SECTION A: CHOOSE THE SINGLE BEST OPTION [50 marks]

CHOOSE THE SINGLE BEST OPTION. EACH QUESTIONS CARRIES 1 MARK

1. What is the purpose of surfactant?
   a) Facilitate in the diffusion of oxygen across the respiratory membrane
   b) Transport oxygen to the alveoli
   c) Purify the air entering the respiratory tract
   d) Keep alveoli from collapsing

2. Which gas is the primary regulator of respiration?
   a) Oxygen
   b) Carbon dioxide
   c) Nitrogen
   d) Bicarbonate

3. Smooth muscle contributes to the structure of the
   a) Respiratory membrane
   b) Respiratory bronchiole
   c) Terminal bronchiole
   d) Alveolar ducts

4. The primary way oxygen is transported in the blood is:
   a) In the form of bicarbonate
   b) In the form of carbaminohemoglobin
   c) In the form of oxyhemoglobin
   d) Dissolved in plasma

5. Which of the following is true during inspiration?
   a) Intrapleural pressure is positive
   b) The volume in the lungs is less than the functional residual capacity (FRC)
   c) Alveolar pressure is higher than atmospheric pressure
   d) Intrapleural pressure is more negative than it is during expiration

6. Which volume remains in the lungs after a tidal volume (TV) is expired?
   a) Inspiratory reserve volume (ERV
   b) Expiratory reserve volume (ERV)
   c) Residual volume (RV)
   d) Functional residual capacity (FRC)

7. When a person is standing, blood flow in the lungs is
   a) Equal at the apex and the base
   b) Highest at the apex owing to the effects of gravity on arterial pressure
   c) Highest at the base because that is where the difference between arterial and venous pressure is greatest
   d) Lowest at the base because that is where alveolar pressure is greater than arterial pressure

8. Compared with the apex of the lung, the base of the lung has
   a) A higher pulmonary capillary PO2
   b) A higher pulmonary capillary PCO2
   c) A higher ventilation/perfusion (V/Q) ratio
   d) The same V/Q ratio

9. If an area of the lung is not ventilated because of bronchial obstruction, the pulmonary capillary blood serving that area will have a PO2 that is
   a) Equal to mixed venous PO2
   b) Equal to normal systemic arterial PO2
   c) Higher than inspired PO2
   d) Lower than mixed venous PO2

10. In the transport of CO2 from the tissues to the lungs, which of the following occurs in venous blood?
   a) Conversion of CO2 and H2O to H+ and HCO3– in the red blood cells
   b) Buffering of H+ by oxyhemoglobin
   c) Shifting of HCO3– into the RBCs from plasma in exchange for Cl
   d) Alkalinization of the RBCs

11. Which of the following causes of hypoxia is characterized by a decreased arterial PO2 and an increased difference between alveolar PO2 and arterial PO2?
   a) Right-to-left cardiac shunt
   b) Anemia
   c) Carbon monoxide poisoning
   d) Ascent to high altitude

12. The maximum amount of moveable air in the lungs is called _____ and has a volume of about _____ mL.
   a) Vital capacity, 4600
   b) Total lung capacity, 5800
   c) Inspiratory reserve volume, 3000
   d) Inspiratory capacity, 3500.

13. A 38-year-old woman moves with her family from Katete sea level to Mt. Kilimanjaro (10,200 feet above sea level). Which of the following will occur as a result of residing at high altitude?
   a) Hypoventilation
   b) Arterial PO2 greater than 100 mm Hg
   c) Decreased 2,3-DPG concentration
   d) Right shift of the Hb–O2 dissociation curve

