECTION B [50]**QUESTION 4****[25]**

T lymphocytes are central to the adaptive immune response. $\alpha\beta$ -T lymphocytes can be subdivided into groups. Each group has a different role to play in the immune system. Discuss the different groups of T lymphocytes. In your answer refer to the function, the cytokines that they produce, the cytokines that affect their development and the markers which enable a scientist to characterise them. (25)

QUESTION 5

[25]

Jonathan is diagnosed with nasopharyngeal diphtheria, a disease in which the bacterial specie, *Corynebacterium diphtheriae* produces a neurotoxin. The toxin is then able to enter the epithelial cells of the upper respiratory tract and cause necrosis (the death) of epithelial cells as well as polymorphonuclear cells in the underlying tissue.

- 5.1 Our bodies are constantly under threat by infectious organisms trying to get access to our bodies. Fortunately, commensals are able to protect us and prevent the entry of the bacteria. Explain how commensals can prevent entry of pathogens into our body. (1)
- 5.2 Once the *Corynebacteria* gain access to Jonathan's tissues, the *Corynebacteria* are confronted with phagocytes in the underlying tissue and inflammation sets in. How are the phagocytes able to recognize and attack the *Corynebacteria*? (2)
- 5.3 Which phagocyte would the *Corynebacteria* first encounter at the site of infection? Give a reason for your answer. (2)
- 5.4 Discuss the features of the adaptive immune response that makes it more effective in protecting Jonathan's body in the long run against *Corynebacteria*. (15)
- 5.5 Fortunately, the cases of diphtheria are few thanks to vaccination. Name the person who performed the first vaccination as we know it today and describe the events leading up to and including this significant event. (5)

End of Examination

Total Marks: [100]

Good Luck!