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 I

MODULE CODE:	**BMS104**
MODULE NARRATION:	**PHYSIOLOGY**
DATE:	**6 DECEMBER 2024**
DURATION:	**2 HOURS**

INSTRUCTION TO CANDIDATES:

1. Answer all multiple choice questions (MCQs), answer **True (T) or False (F)** on the answer sheet provided. Indicate the correct answer by putting a circle around the correct answer and putting an X to cancel a wrong answer.
2. Negative marking will be applied for all MCQs. You are awarded one mark for a correct answer and one mark shall be deducted for every wrong answer and zero mark is awarded for not answering.
3. The question paper is comprised of **60 MCQs**. Each question carries 5 marks and the paper has a total of **300 marks**.
4. This paper is constituted by the following 7 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 **12 printed pages** including this cover page

1. **The sino-atrial node (SAN):**
   a. Is a cardiac pacemaker.
   b. The beta-adrenergic blocking agents increase the firing rate of the SAN.
   c. Cells have a stable resting membrane potential.
   d. Depolarisation corresponds with the P-wave on an electrocardiograph recording.
   e. Depolarises before the atrioventricular (A-V) node.

2. **Identify the True and the False statement(s):**
   a. In postural hypotension, a decrease in venous return is caused by gravitational effects.
   b. Blood in the systemic veins carries more oxygen than the pulmonary veins.
   c. Coronary blood flow is greater in systole than in diastole.
   d. Venous return is decreased when intrathoracic pressure increases.
   e. Venous return is enhanced during inspiration.

3. **Identify the True and the False statement(s):**
   a. Isovolumetric contraction occurs when cardiac valves are closed.
   b. Ventricular systole lasts longer than ventricular diastole.
   c. In the electrocardiogram recording heart rate is calculated from the R-R interval.
   d. In the electrocardiogram recording atrial repolarisation is masked by the QRS complex.
   e. The P-R interval increases during exercise as compared to at rest.

4. **Identify the True and the False statement(s):**
   a. The pulse rate change with exercise is due to an increased sympathetic activation.
   b. The pulse rate change with exercise is caused by activation of the atrioventricular node.
   c. The change in systolic blood pressure observed during exercise is due to an increased stroke volume.
   d. The change in systolic blood pressure observed during exercise is due to an increased total peripheral resistance.
   e. Pulse volume decreases with exercise.

5. **Compared with a healthy person, a patient with increased cardiac wall tension has:**
   a. A greater myocardial oxygen demand.
   b. Increased left ventricular wall thickness.
   c. Decreased end-diastolic volume.
   d. An increased ejection fraction.
   e. Angina during exercise.

6. **Right-sided heart failure results in:**
   a. dyspnoea.
   b. nausea.
   c. a raised jugular venous pressure.
   d. right atrial hypertrophy.
   e. an increased left atrial pressure.

7. Identify the True and the False statement(s):

a. During heart failure, additional heart sounds are heard.
b. The first heart sound results from the closing of the semilunar valves.
c. The second heart sound occurs when the pulmonary valve closes.
d. The third heart sound occurs during isovolumetric relaxation.
e. The fourth heart sound occurs during the last third of diastole.

8. Cardiac output:

a. increases with an increase in stroke volume
b. is higher in the left ventricle as compared to the right ventricle
c. increases with an increase in plasma epinephrine concentration
d. decreases with an increase in myocardial contractility
e. is increased by an increase in end diastolic volume

9. Venous return is increased:

a. by venodilation
b. by increased skeletal muscle activity
c. during respiratory inspiration
d. by an increased heart rate
e. by standing as compared to lying down

10. Identify the correct and incorrect statement(s):

a. laminar blood flow does not produce any sound
b. a stenotic valve is a stiff narrowed valve that does not close completely
c. an incompetent valve is one that cannot open completely
d. both stenotic and incompetent valves cause murmurs
e. an insufficient valve creates a swishing or gurgling murmur

