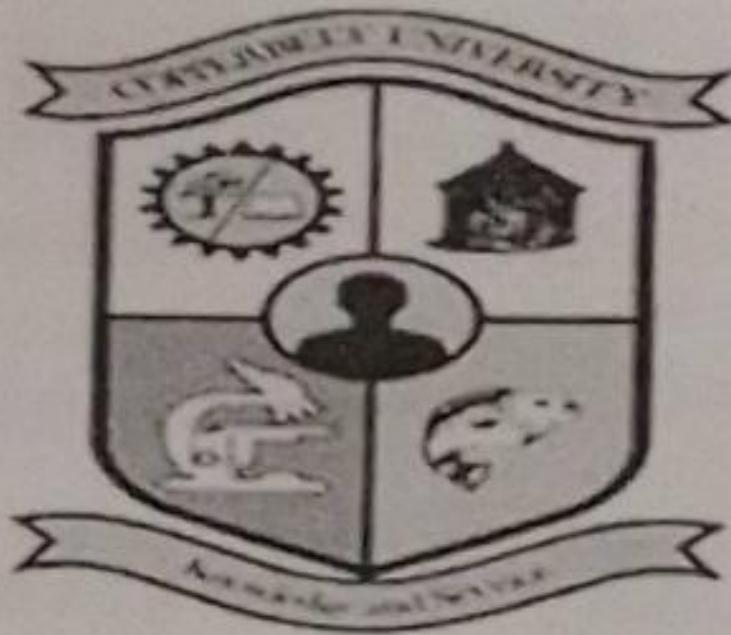


02/10/20



THE COPPERBELT UNIVERSITY

SCHOOL OF MEDICINE

2019/2020 SESSIONAL EXAMINATION

OCTOBER 2020

MBS 210/INTRODUCTION TO HUMAN PHYSIOLOGY I

STUDENT NUMBER: .....

PROGRAMME: .....

TOTAL MARKS: 130

TIME ALLOWED: 3 HOURS

INSTRUCTIONS:

1. Do not write your name or phone number or anything that discloses your identity on any page apart from your student identification number. Defaulters will have their evaluation nullified.
2. Write your computer number on every other page
3. There are three sections (A, B and C). Section A must be answered within the question paper. Use a separate answer booklet for sections B and C.

## SECTION A: Single best answer - 60 marks

Select the single best answer in each case. Encircle the correct answer

1. Choose a variable that cannot be measured with a simple spirometer and a stop watch

- A. Tidal volume
- B. Functional residual capacity
- C. Vital capacity
- D. Total ventilation
- E. Respiratory frequency

2. In a measurement of FRC by helium dilution, the original and final helium concentrations were 10% and 6%, and the spirometer was kept at 5 liters. What was the volume of the FRC in liters?

- A. 2.5
- B. 3.0
- C. 3.3
- D. 3.8
- E. 5.0

$$FRC = \frac{V_i(C_1 - C_2)}{C_2}$$

$$FRC = \frac{5L(10 - 6)}{6}$$

$$FRC = 5L(4)$$

$$FRC = \frac{30}{6} L$$

~~11~~

3. If CO<sub>2</sub> production remains constant and alveolar ventilation is increased threefold, the alveolar PCO<sub>2</sub> after a steady state is reached will be what percentage of its former value?

- A. 25
- B. 33
- C. 50
- D. 100
- E. 300

4. Which of the following does not contribute to increased stroke volume during exercise?

- A. Increased contractility of cardiac muscle
- B. Increased venous return
- C. Increased length of filling time during diastole
- D. Increased sympathetic stimulation of ventricular muscle
- E. Increased end-diastolic volume

5. During the cardiac cycle

- A. The volume of blood leaving the left side of the heart is greater than that leaving the right side
- B. The pressure of blood leaving the right side of the heart is greater than that leaving the left side
- C. The duration of systole is greater than that of diastole
- D. The duration of diastole is greater than that of systole
- E. A and D

