

KATTAR NEET 2026

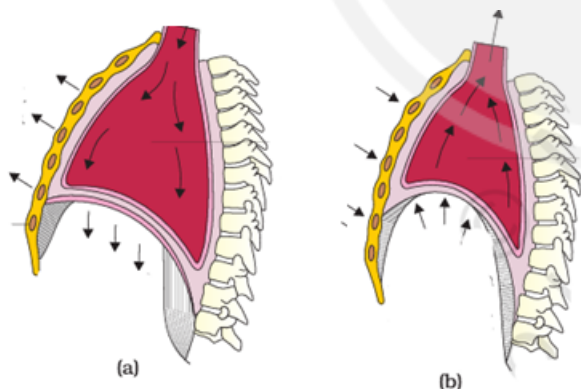
Zoology By Samapti Sinha Ma'am

Breathing and Exchange of Gases

Q1 Respiration in insects is called direct because:

- (A) the cell exchange O_2 / CO_2 directly with the air in the tubes.
- (B) the tissues exchange O_2 / CO_2 directly with coelomic fluid.
- (C) the tissues exchange O_2 / CO_2 directly with the air outside through body surface.
- (D) tracheal tubes exchange O_2 / CO_2 directly with the haemocoel which then exchange with tissues.

Q2 Consider the transitions between the states depicted in diagrams (a) and (b). If a neuromuscular toxin selectively and reversibly inhibited the function of only the **external intercostal muscles**, while the diaphragm remained fully functional, which of the following scenarios would most accurately describe the immediate effect on the depicted breathing mechanics?



- (A) Diagram (a) (inspiration) would be entirely abolished, while diagram (b) (expiration) would proceed normally.
- (B) Diagram (b) (expiration) would be severely impaired due to the inability of the rib cage to return to its original position.
- (C) Diagram (a) (inspiration) would still occur, but with a reduced increase in the thoracic

volume compared to normal.

- (D) Both diagrams (a) and (b) would be unaffected, as the diaphragm is the primary muscle of breathing.

Q3 Read the following statements (I-V).

- I. O_2 binds with haemoglobin in a irreversible manner to form oxyhaemoglobin.
- II. Approximately 4 ml of CO_2 is delivered to alveoli per 100 ml of deoxygenated blood, facilitated by carbonic anhydrase-catalyzed bicarbonate conversion.
- III. The role of oxygen in the regulation of respiratory rhythm is very significant.
- IV. Tissue conditions favor O_2 release from oxyhemoglobin.
- V. pO_2 in alveoli is always considerably less than that in the atmosphere.

Which of the given statements are **correct**?

- (A) I and II only
- (B) I, II and III only
- (C) I and III only
- (D) II, IV and V only

Q4 A person suffers punctures in his chest cavity in an accident without any damage to the lungs. Its ultimate effect could be:

- (A) reduced breathing rate
- (B) rapid increase in breathing rate
- (C) no change in respiration
- (D) cessation of breathing

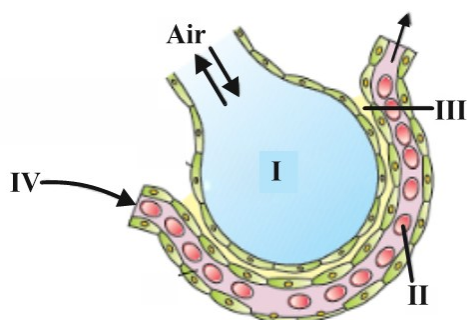
Q5 Mark the **true** statement among the following with reference to normal breathing:

- (A) Inspiration is a passive process where as expiration is active.
- (B) Inspiration is a active process where as expiration is passive.



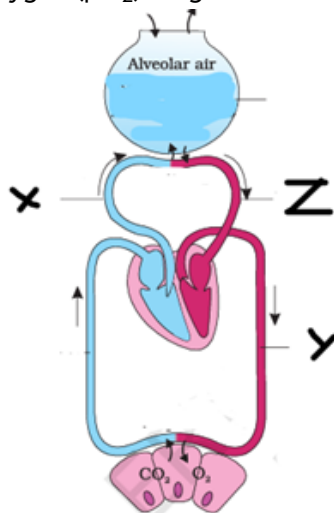
- (C) The thoracic chamber is ventrally formed by the vertebral column.
- (D) Human being can directly alter the pulmonary volume.

Q6 Refer to the given below diagram. Which of the following options **correctly** identifies a structure and its function?



