



FACULTY OF SCIENCE
FAKULTEIT NATUURWETENSKAPPE

DEPARTMENT OF BIOCHEMISTRY

MODULE **BIC 3B01 / BIC 03B3**
Molecular Physiology

CAMPUS **APK**

DATE 07 JANUARY 2019 **SESSION** 08h00 – 11h00

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DURATION 3 HOURS **MARKS** 100

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NUMBER OF PAGES: 7 PAGES

INSTRUCTIONS: ANSWER ALL THE QUESTIONS

- Answer Section A, Question 1 – 5 in the 1st color Exam Book provided.
- Answer Section B, Question 1 – 5 in the 2nd color Exam Book provided.

SECTION A:

[50]

QUESTION 1

[10]

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 answered on the question paper will not be assessed. Multiple choice questions must be marked clearly with a pen and not pencil. MCQ 1.1-1.10 (Section A) only have ONE correct answer.

1.1 Which of the following factors would tend to increase membrane fluidity?

- A. a greater proportion of unsaturated phospholipids
- B. a greater proportion of saturated phospholipids
- C. a lower temperature
- D. a relatively high protein content in the membrane

1.2 Endocytosis:

- A. Results from the contact of two inner and two outer surface monolayers.
- B. Results from the contact of two inside surface (cytoplasmic side) monolayers.
- C. Is a special type of phagocytosis.
- D. Is often followed by fusion with primary lysosomes; a key role in intracellular disposal.

1.3 Tgb, thyroglobulin:

- A. Transports iodide into thyroid cells.
- B. Is the precursor for T3 and T4.
- C. Is a group I hormone.
- D. Oxidises iodide.

1.4 Steroid hormones exert their action by _____.

- A. entering the nucleus of a cell and initiating or altering the expression of a gene
- B. finding an appropriate cell receptor and initiating cAMP activity
- C. stimulating the synthesis of a glycogen
- D. increasing blood pressure

1.5 One of the major differences among skeletal muscle fiber types is in their resistance to fatigue.

The fibers with the most endurance rely on _____ for energy.

- A. lactic acid accumulation
- B. ketone body degradation
- C. anaerobic glycolysis
- D. oxidative phosphorylation

1.6 Ca^{2+} is important in the contraction of smooth muscle. Which of the following is NOT true about smooth muscle contraction?

- A. Ca binds to calmodulin.
- B. Ca enters the cytosol from the sarcoplasmic reticulum.
- C. Contraction is immediately triggered by calmodulin binding.
- D. MLCK (myosin light chain kinase) forms a complex to activate myosin.

1.7 Hemophilia A is a condition which results in a deficiency of factor

- A. I
- B. II
- C. VIII
- D. IX

1.8 Nitric oxide (NO):

- 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

1.9 Immediate hemostatic responds to the damage vessel:

- A. platelet adhesion
- B. platelet aggregation
- C. platelet viscous metamorphosis
- D. vasoconstriction

1.10 Which of the proteins below is a protease inhibitor controlling blood clotting?

- A. Thrombin
- B. Plasmin
- C. Antithrombin
- D. Tissue plasminogen activator

QUESTION 2

[13]

2.1 Based on chemical classification, what are the three classes of hormones and what is each of them composed of?

(3)

2.2 Thyroid hormones are produced from thyroglobulin. Describe, in detail, the synthesis of these hormones in their producing cells and the response these hormones elicit in their target cells.

(10)

QUESTION 3

[12]

Describe in detail the process and mechanisms of platelet activation and adherence during the blood clotting process.

QUESTION 4

[10]

Mary 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 Mary 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?

QUESTION 5

[5]

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

SECTION B:

[50]

QUESTION 1

[12]

Discuss the molecular and cellular processes during *Mycobacterium tuberculosis* (*Mtb*) infection, referring to the following.

- A. The ease of transmission compared to HIV. (1)
- B. The type of host immune cell that targets *Mtb*. (1)
- C. The host receptors and *Mtb* patterns recognised, essential in host-pathogen interaction. (1)
- D. The mechanism of pathogen entry into the target host cells and subsequent strategies by *Mtb* bacilli to survive. (3)
- E. Types of immune responses directed towards *Mtb* and the protective outcome. Name all host cells involved and subsequent processes. (3)
- F. The impact later in life if disease or drugs of immunosuppression weaken the immune system. (1)
- G. Which fraction of the global population is infected with *Mtb* and what is the impact of this on sub-Saharan Africa? (2)

QUESTION 2

[12]

Suggest the most suitable and accurate immunochemical technique to detect each of the following. Describe the immunochemical technique and motivate your choice for each.

- A. Specific antibodies to HIV proteins in serum from people at risk for HIV infection. (4)
- B. Relative levels of an intracellular protein in monocytes, which occur in a mixed population of cells. (4)
- C. The role of NFκB in regulation of provirus transcription in HIV-infected individuals. (4)

QUESTION 3

[8]

Answer the following section on the **MULTIPLE-CHOICE ANSWER SHEET** provided on the inside, back cover of the **EXAMINATION BOOK**. **Only one answer is correct.** You may lose marks if more than one answer is marked or if your single answer is not marked clearly.

Human red blood cell membrane(s):

- A. Were studied particularly by native PAGE
- B. Are composed of mostly proteins
- C. Help with the phagocytosis of pathogens
- D. Proteins are all glycoproteins
- E. Contain the proteins of the ABO blood group system

Select the one of the following statements that is NOT CORRECT:

- A. The high surface area of biconcave red blood cells facilitates gas exchange.
- B. Hereditary elliptocytosis can be caused by defects in or a deficiency of spectrin.
- C. The diameter of red blood cells exceeds that of many peripheral capillaries.
- D. Protein 4.1 helps link the erythrocyte cytoskeleton to proteins in the cell's plasma membrane.
- E. In order to pass through narrow capillaries, red blood cells must be squeezed into a compact, spherical shape.

Select one of the following statements that is NOT CORRECT:

- A. Red blood cells contain high levels of superoxide dismutase.
- B. A and B substance are formed by the addition of fucose and N-acetyl glucosamine, respectively, to H substance.
- C. Platelets generate ATP exclusively via glycolysis.
- D. Mature red blood cells are devoid of internal organelles.
- E. Erythrocyte membranes contain high levels of the Band 3 anion exchange protein.

Select one of the following statements that is NOT CORRECT:

- A. Erythropoietin stimulates the formation of red blood cells from haematopoietic stem cells.
- B. Multipotent stem cells are able to differentiate into cells of a closely related type.
- C. Carbonic anhydrase increases the capacity of red blood cells to transport CO₂.
- D. GLUT1 mediates the active transport of glucose into erythrocytes.
- E. Hypoxia stimulates the production of erythropoietin by the kidneys.

TRUE OR FALSE

Iron deficiency anemia can be treated by donating blood.

- A. True
- B. False

Iron catalyzes both the Fenton reaction and the Haber-Weiss reactions.

- A. True
- B. False

Super oxide anion is the most dangerous reactive oxygen species and free radical.

- A. True
- B. False

Oxidative stress is characterized by injury to proteins, DNA and lipids.

- A. True
- B. False

QUESTION 4

[10]

Describe how α 1-Antiproteinase (α 1-Antitrypsin) is associated with emphysema.

QUESTION 5

[10]

A. Write an essay on the immunological aspects of cancer.

(6)

B. Explain how obesity is related to cancer.

(4)

