STUDENT REGISTRATION #: .....

QUESTION PAPER # .....

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SIMON MAZORODZE SCHOOL OF MEDICAL AND HEALTH SCIENCES

DEPARTMENT OF BIOMEDICAL SCIENCES: PHYSIOLOGY UNIT

BACHELOR OF SCIENCE/BACHELOR OF SCIENCE HONOURS DEGREE IN BIOMEDICAL SCIENCES

LEVEL 1 SEMESTER 2

END OF SEMESTER EXAMINATION: PAPER II

MODULE CODE:	**BMS104**
MODULE NARRATION:	**PHYSIOLOGY**
DATE:	**6 DECEMBER 2024**
DURATION:	**3 HOURS**

INSTRUCTION TO CANDIDATES:

1. Answer all questions **on the examination question paper**. The space provided is adequate for the expected answers.
2. The paper has 100 marks. There is **no negative marking** for the short answer or essay questions.
3. The paper shall comprise of problem solving exercises: **Six (6) Applied Practical Questions (60 Marks) and Three (3) General Descriptive Questions (40 Marks)**.
4. This paper is constituted by the questions drawn from any of the following 15 courses: **Blood, Cardiovascular, Respiratory, Renal, and Exercise Physiology**.
5. Paper I shall contribute 50%; Paper II, 50%; of the final examination mark.
6. This paper consists of **18 printed pages** including the cover page.

APPLIED PRACTICAL QUESTIONS (APQs) – 60 MARKS

APQ 1

The table below indicates the presence (✓) or absence (X) of clinical features in three patients (A, B, and C) with heart failure.

Clinical feature	**A**	**B**	**C**
Increased jugular venous pressure	✓	✓	✓
Increased right ventricular end diastolic pressure	X	✓	✓
Increased left atrial pressure	X	X	✓
Coughing up a pink frothy sputum	X	X	✓

1. Giving a physiological reason for each of the **underlined** observations in each case, identify which patient, A, B, or C shows clinical features **best** fitting:

a) tricuspid valve stenosis. (3)

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b) mitral valve stenosis. (4)

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c) right ventricular dysfunction. (3)

2. Patient C had a decreased cardiac output and an increased heart rate. Explain the mechanistic pathway that leads to the increased heart rate. (5)

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[Total 15 marks]

APQ 2

1. Xolile always seems to be very thirsty. She is a 30-year-old housewife whose symptoms have troubled her for some years. She now reports chronic, intense thirst and excessive drinking with polyuria. Xolile is losing weight, she has dry mucous membranes and skin even though she drinks large quantities of water and juice all day. Her excessive fluid intake and constant need to urinate, even at night (nocturia), make her constantly tired and irritable. Her family is worried and persuades her to visit the doctor. A sample of Xolile's urine was tested for glucose: this test proved negative. A blood sample was sent off for determination of plasma anti-diuretic hormone (ADH), which appeared to be within normal limits. Xolile was also asked to collect a 24-hour urine sample for analysis. Her 24-hour urine volume was 6.5 litres. Following a water deprivation test, Xolile's urine was found to have an osmotic pressure of 460 mOsm kg−1 water. The normal kidney can concentrate urine to approximately 1000 mOsm kg−1 water. A diagnosis of diabetes insipidus was made.

   a. List one way in which water is gained and one way in which water is lost in the body.

   (2 x ½ = 1 mark)

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b. There are two types of diabetes insipidus: central and nephrogenic. Distinguish between the two and state the type Xolile was suffering from. (4 x ½ = 2 marks)

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c. Briefly outline the portions of the kidney critical to preventing excessive loss of free water and the processes involved. (4 x ½ = 2 marks)

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d. Name two stimuli for the secretion of ADH and briefly describe its role in the kidney, (6 x ½ = 3 marks)

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e. Besides dietary salt, which other **TWO** dietary components would influence the patient's urine output and how? (4 x ½ = 2 marks)