- (A) II: Red blood cell, Transport of CO_2 mainly
- (B) III: Arterial capillary, Passes oxygen to tissues
- (C) I: Alveolar cavity, Main site of exchange of respiratory gases
- (D) IV: Basement substance, Exchange of O_2 and CO_2 takes place here

Q7 The provided diagram illustrates a simplified model of the human circulatory system. Identify the option that accurately correlates the labeled blood vessels with their characteristic oxygenation status and typical partial pressure of oxygen (pO_2) ranges:



Oxygenation Status and pO_2 Ranges:

- Vessels carrying predominantly deoxygenated blood with a low pO_2 .

- Vessels transporting blood towards the heart that is highly oxygenated.
 - Transports oxygen-rich blood, enabling the delivery of O_2 to tissues where it is offloaded.
- (A) 1-Z - Pulmonary vein, 2-X - Systemic veins, 3-Y - Systemic arteries
- (B) 1-X - Pulmonary artery, 2-Z - Pulmonary vein, 3-Y - Systemic arteries
- (C) 1-X - Systemic veins, 2-Z - Pulmonary vein, 3-Y - Systemic arteries
- (D) 1-X - Pulmonary artery, 2-Z - Pulmonary vein, 3-Y - Systemic veins

Q8 Given below are two statements: one is labelled as Assertion A and the other is labelled as Reason R:

Assertion A: A significant accumulation of fluid in the pleural cavity can impair breathing.

Reason R: Excess pleural fluid compresses the lungs, limiting their ability to expand fully.

In the light of the above statements, choose the **correct** answer from the options given below:

- (A) A is true but R is false.
- (B) A is false but R is true.
- (C) Both A and R are true and R is the correct explanation of A.
- (D) Both A and R are true but R is NOT the correct explanation of A.

Q9 CO_2 dissociates from carbaminohaemoglobin when

- (A) pCO_2 is high & pO_2 is low
- (B) pO_2 is high and pCO_2 is low
- (C) pCO_2 and pO_2 are equal
- (D) None of the above

Q10 The oxygen - haemoglobin dissociation curve will show a right shift in case of

- (A) High pCO_2
- (B) High pO_2
- (C) Low pCO_2
- (D) Less H^+ concentration

Q11 From the following relationships between respiratory volume and capacities and mark the



correct answer

I. Inspiratory capacity (IC) = Tidal Volume + Residual Volume

II. Vital Capacity (VC) = Tidal Volume (TV) + Inspiratory Reserve Volume (IRV) + Expiratory Reserve Volume (ERV).

III. Residual Volume (RV) = Vital Capacity (VC) – Inspiratory Reserve Volume (IRV)

IV. Tidal Volume (TV) = Inspiratory Capacity (IC) – Inspiratory Reserve Volume (IRV)

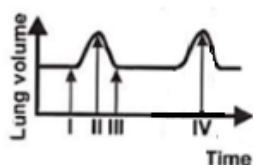
(A) (I) Incorrect, (II) Incorrect, (III) Incorrect, (IV) Correct

(B) (I) Incorrect, (II) Correct, (III) Incorrect, (IV) Correct

(C) (I) Correct, (II) Correct, (III) Incorrect, (IV) Correct

(D) (I) Correct, (II) Incorrect, (III) Correct, (IV) Incorrect

Q12 The given figure illustrates the changes in lung volume during the process of breathing.



The change from II to III indicates the:

(A) movement of diaphragm away from the lungs.

(B) expansion of the thoracic cavity.

(C) movement of air out of the lungs.

(D) expansion of ribs.

Q13 How many of the following statements are **incorrect**?

I. CO_2 accumulation in the blood is associated with increase in pH.

II. The tracheae, primary, secondary and tertiary bronchi, and terminal bronchioles are supported by incomplete cartilaginous rings.

III. Expiration takes place when the intra-pulmonary pressure is lower than the atmospheric pressure

IV. Mechanisms of breathing depend mainly on habitats and levels of organisation of the

organism.

(A) I and II

(B) I, II and III

(C) I and III

(D) All

Q14 Choose the **incorrect** statement.

(A) CO_2 is trapped as bicarbonate at the alveoli level and transported to the lungs is released out.

(B) Pulmonary capacities can be used in clinical diagnosis.

(C) Lower side of thoracic chamber is formed by the dome-shaped diaphragm.

(D) Every 100 ml of oxygenated blood can deliver around 5 ml of O_2 to the tissues.

