

DEPARTMENT OF ZOOLOGY

MODULES PHS3B01/PHS03B3

CAMPUS APK

EXAM Paper 2, 2019

DATE: TBA ASSESSOR(S) INTERNAL MODERATOR EXTERNAL MODERATOR DURATION: 3 HOURS

SESSION: TBA Prof. Peter Teske Prof. Bettine Jansen van Vuuren Dr Priyesh Bipath MARKS: 100

NUMBER OF PAGES: 5

INSTRUCTIONS:

- Answer all questions and write legibly
- "Example answers" are sometimes given in italics; these only indicate the format that should be used for a particular answer, they provide no information on which answers are correct
- Some answers have word limits
- Square brackets indicate total marks given for a question, round brackets indicate marks given for sub-questions

<u>PART 1, TERM 3:</u>

QUESTION 1

Briefly define the following (in 1-2 sentences each):	[10]
1.1 Threshold of conductive myocytes' action potential	(2)
1.2 Vascular remodelling	(2)
1.3 Steal Effect	(2)
1.4 Exercise hyperemia	(2)
1.5 eNOS	(2)

1.5 eNOS

QUESTION 2

The figures below depict the Heart Rate, the Stroke Volume and the Cardiac Output in a group of cyclists during a 40 km cycling time trial. The trial was first conducted under cool conditions (circles) and repeated a month later under hot, dry conditions (triangles). *Significant difference between cool and hot conditions at the same time; ⁺Significantly lower than at 10 min. Answer the following questions (in <30 words each)



2.1 Why does the Stroke Volume (SV) decrease significantly more during hot conditions than under cool conditions? (2)

2.2 Name the term for the decrease in SV over time. (2)

2.3 Why is the Heart Rate (HR) higher during hot conditions throughout most of the trial? (2)

2.4 Describe and explain the expected trends in Cardiac output (Q) change over time (please note: trends are the same for both groups). (4)

2.5 How would the SV differ from that under hot/dry conditions if the environment was hot/humid? Motivate your answer. (3)

[13]

QUESTION 3

This figure depicts how the injection of Acetylcholine (ACh) changes the diameter of an arteriole at the point of injection (local) and at distances of 660 μ m and 1320 μ m. The arrows indicate that time at which the ACh was injected. Answer the following questions (in <30 words, unless stated otherwise).



3.1 What is the name of the process depicted in the figure? (2)

3.2 Briefly describe its purpose. (2)

3.3 Describe the effect of the ACh injection on the flow of ions in the cells surrounding the arteriole (*no word limit*). (6)

3.4 Briefly explain why an injection with K+ (instead of ACh) has the opposite effect on arteriole diameter. (6)

QUESTION 4

The figure on the right depicts leg blood flow (LBF) in resting individuals over time. At 0 min, LBF was measured for the first time. At 1 min, a large quantity of Acetylcholine (ACh) was injected into the blood of both individuals. At 3, 4 and 5 min, LBF was measured again. White circles depict a healthy individual, black circles a person with type 2 diabetes. Answer the following questions by selecting the correct lower case letter (*Example: 4.1a, 4.2b, 4.3c etc*).



4.1 The change in LBF from A to B (white circles) can be best explained by: a) vasodilation; b) vasoconstriction; c) skeletal muscle pump; d) abdominothoracic muscle pump; e) a and c; f) b and c

4.2 The effect in 5.1 can be explained by the following molecular process(es): a) Endothelin-1 being released from the endothelium; b) Calcium flowing into smooth muscle cells; c) Active sites of actin being unblocked; d) All of the above; e) b and c above; e) None of the above

4.3 The following term describes the observed change in LBF best: (3)

a) flow-mediated vasodilation; b) reactive hyperemia; c) functional sympatholysis d) cardiovascular drift; e) Frank-Starling law of the heart

4.4 What is the best explanation for the difference between healthy (white circles) and (4) diabetic (black circles) individuals at 3-5 min?

a) Diabetics have a suppressed parasympathetic nervous system; b) Diabetics have high blood sugar levels; c) Diabetics do not respond well to endothelial vasodilators

d) All of the above; e) None of the above

SUBTOTAL: [50]

(2)

(2)

PART 2, TERM 4:

QUESTION 5 Briefly define the following terms (in 1-2 sentences each):	[10]
5.1 Hypertonic hyponatremia	(2)
5.2 Osmosis	(2)
5.3 Polyuria	(2)
5.4 Hypoparathyroidism	(2)
5.5 BRCA2	(2)
QUESTION 6 A 5-year-old boy drowned in a farm dam during winter. When the ambulance arrived, he was apparently dead, as no pulse could be felt. Cardio-pulmonary resuscitation (CPR) and the removal of water from the lungs commenced immediately. The boy then received assisted (mechanical) ventilation and Lasix [®] treatment (a diuretic). Over time, the following signs were recorded. In each case, provide an explanation (in <30 words). More than one explanation may be provided, and only the most convincing one will be marked	[10]
6.1 Although no pulse could be felt after the CPR, there was a slow and irregular	(2)
 heartbeat after half an hour. 6.2 A blood test revelated that the boy was suffering from acidosis. 6.3 Sometime later, the boy's heart rate had become normal, but he remained cyanotic (e.g. blue lips), which indicated that not enough oxygen was being transported by the blood 	(2) (2)
6.4 A blood transfusion was carried out (the boy received blood from a donor), and the cyanosis eventually disappeared; however, a blood test revealed that the boy had developed an alkalosis.	(2)
6.5 A week after being released from hospital, the boy developed kidney failure, and died.	(2)

QUESTION 7

The three figures on the right report changes in the concentrations of three ions in the plasma of a healthy person (white columns) and in a person suffering from a disease (black columns). In all cases, differences in ion concentration are significant.



7.1 What is the name of the disease represented by the black columns?
7.2 The increase or decrease in ion concentrations may result in a number of symptoms. State which of the ions depicted in the figure (K+, Na+ or Cl-) is most directly responsible for each the following five symptoms. In each case, briefly describe the process responsible for the symptom. (*Potentially incorrect model answers:3.2 a*) *K*+: *It causes vasodilation; b*) *Na*+: too many action potentials occur etc.)

- a) high blood pressure
- **b**) muscle weakness
- c) metabolic alkalosis
- d) metabolic acidosis
- e) edema in arms and legs

QUESTION 8

[8]

(2)

(10)

Disorders of calcium and potassium in the serum can strongly affect action potentials. State whether the resting potential and the threshold potential would be <u>unchanged</u>, <u>more negative</u> or <u>less negative</u> under each of the following disorders (*potentially incorrect model answer: a*) *resting: more negative, threshold: less negative; b*) *resting: less negative, threshold: more negative etc.*):

- a) Hypercalcemia
- b) Hypocalcemia
- c) Hyperkalemia
- d) Hypokalemia

SUBTOTAL: [50]