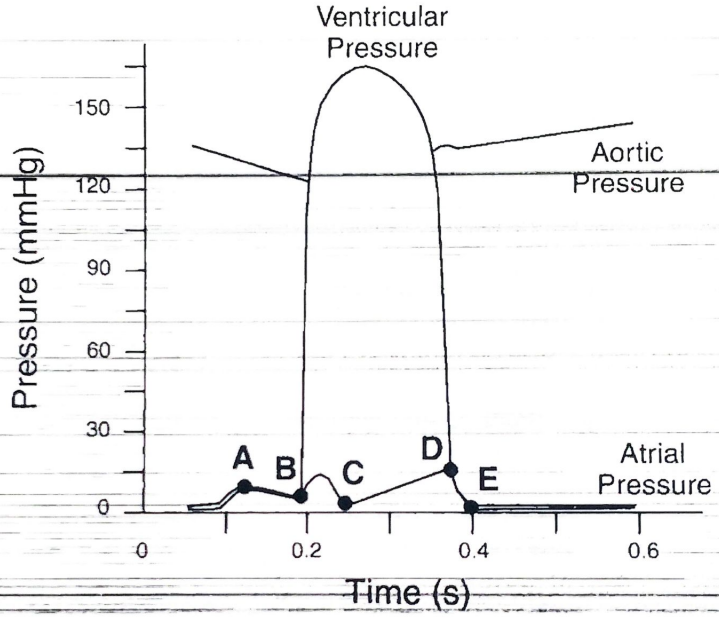
14. The pH of venous blood is only slightly more acidic than the pH of arterial blood because
   a) There is no carbonic anhydrase in venous blood
   b) The H+ generated from CO2 and H2O is buffered by HCO3– in venous blood
   c) The H+ generated from CO2 and H2O is buffered by deoxyhemoglobin in venous blood
   d) Oxyhemoglobin is a better buffer for H+ than is deoxyhemoglobin

15. Chloride shift shows all of the following EXCEPT:
   a) Occurs in the lung capillaries
   b) Occurs to maintain ionic equilibrium
   c) Rises chloride level in the RBC
   d) Necessary for CO2 transport

16. At what level of alveolar oxygen pressure the peripheral chemoreceptors are activated? (Pressure in mmHg)
   a) 150
   b) 100
   c) 90
   d) 60

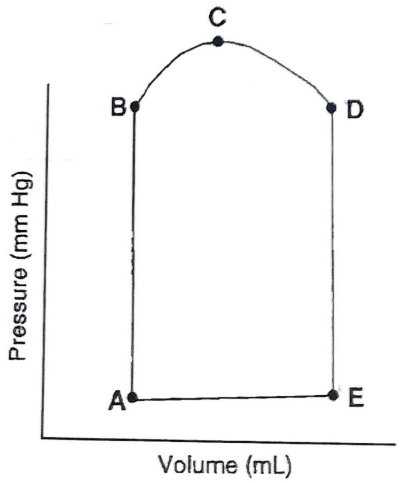
26. A resting individual has a respiratory rate of 12 breaths per minute. How much air is wasted (not involved in gas exchange) per minute?
    a) 500 mL/min
    b) 1800 mL/min
    c) 4200 mL/min
    d) 6000 mL/min

27. In the hemodynamic pressure tracings below, rapid ventricular filling begins at which point or points on the figure below?



    a) A
    b) B
    c) C and E
    d) D

28. In the pressure-volume loop below, systole begins at which of the following points?



    a) A
    b) B
    c) D
    d) E

17. The affinity of hemoglobin for oxygen is increased if there is an increase in:
    a) pH
    b) temperature
    c) 2,3 DPG
    d) PCO2

18. Thickening of alveolar capillary membrane causes:
    a) Emphysema
    b) Pulmonary edema
    c) Hypoxemia
    d) Atelectasis

19. During inspiration, all of the following show an increase EXCEPT:
    a) Intrapleural pressure
    b) Stroke volume
    c) Venous return
    d) Intrapulmonary pressure

20. When we exhale deeply some air is still left in the lungs, this air left is called?
    a) Tidal Volume
    b) Vital Capacity
    c) Expiratory reserve Volume
    d) Residual Volume