Q15 Arrange the steps of respiration in the following as:

- Oxygen is drawn in and carbon di oxide released out - 4
- Transport of gases by blood - 3
- Utilisation of Oxygen by the cells and release of Carbon dioxide - 1
- Diffusion of gases across Alveolar membranes - 5
- Diffusion of gases between tissues - 2

(A) 2 - 1 - 5 - 3 - 4

(B) 5 - 1 - 3 - 2 - 4

(C) 3 - 1 - 4 - 2 - 5

(D) 4 - 5 - 3 - 2 - 1

Q16 A person being rescued from drowning is brought to the surface and immediately takes a very deep breath. The volume of air inhaled in this large breath is best described as:

(A) Tidal Volume only

(B) Inspiratory Reserve Volume only

(C) Vital Capacity

(D) Total Lung Capacity

Q17 A terrestrial invertebrate inhabiting a very dry environment exhibits a significantly reduced surface area-to-volume ratio compared to its aquatic relatives. Which of the following



respiratory mechanisms would be LEAST efficient for this organism?

- (A) A well-developed tracheal system with spiracles that can be tightly controlled.
- (B) Highly vascularized lungs with internal folds to increase surface area.
- (C) Simple diffusion across a moist cuticle covering the entire body surface.
- (D) Specialized internal gills that remain moist within a protective cavity.

Q18 Choose the **incorrect** statement regarding the mechanism and functions of breathing in mammals:

- (A) Forceful exhalation requires muscular effort.
- (B) Mammalian ventilation relies on establishing a pressure gradient where pulmonary pressure is typically lower than atmospheric pressure during inhalation.
- (C) Contraction of diaphragm increases the volume of thoracic chamber in the dorso-ventral axis.
- (D) The respiratory system plays a role in eliminating metabolic waste products like carbon dioxide and water vapor.

Q19 To protect workers in high-risk industries from developing occupational respiratory disorders, a comprehensive primary prevention strategy should prioritize:

- (A) Regular spirometry testing for early detection of lung function decline.
- (B) Administration of anti-inflammatory drugs to workers with prolonged dust exposure.
- (C) Mandatory and consistent use of appropriate respiratory protective equipment.
- (D) Relocation of industries away from densely populated areas to minimize public exposure.

Q20 A non-smoking patient presents with symptoms of headache, dizziness, and fatigue. Blood tests show a markedly elevated carboxyhemoglobin level. What is the most probable environmental exposure leading to this condition?

(A)

Prolonged exposure to industrial solvents containing carbon disulfide.

- (B) Chronic inhalation of anesthetic gases like chloroform.
- (C) Exposure to poorly ventilated areas with high carbon dioxide accumulation.
- (D) Inhalation of combustion fumes containing carbon monoxide.

Q21 The partial pressures (in mmHg) of oxygen (P) and carbon dioxide (Q) were measured at three points in the respiratory system. The results are shown below:

Respiratory Gas	A	B	C
Oxygen (P)	40	159	104
Carbon dioxide (Q)	45	0.3	40

Identify the correct sequence of locations A, B, and C:

- (A) A - Tissues, B - Atmospheric air, C - Alveoli
- (B) A - Alveoli, B - Atmospheric air, C - Pulmonary artery
- (C) A - Pulmonary vein, B - Alveoli, C - Systemic tissues
- (D) A - Systemic veins, B - Trachea, C - Pulmonary veins

Q22 In human under normal physiological condition every 500 mL of oxygenated blood can deliver how much O_2 to the tissue?

- (A) 20 mL
- (B) 25 mL
- (C) 30 mL
- (D) 4 mL

Q23 Given below are two statements:

Statement I: Yawning is initiated by irritation of the nasal mucosa.

Statement II: $ERV = EC - TV$, where EC = Expiratory capacity and TV is Tidal volume.

In the light of the above statements, choose the most appropriate answer from the options given below:

- (A) Statement I is correct but Statement II is incorrect.
- (B)



Statement I is incorrect but Statement II is correct.

(C) Both Statement I and Statement II are correct.

(D) Both Statement I and Statement II are incorrect.

Q24 Given below are two statements:

Statement I: Hypoxia is characterized by labored and painful breathing.

Statement II: Rhinitis involves inflammation of the mucous membrane of the nose.

In the light of the above statements, choose the *most appropriate* answer from the options given below:

(A) Statement I is correct but Statement II is incorrect.

(B) Statement I is incorrect but Statement II is correct.

(C) Both Statement I and Statement II are correct.

(D) Both Statement I and Statement II are incorrect.

