UNIVERSITY OF JOHANNESBURG

FACULTY OF SCIENCE

FAKULTEIT NATUURWETENSKAPPE

DEPARTMENT OF BIOCHEMISTRY /DEPARTEMENT BIOCHEMIE

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

CAMPUS **APK**
KAMPUS APK

EXAM **9 NOVEMBER 2015**

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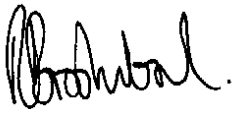
DURATION	3 HOURS	MARKS	110
TYDSDUUR	**3 UUR**	**PUNTE**	**110**

NUMBER OF PAGES: 8 PAGES
AANTAL BLADSYE: 8 BLADSYE

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



SECTION A **[12]**

Answer the following section on the multiple choice answer sheet provided. Choose the option that best completes the statement or answers the question. Only one answer is correct for questions 1-12.

1. Which one of the following is a life science search engine?

A. PubMed
B. Entrez
C. Mozilla.
D. EBI

2. _____ compares protein sequence against protein databases.

A. blastp.
B. blastn.
C. blastx.
D. tblastx

3. SNP stands for _____.

A. Small Nucleic Polymorphism
B. Single Nucleic Polymorphism
C. Single Nucleotide Polymorphism
D. Small Nucleotide Polymorphism

4. Areas considered to be the well-conserved regions in multiple sequence alignments…

A. reflect areas of structural importance.
B. reflect areas of functional importance.
C. reflect areas of both functional and structural importance.
D. reflect areas likely to be of functional and/or structural importance.

5. _____ are membrane-bound or soluble proteins or protein complexes exerting a physiological effect after binding of a ligand.

A. Antagonists
B. Agonists
C. Receptors
D. Transporters

6. Fitting a ligand from a 3D structure database into the binding site of a target protein is called _____.

A. modelling.
B. docking.

C. threading.
D. comparative modelling.

7. Which database would <u>not</u> provide information on heritable disorders in humans?

A. OMIM (Online Mendelian Inheritance in Man).
B. PDB (Protein Data Bank).
C. Entrez
D. HGMD (Human Gene Mutation Database).

8. 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

9. Thyroid hormone (a small iodinated amine) enters target cells in a manner similar to _____.

A. insulin, because insulin is a small peptide
B. steroid hormones, because both diffuse easily into target cells
C. growth hormone, because the thyroid works synergistically with thyroid hormone
D. glucagon, because the structure of glucagon is similar to that of thyroid hormone

10. Mineralocorticoid is to aldosterone as glucocorticoid is to _____.

A. testosterone
B. estrogen
C. cortisol
D. epinephrine

11. Which energy system has the greatest capacity for energy production, i.e., endurance?

A. ATP-PCr
B. aerobic oxidation
C. anaerobic glycolysis
D. lactic acid

12. Place the events of signalling listed below in the correct order.

1. G-protein binds to activated receptor forming a receptor-G protein complex
2. Release of GDP by the G-protein
3. Change in formation of the cytoplasmic loops of the receptor
4. Binding of GTP by the G-protein
5. Increase in the affinity of the receptor for the G-protein on the cytoplasmic surface of the membrane

6. Binding of the hormone or neurotransmitter to a G-protein coupled receptor
7. Conformational shift in the α- subunit of the G-protein

A. 6-3-5-1-2-4-7
B. 6-5-4-1-7-2-3
C. 6-3-5-1-7-4-2
D. 6-3-5-1-7-2-4
E. 6-7-3-5-1-2-4

SECTION B **[48]**

Question 1 **(12)**

The following statements are ALL FALSE. Indicate why they are false by correcting the statement so that it is true.

1.1 Cell signalling molecules are small, membrane permeable molecules such as steroids, ions and dissolved gases and non-permeable molecules such as proteins, peptides and nucleotides.