6. The aortic valve
- A. Prevents the backflow of blood into the aorta during ventricular diastole
  - B. Prevents the backflow of blood into the left ventricle during ventricular diastole
  - C. Prevents the backflow of blood into the left ventricle during ventricular ejection
  - D. Prevents the backflow of blood into the aorta during ventricular ejection
  - E. Closes when the first heart sound is heard
7. Inhalation/inspiration occurs as a result of
- A. An upward movement of the diaphragm
  - B. Movement of the ribs closer together due to contraction of inhalatory/inspiratory intercostal muscles
  - C. A downward movement of the diaphragm
  - D. A and B
  - E. B and C
8. Midway through a normal expiration
- A. Intrapleural pressure is below atmospheric pressure and becoming more negative
  - B. Alveolar pressure is below atmospheric pressure and is becoming more negative
  - C. Alveolar pressure is below atmospheric pressure and is becoming less negative
  - D. Transpulmonary pressure positive and is decreasing
  - E. Lung volume is increasing
9. Which of the following formulae would correctly calculate residual volume?
- A. (inspiratory reserve volume) minus (expiratory reserve volume)
  - B. (total lung capacity) minus (vital capacity)
  - C. (functional residual capacity) minus (tidal volume)
  - D. (functional residual capacity) minus ( inspiratory reserve volume)
  - E. (expiratory reserve volume) minus (tidal volume)
10. Compared to the systemic arteries, the pulmonary arteries are characterized by:
- A. Carrying blood at a higher blood pressure
  - B. Having a higher resistance to blood flow
  - C. Having a greater tendency for vascular resistance to increase as blood flow and blood pressure increase
  - D. Carrying blood with a higher PCO<sub>2</sub>
  - E. Carrying blood with higher pH

11. Which of the following is a condition in the interstitial fluid of exercising skeletal muscles that favors the unloading of oxygen from hemoglobin
- Higher temperature than in resting muscle
  - Higher pH than in resting muscle
  - Higher  $\text{PO}_2$  than in resting muscle
  - Higher concentration of 2,3 bisphosphoglycerate than in resting skeletal muscle
  - Lower concentration of 2,3-bisphosphoglycerate than in resting skeletal muscle
12. Which of the following would have the effect of making expired volume less than inspired volume?
- Expired air is warmer than inspired air
  - Expired air carries more water vapor than inspired air
  - Oxygen consumption is greater than carbon dioxide production
  - A and B are correct
  - A, B and C are correct
13. Which one of the following is a characteristic of both obstructive pulmonary disease and restrictive pulmonary disease?
- Bigger than normal swings in alveolar pressure are required to maintain a normal tidal volume
  - Bigger than normal swings in intrapleural pressure are required to maintain a normal tidal volume
  - The compliance of the lung tissue is increased above normal
  - The compliance of the lung tissue is decreased below normal
  - The conductance of the airways is increased above normal
14. Which of the following is a characteristic of emphysema but not pulmonary edema
- Hypoxemia
  - A diffusion barrier is created between the alveolar air and the blood
  - Abnormally high lung compliance
  - Abnormally low airway resistance
  - Right-to-left shunting of blood
15. Doubling the  $\text{PO}_2$  of arterial blood, from 50mmHg to 100mmHg, would double:
- The  $\text{O}_2$  content of blood
  - The amount of dissolved  $\text{O}_2$  in the blood
  - The percent saturation of hemoglobin
  - Both A and B are correct
  - A, B and C are correct

16. Which of the following would be most likely to increase the arterial pH above normal in an otherwise normal person?

- A. Hypoventilation
- B. Hypercapnia
- C. Ascent to high altitude
- D. Renal compensation for respiratory acidosis
- E. A and D are correct

17. As one goes to higher and higher elevations:

- A. The PO<sub>2</sub> in dry, atmospheric air decreases
- B. The fraction of O<sub>2</sub> in dry, atmospheric air decreases
- C. The fraction of CO<sub>2</sub> in dry, atmospheric air increases
- D. The water vapor pressure in saturated, inspired air at body temperature increases
- E. All of the above are correct

18. Which of the following would be most likely to increase [HCO<sub>3</sub><sup>-</sup>] above normal in an otherwise normal person?

