

THE COPPERBELT UNIVERSITY

MCS SCHOOL OF MEDICINE

SUPPLEMENTARY EXAMINATION – JANUARY 2022

MBS 210 - PHYSIOLOGY

STUDENT NUMBER:..... PROGRAMME: .....

TIME ALLOWED: 3 hours

TOTAL MARK: 100 marks

INSTRUCTIONS:

1. Do not write your name, phone number or anything that discloses your identity on any other page apart from this page. Defaulters will have their evaluation nullified.
2. Write your computer number on every other page
3. Answer ALL questions in all SECTIONS (A, B & C)

**SECTION A: CHOOSE THE SINGLE BEST OPTION [40 marks]**

**EACH QUESTION CARRIES 0.5 MARK**

1. If an axon of a motor neuron is stimulated with a super-maximal stimulus one can record:
  - A. An action potential in all parts of the axon and the cell body
  - B. An action potential throughout the course of motor neuron
  - C. Action potential only in muscle fibers that this neuron innervates
  - D. Action potential in all parts of the axon
2. A nerve impulse:
  - A. Is a propagated action potential
  - B. Travels in one direction on the axon
  - C. Can travel both in both directions at a synapse
  - D. Is conducted at approximately same speed as electric current in a cable
3. Which of the following would justify excluding sodium conductance from the equation for estimating resting membrane potential in skeletal muscle fibers?
  - A. Extracellular  $[Na]$  is higher than ICF  $[Na]$
  - B. Na-K pump extrudes 3 Na for 2 K pumped in
  - C. Negligible Na permeability of the resting membrane
  - D. Unexcited cells are equally permeable to  $Na^+$  and  $K^+$
4. The number of Na channels per square micrometer of membrane in myelinated mammalian neurons is maximum in the
  - A. cell body
  - B. dendritic zone
  - C. initial segment
  - D. node of Ranvier
5. A stronger than normal stimulus can cause excitation of nerve or muscle during the:
  - A. absolute refractory period
  - B. relative refractory period
  - C. spike potential
  - D. overshoot
6. According to action potentials:
  - A. A net efflux of  $K^+$  from the cell results in depolarization
  - B. Increasing the  $K^+$  concentration in the ECF results in hyperpolarization
  - C. Increasing the  $Na^+$  concentration in the ECF does not alter the resting membrane potential of a nerve
  - D. The larger the cell diameter of a neuron, the slower its conduction velocity
7. Staircase phenomenon (*Treppe*) is due to:
  - A. increased availability of intracellular calcium

- B. summation
  - C. tetanus
  - D. increased excitability
8. Which one of the following statements is incorrect about graded potentials?
- A. They can be depolarizing or hyperpolarizing
  - B. They are local(non-propagated) responses
  - C. They are produced by a threshold stimulus
  - D. They can undergo the process of summation
9. The cells responsible for the blood brain barrier in the central nervous system is the
- A. Schwann cells
  - B. Astrocytes
  - C. Oligodendrocytes
  - D. Endothelial cells
10. In smooth muscle
- A. There is actin, myosin, tropomyosin, and troponin
  - B. Actin and myosin are arranged in rosette fashion
  - C. T-tubules are well developed
  - D. All types are characterized by presence of gap junctions
11. Which structure is present in smooth muscle cells and lacking in skeletal muscle cells?
- A. Junctions between muscle cells
  - B. Overlapping thick and thin filaments
  - C. Sarcoplasmic reticulum
  - D. Neuromuscular junctions
12. The intracellular calcium concentration in smooth muscle is NOT modulated by
- A. Calcium channels in the sarcoplasmic reticulum
  - B. Receptor mediated calcium mobilization
  - C. Activity of the Na-K pumps in the sarcoplasmic reticulum
  - D. Na<sup>+</sup>-Ca<sup>++</sup> exchanger in the sarcolemma
13. The term 'size principle' refers to the fact that
- A. Chronically denervated skeletal muscle decreases in size due to reduced release of growth factors from motor neurons
  - B. Neurons in small motor units conduct slowly
  - C. Small motor units are recruited for more slowly forceful contractions
  - D. Large, fast motor units are recruited after small, slow motor units
14. The total tension generated during skeletal muscle contraction is highest when the muscle
- A. Is appreciably shorter than the resting length
  - B. Contracts isometrically at resting length
  - C. Is stretched beyond its resting length