Q25 Match **List-I** with **List-II**:

	List-I		List-II
(A)	Inspiratory Capacity	(I)	4000-4600 ml
(B)	Expiratory Capacity	(II)	2100-2200 ml
(C)	Functional Residual Capacity	(III)	1500-1600 ml
(D)	Vital Capacity	(IV)	3000-3500 ml

Choose the **correct** answer from the options given below:

(A) A-III, B-IV, C-II, D-I

(B) A-I, B-IV, C-II, D-III

(C) A-IV, B-III, C-II, D-I

(D) A-III, B-II, C-I, D-IV

Q26 Find the **correct** statements:

A. The function of the tracheal cilia is to pass mucus out.

B. Tracheal rings are ventrally incomplete to help deglutition.

C. The entry of air into the lungs leads to the expansion of chest.

D. Pulmonary ventilation is always more than that of alveolar ventilation.

E. Typical value of total lung capacity of an adult is 6 litres.

Choose the **correct** answer from the options given below:

(A) A, B and E Only

(B) A, C and D Only

(C) A, B, C and D Only

(D) A, D and E Only

Q27 Fear or excitement generally causes one to breathe rapidly and it results in the decrease of CO_2 concentration in one's blood. In what way does this change the pH of blood?

(A) pH increases

(B) pH decreases

(C) pH does not change

(D) The pH level adjusts to 7

Q28 Similarity between the trachea of cockroach and human is that;

(A) Both are paired and branched

(B) Both open outside with spiracles and alveoli respectively

(C) Walls of both cannot be deformed/non-collapsible walls

(D) In both exchange of gases occurs through tracheoles

Q29 Find the **incorrect** statement.

(A) Normal breathing is known as abdominal breathing.

(B) The human ribs are not respiratory organs.

(C) For proper transport of O_2 and CO_2 blood should be slightly acidic.

(D) During transport of CO_2 blood does not become acidic due to blood buffers.



Q30 Match List-I with List-II.

List-I		List-II	
(A)	Hypoxia	(I)	Binding of oxygen with haemoglobin decreases
(B)	Damaged alveolar walls	(II)	Deficiency of oxygen in tissues
(C)	Left shift in O_2 dissociation curve	(III)	Emphysema
(D)	Blood is acidic	(IV)	P_{CO_2} decreases

Choose the **correct** answer from the options given below:

- (A) A-III, B-II, C-I, D-IV
 (B) A-II, B-III, C-I, D-IV
 (C) A-II, B-III, C-IV, D-I
 (D) A-III, B-II, C-IV, D-I

Q31 Given below are two statements:

Statement (I): The residual air in the lungs slightly decreases the efficiency of respiration in mammals.

Statement (II): In insects circulating body fluids serve to distribute oxygen to tissues.

In the light of the above statements, choose the most appropriate answer from the options given below:

- (A) Statement I is correct but Statement II is incorrect.
 (B) Statement I is incorrect but Statement II is correct.
 (C) Both Statement I and Statement II are correct.
 (D) Both Statement I and Statement II are incorrect.

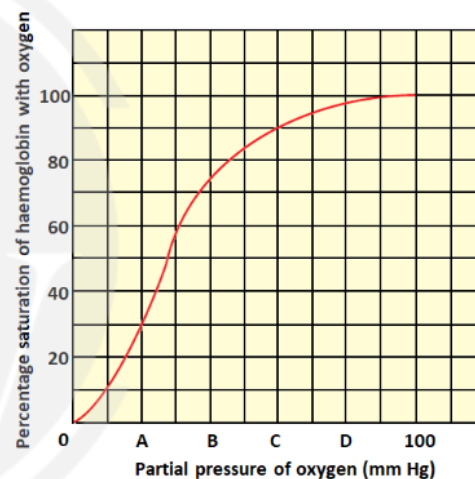
Q32 Given below are two statement: one is labelled as Assertion A and the other is labelled as Reason R:

Assertion A: The oxygen dissociation curve has sigmoidal pattern.

Reason R: The binding of oxygen with haemoglobin occurs in a cooperative manner. In the light of the above statements, choose the **correct** answer from the options given below:

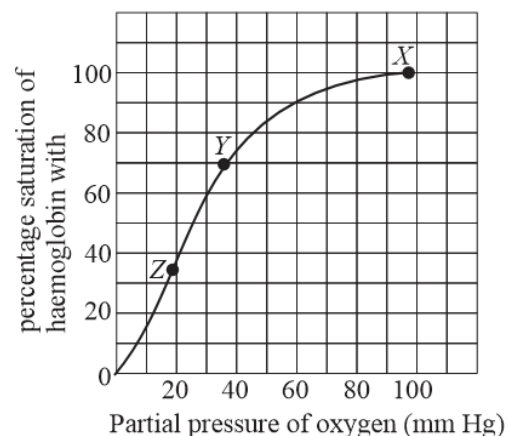
- (A) A is true but R is false.
 (B) A is false but R is true.
 (C) Both A and R are true and R is the correct explanation of A.
 (D) Both A and R are true but R is not the correct explanation of A.

Q33 In the given diagram of the oxygen dissociation curve, under normal physiological conditions, the partial pressure of oxygen at the tissue level is represented by:



- (A) A
 (B) B
 (C) C
 (D) D

Q34 Given below graph shows an oxygen dissociation curve:-



Where in the body will haemoglobin be saturation at the percentage shown at points **X**, **Y** and **Z**.