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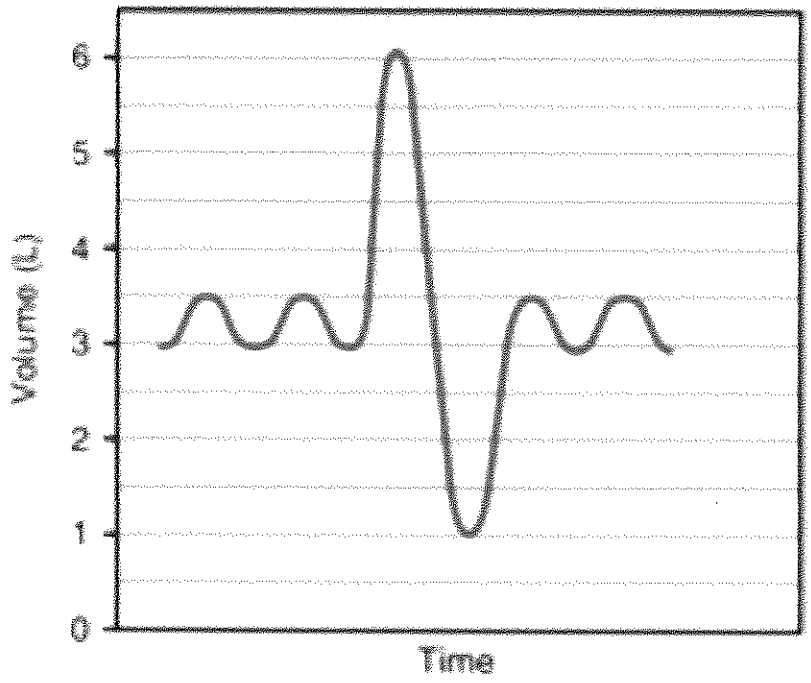
[Total 10 marks]

APQ 3

1. A 22–year–old woman inhales as much air as possible and exhales as much air as she can, producing the spirogram shown in the figure below.



a. Assuming a respiratory rate of 12 breaths/min, calculate the minute ventilation. (2)

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b. A residual volume of 1.0 liter was determined using the helium dilution technique. Calculate her FRC (in liters)? (3)

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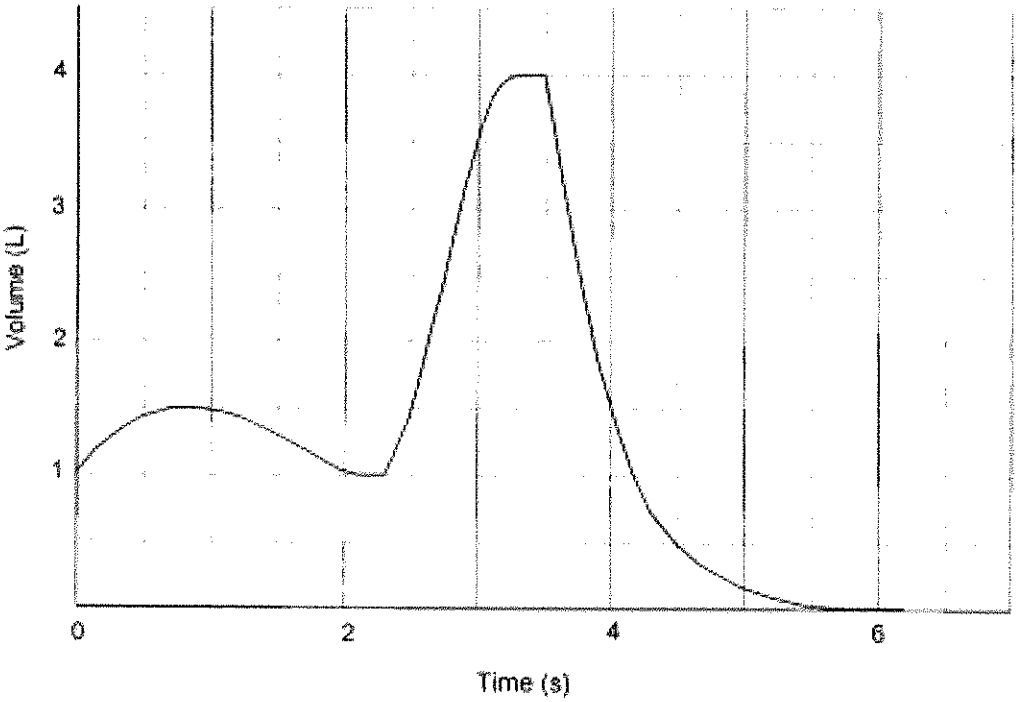
4. The diagram below represents a spirometry tracing illustrating the changes in lung volume that occurred when a subject inhaled maximally and then rapidly exhaled as much gas as possible.