- D. None of the above
15. Which one of the following statements is incorrect?
- Contraction can occur without an appreciable decrease in the length of a muscle
  - Contraction against a constant load while the muscle is shortening is called concentric muscle contraction
  - Muscles can lengthen while doing work
  - Isometric contractions do work while isotonic contractions do not
16. Which of the following is not true regarding the comparison of type I (slow oxidative) and type IIb(fast-glycolytic) skeletal muscle fibers?
- Type I fibres have more abundant mitochondria
  - Type I fibres fatigue more readily
  - Type I fibres have more abundant myoglobin
  - Type I motor units contain fewer fibres than type IIb motor units
17. Cardiac inotropy is enhanced by
- Agonists coupled to Gi-protein
  - Decreased calcium binding to troponin-C
  - Decreased release of calcium by terminal cisternae
  - Protein kinase A phosphorylation of L-type calcium channels
18. Oxidative capacity is highest in
- Type I muscle fibers
  - Type IIA muscle fibers
  - Type IIB muscle fibers
  - B and C are correct
19. Which one of the following characteristics is unique to skeletal muscle and is not observed in cardiac muscle?
- Gradation of force production
  - Refractoriness
  - Tetanizability
  - Conduction of impulse through gap junctions
20. The resting transmembrane potential ( $V_m$ ) of a nerve axon is essential for signal generation. Instantaneous elimination of which of the following would most rapidly bring  $V_m$  close to 0 mV?
- Active transport of  $K^+$  out of the cell
  - Active transport of  $Na^+$  out of the cell
  - High membrane permeability to  $K^+$
  - High membrane permeability to  $Na^+$

21. Hyperkalemia reduces the excitability of neurons and muscle cells. Which of the following best describes the effect of increased extracellular potassium [K+]?
- A. Depolarizes the cell, thus reducing action potential amplitude
  - B. Depolarizes the cell, thus inactivating voltage-gated Na<sup>+</sup> channels
  - C. Hyperpolarizes the cell, which increases the action potential threshold
  - D. Increases the activity of the Na-K-ATPase, which hyperpolarizes the cell
22. While you are standing, holding a tray piled with dishes, an additional 10 Kg of dishes is placed on your tray. Your muscles that are holding the dishes increase their force of contraction through an increase in which of the following?
- A. Length of the muscle
  - B. Number of motor units activated and the frequency of their activation
  - C. Peak intracellular calcium concentration in the muscle
  - D. Strength of each individual cross-bridge interaction with actin
23. A bundle of muscle cells is found to contract rhythmically and in unison even when its nerve supply is disrupted. Although muscle contractions are dependent on the presence of extracellular calcium, the cells have poorly developed T tubules. Which of the following most likely describes the muscle type?
- A. Fast-twitch skeletal muscle
  - B. Multiunit smooth muscle
  - C. Slow-twitch skeletal muscle
  - D. Unitary smooth muscle
24. An EPSP:
- A. May summate temporarily or spatially to reach threshold
  - B. Hyperpolarizes the postsynaptic membrane
  - C. Represents a propagated change in membrane potential
  - D. Always produces an action potential
25. Drug A when applied to a nerve fiber results in both gradual decrease in amplitude of individual action potentials and slow depolarization of the resting potential. The drug is most likely;
- A. Blocking the process of Na<sup>+</sup> inactivation
  - B. Blocking the voltage dependent Na<sup>+</sup> permeability
  - C. Blocking the voltage dependent K<sup>+</sup> permeability
  - D. Blocking the Na-K pump
26. Skeletal muscle fibers
- A. Contract when actin and myosin filaments shorten
  - B. Contract when calcium is taken up by transverse tubular system
  - C. Have a single motor end plate each
  - D. Do not show any of the characteristics above