- (A) X-Pulmonary artery, Y-Pulmonary vein, Z-Carotid artery
- (B) X-Systemic artery, Y-Pulmonary artery, Z-pulmonary vein
- (C) X-pulmonary vein, Y-Systemic vein, Z-Systemic vein during exercise
- (D) X-Left ventricle, Y-Right ventricle, Z-Systemic artery

Q35 Identify the following statements as **true(T)** or **false(F)**.

- A. Larynx is a cartilaginous box which helps in sound production.
- B. Mammals have positive breathing.
- C. Mammals can eat and breathe at the same time.
- D. In case of carbon monoxide poisoning, oxygen haemoglobin curve shifts to the right side.
- (A) A-T, B-T, C-F, D-F
- (B) A-T, B-F, C-T, D-F
- (C) A-F, B-T, C-F, D-T
- (D) A-T, B-F, C-F, D-T

Q36 Individuals who shifted from the plains to a high-altitude region near the Rohtang Pass approximately six months ago are likely to experience which of the following physiological adaptations?

- (A) They still suffer from symptoms of altitude sickness such as nausea and fatigue.
- (B) They have a normal red blood cell (RBC) count, but their haemoglobin exhibits a much higher affinity for oxygen.
- (C) Their RBC count has increased, and their haemoglobin shows a reduced affinity for oxygen.
- (D) They remain physically unfit to participate in strenuous activities like football.

Q37 Which of the following statement is not **correct**?

- (A) Formation of oxyhaemoglobin is a process of oxidation.

(B) Every 100 ml of oxygenated blood can deliver around 5 ml of O_2 to tissue under physiological condition.

(C) Dissociation curve is curve between percentage saturation of Hb with oxygen and partial pressure of oxygen.

(D) High concentration of CO_2 activates dissociation of oxyhaemoglobin.

Q38 Why is carbon monoxide (CO) considered highly toxic to animals, particularly in relation to gas transport in the blood?

- (A) It primarily interferes with the transport of carbon dioxide.
- (B) It significantly impairs the transport of oxygen.
- (C) It enhances the transport of carbon dioxide.
- (D) It increases the amount of oxygen carried in the blood.

Q39 Select the **incorrect** statement.

- (A) Respiration is the catabolic process.
- (B) When CO_2 concentration in blood decreases, breathing becomes shallower.
- (C) Reduction in pH of blood will not alter the breathing rate.
- (D) pO_2 in alveoli is always considerably less than that in the atmosphere.

Q40 Diffusion of gases occurs in the alveolar region only and not in the other parts of respiratory system because

- (A) Its surface area is small
- (B) Its diffusion membrane is thick
- (C) Its plasma membrane is too moist
- (D) It is non-vascular

Q41 Given below are two statement: one is labelled as Assertion A and the other is labelled as Reason R:

Assertion A : Our lungs do not burst during inhalation because a protective mechanism is in place.

Reason R : Stretch receptors located in the walls of the bronchi and bronchioles detect excessive



expansion and trigger reflex signals to the brain, which inhibit further inhalation, thereby preventing over-inflation of the lungs.

In the light of the above statements, choose the correct answer from the options given below:

- (A) A is true but R is false.
- (B) A is false but R is true.
- (C) Both A and R are true and R is the correct explanation of A.
- (D) Both A and R are true but R is not the correct explanation of A.

Q42 If an injury tore a small hole in the membrane surrounding the lungs, what effect on lung function one would expect?

- (A) Expulsion of air from the space between the inner and outer layer of the double membrane, resulting in stickiness of pleural membranes
- (B) Entrance of air into the space between pleural membranes resulting in collapse of lung with the hole.
- (C) Increase in secretion of surfactant that results in stickiness of pleural membranes
- (D) Stimulation of release of cortisol that decreases the secretion of lecithin.

Q43 The central chemoreceptors are directly affected by

- (A) H^+ concentration in blood
- (B) O_2 concentration in blood
- (C) H^+ concentration in C.S.F.
- (D) O_2 in trachea

Q44 Spasm of bronchi and bronchioles : "A"
Loss of elasticity of alveolar walls : "B"
Fibrosis of upper part of lungs : "C"
Collapse of alveoli : "D"
identity "A", "B", "C", "D" and choose the **correct** option

- (A) A-asthma, B-Asbestosis, C-Emphysema, D-Atelectasis
- (B) A-asthma, B-Emphysema, C-Silicosis, D-Atelectasis
- (C)

A-Emphysema, B-Asthma, C-Asbestosis, D-Pleurisy

(D) A-Emphysema, B-Atelectasis, C-Asthma, D-Pleurisy

Q45 Pneumotaxic centre is present in _____ and its hyperactivation causes _____ respectively.