21. In which of these areas is the partial pressure of oxygen (PO2) normally ~~the~~ Low.
    a) Alveolar air
    b) Expired air
    c) Pulmonary capillaries
    d) Tissues

22. Which of these conditions produces increased compliance of the lungs?
    a) Airway obstruction
    b) Emphysema
    c) Fibrosis of lungs
    d) Pulmonary edema

23. Lung recoil occurs because of elastic fibers in the alveolar walls and
    a) The elastic fibers in the ribcage
    b) Pleural pressure
    c) Surface tension of the fluid that lines the alveoli
    d) Surfactant secretion in the alveoli

24. In which of these sequences does PO2 progressively decrease?
    a) Arterial blood, alveolar air, body tissues
    b) Body tissues, arterial blood, alveolar air
    c) Body tissues, alveolar air, arterial blood
    d) Alveolar air, arterial blood, body tissues

25. Arterial blood entering the tissues has a PO2 = 95 mm Hg and a PCO2 = 40 mm Hg. Venous blood leaving the tissues has a PO2 = _____ mm Hg and a PCO2 = _____ mm Hg.
    a) 104, 40
    b) 95, 40
    c) 40, 45
    d) 20, 46

29. Ms Mwiila has a complaint of chest pain suddenly. The following are true about the ECG
    a) To get readings of an ECG, electrodes that are positive and negative are placed on the surface of the breast
    b) It is possible to get readings as due to fluids being bad conductors and having the ability to bring the electrical activity to the body surface
    c) Applying a positive electrode to the left lower limb will pick activities as though the electrode is at the apex of the heart
    d) If electrode is placed on the left arm, it will be as though this electrode is placed on the right atrium of the heart

30. Reason for AV nodal delay is
    a) Less desmosomes
    b) Less gap junctions
    c) Less hemidesmosomes
    d) More desmosomes

31. Right axis deviation is seen in the following:
    a) Right atrial hypertrophy
    b) Left posterior fascicular block
    c) Lateral leg muscular Infarction
    d) Inferior myocardial infarction

32. Functions of peripheral Chemoreceptors
    a) Monitors changes in pH either induced by PCO2 or independent of PCO2
    b) Are stimulated by increase in PO2
    c) Leads to decrease in rate and depth of respiration when pH goes down
    d) Are stimulated by a decrease in oxygen bound to hemoglobin

33. _____ are microscopic blood vessels that form an intricate network among the tissue cells.
    a) Arteries
    b) Met-arterioles
    c) Capillaries
    d) Arterioles

34. _____ in arteriole walls regulate the distribution of blood to the capillaries of organs.
    a) Elastic fibers
    b) Collagen fibers
    c) Endothelium
    d) Smooth muscle fibers

35. _____ control blood flow into branching capillaries.
    a) Elastic fibers
    b) Collagen fibers
    c) Smooth muscle fibers
    d) Pre capillary sphincters

36. The _____ pressure tends to force fluid out and its dissolved substances through the capillary pores into the interstitial spaces.
    a) Oncotic
    b) Interstitial hydrostatic
    c) Capillary blood
    d) Capillary hydrostatic

37. If the sum of the Starling forces is negative, there will be a net _____ from the interstitial spaces into the capillaries.
    a) Oncotic disturbance
    b) Capillary blood diffusion
    c) Fluid absorption
    d) Fluid filtration

38. The flow of blood through the vascular system is due to the difference in _____ at the two ends
    a) Blood movement
    b) Pressure
    c) Diameter
    d) Radius

39. Major regulators of blood flow through an organ are:
    a) Blood and gas movement
    b) Pressure and volume
    c) Mean arterial pressure and resistance
    d) Radius and pressure across

40. Effect of parasympathetic stimulation on external genitalia
    a) Vasoconstriction in skin epidermis
    b) Vasodilation in skin dermis
    c) Vascular resistance
    d) Vasodilate

41. Which of the following statements best describes the role of endothelial nitric oxide synthase (eNOS) in arterioles and its physiological significance?
    a) eNOS is responsible for the production of endothelin, which causes vasodilation in arterioles.
    b) eNOS produces nitric oxide (NO), which acts as a vasodilator, leading to increased blood flow and reduced vascular resistance.
    c) eNOS generates reactive oxygen species (ROS) that promote vasoconstriction in arterioles.
    d) eNOS is involved in the synthesis of prostaglandins, which primarily regulate platelet aggregation.