1.2 The role of ATP during muscle contraction is to separate the myosin head from troponin.

1.3 Factor V is an important plasma component that forms the fibrous skeleton of a clot during the coagulation cascade.

1.4 Factor XII initiates the coagulation cascade *in vivo.*

1.5 XIIIa is a zymogen that causes cross-linking of lysine which solidifies the fibrin clot.

1.6 17-alpha-hydroxylase is the enzyme that converts pregnenolone to progesterone.

Question 2 **(30)**

"The underlying basis for the control of movement in all sports is energy, and successful performance depends upon the ability of the athlete to produce the right amount of energy and to control its application to the specific demands of the sport."

Discuss this statement with regards to:

1. The energy sources used during exercise (12)
2. The advantages and limiting factors of these energy sources (6)
3. The kind of eenergy metabolism that takes place in different muscle fibres and how the distribution of these fibre differ between elite athletes involved in different events e.g. a sprinter vs a marathon runner (6)

4. The role of epinephrine and Ca^{2+} in muscle tissue during exercise (6)

Question 3 **(6)**

Discuss the differences between Systemic Aquired resistance (SAR) and Induced Systemic Resistance (ISR)?

Section C **[50]**

Explain all terms and phrases used.

Question 1 **[20]**

Compare and **contrast** innate and adaptive immunity by filling in the Table below, on the question paper. Name any subclasses/branches of immunity, where applicable. (18):

Characteristic	**Innate**	**Adaptive**
Cells involved, lineage (committed common progenitor), place of development in adult mammals, distinctive membrane molecules, what they recognize, signalling molecules secreted and their function. **(5)**		
End products or outcome of the response. **(3)**		
Species occurrence. **(2)**		
Timing. **(2)**		
Memory. **(2)**		
Specificity. **(2)**		
Location of response. **(2)**		

Conclude by motivating the following statement with two arguments: “Innate and adaptive immunity cannot be considered independently” (2)

Question 2 **[4]**

According to Statistics South Africa, Tuberculosis ranks as the number one leading cause of death in South Africa. Using mycobacteria as your example, illustrate how pathogens:

a. Misuse host proteins. (2)
b. Evade host defence mechanisms. (2)

Question 3 **[5]**

Describe and illustrate the use of Western blotting in determining the HIV status of an individual. Indicate and motivate the status of all antibodies (Abs) used (McAb/PcAb). Clearly indicate what the different layers of protein or Ab used are. Indicate whether the Ab used is a primary or secondary Ab and state whether it is labelled. If labelled, what is it labelled with and why? Explain the potential danger of relying on the interaction between antigens prepared in SDS sample buffer and Ab raised against native protein. Indicate what is detected with SDS-PAGE, molecular weight (kDa) or relative molecular mass Mr, and state the difference between these two measurements? Name another immunochemical technique used to test HIV status and the advantage that Western blotting has over it.

Question 4 **[11]**

The electron transport chain system, NADPH oxidase, plays a key role in phagocytic cells when they engulf bacteria.

a. What is the process called which this electron transport chain system is catalysing? (1)
b. What is the composition of the electron transport chain system, NADPH oxidase? (1)
c. What is the location of NADPH oxidase (subcellular and specific phagocytic cells)? (1)
d. Give the following three reactions:
    i. The reaction NADPH oxidase catalyses. (1)
    ii. A subsequent spontaneous reaction and the enzyme that catalyses this reaction. (1)
    iii. A further reaction leading from products in reaction ii. and the catalysing enzyme present in large amounts in neutrophil granules. (1)
e. What is the aim of NADPH oxidase activation? (1)
f. What defence does the host have against the reaction products? Give two chemical reactions and the enzymes involved. (2)
g. Give a simplified scheme of the sequence of events of a disease involving NADPH oxidase. You may use a flow diagram. (2)

Question 5 **[10]**

Summarise cancer by listing and briefly explaining:

a. Six features of a cancer cell. (3)
b. Four types of potential genetic changes. (2)
c. Two types of potential epigenetic changes. (1)
d. How you would go about treating breast cancer displaying unique cell surface receptors, using a McAb and anti-idiotype antibodies. Explain all terms and phrases used. (4)