- (A) Medulla ; \uparrow increased Breathing rate
- (B) Medulla ; \downarrow decreased depth of breathing
- (C) Pons ; \uparrow increased breathing rate
- (D) Pons ; \uparrow increased depth of breathing

Q46 What will be the pulmonary ventilation rate in an adult man under normal physiological conditions if the tidal volume is 500 mL?

- (A) 8000 mL/min
- (B) 9000 mL/min
- (C) 10000 mL/min
- (D) 5000 mL/min

Q47 Given below are two statement: one is labelled as Assertion A and the other is labelled as Reason R:

Assertion A: Cigarette smoking causes emphysema.

Reason R: Cigarette smoke contains toxic chemicals and free radicals that trigger inflammation in the lungs. This leads to the breakdown of elastin fibres in the alveolar walls, increasing their elasticity and causing them to rupture.

In the light of the above statements, choose the **correct** answer from the options given below:

- (A) A is true but R is false.
- (B) A is false but R is true.
- (C) Both A and R are true and R is the correct explanation of A.
- (D) Both A and R are true but R is not the correct explanation of A.

Q48 Which one of the following statements refers to Reductionist Biology?

- (A) Physico-chemical approach to study and understand living organisms.
- (B) Physiological approach to study and understand living organisms.



- (C) Chemical approach to study and understand living organisms.
- (D) Behavioural approach to study and understand living organisms.

Q49 The enzyme carbonic anhydrase facilitates which of the given reactions?

- a. $\text{CO}_2 + \text{H}_2\text{O} \rightarrow \text{H}_2\text{CO}_3$
- b. $\text{H}_2\text{CO}_3 \rightarrow \text{HCO}_3^- + \text{H}^+$
- c. $\text{H}_2\text{CO}_3 \rightarrow \text{CO}_2 + \text{H}_2\text{O}$
- d. $\text{HCO}_3^- + \text{H}^+ \rightarrow \text{H}_2\text{CO}_3$

- (A) a, d only (B) b, c only
- (C) a, c only (D) a, b, c, d

Q50 Find the **correct** statements:

- A. Each gram of haemoglobin carries 1.34 mL of oxygen.
- B. During strenuous exercise 75 percent of blood carried by Hb is released at the tissue site.
- C. If you trace the path of a molecule of carbon dioxide that starts in an arteriole in the right thumb and leaves the body in exhaled air, the minimum number of capillary beds the molecule encountered is 2.
- D. During fight and flight condition, a significant change in breathing rate is observed. Strong signals from pneumotaxic area result in shallow and fast breathing.
- E. During expiration pO_2 of expired air is less than alveolar air and atmospheric air.

Choose the **correct** answer from the options given below:

- (A) A, B and E Only
- (B) A, C and D Only
- (C) A, B, C and D Only
- (D) A, D and E Only



Answer Key

Q1 (A)
Q2 (C)
Q3 (D)
Q4 (D)
Q5 (B)
Q6 (C)
Q7 (B)
Q8 (C)
Q9 (B)
Q10 (A)
Q11 (B)
Q12 (C)
Q13 (B)
Q14 (A)
Q15 (D)
Q16 (C)
Q17 (C)
Q18 (C)
Q19 (C)
Q20 (D)
Q21 (A)
Q22 (B)
Q23 (B)
Q24 (B)
Q25 (C)

Q26 (D)
Q27 (A)
Q28 (C)
Q29 (C)
Q30 (C)
Q31 (A)
Q32 (C)
Q33 (B)
Q34 (C)
Q35 (B)
Q36 (C)
Q37 (A)
Q38 (B)
Q39 (C)
Q40 (C)
Q41 (C)
Q42 (B)
Q43 (C)
Q44 (B)
Q45 (C)
Q46 (A)
Q47 (A)
Q48 (A)
Q49 (D)
Q50 (C)



Hints & Solutions

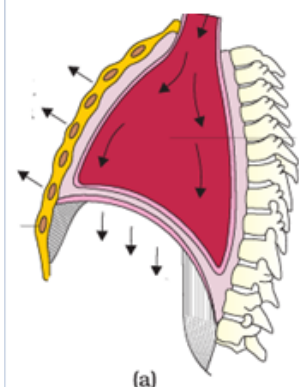
Note: scan the QR code to watch video solution

Q1 Text Solution:

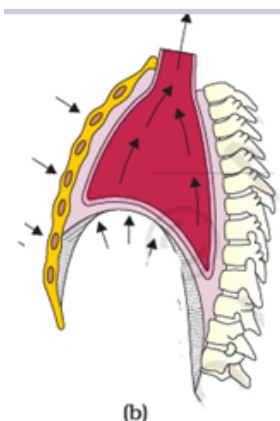
Oxygen from the air enters the tracheal system through openings called spiracles on the body surface. This oxygen travels through the tracheae and tracheoles (smaller branches) directly to the cells. Similarly, carbon dioxide produced by the cells diffuses directly into the tracheoles and is expelled through the spiracles.