42. Which sequence of events correctly describes how acetylcholine (ACh) indirectly increases the production of nitric oxide (NO) in endothelial cells?
    a) ACh stimulates the opening of K+ channels, leading to hyperpolarization and decreased Ca2+ levels, which reduces NO production.
    b) ACh binds to receptors, causing the opening of Ca2+ channels, leading to increased intracellular Ca2+, which then binds to calmodulin, activating an enzyme that produces NO.
    c) ACh directly activates nitric oxide synthase (NOS), resulting in immediate NO production without the need for Ca2+ signaling.
    d) ACh stimulates the release of endothelin, which causes vasodilation and increases NO levels through a secondary pathway.

43. Which of the following statements accurately describes the myogenic control mechanism in the regulation of cerebral blood flow?
    a) The myogenic response is primarily mediated by neural control, which adjusts vessel diameter in response to changes in blood pressure.
    b) Increased systemic arterial pressure leads to the stretching of vascular smooth muscle, causing cerebral vessels to contract and maintain stable blood flow despite fluctuations in pressure.
    c) The myogenic control mechanism relies on the release of hormones that cause vasodilation in response to increased arterial pressure.
    d) Myogenic control is ineffective in maintaining cerebral blood flow during episodes of hypotension, leading to potential ischemia.

44. Which of the following best describes the physiological response of cerebral vessels to a decrease in systemic arterial pressure, and how does this relate to the stress relaxation effect?
    a) A decrease in systemic arterial pressure causes cerebral vessels to constrict, leading to reduced blood flow and potential ischemia in the brain.
    b) The stress relaxation effect allows cerebral vessels to dilate in response to decreased systemic arterial pressure, thereby maintaining adequate cerebral blood flow despite lower perfusion pressures.
    c) Cerebral vessels remain unchanged in diameter during a decrease in systemic arterial pressure, relying solely on neural mechanisms to regulate blood flow.
    d) A decrease in systemic arterial pressure triggers the release of vasoconstrictors that cause cerebral vessels to narrow, increasing resistance and stabilizing flow.

45. Which of the following statements correctly describes the physiological mechanisms leading to vasodilation in response to changes in oxygen (O_2) and carbon dioxide (CO_2) levels?
    a) Vasodilation occurs primarily due to increased oxygen levels resulting from enhanced ventilation, which decreases carbon dioxide levels and promotes smooth muscle contraction.
    b) Vasodilation is solely mediated by neural signals that respond to increased oxygen and carbon dioxide levels, independent of metabolic activity.
    c) Increased metabolic activity leads to vasoconstriction due to the accumulation of carbon dioxide, which enhances oxygen delivery to tissues.
    d) Decreased oxygen levels, resulting from an increased metabolic rate, lead to vasodilation, while increased carbon dioxide levels, due to decreased ventilation, also contribute to this response.

46. Which of the following best describes the relationship between tissue hypoxia and the production of vascular growth factors, and how does this process contribute to angiogenesis?
    a) Tissue hypoxia directly stimulates the release of vascular growth factors, which inhibit the formation of new blood vessels and promote vasoconstriction to reduce blood flow.
    b) The presence of adequate tissue oxygen and nutrients suppresses the production of vascular growth factors, which are only released during periods of excess blood flow.
    c) Tissue hypoxia or a deficiency of other essential nutrients triggers the production of vascular growth factors, such as VEGF, which stimulate the formation of new blood vessels to improve oxygen and nutrient delivery.
    d) Vascular growth factors are constitutively produced and are not influenced by the tissue's oxygen or nutrient status, but rather by neural signals that regulate angiogenesis.

