UNIVERSITY OF JOHANNESBURG

FACULTY OF SCIENCE

FAKULTEIT NATUURWETENSKAPPE

DEPARTMENT OF BIOCHEMISTRY /DEPARTEMENT BIOCHEMIE

MODULE **BIC 3B01**
Molecular Physiology
Molekulêre Fisiologie

CAMPUS **APK**
KAMPUS APK

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DURATION 3 HOURS MARKS 100
TYDSDUUR 3 UUR **PUNTE 100**

NUMBER OF PAGES: 7 PAGES
AANTAL BLADSYE: 7 BLADSYE

INSTRUCTIONS: ANSWER ALL THE QUESTIONS
INSTRUKSIES: BEANTWOORD AL DIE VRAE

SECTION A **[50]**

All questions must be answered in the answer booklet provided. Choose the correct answer and use a cross to indicate your choice *at the back of the answer booklet.* Multiple choice questions (MCQs) answered on the question paper will not be marked. To indicate the correct answer for each MCQ, a clear cross must be made with a pen and NOT a pencil.

QUESTION 1 **[8]**

Multiple Choice Questions (1.1 -1.8), choose ONE correct answer.

1.1 The nonpolar tails of phospholipid molecules tend to…

A. repel fat-soluble molecules but let ions pass through.
B. repel gas molecules but let water pass through.
C. repel ions but let fat-soluble molecules pass through.
D. repel fat-soluble molecules but let gases pass through.
E. repel water molecules but let ions pass through

1.2 Cystic fibrosis is caused by a mutation in the gene encoding the cystic fibrosis transmembrane regulator (CFTR) protein, a membrane protein that functions as a(n):

A. Receptor.
B. Transporter.
C. Ion channel.
D. Enzyme.
E. Structural protein.

1.3 When cholesterol is converted to various steroid hormones, which of the following happens?

1. Number of carbon atoms decrease
2. Enzymes in the smooth ER and mitochondria are involved
3. OH groups on various positions in the side chain and ring structure of cholesterol are modified
4. In oestradiol, ring A is converted to an aromatic ring

A. Only 1 and 3 are correct
B. Only 3 is correct.
C. Only 4 is correct
D. 1, 3, 4 are only correct
E. All of the above is correct

1.4 Which of the following statements regarding Nitric oxide (NO) is correct:

A. Differs from endothelium-derived relaxing factor.
B. Contracts smooth muscle of blood vessels to increase blood flow and blood pressure.

C. Is synthesized from arginine by NO synthase.
D. Causes an intracellular increase in calcium.
E. Relaxes skeletal muscle

1.5 Athletes sometimes complain of oxygen debt, a condition that results when insufficient oxygen is available to completely break down pyruvic acid. As a result, the pyruvic acid is converted to

A. hydrochloric acid.
B. stearic acid.
C. lactic acid.
D. a strong base.
E. succinyl-CoA

1.6 Suppose a white muscle fiber gains 60 ATP's from metabolism. How many glucose molecules were consumed to yield this much energy, assuming the white muscle is operating ANAEROBICALLY?

A. 120
B. 30
C. 38
D. 2
E. 60

1.7 What does von Willebrand factor do?

A. Binds platelets to each other
B. Binds platelets to the subendothelium
C. Binds platelets to the phospholipid surface
D. Carries factor VII
E. Cleaves factor V

1.8 What is the mechanism by which heparin prevents blood clotting?

A. It binds vitamin K and prevents it from acting
B. It binds to antithrombin, causing a conformational change in antithrombin
C. It inhibits platelet aggregation
D. It inhibits the conversion of fibrinogen to fibrin
E. It inhibits factor IXa

<u>QUESTION 2</u> **[12]**

Provide definitions for the following terms: **(4)**

2.1.1 Fluid mosaic model

2.1.2 Membrane potential

2.2 If during the action of the sodium-potassium pump, 200 molecules of ATP are used, how many sodium and potassium ions are transported across the membrane? Justify your answer by describing the action of this pump. (8)

QUESTION 3 **[12]**

Describe the events involved in the formation of platelet plug.