[NCERT(2024-25) Class 11th Page No. 183]

Q2 Text Solution:



- The diagram shows "Ribs and sternum raised" and "Diaphragm contracted," leading to "Volume of thorax increased." These indicate the active process of inspiration.



- The diagram shows "Ribs and sternum returned to original position" and "Diaphragm relaxed and arched upwards," leading to "Volume of thorax decreased." These indicate expiration.

- Inspiration (diagram a) would still occur because the diaphragm, the primary muscle of breathing, can contract to increase thoracic volume, though the expansion would be reduced without the external intercostals, which normally lift the ribs. Expiration (diagram b) would be largely unaffected since it is mostly a passive process driven by elastic recoil of the lungs and chest wall, not requiring active muscle contraction in normal breathing.

[NCERT(2024-25) Class 11th Page No. 185, 186]

Q3 Text Solution:

Oxygen binds to hemoglobin in a *reversible* manner. This is crucial for oxygen to be loaded in the lungs and unloaded in the tissues. The role of oxygen in the regulation of respiratory rhythm is quite insignificant.

[NCERT(2024-25) Class 11th Page No. 189]

Q4 Text Solution:

The chest cavity normally maintains a negative pressure relative to the atmosphere. This negative pressure is essential for the lungs to expand during inhalation. If the chest cavity is punctured, air rushes into this space, equalizing the pressure with the atmosphere. This loss of negative intrapleural pressure causes the lungs to collapse, leading to the cessation of breathing.

[NCERT(2024-25) Class 11th Page No. 185]

Q5 Text Solution:

Inspiration (Inhalation): This is typically an **active process** during normal breathing. It involves the contraction of the diaphragm and the external intercostal muscles.

Expiration (Exhalation): This is typically a **passive process** during normal breathing. It relies on the relaxation of the inspiratory muscles and the elastic recoil of the lungs and the chest wall.



Android App

iOS App

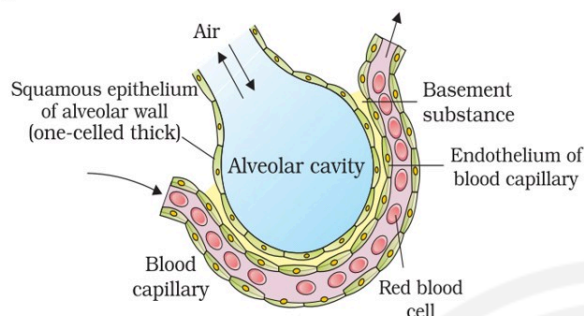
PW Website

The thoracic chamber is formed dorsally by the vertebral column, ventrally by the sternum, laterally by the ribs and on the lower side by the dome-shaped diaphragm.

Human being can not directly alter the pulmonary volume.

[NCERT(2024-25) Class 11th Page No. 185, 186]

Q6 Text Solution:



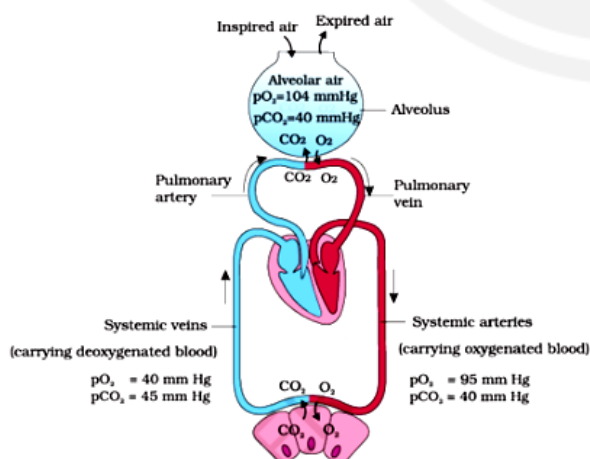
A diagram of a section of an alveolus with a pulmonary capillary.

[NCERT (2023-24) Class 11th Page No. 188]

Video Solution:



Q7 Text Solution:



[NCERT(2024-25) Class 11th Page No. 188]

Q8 Text Solution:

The pleural cavity is the space between the visceral pleura (covering the lungs) and the

parietal pleura (lining the chest wall). Normally, this space contains a small amount of lubricating fluid. However, an abnormal accumulation of fluid (pleural effusion) can indeed impair breathing.