- A. Respiratory acidosis with renal compensation
- B. Metabolic acidosis without respiratory compensation
- C. Metabolic acidosis with respiratory compensation
- D. Acute(uncompensated) respiratory alkalosis
- E. Respiratory alkalosis with renal compensation

19. When normal blood passes through the muscles of a normal subject, most of the CO<sub>2</sub> added to the blood:

- A. Remains in a dissolved form
- B. Becomes bound to plasma proteins
- C. Becomes bound to hemoglobin
- D. Becomes bound to 2,3-bisphosphoglycerate
- E. Become hydrated to form carbonic acid

20. During renal compensation for respiratory acidosis:

- A. Total urinary acid excretion would be increased
- B. Urinary bicarbonate excretion would be decreased
- C. Urinary pH would be increased
- D. A and B are correct
- E. A, B and C are correct

21. The mechanism of hypoxic vasoconstriction and hypercapnic bronchodilation work together in the lung to:
- A. Maintain acid-base balance
  - B. Maintain ventilation-perfusion matching
  - C. Prevent pneumothorax
  - D. Prevent cor pulmonale and "blue bloater" syndrome
  - E. Cause pulmonary blood vessels to dilate when cardiac output increases
22. Hemoglobin that binds to carbon monoxide and therefore cannot transport oxygen is called
- A. carboxyhemoglobin
  - B. carbaminohemoglobin
  - C. methemoglobin
  - D. reduced hemoglobin
  - E. None of the above
23. Which of the following best represents the systemic arterial blood of an individual with anemia?
- A. Low PO<sub>2</sub>, low hemoglobin, normal O<sub>2</sub> content
  - B. Low PO<sub>2</sub>, low hemoglobin, low O<sub>2</sub> content
  - C. Normal PO<sub>2</sub>, low hemoglobin, low O<sub>2</sub> content
  - D. Normal PO<sub>2</sub>, normal hemoglobin, low O<sub>2</sub> content
  - E. Higher PO<sub>2</sub>, low hemoglobin, low O<sub>2</sub> content
24. A 35-year-old man has a vital capacity (VC) of 5 L, a tidal volume (TV) of 0.5 L, an inspiratory capacity of 3.5 L, and a functional residual capacity (FRC) of 2.5 L. What is his expiratory reserve volume (ERV)?
- A. 4.5 L
  - B. 2.5 L
  - C. 2.0 L
  - D. 1.5 L
  - E. 1.0 L
- $$\begin{aligned} \text{ERV} &= VC - TV - IRV \\ \text{ERV} &= 5 - 0.5 - 3.5 \\ \text{ERV} &= 5 - 4.0 \\ \text{ERV} &= 1.0 \end{aligned}$$
25. The most important stimulus controlling the level of resting ventilation is:
- A. PO<sub>2</sub> on peripheral chemoreceptors
  - B. PCO<sub>2</sub> on peripheral chemoreceptors
  - C. pH on peripheral chemoreceptors
  - D. pH of CSF on central chemoreceptors
  - E. H<sup>+</sup> of arterial blood on central chemoreceptors

26. Concerning the respiratory centers:

- A. The normal rhythmic pattern of breathing originates from neurons in the motor area of the cortex
- B. During quiet breathing, expiratory neurons fire actively
- C. The cortex of the brain can override the function of the respiratory centers
- D. The only output from the respiratory centers is via the phrenic nerves
- E. The pneumotaxic center is located in the medulla oblongata

27. Pulmonary surfactant:

- A. Increases the surface tension of the alveolar lining liquid
- B. Is secreted by type I alveolar epithelial cells
- C. Increases the work required to expand the lung
- D. Helps to prevent transudation of fluid from the capillaries into the alveolar spaces
- E. Decreases lung compliance

28. A patient with carbon monoxide poisoning is treated with hyperbaric oxygen that increases the arterial  $\text{PO}_2$  to 2,000 mm Hg. The amount of oxygen dissolved in the arterial blood (in ml/dL) is

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

29. What is the  $\text{PO}_2$  (in mm Hg) of moist inspired gas of a climber on the summit of Mt. Everest (assume barometric pressure is 247 mm Hg)?