11. Starling's law of the heart:

a. Does not operate in the failing heart.
b. Does not operate during exercise.
c. Explains the increase in heart rate produced by exercise.
d. Explains the increase in cardiac output that occurs when venous return is increased.
e. Explains the increase in cardiac output when the sympathetic nerves supplying the heart are stimulated

12. Myocardial Infarction causes:

a. Peaked T waves
b. S-T segment elevation
c. S-T segment depression
d. T wave inversion
e. Deep Q waves

13. Normal renal tubular function include:

a. formation of ammonia
b. reabsorption of up to 50% of the water of the glomerular filtrate
c. reabsorption of all the glucose in the glomerular filtrate
d. secretion of urea
e. formation of bicarbonate

14. Hydrostatic pressure in renal glomerular capillaries:

a. is lower than pressure in efferent arterioles.
b. rises when afferent arterioles constrict.
c. rises higher than in most capillaries at heart level.
d. falls by 10 per cent when arterial pressure falls by 10 per cent.
e. falls along the length of the capillary.

15. The cells of the distal convoluted tubule:

a. reabsorb about 50 per cent of the water filtered by the glomeruli.
b. secrete hydrogen ions into the tubular lumen.
c. form ammonium ions.
d. reabsorb sodium in exchange for hydrogen or potassium ions.
e. determine the final composition of urine

16. The proximal convoluted tubules:

a. reabsorb most of the sodium ions in the glomerular filtrate.
b. reabsorb most of the chloride ions in glomerular filtrate.
c. reabsorb most of the potassium ions in glomerular filtrate.
d. contain juxtaglomerular cells which secrete rennin.
e. contain the main target cells for antidiuretic hormone

17. Diabetes insipidus (deficiency of antidiuretic hormone) causes a fall in the:

a. osmolality of the urine.
b. reabsorption of water from the proximal tubules.
c. extracellular but not intracellular fluid volume.
d. extracellular fluid osmolality.
e. intracellular fluid osmolality

18. A drug which inhibits carbonic anhydrase decreases:

a. bicarbonate formation and reabsorption in the kidney.
b. plasma bicarbonate levels.
c. blood pH.
d. urinary loss of potassium ions.
e. urinary volume and pH.

19. Renal reabsorption of sodium ions in the distal tubule is increased by:

a. atrial natriuretic peptide (ANP)
b. aldosterone
c. diuretics
d. an increased plasma potassium ion concentration
e. a decrease in the activity of Na^+/K^+ ATPase

20. Carbonic acid:

a. is formed in the presence of carbonic anhydrase
b. is a strong acid
c. is formed in plasma during hypoventilation
d. concentration in plasma is greater than the plasma bicarbonate concentration
e. is formed when hydrogen ions are in excess

21. The activity of the Na^+/K^+ ATPase pump is increased by an increase in the plasma concentration of:

a. aldosterone
b. potassium
c. atrial natriuretic peptide
d. erythropoietin
e. angiotensin II

22. Effects of acidosis include:

a. coma
b. tetany (tonic spasm)
c. hypoventilation
d. decreased urine pH
e. decreased renal bicarbonate (HCO_3^-)

23. Urea:

a. And glucose have similar molar concentrations in normal blood.
b. Concentration rises in tubular fluid as the glomerular filtrate passes down the nephron.
c. Is actively secreted by the renal tubular cells into the tubular fluid.
d. Concentration in blood may rise ten-fold after a high-protein meal.
e. causes a diuresis when its blood concentration is increased

24. Aldosterone:

a. is a hormone secreted by the adrenal medulla.
b. production ceases following removal of the kidneys and their juxtaglomerular cells.
c. production decreases in treatment with drugs which block angiotensin-converting enzyme.
d. secretion results in increased potassium reabsorption by the nephron.
e. secretion results in a fall in urinary pH.

25. Exercise physiology is concerned with:

a. rehabilitation of heart disease and other chronic diseases and/or disabilities
b. the professional guidance and counsel of athletes.
c. human adaptability to acute and chronic exercise.
d. maintenance of health and fitness.
e. identification of physiological mechanisms underlying physical activity.