27. Which of the following structures has the slowest rate of conduction of action potentials?
- Internodal atrial pathways
  - Sino atrial node
  - Purkinje fibers
  - Ventricular muscle
28. Which of the following conditions at the sino-atrial node causes the heart rate to decrease?
- Increased sodium permeability
  - Increased calcium permeability
  - Increased potassium permeability
  - Decreased acetylcholine levels
29. What is the membrane potential (threshold) at which the sino-atrial node discharges?
- 40 mV
  - 55 mV
  - 65 mV
  - 85 mV
30. If the atrioventricular node becomes the pacemaker of the heart, what is the expected heart rate?
- 30 beats/minute
  - 50 beats/minute
  - 65 beats/minute
  - 75 beats/minute
31. Which of the following conditions causes dilated, flaccid heart?
- Hypercalcemia
  - Hyperkalemia
  - Hypernatremia
  - Increased body temperature
32. To gather information about impulse conduction from the atria to the ventricles, study the
- P wave
  - PR interval
  - ST segment
  - T wave
33. About intravascular clotting, all the following are true except:
- It occurs by the intrinsic system of coagulation
  - It is induced by a decrease in the blood flow rate
  - It occurs with accumulation of lipids in the arterial walls

- D. It does not normally occur because  $\text{Ca}^{++}$  is present
34. A reduction of the blood level of coagulation factor VIII:  
A. Increases the bleeding time beyond the normal range  
B. Is a hereditary disease due to an abnormal gene on the Y Chromosome  
C. Causes prolongation of the clotting time  
D. May occur secondary to excessive formation of von Willebrand factor
35. The treatment of patients suffering from increased tendency of blood clotting is:  
A. I.V heparin followed by vitamin K antagonists (e.g. dicumarol)  
B. I.V administration of sodium citrate  
C. Increasing the rate of erythropoiesis  
D. Decreasing the lymphocytic count
36. About bleeding from a small skin cut, all the following are true except:  
A. It ceases within about 4 minutes in normal people  
B. It is prolonged if factor VIII is deficient  
C. It is normally diminished by local vascular spasm  
D. Its stoppage depends on the platelet count in the blood
37. If you want to prolong the coagulation time in a patient having intravascular thrombosis you choose:  
A. I.V. injection of heparin  
B. I.V injection of calcium  
C. I.V injection of vitamin K  
D. Oral administration of dicumarol.
38. Choose the correct statement concerning granulocytes:  
A. The most abundant type is eosinophil  
B. The eosinophil count increases in ascaris infection  
C. The neutrophils phagocytize bacteria by a passive process  
D. The basophils play no role in hypersensitivity reactions
39. All the following about erythroblastosis fetalis is true except:  
A. Jaundice of the newborn is a major manifestation  
B. It is treated by blood transfusion having a Rh characteristic as that of the mother.  
C. It can be avoided by giving the mother anti-Rh antibodies immediately after labour.  
D. It cannot affect the first baby of Rh -ve mothers
40. If a man's plasma agglutinate both A and B red cells, he is group:  
A. B  
B. A  
C. AB  
D. O

41. A 52-year-old man is brought to the Emergency Department with severe chest pain. An imaging of the coronary artery demonstrates a severe coronary occlusion. A thrombolytic agent is administered to re-establish perfusion. Which of the following does the thrombolytic agent activate?
- A. Heparin
  - B. Plasminogen
  - C. Thrombin
  - D. Prothrombin
42. 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. Hemophilia
43. Calcium citrate prevents coagulation by which of the following actions?
- A. Blocking thrombin
  - B. Binding factor XII
  - C. Binding vitamin K
  - D. Chelating calcium
44. 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. Heparin
  - B. Protamine
  - C. Protein C
  - D. Vitamin K
45. The function of lymphocytes is:
- A. Heparin formation
  - B. Antibody formation
  - C. Release of serotonin
  - D. All the above
46. Neutrophils are attracted to infection sites by the process of:
- A. Phagocytosis
  - B. Endocytosis
  - C. Opsonization
  - D. Chemotaxis
47. Concerning lymphocytes, all the following are true except:

- A. The T-lymphocytes develop in the thymus gland
  - B. The B-lymphocytes produce cellular immunity
  - C. Transplanted tissue grafts are rejected by sensitized T-lymphocytes
  - D. They are formed mainly in the lymphoid tissues
48. The platelets assist haemostasis by releasing all the following substances except:
- A. Serotonin
  - B. Platelet factor 3
  - C. Thromboxane A2
  - D. Thrombopoietin
49. Which of the following describes the red cell morphology in Iron deficiency anemia?
- A. Microcytic normochromic
  - B. Macrocytic hypochromic
  - C. Microcytic hypochromic
  - D. Microcytic hyperchromic
50. In pernicious anemia:
- A. The life span of RBCs is longer than normal
  - B. There is microcytic hyperchromic anemia
  - C. Decreased absorption of Vitamin B12 is suspected
  - D. The rate of RBCs maturation is enhanced.
51. The defensive function of neutrophils is achieved by:
- A. Becoming macrophages which destroy large particles
  - B. Playing a major role in cellular immunity
  - C. Phagocytizing bacteria and killing them using  $H_2O_2$  and superoxide
  - D. Migrating into blood clots and producing a fibrinolysin
52. All the following conditions cause anemia except:
- A. Erythroblastosis fetalis
  - B. Aplasia of the bone marrow
  - C. Hypothyroidism
  - D. Living at high altitudes
53. The hemostatic disorder in obstructive jaundice is:
- A. Due to deficiency of factor IV
  - B. Caused by insufficient pancreatic secretion
  - C. Secondary to lack of platelets
  - D. Characterized by a longer coagulation time than normal
54. Leukopenia tends to occur in all the following conditions except:
- A. Starvation
  - B. Trauma
  - C. Pernicious anemia
  - D. When using drugs that depress the bone marrow
55. Site of erythropoietin production is:

- A. Brain
  - B. Liver
  - C. Bone marrow
  - D. Thymus
56. Concerning platelets, all the following are true except:
- A. Their membrane contains phospholipids that are involved in blood clotting
  - B. Their cytoplasm contains contractile proteins that cause clot retraction
  - C. Their aggregation is inhibited by both thrombin and the Von Willebrand factor
  - D. They are concerned with formation of the primary haemostatic plug
57. What will happen to RBC if the heme group is removed from haemoglobin?
- A. They will be able to transport oxygen normally
  - B. They will be able to carry Carbon dioxide
  - C. They will be able to carry proteins
  - D. They will be megaloblastic
58. Glycosylated haemoglobin is:
- A. Haemoglobin combines glycerol
  - B. Haemoglobin combined with fructose
  - C. Haemoglobin combined with glucose
  - D. Haemoglobin present in iron deficiency anaemia
59. About protein C, all the following are true except:
- A. It is involved in blood viscosity
  - B. Its activator is formed from thrombin by the action of thrombomodulin
  - C. It is a natural anticoagulant protein
  - D. It activates the inhibitor of TPA
60. The maintenance of blood fluidity depends on all the following factors except:
- A. The smooth intact vascular endothelium
  - B. The presence of heparin and antithrombin III
  - C. Absence of plasminogen
  - D. An intact fibrinolytic system
61. All the following can be used in blood volume determination except:
- A. Radioactive iodine ( $^{131}\text{I}$ ) labelled albumin
  - B. Labelled red cell blood cells
  - C. A harmless dye like Evans's blue
  - D. Deuterium oxide
62. The total body water:
- A. Is equally distributed inside and outside the body cells
  - B. Is not important for the body temperature
  - C. Forms a smaller percentage of the weight in fat persons
  - D. Its percentage tends to increase with age