- A. 32
- B. 42
- C. 52
- D. 62
- E. 72

30. Resistance in the airways of the lungs decreases:

- A. In response to sympathetic nerve stimulation
- B. In response to parasympathetic nerve stimulation
- C. In response to a decrease in alveolar  $\text{PCO}_2$
- D. As the diameter of the air tubes decreases
- E. As the  $\text{PO}_2$  decreases

31. During a cardiac cycle, the first part of the ventricles to contract is:
- Apex of left ventricle
  - Base of left ventricle
  - Septum
  - Epicardium at base of left ventricle
  - Right ventricle
32. Which of the following conditions results in dilated, flaccid heart?
- Excess calcium ions in the blood
  - Excess potassium ions in blood
  - Excess sodium ions in blood
  - Increased noradrenaline concentration in blood
  - Low potassium ions in blood
33. During isovolumetric contraction of the ventricles:
- Aortic blood flow is reversed
  - Coronary blood flow increases
  - The pulmonary valve is not yet shut
  - Aortic pressure is falling
  - When both ventricles reach the same pressure their respective outflow valves open
34. A diastolic murmur accompanied by an increased preload can be caused by
- Mitral stenosis
  - Mitral regurgitation
  - Atherosclerosis
  - Aortic regurgitation
  - Tachycardia
35. Concerning acclimatization to high altitude:
- Hyperventilation is of little value
  - Polycythemia occurs rapidly
  - There is a rightward shift of the O<sub>2</sub> dissociation curve at extreme altitudes
  - The number of capillaries per unit volume in skeletal muscle falls
  - Changes in oxidative enzymes occur inside muscle cells
36. If helium-oxygen mixtures rather than nitrogen-oxygen mixtures (with the same oxygen concentration) are used for very deep diving:
- Risk of decompression sickness is reduced
  - Work of breathing is increased
  - Airway resistance is increased
  - Risk of O<sub>2</sub> toxicity is reduced
  - Risk of inert gas narcosis is increased

37. A 66-year-old woman presents with a 9-month history of worsening dyspnea on exertion. Spirometry reveals an FEV<sub>1.0</sub> that is significantly lower than predicted based on her age, height and gender, a lower than predicted FVC, and a decreased FEV<sub>1.0</sub>/FVC ratio. Which of the following could explain these results?
- A. Decreased number of pulmonary capillaries
  - B. Decreased lung elastic recoil
  - C. Fibrotic changes in the interstitial space
  - D. Increased cross-sectional area for airflow
  - E. Thickening of the blood-gas barrier
38. A 52-year-old man is brought to the Emergency Department with severe chest pain. Angiography demonstrates a severe coronary occlusion. A thrombolytic agent is administered to reestablish perfusion. Which of the following does the thrombolytic agent activate?
- A. Heparin
  - B. Plasminogen
  - C. Thrombin
  - D. Kininogen
  - E. Prothrombin
39. A 42-year-old patient with a rare blood type is scheduled for surgery that will likely require a transfusion. Because the patient has a rare blood type, an autologous blood transfusion is planned. Prior to surgery, 1500 mL of blood is collected. The collection tubes contain calcium citrate, which prevents coagulation by which of the following actions?
- A. Blocking thrombin
  - B. Binding factor XII
  - C. Binding vitamin K
  - D. Chelating calcium
  - E. Activating plasminogen
40. Prior to having his first colonoscopy, a 50-year-old male undergoes a bleeding time test to rule out any clotting disorders. Bleeding time is determined by nicking the skin superficially with a scalpel blade and measuring the time required for hemostasis. It will be markedly abnormal (prolonged) in a person who has which of the following?
- A. Anemia
  - B. Vitamin K deficiency
  - C. Thrombocytopenia
  - D. Leukopenia
  - E. Hemophilia

