NAMIBIA UNIVERSITY
OF SCIENCE AND TECHNOLOGY

FACULTY OF HEALTH, APPLIED SCIENCES AND NATURAL RESOURCES

DEPARTMENT OF HEALTH SCIENCES

QUALIFICATION: BACHELOR OF MEDICAL LABORATORY SCIENCES	
QUALIFICATION CODE: 08BMLS	**LEVEL: 5**
COURSE CODE: IMY521S	**COURSE NAME:** IMMUNOLOGY
SESSION: JANUARY 2023	**PAPER:** THEORY
DURATION: 3 HOURS	**MARKS:** 100

SUPPLEMENTARY / SECOND OPPORTUNITY EXAMINATION PAPER	
EXAMINER(S)	**DR MAURICE NYAMBUYA**
MODERATOR:	**MS FREDRIKA ENGELBRECHT**

INSTRUCTIONS
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 In the immune response to a hapten-protein conjugate, in order to get anti-hapten antibodies, it is essential that;

(a) Hapten be recognized by helper T-cells.
(b) The hapten be recognized by natural killer-cells.
(c) The hapten be recognized by suppressor T-cells.
(d) The protein be recognized by B-cells.
(e) The protein be recognized by helper T-cells. (1)

1.2 Antigen-presenting cells that activate helper T-cells must express which one of the following on their surface?

(a) CD4
(b) Class I MHC
(c) Class II MHC
(d) IgM
(e) Thy-1 (1)

1.3 One principal function of complement is to

(a) Bind antibodies attached to cell surfaces and to lyse these cells.
(b) Cross-link allergens.
(c) Inactivate perforin.
(d) Mediate the release of histamine.
(e) Phagocytose antigens. (1)

1.4 Cytokines always act

(a) Antagonistically with other cytokines.
(b) Act long range.
(c) By binding to specific receptors.
(d) In an autocrine manner.
(e) Synergistically with other cytokines. (1)

1.5 Which of the following cytokines is characteristically produced by Th2 lymphocytes which provide help for antibody production?

(a) GM-CSF
(b) IL-1
(c) IL-4
(d) IFN-γ
(e) TNF-α (1)

1.6 High-affinity B cell clones are usually generated by

(a) Class switching.
(b) Expression of high affinity precursors in the naive B cell population.
(c) Positive selection.
(d) Negative selection.
(e) Somatic hypermutation. (1)

1.7 Prior to class-switching, B cells express

(a) IgA
(b) IgA and IgG
(c) IgD
(d) IgD and IgM
(e) No surface antibody (1)

1.8 Which of the following is a primary lymphoid organ?

(a) Lymph nodes
(b) Peyer's Patches
(c) Spleen
(d) Thymus
(e) Tonsil (1)

1.9 When antigen reaches the lymph node

(a) There is an increase in the number of cells leaving the lymph node.
(b) There is a decrease in the number of cells leaving the lymph node.
(c) There is an immediate increase in the number of activated B cells.
(d) It is transported to the spleen.
(e) It is immediately destroyed by the macrophages. (1)

1.10 The specialised cell type involved in the entry of lymphocytes into a lymph node is called

(a) HEV endothelial cells
(b) M cells
(c) PALS cells
(d) Selectins
(e) Synovial cells (1)

1.11 The following is characteristic of B cells but not T cells:

(a) CD3
(b) CD40 ligand
(c) MHC class I
(d) Polyclonal activation by concanavalin A
(e) Surface immunoglobulin (1)

1.12 A Fab fragment

(a) Is produced by pepsin treatment.
(b) Is produced by the separation of heavy and light chains.
(c) Binds antigens.
(d) Lacks light chains.
(e) Has no interchain disulphide bonds. (1)

1.13 Pattern recognition receptors include

(a) PAMPs
(b) LPS
(c) Lipotechoic acid
(d) Lectin-like molecules
(e) Bacterial peptidoglycan (1)

1.14 The complement component C3 is cleaved by

(a) Factor D
(b) C4b2a3b
(c) C3bBb
(d) C3b
(e) C1s (1)

1.15 C3b

(a) Opsonises bacteria.
(b) Is an anaphylatoxin.
(c) Is chemotactic.
(d) Is the inactive form of C3.
(e) Directly injures bacteria. (1)