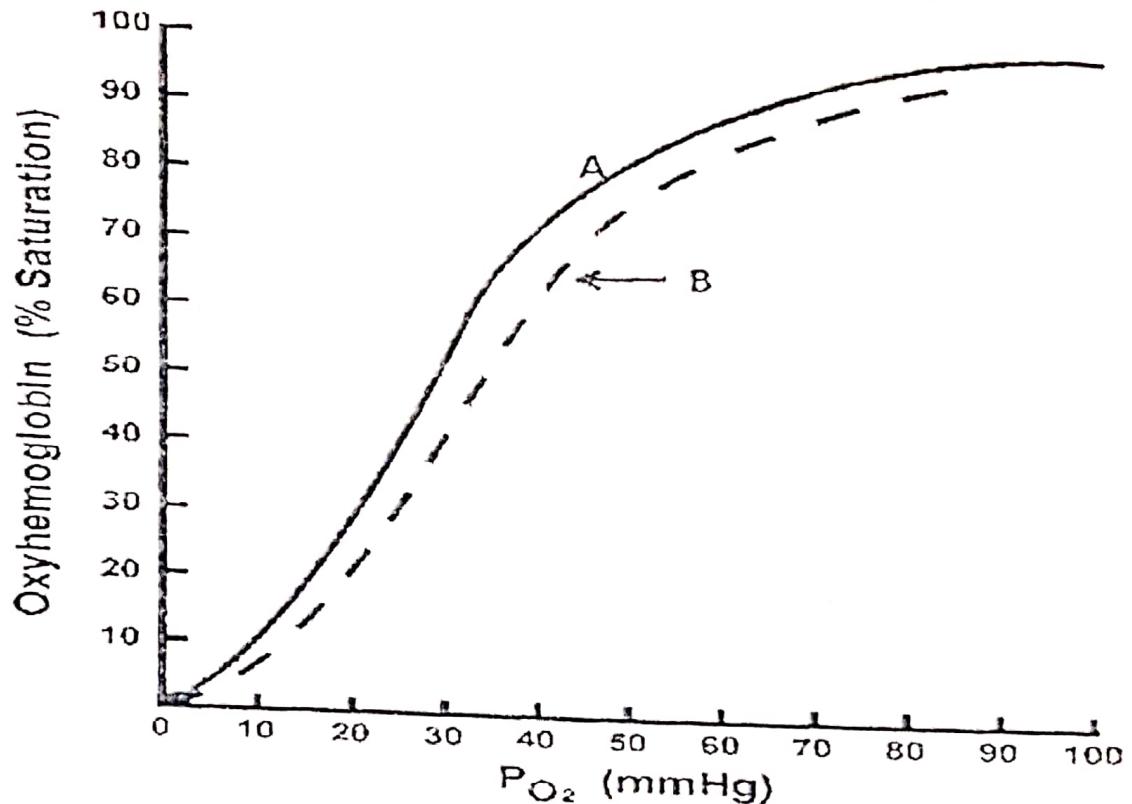
63. About the total body water, all the following is true except:
- A. It constitutes 1/2-2/3 of the body weight (about 60%)
  - B. It is measured by the indicator dilution technique using deuterium oxide
  - C. Together with solutes it forms the body fluids
  - D. It is found mainly of the interstitial fluid
64. In a man, aged 32 years whose body weight is 60kg the:
- A. Total body water is 0.6 litres /kg body weight
  - B. ECF volume is 8 litres
  - C. ICF volume is 28 litres
  - D. Plasma volume is 5 litres
65. The deuterium oxide space ( $D_2O$ ) measures the volume of the:
- A. Interstitial fluids
  - B. Total body water
  - C. Extracellular fluid
  - D. Intracellular fluid
66. The intraocular fluid volume
- A. Is measured as the tritium oxide space
  - B. Is measured as the  $K^+$  space
  - C. Equals the  $D_2O$  space minus the sucrose space
  - D. Equals 5 times the extracellular fluids volume
67. The nephron reabsorbs glucose through a sodium / glucose transporter. What sort of transporter is it?
- A. Antiporter
  - B. Symporter
  - C. Counter-transporter
  - D. Primary active transport
68. According to the fluid mosaic model of membrane structure, proteins of the membrane are mostly
- A. Confined to the hydrophobic core of the membrane.
  - B. Embedded in a lipid bilayer.
  - C. Randomly oriented in the membrane, with no fixed inside-outside polarity.
  - D. Free to depart from the fluid membrane and dissolve in the surrounding solution.
69. The presence of cholesterol in the plasma membranes of some animals
- A. Enables the membrane to stay fluid more easily when cell temperature drops.
  - B. Enables the animal to remove hydrogen atoms from saturated phospholipids.
  - C. Enables the animal to add hydrogen atoms to unsaturated phospholipids.
  - D. Makes the membrane less flexible, allowing it to sustain greater pressure from within the cell.
70. For a protein to be an integral membrane protein it would have to be which of the following?
- A. hydrophobic
  - B. amphipathic
  - C. completely covered with phospholipids
  - D. exposed on only one surface of the membrane