47. Which of the following statements accurately describes the role of collateral circulation in restoring blood supply to tissues when a major artery or vein is blocked?
   a) Collateral circulation develops rapidly within minutes to hours after an arterial blockage, allowing for immediate restoration of blood flow to the affected tissue.
   b) The formation of collateral vessels is stimulated by neural signals that detect the blockage and trigger the rapid dilation of pre-existing vessels around the obstruction.
   c) When a major artery or vein is blocked, collateral vessels gradually develop over a period of weeks to months, allowing for a partial resupply of blood to the affected tissue over the long term.
   d) Collateral circulation is ineffective in restoring blood flow to tissues distal to a major arterial blockage, leading to tissue ischemia and necrosis.

48. Which of the following statements accurately describes the role of sympathetic cholinergic and β-adrenergic receptors in the vasodilation of skeletal muscles during sympathetic activation?
   a) Sympathetic cholinergic receptors primarily mediate vasoconstriction in skeletal muscles, while β-adrenergic receptors have no significant effect on vascular tone.
   b) Both sympathetic cholinergic and β-adrenergic receptors contribute to vasodilation in skeletal muscles by promoting smooth muscle relaxation in response to increased sympathetic activity.
   c) Vasodilation in skeletal muscles is solely mediated by parasympathetic cholinergic receptors, with sympathetic cholinergic and β-adrenergic receptors playing no role.
   d) Sympathetic cholinergic receptors are responsible for vasodilation only during rest, while β-adrenergic receptors are activated exclusively during exercise to cause vasoconstriction.

49. Which of the following statements accurately describes the myogenic mechanism in cerebral circulation and its response to changes in blood pressure?
   a) The myogenic mechanism causes cerebral arterioles to constrict in response to decreased blood pressure, ensuring consistent blood flow to the brain.
   b) In response to decreased blood pressure, the myogenic mechanism induces vasodilation of cerebral arterioles, allowing for increased blood flow to maintain adequate cerebral perfusion.
   c) The myogenic response is solely dependent on neural regulation, with no direct influence from changes in blood pressure on vascular smooth muscle tone.
   d) Cerebral vessels do not respond to changes in blood pressure through myogenic mechanisms, relying instead on metabolic factors to regulate blood flow.

50. Which of the following statements best describes the metabolic control of cerebral circulation and its response to changes in metabolic activity?
   a) Increased metabolic activity in specific areas of the brain leads to vasoconstriction, reducing blood flow to those areas.
   b) Areas of the brain with high metabolic activity receive the most blood flow due to the release of vasodilatory metabolites such as K+, which promote relaxation of vascular smooth muscle.
   c) The metabolic control of cerebral circulation is primarily mediated by sympathetic nervous system activation, which constricts blood vessels in response to increased metabolic demand.
   d) Decreased metabolic activity in the brain results in increased oxygen levels, which causes vasodilation and enhances blood flow to all areas uniformly.