41. A 67-year-old woman with a history of venous thromboembolism is placed on warfarin (Coumadin) prophylactically. The blood concentration of Coumadin becomes too high and bleeding occurs. The bleeding can best be treated by the administration of which of the following?
- A. Fibrinogen
  - B. Thrombin
  - C. Platelets
  - D. Protein C
  - E. Vitamin K
42. A 65-year-old smoker develops a squamous cell bronchogenic carcinoma, which metastasizes to the tracheobronchial and parasternal lymph nodes. Flow of fluid through the lymphatic vessels will be decreased if there is an increase in which of the following?
- A. Capillary pressure
  - B. Capillary permeability
  - C. Interstitial protein concentration
  - D. Capillary oncotic pressure
  - E. Central venous pressure
43. A 61-year-old male presents to his family physician with the chief complaint of frequent diarrhea accompanied by weight loss. He reports a tendency to bruise easily and laboratory data reveal a prothrombin time of 19 seconds (normal = 11–14 seconds). The bruising and prolonged prothrombin time can be explained by a decrease in which of the following vitamins?
- A. Vitamin A
  - B. Vitamin C
  - C. Vitamin D
  - D. Vitamin E
  - E. Vitamin K
44. Which of the following muscle proteins plays an important role in contraction of both smooth and striated muscle?
- A. Calmodulin
  - B. Troponin
  - C. Tropomyosin
  - D. Actin
  - E. Myosin light chains

45. When comparing the contractile responses in smooth and skeletal muscle, which of the following is most different?
- A. The source of activator calcium
  - B. The role of calcium in initiating contraction
  - C. The mechanism of force generation
  - D. The source of energy used during contraction
  - E. The nature of the contractile proteins
46. Which of the following is true regarding the action potential of skeletal muscle?
- A. It spreads inward to all parts of the muscle via the T-tubules
  - B. It has a prolonged plateau phase
  - C. It causes the immediate uptake of  $\text{Ca}^{2+}$  into the lateral sacs of the sarcoplasmic reticulum
  - D. It is longer than the action potential of cardiac muscle
  - E. It is not essential for contraction
47. Dicoumarol acts as an anticoagulant by:
- A. Precipitation of  $\text{Ca}^{2+}$
  - B. Inhibition of thrombin
  - C. Inhibition of vitamin K action
  - D. Preventing activity of factor IX
  - E. Binding to antithrombin III
48. Erythroblastosis fetalis occurs with:
- A. Rh -ve mother and Rh +ve fetus
  - B. Rh -ve mother and Rh -ve father
  - C. Rh +ve mother and Rh -ve fetus
  - D. Rh +ve mother and Rh -ve father
  - E. Rh +ve mother and Rh +ve father
49. The polypeptide in the globin part of normal adult Hb consist of:
- A. 2 alpha and 2 beta chains
  - B. 2 alpha and 2 gamma chains
  - C. 2 alpha and 2 delta chains
  - D. 2 beta and 2 gamma chains
  - E. 2 beta and 2 delta chains

50. In the normal human blood

- A. The eosinophils are the most common white blood cells
- B. The iron is mostly in Hb
- C. There are more lymphocytes than neutrophils
- D. There are more white cells than red cells
- E. The platelet count is about 5 millions/mm<sup>3</sup>

51. A child of a group Rh +ve mother and group AB Rh -ve father could be any of the following except:

- A. A Rh +ve
- B. B Rh +ve
- C. AB Rh -ve
- D. B Rh -ve
- E. O Rh +ve

52. Pernicious anaemia may be all the following except:

- A. Sometimes the result of the malabsorption syndrome
- B. The cause of thrombocytopenia
- C. Treated with iron
- D. The cause of peripheral neuropathy
- E. Associated with carcinoma of the stomach

53. About iron deficiency anaemia:

- A. It is more common in men than in women
- B. It is characterized by large pale erythrocytes
- C. It is typically found chronic blood loss from the body
- D. Oral iron therapy is often inadequate with a normal stomach
- E. It occurs in gastric disease associated with lack of the intrinsic factor

54. All the following conditions cause anaemia except:

- A. Erythroblastosis fetalis
- B. Aplasia of the bone marrow
- C. Vitamin B12 deficiency
- D. Hypothyroidism
- E. Living at high altitudes

55. Violent antigen-antibody reactions occur due to release of:

- A. Histamine
- B. Serotonin
- C. Acetylcholine
- D. Catecholamines
- E. None of the above

56. Visceral smooth muscles:

- A. Show increased membrane potential during activity
- B. Have a stable membrane potential
- C. Have a resting membrane potential averaging about -50 mV
- D. Respond better to electric stimuli than to chemical stimuli
- E. Are not affected by autonomic nerves