26. Concerning respiration during exercise:

a. A rightward shift of the O_2 - Hb dissociation curve is caused by increased pH.
b. A rightward shift of the O_2 - Hb dissociation curve is caused by decreased PO_2.
c. A rightward shift of the O_2 - Hb dissociation curve is caused by decreased temperature
d. Muscle, as a proprioceptor, increases ventilation.
e. Plasma epinephrine decreases ventilation

27. Concerning regulation of blood pressure:

a. There is a linear increase in systolic blood pressure in normotensive individuals, and the diastolic pressure value remains near the rest level
b. Systolic blood pressure can reach peak values of 200 to 249 mmHg in normotensive individuals.
c. Hypertensive individuals reach higher systolic and diastolic blood pressures at a given rate of work, and the diastolic pressure value remains near rest level
d. Two to three hours post-exercise blood pressure is higher than pre-exercising values.
e. Hypertension patients have increased peripheral resistance compared to normal, and this is a major cause of their higher average blood pressure.

28. Concerning oxygen storage:

a. Approximately 0.5 liter is stored in the air of the lungs.
b. Approximately 0.25 liter is dissolved in the body fluids.
c. Approximately 1 liter is combined with the hemoglobin of the blood.
d. Approximately 0.3 liter stored in the muscle fibers combined mainly with hemoglobin.
e. In heavy exercise, almost all the stored oxygen is used within a minute of aerobic metabolism.

29. Severe sweating due to exercise can cause:

a. An increase in plasma volume.
b. An increase in plasma aldosterone.
c. A decrease in GFR.
d. An increase in plasma vasopressin.
e. An increase in plasma osmolarity.

30. True or false:

a. Endurance training leads to an increase in the density and capacity of mitochondria within the muscle cells
b. Muscle contraction acts upon the skeleton and initiates movement.
c. Resistance training decreases the strength of the connective tissue within the muscle-tendon unit.
d. The primary fuel source for high-intensity, short-duration exercise is stored glycogen in the skeletal muscles.
e. Accumulation of lactic acid as the primary cause of muscle fatigue.

31. True or false:

a. Exercise will cause the bones to increase their mineral density over time to manage the increasing load.
b. The central and peripheral control systems work together to control cardiopulmonary activity.
c. Isotonic contraction uses more energy per muscle contraction than isometric contraction.
d. IGF-1 is secreted during exercise by the liver and stimulates growth.
e. Diffusion capacity of oxygen at rest is 23ml/min.

32. Concerning the level of exercises:

a. Moderate exercises are above the subject's anaerobic threshold and arterial blood lactate is not raised.
b. During moderate exercise the subject can transport all the oxygen required and is in a steady state
c. During heavy exercises the subject's the anaerobic threshold but the arterial blood lactate elevation remains constant.
d. Heavy exercise is regarded as a steady state.
e. During severe exercise, the anaerobic threshold and the arterial blood lactate continues to rise.

33. Concerning energy during exercise:

a. It is the strength and vitality required for sustained physical or mental activity
b. The anaerobic glycolytic system, relies on the breakdown of muscle glycogen to produce ATP during high intensity exercise.
c. In the phosphogen system ATP is the immediate energy source for cellular processes, but its availability is limited within the cell
d. The aerobic energy system relies on the complete oxidation of glucose.
e. The oxidative system provides energy for weightlifting

34. The following is/are the benefit(s) of exercise training in heart failure patients:

a. Decrease in dead space
b. Increase in neurohormones
c. Decrease in sympathetic/parasympathetic balance.
d. Decrease in endothelial dysfunction.
e. Decrease in fat infiltration.

35. Concerning skeletal muscle:

a. exercise places a burden of stress on muscle fibres and bones which causes micro-tears and trauma.
b. Satellite cells play a role in muscle repair and growth process.
c. is responsible for as much as 85 of body heat, which is vital for enzymatic reactions.
d. fibres are striated and uninucleated.
e. overloading exercise training can result in hypertrophy.