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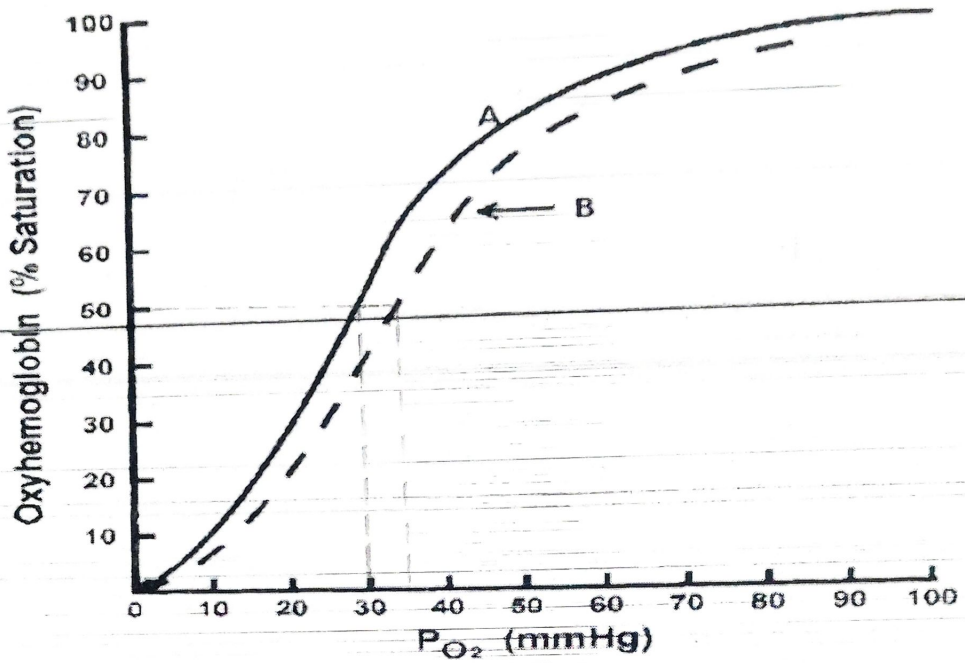
SECTION B: Structured questions **[25 marks]**

1. Study the graph below and answer the questions that follow

Study the O_2 dissociation curve below



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

increase in CO_2 ✓ increase in 2-3-BPG

Increase in H^+ ions ✓ (Biphosphoglycerate)

Increase in temperature ✓

b) What is the P50 in curve A and curve B? show it on the graph. What does this change mean? [2 marks]

P50 in A is 30mmHg

P50 in B is 35 mmHg ✓

c) What is responsible for the sigmoid shape of the curve? [1 mark]

The cooperative effect of Hb → It describes the increase in the affinity of Hb for O_2 with the increasing O_2 molecules that bind to Hb

d) What is the significance of the flat portion of the curve? [1 mark]

It indicates the Partial Pressure of O_2 at which all the Hb molecules would have ~~comp~~ been bounded to O_2 molecules and so rise in PO_2 won't cause any further rise in the saturation

e) Define the coefficient of oxygen utilization? [0.5 mark]

This is the % of oxygen in the arterials that will be taken into the tissues ✓

f) What is oxygen content? [0.5 mark]

Oxygen Content is the volume of Oxygen that in chemical combination with Hemoglobin 0.5

g) State two factors that determine the amount gas dissolved in physical solution [0.5 mark]