57. The action potential of skeletal muscles:

- A. Has a prolonged plateau phase
- B. Has a smaller magnitude than that of smooth muscles
- C. Spreads inwards to all parts of the muscle fibre via the T-tubules
- D. Causes uptake of  $\text{Ca}^{2+}$  into the lateral sacs of the sarcoplasmic reticulum
- E. Is not essential for contraction

58. About interferons, all the following is true except:

- A. The alpha interferon is released by leukocytes
- B. They activate viruses and stimulate cell proliferation
- C. The beta interferon is released by fibroblasts
- D. The gamma interferon is released by the T-lymphocytes and NK cells
- E. The alpha interferon increases the NK cell activity

59. A researcher was examining some arrows sent from Cameroon. He accidentally pierced his hand with one of the arrows. After a while he started to notice muscle weakness. He went to the hospital immediately. Electrical recordings from nerves innervating muscles in his arm indicated normal frequencies and amplitudes of impulses when stimulated; however, nerve-induced contractions of the muscles were weak. When the muscles were stimulated directly, normal contractions occurred. Which of the following is the most likely reason for the muscle weakness?

- A. Decreased ability of ACh to stimulate the muscle fibers
- B. Decreased ability of calcium to bind to troponin in the muscle fibers
- C. Decreased ability of the muscle to produce adenosine triphosphatase (ATP)
- D. Decreased ability of the muscle to undergo summation and tetanus
- E. Depletion of intracellular calcium

60. If a person lifts weights routinely, the muscles involved in the lifting undergo hypertrophy and become capable of generating greater force. Which of the following is the best explanation for the basis for these adaptations?

- A. Increased length of the muscle fibers
- B. Increased maximal velocity ( $V_{\max}$ ) of contraction
- C. Increased number of fast-twitch fibers in the muscle
- D. Increased number of sarcomeres arranged in parallel
- E. Greater specific activity of the myosin ATPase

## **SECTION B: Structured questions-30 Marks**

Answer all the questions. All your answers must be written in the answer booklets provided.

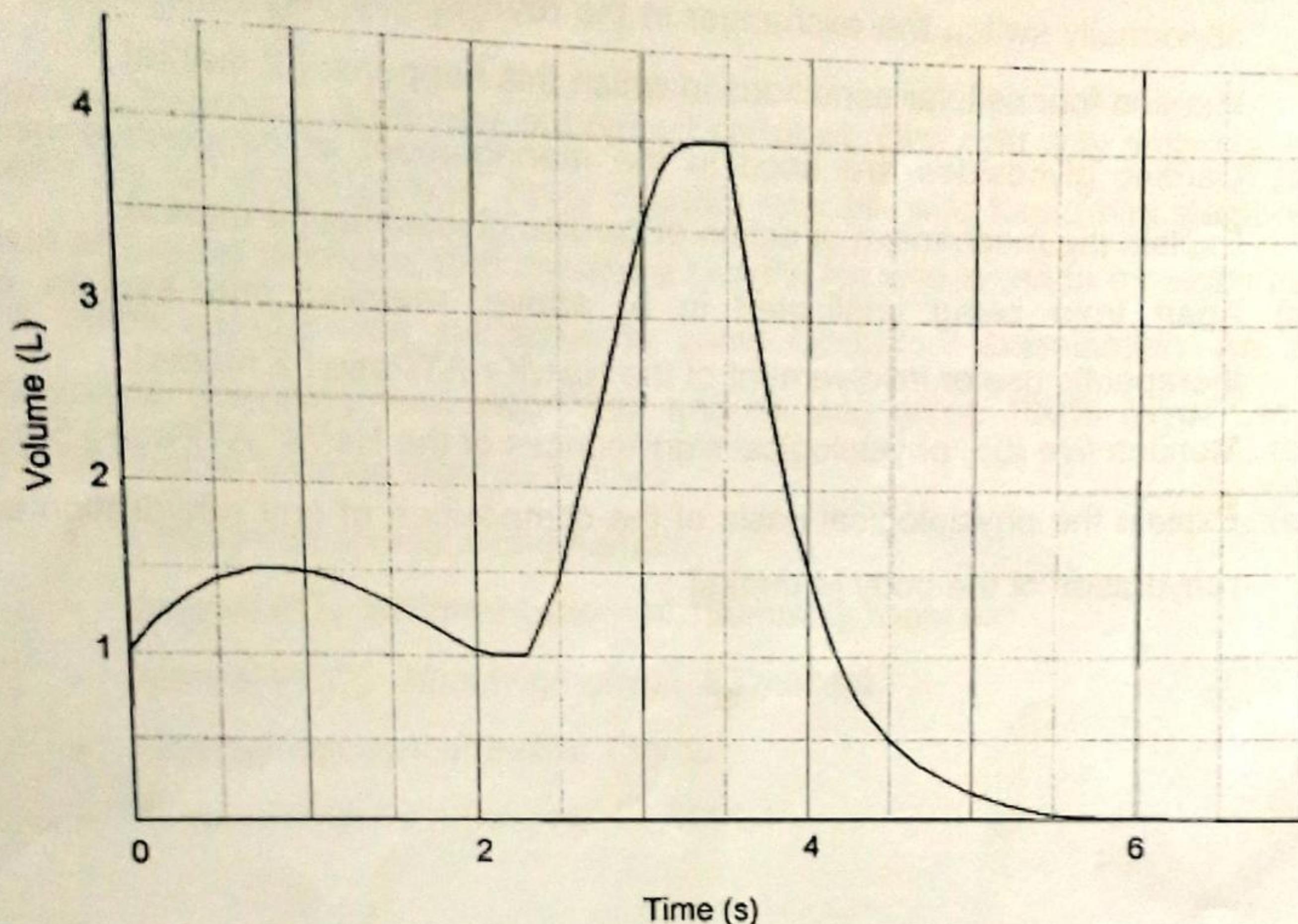
1. Match each of the given pressures in the first column to their correct description in the second column [5 marks]