36. Concerning types of muscle fibres:

a. Type I are known as slow twitch fibres.
b. Type I has low myosin ATPase activity.
c. Type IIa are known as fast twitch oxidative fibres.
d. Type IIa has low myosin ATPase activity.
e. Type IIa T fibres are recruited for power activities.

37. Regarding doping:

a. The World Anti-Doping Agency (WADA) publishes a list of prohibited substances and methods
b. Androgenic Anabolic Steroids can cause aggressive behaviour.
c. Use of Human Growth Hormone can cause diabetes.
d. Erythropoietin (EPO) can cause an increase in blood pressure.
e. Stimulants cause nerve damage.

38. Which of the following lung volumes or capacities can be measured by spirometry?

a. Functional residual capacity FRC.
b. Physiologic dead space
c. Residual volume RV.
d. Total lung capacity TLC.
e. Vital capacity VC.

39. The pH of venous blood is only slightly more acidic than the pH of arterial blood because

a. CO_2 is a weak base
b. There is no carbonic anhydrase in venous blood
c. The H^+ generated from CO_2 and H2O is buffered by HCO_3^- in venous blood
d. The H^+ generated from CO_2 and H2O is buffered by deoxyhemoglobin in venous blood
e. Oxyhemoglobin is a better buffer for H^+ than deoxyhemoglobin

40. Regarding the carotid bodies, all the following is/are true:

a. Are stretch receptors in the walls of the internal carotid arteries
b. Have the greatest flow rate/unit volume in the body
c. Are influenced more by blood PO_2 than by its oxygen content
d. Generate more afferent impulses when blood H^+ ion concentration rises
e. And the aortic bodies are mainly responsible for the increased ventilation in hypoxia

41. Carbon dioxide is carried in the blood in the following forms:

a. Combination with the haemoglobin molecule
b. Combination with plasma proteins
c. Physical solution in plasma
d. Greater quantity in red blood cells than in plasma
e. Greater quantity of HCO_3^- ions than in other forms

42. Bronchial asthma is likely to be relieved by all the following:

a. Stimulation of cholinergic receptors
b. Stimulation of beta-adrenoceptors
c. Histamine aerosols
d. Drugs that stabilize mast cell membranes
e. Glucocorticoids

43. Which of the following is/are a function(s) of the lungs?

a. Metabolism
b. Serves as a reservoir of blood for the left ventricle
c. It is a filter to protect the systemic vasculature
d. Facilitates the exchange of O_2 and CO_2 between air and blood
e. Enables phonation

44. Which of the following is/are true concerning the relationships of the variables in the diffusion of O_2 across a membrane?

a. Doubling the thickness of the membrane would cut the total flow of O_2 in half
b. Doubling the area of the membrane would double the total flow of O_2
c. If you increased the alveolar concentration of O_2, you would increase the total flow of O_2 across the alveolar membrane
d. The lower the diffusion coefficient, the higher the total flow
e. Increasing the arterial concentration of O_2 would decrease the total flow of O_2

45. The following is/are normal occurrence(s) with increasing age

a. Vital capacity of the lung decreases
b. Residual volume increases
c. Functional residual capacity increases
d. Inspiratory capacity decreases
e. Expiratory reserve volume increases

46. Ventilation in the healthy lung:

a. Dead space comprises both anatomic and physiological space.
b. Physiological dead space is much greater than anatomical dead space.
c. Minute ventilation is greater than alveolar minute ventilation.
d. Ventilation per unit lung tissue is higher at the top of the lung.
e. The V/Q ratio is slightly more than 1.

47. The following statements relate to the pulmonary circulation:

a. The volume of blood is much lower than the systemic circulation.
b. Alveolar vessels will dilate as the lung expands.
c. Histamine will increase pulmonary vascular resistance.
d. Low P_aO_2 will cause hypoxic vasoconstriction.
e. Hydrostatic pressure can recruit more vessels.