1.16 Positive selection in the thymus is mediated by:

(a) B cells.
(b) Cortical epithelial cells.
(c) Follicular dendritic cells.
(d) Interdigitating medullary cells.
(e) Macrophages. (1)

1.17 Specific antibodies are readily detectable in serum following primary contact with antigen after

(a) 10 minutes.
(b) 1 hour.
(c) 5-7 days.
(d) 3-5 weeks.
(e) Only following a second encounter with the antigen. (1)

1.18 The antigen portion on an antigen –presenting cell that is recognised by the αβ-TCR is

(a) The native protein antigen together with the Major Histocompatibility Complex molecule.
(b) Processed peptide antigen together with the Major Histocompatibility Complex molecule.
(c) Processed peptide antigen.
(d) Native antigen.
(e) The Major Histocompatibility Complex molecule alone. (1)

1.19 Antigen processing for presentation by an MHC class II molecule involves

(a) Calnexin
(b) HLA-DM
(c) LMP2
(d) Proteasome
(e) TAP 1 and TAP 2 (1)

1.20 Suppression of Th2 lymphocytes by Th1 lymphocytes may be mediated by

(a) IL-4
(b) GM-CSF
(c) IL-1
(d) TNF-β
(e) INF-γ (1)

SECTION B [80]

QUESTION 2 [55]

Thando had been a healthy until she developed pneumonia caused by *Pneumocystis jirovecii*, an opportunistic pathogen, at the age of 7 months. The paediatrician suspected that she may have a severe combined immunodeficiency disease and ordered an investigation of her lymphocyte functions. The T cells were found to have normal proliferative activity but further diagnostic tests revealed that her T cells could not respond to specific antigen stimuli. Her serum antibody levels were determined (see results in the table below). Analysis of her B cells revealed that there were no HLA-DQ or HLA-DR molecules. All tests pointed to the fact that she did not have Severe Combined Immunodeficiency Disease but that she had inherited an autosomal recessive trait of her HLA-DQ & HLA-DR which explains the absence of HLA-DQ and HLA-DR molecules. She received a bone marrow transplant from her brother and her immune function was restored. Her $CD4^+$ cells were also very low in number. Normally, her $CD4^+$ count would be expected to be twice her $CD8^+$ T-lymphocyte count.

TEST	RESULT	COMMENT
Leukocytes	20 000 cells /μℓ	4000-7000 cells /μℓ
Lymphocytes	10%	
Neutrophils	82%	
Monocytes	6 %	
Eosinophils	2%	
B lymphocytes	27%	
T lymphocytes	47%	
Helper T cells *	10%	
Cytotoxic T cells *	34%	
IgM	30 mg/dℓ	normal : 40-345 mg/dℓ
IgG	96 mg/dℓ	normal : 600-1400 mg/dℓ
IgA	6 mg/dℓ	normal : 60-380 mg/dℓ

2.1 Comment on the levels of leucocytes in her body. Include what the expected levels would be. (6)

2.2 What function is affected by the absence of HLA-DQ and HLA-DR molecules? (1)

2.3 Why is it important that B lymphocytes have HLA-DQ and HLA-DR molecules? (1)

2.4 In the event that Thando has a S.aureus infection and a healthy immune system, describe the events leading to the activation and differentiation of B cells. S. aureus are extracellular pathogens. Mention the cytokines that are involved. (8)

2.5 Sketch and label a HLA-DQ molecule named (½ mark per label). (6)

2.6 Describe how S.aureus would be processed and presented if HLA-DQ and HLA-DR molecules were present and functional. (12)

2.7 The activation of B and T lymphocytes would take place in the lymph node. Describe the organisation of the lymphoid cells in this structure. (9)

2.8 T lymphocytes tend to spend more time outside the lymph node and spleen than B cells. Explain how a naïve T lymphocyte which found itself in blood could gain entry into the lymph node to see whether it could recognise any antigen that had been sequestered in the lymph node and then leave the lymph node if it didn't become activated. (12)

QUESTION 3 [25]

Shawn 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.

3.1 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)

3.2 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)

3.3 Which phagocyte would the *Corynebacteria* first encounter at the site of infection? Give a reason for your answer. (2)

3.4 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)

3.5 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]