<b>Pressures</b>	<b>Description</b>
B 1. Intrapleural pressure	A. Intra-alveolar pressure at end -inspiration and end - expiration
D 2. Intra-abdominal pressure	B. Shows transient falls and rises during the respiratory cycle peaking at mid expiration and mid inspiration respectively
E 3. Intra-alveolar pressure	C. Approximates to intrapleural pressure
C 4. Intra-oesophageal pressure	D. Rises markedly during vomiting reflex
A 5. Atmospheric pressure	E. Determines the pressure gradient for inspiration and expiration

2. Heart murmurs may clinically indicate heart valve abnormalities. The table below shows abnormalities of heart valves and their associated murmurs. Complete the table by filling in the blank spaces [5 marks]

<b>VALVE</b>	<b>ABNORMALITY</b>	<b>TIMING OF THE MURMUR</b>	<b>AUSCULTATION AREA</b>
<b>AORTIC VALVE</b>	Aortic stenosis	Systolic	Right second intercostal space
		Diastolic	
<b>PULMONARY VALVE</b>	Pulmonary stenosis		
<b>TRICUSPID VALVE</b>		Diastolic	
<b>MITRAL VALVE</b>		Systolic	Left fifth intercostal space in mid clavicular line

3. 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



Given that the patient's total lung capacity is 6.0 L, compute the following:

- Functional residual capacity (FRC) [1 mark]
- Forced expiratory volume ( $FEV_1$ ) [1 mark]
- Inspiratory capacity(IC) [1 mark]
- Comment whether the patient has an obstructive, restrictive disease or normal lungs with a reason [2 marks]

**4. Concerning transport across the cell membrane [ 15 marks]**

- a) The exchanger works normally in the  $\text{Ca}^{2+}$  efflux position, certain conditions can abnormally switch the exchanger in the reverse ( $\text{Ca}^{2+}$  influx,  $\text{Na}^+$  efflux) position. Mention four cellular conditions in which this happens: [ 2 marks]
- b) Cardiac glycosides are used in the management of congestive heart failure. Explain the mechanism of action of cardiac glycosides [ 2 marks]
- c) Apart from being implicated in b) above, mention and explain one other therapeutic use or involvement of the  $\text{Na}^+/\text{K}^+$  ATPase [ 2 marks]
- d) Mention five (05) physiological significances of the  $\text{Na}^+/\text{K}^+$  ATPase [ 5 marks]
- e) Explain the physiological basis of the composition of oral rehydration solution in rehydration of the body [4 marks]