a. If the patient's total lung capacity is 6 L, calculate the functional residual capacity. (1)

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b. Calculate the FEV1? (2)

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c. Calculate the inspiratory capacity (2)

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[Total 10 marks]

APQ 4

The following table shows data obtained from a patient with renal failure with a number of typical signs including generalised body swelling.

	Patient	**Normal values**
Plasma creatinine concentration (μmol/l)	250	60 – 120
Urine creatinine concentration (mmol/l)	15	-
Plasma urea concentration (μmol/l)	10.5	2.6 - 7
Urine volume (ml/min)	0.3	-
Urine protein concentration (g/day)	4	<0.15
Plasma albumin concentration (g/l)	20	35 – 52

2. Showing your calculation, estimate the patient's glomerular filtration rate (GFR) (2)

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2. Showing an appropriate calculation to support your answer, indicate whether the patient has acute intra-renal or pre-renal failure. (2)

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3. Assuming a normal GFR of 125ml/min, give a physiological explanation for the patient's plasma urea concentration. (2)

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4. Give a full physiological explanation for the patient's generalised body swelling. (4)

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[Total 10 marks]

APQ 5

The following table shows data obtained from four patients (A, B, C and D) who each weigh 70kg and have body fluid balance abnormalities

	Patient				Normal Values
	A	**B**	**C**	**D**	
Plasma osmolarity (mmol/l)	285	296	301	272	280 - 295
Extracellular fluid volume (l)	13	13	15	15	14
Intracellular fluid volume (l)	28	27	27	29	28

1. Giving a physiological explanation for the data shown in **each** case, identify which patient (A, B, C or D) **best** represents a person:

(a) who is sweating profusely without fluid replacement. (2)

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(b) with increased aldosterone secretion (Conn's syndrome) (2)

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(c) with acute haemorrhage. (2)

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(d) with increased antidiuretic hormone (ADH or vasopressin) secretion (2)

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2. Citing evidence from the table to support your answer, identify the patient (A, B, C or D) that is most likely to have an increased blood pressure. (2)

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[Total 10 marks]

APQ 6

1. Arterial pH and blood gas data are summarised for several patients with different acid-base disorders. Indicate the type of acid-base disorder that exists for each patient given that the normal values are pH = 7.40, bicarbonate concentration [HCO_3^-] = 24mEq/L and partial pressure of carbon dioxide (PCO_2) = 40 mmHg

Patient	pH	[HCO_3^-) (mEq/L)	$PC0_2$ (mm Hg)	Acid-base disorder	
A	7.34	15	29	----------	(1½)
B	7.47	14	20	----------	(1½)
C	7.40	15	25	----------	(2)

a. Use the space provided in the table above to write the acid-base disorder for Patients A, B and C.

[Total 5 marks]

GENERAL DESCRPTIVE QUESTIONS (GDQs) – 40 MARKS

GDQ 1

a. Compare and contrast Type I and Type II muscle fibers. Include details on characteristics, recruiting patterns and roles during exercise (4 marks)

b. Explain the importance of hydration for exercise performance and recovery. Include details on fluid loss pathways and appropriate rehydration strategies (4 marks)

c. Explain how the cardiovascular system adapts to regular aerobic exercise to enhance performance (4 marks)

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[Total 12 marks]

GDQ 3

a) What is surfactant? Describe its functions within the lung (5)

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b) Write short notes on carbon dioxide transport in blood (5)

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c) Describe the central control of respiration (5)

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[Total 15 marks]

GDQ 4

a. Write short notes on ABO(H) blood group system antigens and antibodies. (4)

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b. Briefly outline, in point form Role of platelets in haemostasis. (4)

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c. Briefly outline Factor VIII and Haemophilia A. (5)

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[Total 13 marks]

END OF QUESTION PAPER