PO2 and the alveolar-blood diffusion quality

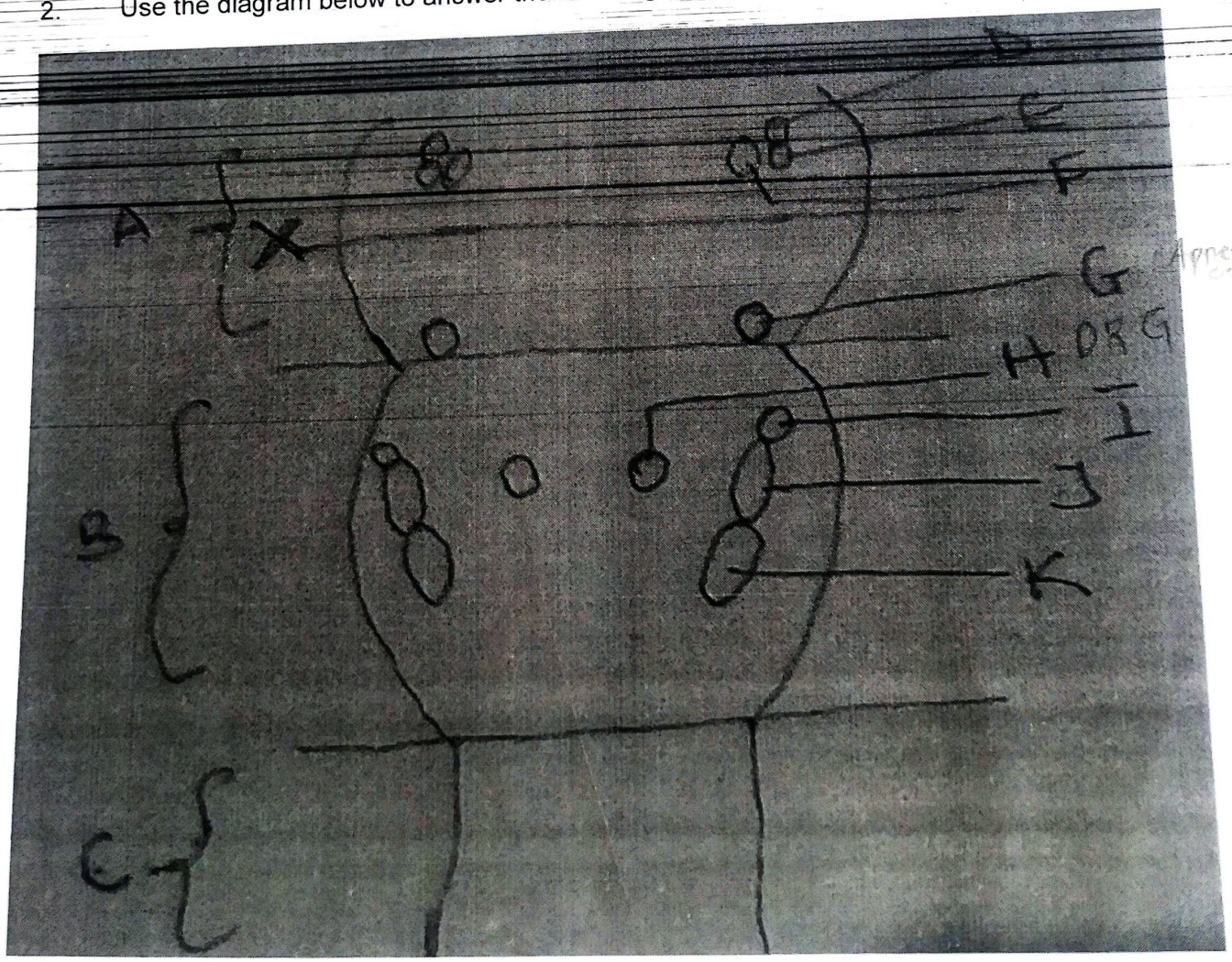
h) State two factors that determine the oxygen combined to hemoglobin [0.5 mark] 0.5

Partial Pressure of O2 & state of Hb, in anemia O2 combined to Hb is little

i) ~~A drop in PO2 has little effect on the respiratory centers until the arterial PO2~~ drops by about 40%. However, a 10% rise in arterial PCO2 will cause the respiratory rate to double. Explain in one sentence only [2 marks]

CO_2 maintains the acid-base (pH) of the blood, therefore, a slight change (rise) in PCO_2 will cause blood to be slightly acidic and hence respiratory rate will increase to lower the PCO_2

2. Use the diagram below to answer the following questions



G - Apneustic Center
H - Dorsal Respiratory Group
I - Botzinger Complex
I - Nucleus Ambiqualis
K - Nucleus Ambiguus

a) Name the parts labeled A-K. [2.5 marks]

A - Pons
B - Medulla
C - Spinal Cord
D - Kinikuler Fuse
E - Nucleus Parabrachialis lateqlis
F - Pneumotaxic Center

b) Mention 2 functions of H? [1 mark]

* It has i-neurons that send inspiratory signals to the respiratory muscles
* It has an inhibition effecton to the e-neurons of the Ventral R. Group

c) Describe the activity of the structure mention in G [1 mark]

G is considered the Respiratory pacemaker as it send inspiratory signals to the i-nerons & uses inspiration

d) Describe what happens if there is transection of A at point X together with bilateral vagotomy? [1 mark]