QUESTION 4 **[13]**

4.1 Briefly compare the nett ATP production via the three different metabolic pathways in skeletal muscle tissue and the consequence of the ATP generated from these pathways. (5)

4.2 Janet is currently a 100m sprinter but has decided that she would like to enter the Two Oceans Marathon next year. She consults you as to what type of muscle fibres she needs to develop for the upcoming marathon and how she should go about doing it. Why does Janet need to develop a different type of muscle fibre for the upcoming marathon and how would you suggest that she go about her training for the marathon? (8)

QUESTION 5 **[5]**

"Plants lack animal-like adaptive immunity. Therefore, plants have evolved a specific multi-layered system against invading pathogens." In light of this statement, discuss the ZigZag Model with regards to plant immunity.

SECTION B: **[50]**

Answer the following section in the EXAMINATION BOOK. More than one answer may be correct.

Question 1 **[12]**

Consider the following mature, differentiated blood cells:

A. T cell
B. B cell
C. Dendritic cell
D. Monocyte
E. Macrophage
F. Neutrophil
G. Megakaryocyte
H. platelets
I. erytrhrocyte

They all originate from a multipotent hemopoietic stem cell in the bone marrow that gives rise to committed progenitors. Committed progenitors, in turn, give rise to 4 major cell lineages (groups). On the multiple choice answer sheet, indicate the correct choice of cells matching statements 1-6:

A**. Among the cells originating from the lymphoid progenitor.**

1. D, E, F, G, H, I
2. G, H, I
3. D, E, F
4. A, B
5. D, E

B. **Among the cells originating from the myeloid progenitor.**

6. D, E, F, G, H, I
7. G, H, I
8. D, E, F
9. A, B
10. D, E

C. **Phagocytes.**

1. D, G, H, I
2. G, H, I
3. C, E, F
4. A, B
5. A, B, D

D. **HIV target(s).**

1. B
2. A
3. B, G, H, I
4. Only C
5. A, E

E. **Mature in thymus.**

1. A
2. B
3. C
4. D
5. F

F**. Antibody producing and precursor of antibody-secreting plasma cell.**

1. A
2. B
3. C
4. D
5. F

G**. Cascades in which inactive proteases get activated by proteases upstream:**

1. Hemostasis or blood coagulation (clotting).
2. The complement system.
3. Apoptosis.
4. All of the above.

H. **Membranes are important in innate immunity because:**

1. they form the interface between pathogens and hosts.
2. they contain receptors that recognize components of bacterial cell walls.
3. they form cellular and biochemical barriers.
4. all of the above.

I. **Albumin:**

1. is glycosylated.
2. is the major plasma protein and the principle determinant of intravascular osmotic pressure.
3. levels in plasma is not influenced by disease.
4. binds ligands very specifically.
5. is synthesized in plasma cells and endothelial cells.

J. **Haptoglobin:**

1. binds haptens.
2. plays a key role in iron reutilization by binding iron directly.
3. binds heme.
4. bound to hemoglobin is excreted in the urine.
5. polymorphisms appears to be associated with inflammatory diseases.

K. **Transferrin:**

1. bound to iron is called apoTf.
2. saturation is a laboratory test for assessing patients with disorders of iron metabolism.
3. binds iron as Fe^{2+} and delivers it where needed through receptor-mediated endocytosis.
4. is bound by TfRs in the plasma.
5. is an intracellular iron storage protein.

L**. Heparin decreases the activity of antithrombin III.**

1. True
2. False

QUESTION 2 **[4]**

A 33-year-old man walked into the clinic complaining of fever, loss of appetite and night sweats. Upon analysis of his white blood cell count, the following was found: N- 83%, L- 3% and M- 5%. Name any two possible factors that might have contributed to the increase in the neutrophil count. Provide an explanation for each answer (4)

QUESTION 3 **[10]**

HIV weakens the immune system by targeting CD4 cells. Given the HAART as part of controlling the progression of the disease, show with an explanation using the life cycle of HIV how HAART prevents the virus from multiplying.

QUESTION 4 **[7]**

With the aid of a diagram, describe the role of hepcidin in systemic iron regulation. (use macrophage system)

QUESTION 5 **[3]**

What is the difference between a pro-oncogene and an oncogene? Give an example of an oncogene and of a pro-oncogene.

QUESTION 6 **[3]**

Explain two of the factors that can halt the cell from progressing beyond G1 of the cell cycle?

QUESTION 7 **[3]**

Hematopoietic Stem cell differentiate into Myeloid and Lymphoid. Name the immediate products of Common Myeloid progenitors and one chemical that promote such product.

QUESTION 8 **[8]**

Write a short essay on how a cell damaged by an external agent would be eliminated by the process of apoptosis.

_____**END**_____