71. Of the following functions, which is most important for the glycoproteins and glycolipids of animal cell membranes?
- Active transport of molecules against their concentration gradients
  - Maintaining the integrity of a fluid mosaic membrane
  - Maintaining membrane fluidity at low temperatures
  - A cell's ability to distinguish one type of neighboring cell from another
72. An animal cell lacking oligosaccharides on the external surface of its plasma membrane would likely be impaired in which function?
- Transporting ions against an electrochemical gradient
  - Cell-cell recognition
  - Maintaining fluidity of the phospholipid bilayer
  - Attaching to the cytoskeleton
73. What kinds of molecules pass through a cell membrane most easily?
- Large and hydrophobic
  - Small and hydrophobic
  - Large polar
  - Monosaccharides such as glucose
74. Which of the following would likely move through the lipid bilayer of a plasma membrane most rapidly?
- Nitrogen
  - An amino acid
  - Glucose
  - Starch
75. Water passes quickly through cell membranes because
- It moves through hydrophobic channels.
  - Water movement is tied to ATP hydrolysis.
  - It is a small, polar, charged molecule.
  - It moves through aquaporins in the membrane.
76. You are working on a team that is designing a new drug. For this drug to work, it must enter the cytoplasm of specific target cells. Which of the following would be a factor that determines whether the molecule enters the cell?
- Non-polarity of the drug molecule
  - Lack of charge on the drug molecule
  - Similarity of the drug molecule to other molecules transported by the target cells
  - Lipid composition of the target cells' plasma membrane
77. Which of the following membrane activities require energy from ATP hydrolysis?
- Movement of water into a cell
  - Na<sup>+</sup> ions moving out of the cell
  - Movement of glucose molecules
  - Movement of water into a paramecium
78. If a membrane protein in an animal cell is involved in the cotransport of glucose and sodium ions into the cell, which of the following is most likely true?
- The sodium ions are moving down their electrochemical gradient while glucose is moving up.
  - Glucose is entering the cell along its concentration gradient.