## SECTION C: Scenario (clinical) questions-40 marks

**Answer all the questions. All the answers must be written in the answer booklets provided**

1. James Chileshe is a 60-year old retired architect. One cold July morning, he decided to warm his car in the garage. Forty minutes later his wife found him slumped in the front seat of the car confused and breathing rapidly. He was taken to a nearby hospital where his blood sample was subjected to some laboratory examination. An acute carbon monoxide poisoning was diagnosed and he was given 100% oxygen to breath. The hematological findings were as follows:

- Cherry-red arterial blood sample
- Arterial  $\text{PO}_2$  660mmHg(normal, 100mmHg, room air)
- Arterial  $\text{PCO}_2$  36mmHg(normal, 40 mmHg)
- Hemoglobin concentration 15g/dL
- % Saturation 50% (normal, 95-100%)

- a) Calculate the total oxygen concentration in Chileshe's arterial blood before and after administering 100% oxygen. [2 marks]
- b) Give one reason for each of the following clinical signs that were observed from Mr. Chileshe at the hospital:
- i. Cherry-red arterial blood sample [1 mark] - *CO binding to Hb*
  - ii. Breathing rapidly [1 mark] *car expediting mech.*
  - iii. Low  $\text{PCO}_2$  (36mmHg) [1 mark]
- c) Draw a normal oxygen-hemoglobin dissociation curve, and superimpose the oxygen-hemoglobin dissociation curve that would have been obtained on Mr. Chileshe in the emergency department. [4 marks]
- d) What type of hypoxia is caused by carbon monoxide poisoning? [1 mark]

*Hypoxic hypoxia*

2. A 60-year-old woman entered the hospital complaining of shortness of breath, fatigue, and swelling of her ankles and lower legs. She had had these symptoms for about 3 years but refused medical treatment until they became severe. Clinical examination revealed a dyspneic, slightly cyanotic woman with ankle and pretibial edema, distended neck veins, an enlarged tender liver, ascites, and pulmonary oedema. A cardiac workup showed a low cardiac output.
- i. What is the most likely condition that the patient will be diagnosed with? [2 marks]
- ii. Briefly explain why this patient is slightly cyanotic and has distended neck veins [4 marks]
- iii. If the patient's whole-body oxygen consumption was 300 mL/min and the pulmonary artery and the brachial artery blood oxygen content were 8 mL/dL and 18 mL/dL, respectively. What was the patient's cardiac output? [4 marks]
3. A 16-year old girl has the following from her routine hematological checkups: Hb- 8g/dL, RBC count:  $2.3 \times 10^6/\mu\text{L}$ , hematocrit (PCV): 25%, plasma agglutinins (anti-A, anti-B and anti-D absent)
- i. What is her blood type and what blood types can you transfuse in her? [ 2 marks]
- ii. Calculate her MCV and MCHC [4 marks]
- iii. Describe the morphology of her red blood cells and two causes of this type of anemia she has [2 marks]
- iv. Give four examples of conditions that causes hemolytic anemia [2 marks]

4. Wendy, a 23-year-old photographer visits his physician after experiencing "strange symptoms" for the last 8 months. She had severe eyestrain when she read for longer than 15 minutes. She became tired when she chewed her food, brushed her teeth, or dried her hair. She was evaluated by her physician. While awaiting the results, the physician initiated a trial of pyridostigmine, an acetylcholinesterase inhibitor. Wendy immediately felt better while taking the drug; her strength returned to almost normal.
- a. What is the most likely neuromuscular condition that Wendy is suffering from? [2 marks]
  - b. Using your description of neuromuscular transmission, explain why severe muscle weakness (e.g., ocular, jaw) occurs in the condition in 'a' above [2 marks]
  - c. Why does pyridostigmine, an acetylcholinesterase inhibitor, improve muscle strength in this condition? [2 marks]
  - d. Consider the following drugs that act at various steps in neuromuscular transmission. What is the action of each drug? [4 marks]
    - i) Botulinus toxin
    - ii) Curare
    - iii) Neostigmine
    - iv) Hemicholinium

.....END OF EXAMINATION.....