You will experience spasmic inspirations interrupted by short expirations from weakening of the respiratory muscles and this is Apneustic Breathing.

e) State what happens if there is transection separating the medulla from the pons together with bilateral vagotomy [1 mark]

The pre-botzinger complex will take up the role of sending inspiratory signals but they wont be rhythmic

f) 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)? [2 marks]

ERV = VC - IC
= 5L - 3.5L
ERV = 1.5L

g) A healthy 65-year-old man with a tidal volume (TV) of 0.45 L has a breathing frequency of 16 breaths/min. His arterial PCO2 is 41 mm Hg, and the PCO2 of his expired air is 35 mm Hg. What is his alveolar ventilation? [3 marks]

h) An individual's total lung capacity (TLC) is 6.5 L, and her inspiratory capacity is 3.55 L. At the end of a normal expiration, her lung volume is 4.45 L. The individual's tidal volume (VT) is: [1 mark]

3. A 20-year-old woman with a long history of asthmatic attacks was admitted at the Ndola Teaching hospital because of severe respiratory distress. The current asthmatic attack failed to respond to the usual antihistaminic drug that was self-administered. When seen by the physician, she was sitting up, obviously anxious and desperately trying to breathe. She was slightly cyanotic, sweating in addition to other cardinal symptoms of asthma. She was given oxygen and epinephrine and her symptoms subsided considerably after that. Answer the following questions.

a) What is the cause of difficulty in breathing in this patient? [1 mark]

* Spasms or rather Contraction of the Bronchiole smooth muscles,
* Increase mucous secretions * Increased secretion of vasoconstrictors like substance P, Leukotrienes.

b) Comment on the work of breathing in this patient. [1 mark]

Air resistance was high in in Respiratory tract. Hence, other muscle were struggling in getting the air in and out.

c) The patient was using an antihistaminic drug to stop bronchoconstrictor action of histamine. Mention three (03) other chemical agents that produce bronchoconstriction [1.5 marks]

Propranolol, Pindolol and Nadolol

d) Why is epinephrine given? Epinephrine is a Vasodilator [0.5 mark]

e) Which autonomic receptor is stimulated by epinephrine in this case? [0.5 mark]

B_2 Receptors 0.5

f) What type of hypoxia will be caused by this condition? [0.5 mark]

Hypoxic Hypoxia 0.5

SECTION C: SAQ [25 marks]

Answer all the questions in the blank sheets

PLEASE NOTE ONE MARK IS NOT EQUIVALENT TO A SUMMARIZED ANSWER.

4. Elucidate on RAA system and write about its significance and key components [5 marks]
5. During a medical examination, a patient suddenly exhibits signs of confusion, altered consciousness, and increased blood pressure. The physician suspects a potential ischemic event affecting the central nervous system (CNS). What physiological mechanisms are activated in the CNS ischemic response, and how do these mechanisms contribute to health. [5 marks]
6. A student experiences a sudden drop in blood pressure after standing up quickly from a seated position in MLT. The physician/lecturer notes that the patient exhibits symptoms such as lightheadedness and fainting. What physiological processes are involved in the baroreceptor reflex, and elucidate how do these processes work to restore blood pressure following an abrupt change in posture? [5 marks]
7. How does exercise regimen affect cardiac output, preload, and afterload during physical activity, and what physiological mechanisms are responsible for these changes? How might these adaptations contribute to improved cardiovascular health over time? [5 marks]
8. Elucidate the physiological mechanisms that link atherosclerosis to the development of hypertension in Sarah mumba, a 55-year-old woman with elevated blood pressure and a family history of cardiovascular disease? How do factors such as endothelial dysfunction, inflammation, and the presence of atherosclerotic plaques influence vascular resistance and contribute to increased blood pressure? [5 marks]

THE END

ACE - lungs

What is the half life of your data

~ Mr Biete ~