- C. Sodium ions can move down their electrochemical gradient through the cotransporter whether glucose is present outside the cell or not.
  - D. A substance that blocks sodium ions from binding to the cotransport protein would also block the transport of glucose
79. The movement of potassium into an animal cell requires
- A. Low cellular concentrations of sodium.
  - B. High cellular concentrations of potassium.
  - C. An energy source such as ATP or a proton gradient.
  - D. A cotransport protein.
80. White blood cells engulf bacteria through what process?
- A. Exocytosis
  - B. Phagocytosis
  - C. Pinocytosis
  - D. Osmosis

**SECTION B: STRUCTURED QUESTIONS [30 marks]**

1. Study the O<sub>2</sub> Dissociation curve below



- a) State any four causes of shift of curve A to B [2 marks]

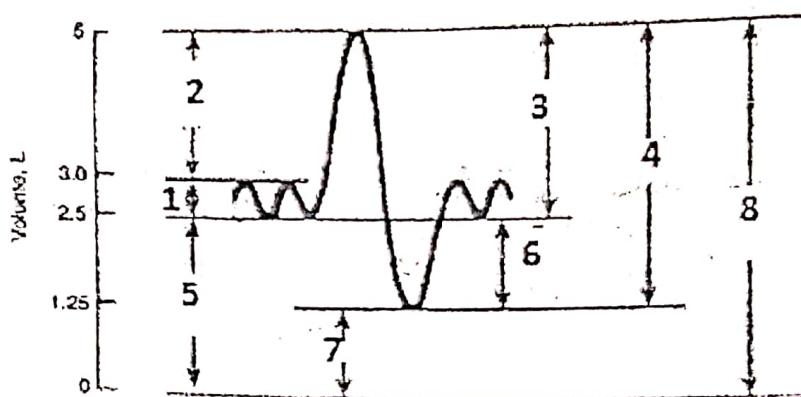
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- b) What is the P50 in curve A and curve B? [2 mark]

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- c) Reasons for the sigmoid shape of the curve? [2 marks]
- d) Applied significance of the flat portion of the curve? [2 marks]
- e) Describe two factors that determine the amount of oxygen combined to hemoglobin [1 mark]
- f) Describe two factors that determine the amount of gas dissolved in physical solution [1mark]

2. Study the spirometry curve below showing different lung volumes and capacities



- a) Define label [1] in the diagram above and state its value [1 mark]

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- b) i. What is labeled [4] in the diagram above? [0.5 mark]

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- ii. State its components and average normal value [1.5 marks]

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- iii. Give 2 examples of lung diseases where [4] is decreased [1 mark]

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- iv. Which lung capacities in the diagram cannot be measured by spirometry?  
Mention their representing number on the curve [1 mark]

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vi. Mention their values [1 mark]

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c) What is labeled [7] in the diagram? [1 mark]

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d) Mention two significances of the labeled [7] [2 marks]

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e) Define the label [6] in the diagram above [1 mark]

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3. Draw a well-labeled diagram of the conducting system of the heart [ 5 marks]

4. Covid infected patients show cough symptoms as a primary finding. Briefly explain the physiology of cough reflex in FOUR (4) steps [2 marks]

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5. Emphasize four factors that affect total body water [2 marks]

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6. State any TWO (02) factors that affect lung compliance [1 mark]

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### SECTION C: SCENARIO QUESTIONS [30 marks]

1. Jack, a 23-year-old medical student visits his physician after experiencing "strange symptoms" for the last 8 months. He had severe eyestrain when he read for longer than 15 minutes. He became tired when he chewed his food, brushed his teeth, or dried his hair. He was evaluated by her physician. While awaiting the results, the physician initiated a trial of pyridostigmine, an acetylcholinesterase inhibitor. Jack immediately felt better while taking the drug; his strength returned to almost normal.

- a) What is the most likely neuromuscular condition that Jack is suffering from? [1 mark]

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- b) With respect to neuromuscular transmission, what is a quantum? [1 mark]

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- c) Why is the neuromuscular junction said to have a high safety margin? [1 mark]

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- d) Mention two factors that account for delay in neuromuscular transmission [1 mark]

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- e) Mention the cholinergic receptor type located on the postsynaptic membrane of the synaptic cleft [0.5 mark]

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- f) What destroys the acetylcholine that diffuses away from the endplate into the blood stream and other tissues? [0.5 mark]
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- g) What is the implication of the blockage by the trial drug? [1 mark].
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- h) What is most likely to be seen in a biopsy sample of intercostal muscles of the patient in this question? [1 mark]
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- i) Why would removal of the thymus gland be beneficial to this patient? [2 marks]
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- j) Mention the site of action of botulinum toxin and the type of muscle paralysis it causes [1 mark]
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2. A male patient aged 70 years, suffered from fracture at the neck femur of the left side. He was operated for the fracture. After the operation, he was unable to move even in bed although he was encouraged to move. Three days after the operation, the doctor observed swelling in his left leg and was diagnosed as deep venous thrombosis.