48. The following statements relate to lung volumes:

a. Functional residual capacity is the amount of air left within the lung following a maximal expiration.
b. Vital capacity is usually about 4800 mL in the upright 70kg male subject.
c. Tidal volume can be measured by spirometry.
d. Total lung volume is normally increased in fibrosing alveolitis.
e. The ratio of FEV_1/FVC is usually greater than 80% in asthmatics.

49. The increase in (physiological) dead space would be expected with:

a. Pulmonary embolism
b. Atelectasis (or: collapse of one lung)
c. Pneumothorax
d. Bronchoconstriction
e. Obesity

50. The homeostasis involves:

a. clotting pathways.
b. fibrinolytic pathways.
c. maintenance of steady states in the body.
d. stoppage of bleeding after injury.
e. maintenance of a constant visceral luminal environment

51. The earliest blood precursors identifiable in the embryo are localised to the yolk sac and are called:

a. Haemangioblasts
b. Myeloblasts
c. Erythroblasts
d. Megakaryocytes
e. Burst forming units – erythroid

52. Regarding normal plasma proteins:

a. Albumin is the main protein in plasma
b. Globulin and albumin are found in equal amounts in plasma
c. Albumin is an important carrier molecule for drugs, metabolites etc
d. Albumin is an important contributor to oncotic pressure
e. Immunoglobulins are gamma globulin in nature

53. Regarding body fluids:

a. Extracellular fluid includes plasma
b. Only interstitial fluid constitutes extracellular fluid
c. Intracellular fluid is mainly made up of water
d. Interstitial fluid drains into the vascular system within the lungs
e. Red blood cell intracellular fluid comprises haemoglobin only

54. The following features of the red blood cell make it ideal for its function:

a. Its perfectly spherical shape which maximises their surface area to absorb oxygen
b. Contain haemoglobin which binds to oxygen
c. Biphospholipid layer membrane's fluidity
d. Lack of endoplasmic reticulum, Golgi apparatus, granules and nucleus
e. It is small and flexible so it can fit through narrow vessels

55. Regarding the distribution of iron in a normal adult:

a. 65 % in haemoglobin
b. 4 % is in myoglobin
c. 15 to 30 % is in the storage form (ferritin)
d. 1 % heme containing compounds (non-haemoglobin heme)
e. 0.1% transferrin in the plasma

56. Regarding sickle cell anaemia:

a. Anaemia may result from increased red cell haemolysis
b. Sickle cell haemoglobin forms insoluble crystals under low oxygen conditions.
c. A child will have sickle cell anaemia if one parents pass on the sickle cell gene
d. It results from a single codon abnormality
e. It may result in jaundice due to increased red cell haemolysis

57. Concerning the body's response to bleeding:

a. Vasoconstriction and platelet adhesion to injured site are the initial steps.
b. Platelet aggregation follows the initial platelet adhesion.
c. Fibrin deposition is part of secondary haemostasis
d. Activated platelets release ADP
e. Heavy bleeding consumes large amounts of platelets and clotting factors

58. Regarding blood groups:

a. Blood group antigens are located in the red blood cell's endoplasmic reticulum
b. The Rh blood group system is the most clinically important blood group system
c. Adults of blood group O have anti-A and anti-B antibodies in their plasma
d. Adults of blood group AB have both blood group A and B antigens on their red blood cells
e. Adults of blood group O may be transfused blood from A, B and AB donors

59. In haemostasis:

a. Fibrinogen is converted to fibrin
b. The initial vasoconstriction does not require platelet activation
c. Thrombin converts Factor XI to activated Factor XI
d. Severe deficiency of clotting Factor VII results in severe Haemophilia A
e. Severe deficiency of clotting Factor IX results in Haemophilia B.

60. About sickle cell anaemia:

a. Number one single-gene disorder in the world
b. If untreated, 90% die in childhood
c. Approximately 300,000 children are born with sickle cell disease (SCD) each year
d. results from the single substitution of glutamic acid for valine at amino acid 6 in the 146-amino-acid chain of the β-haemoglobin chain
e. Is an example of a gain of function mutation

All the best.

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END OF QUESTION PAPER