- a) Mention two causes of occurrence of deep venous thrombosis in this patient [1 mark]

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- b) The patient received heparin three times daily and dicumarol once daily. What is the mode of action of dicumarol? [2 marks]

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- c) How is heparin administered? [1 mark]

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- d) After two days, heparin treatment was stopped and dicumarol treatment continued. The efficacy of dicumarol treatment be adjusted by testing which hemostatic function? [1 mark]

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- e) Ten days later, the patient suffers from severe bleeding from a slight cut in the face. The clotting of blood does not occur. This was diagnosed as a complication of dicumarol therapy. What substance can be given to the patient in this case?

[1 mark]

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- f) Give one reason each for the prolonged bleeding time in the following conditions

1. Vitamin C deficiency [0.5 mark]

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2. Deficiency of von Willibrand factor [0.5 mark]

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3. Prolonged use of aspirin [0.5 mark]

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4. Purpura [0.5 mark]

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g) Briefly state two properties of the normal intact endothelium that makes it to limit hemostatic reactions [2 marks]

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3. Martha Mulenga is a 60-year-old widow who was rushed to the Kitwe Teaching Hospital emergency room last evening by her sister. Early in the day, Mrs. Mulenga had seen bright red blood in her stool, which she attributed to hemorrhoids. She continued with her daily activities: she cleaned her house in the morning, had lunch with friends. However, the bleeding continued all day, and by dinnertime, she could no longer ignore it. Mrs. Mulenga does not smoke or drink alcoholic beverages. She takes aspirin, as needed, for arthritis, sometimes up to 10 tablets daily. In the emergency room, Mrs. Mulenga was light-headed, pale, cold, and very anxious. Her hematocrit was 29% (normal for women, 36 to 46%).

The data below shows Mrs. Mulenga's blood pressure and heart rate in the lying (supine) and upright (standing) positions

Parameter	Lying Down (Supine)	Upright (Standing)
Blood pressure	90/60	75/45
Heart rate beats/min	105 beats/min	135

An infusion of normal saline was started, and a blood sample was drawn to be typed and crossmatched to prepare for a blood transfusion. A colonoscopy showed that the bleeding came from herniations in the colonic wall, called diverticula. (When arteries in the colon wall rupture, bleeding can be quite vigorous.) By the time of the colonoscopy, the bleeding had stopped spontaneously. Because of the quantity of blood lost, Mrs. Mulenga received two units of whole blood and was admitted for observation. The physicians were prepared to insert a bladder catheter to allow continuous monitoring of urine output. However, by the next morning, her normal color had returned, she was no longer light-headed, and her blood pressure, both lying and standing, had returned to normal. No additional treatment or monitoring was needed. Mrs. Mulenga was discharged to the care of her sister and advised to "take it easy."

a) i. Define circulatory shock

[1 mark]

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ii. List the various forms of shock

[2 mark]

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b) After the gastrointestinal blood loss, what sequence of events led to Mrs. Mulenga's decreased arterial pressure

[2 marks]

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c) Why was Mrs. Mulenga's arterial pressure lower in the upright position than in the lying (supine) position? [1 mark]

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d) i. What is hematocrit?

[1 mark]

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ii) Why was Mrs. Mulenga's hematocrit decreased?

[1 mark]

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iii) Why was this decrease potentially dangerous?

[1 mark]

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e) Why was her skin pale and cold?

[1 mark]

**THE END**