The presence of a significant amount of fluid in the pleural cavity exerts pressure on the lungs. This external pressure restricts the expansion of the lung tissue during inhalation. As a result, the lungs cannot fill with air to their normal capacity, leading to breathing difficulties.

[NCERT(2024-25) Class 11th Page No. 184]

Q9 Text Solution:

Carbon dioxide (CO_2) binds to the globin portion of hemoglobin to form carbaminohaemoglobin. This binding is favored when the partial pressure of CO_2 ($p\text{CO}_2$) is high and the partial pressure of oxygen ($p\text{O}_2$) is low. This occurs primarily in the tissues where cellular respiration produces CO_2 and oxygen has been delivered.

[NCERT(2024-25) Class 11th Page No. 189, 190]

Q10 Text Solution:

A right shift in the oxygen-haemoglobin dissociation curve indicates a **decreased affinity** of haemoglobin for oxygen. This means that at a given partial pressure of oxygen ($p\text{O}_2$), haemoglobin will have a lower saturation of oxygen, and oxygen will be released more readily to the tissues.

High $p\text{CO}_2$, High H^+ concentration (low pH), High temperature these conditions decreases haemoglobin's oxygen affinity.

[NCERT(2024-25) Class 11th Page No. 189]

Q11 Text Solution:

I. Inspiratory Capacity (IC) = Tidal Volume + Inspiratory Reserve Volume (not Residual Volume)

III. Residual Volume - Volume of air remaining in the lungs even after a forcible expiration. This averages 1100 mL to 1200 mL.

[NCERT(2024-25) Class 11th Page No. 186, 187]



Q12 Text Solution:

- **Point I:** Represents the end of a normal expiration.
- **Change from I to II:** Shows an increase in lung volume, indicating inspiration (air moving into the lungs).
- **Point II:** Represents the end of a normal inspiration.
- **Change from II to III:** Shows a decrease in lung volume, indicating expiration (movement of air out of the lungs).
- **Point III:** Represents the end of a normal expiration.
- **Change from III to IV:** Shows an increase in lung volume, indicating inspiration.
- **Point IV:** Represents the end of a normal inspiration.

Q13 Text Solution:
(2)**Q14 Text Solution:**

Carbon dioxide is primarily transported in the blood as bicarbonate ions (HCO_3^-). This formation occurs mainly in the red blood cells at the tissue level where pCO_2 is high. The bicarbonate ions are then transported to the lungs. At the alveoli, where pCO_2 is low, the reaction reverses, converting bicarbonate back to CO_2 , which is then released during exhalation. The statement says CO_2 is trapped as bicarbonate at the *alveoli* level, which is incorrect. Bicarbonate formation occurs predominantly at the tissue level.

[NCERT(2024-25) Class 11th Page No. 189]

Q15 Text Solution:

- Pulmonary Ventilation (4): Oxygen is drawn into the lungs, and carbon dioxide is exhaled.
- Diffusion across Alveolar Membranes (5): Oxygen diffuses from alveoli into the blood; carbon dioxide diffuses from blood to alveoli.

- Transport of Gases by Blood (3): Blood carries oxygen to tissues and carbon dioxide back to lungs.
- Diffusion between Blood and Tissues (2): Oxygen diffuses from blood to tissue cells; carbon dioxide diffuses from tissues to blood.
- Oxygen Utilization by Cells (1): Cells use oxygen for energy production, releasing carbon dioxide as a byproduct.

[NCERT(2024-25) Class 11th Page No. 185]

Q16 Text Solution:

Vital Capacity (VC) is the maximum volume of air a person can exhale after a maximum inhalation. It represents the total amount of air that can be moved into and out of the lungs with forceful effort.

[NCERT(2024-25) Class 11th Page No. 187]

Q17 Text Solution:

The key challenge for a terrestrial invertebrate in a very dry environment is minimizing water loss.

A large, moist surface area exposed to the air would lead to rapid desiccation.

The organism already has a *reduced* surface area-to-volume ratio. This adaptation helps to conserve water by minimizing the surface exposed to the drying environment.

[NCERT(2024-25) Class 11th Page No. 183]

Q18 Text Solution:

Contraction of diaphragm increases the volume of thoracic chamber in the antero-posterior axis.

[NCERT(2024-25) Class 11th Page No. 185]

Q19 Text Solution:

By ensuring workers use respirators, masks, and other protective gear suitable for the specific hazards in their workplace, the inhalation of harmful substances is significantly reduced or prevented altogether. This directly tackles the cause of occupational respiratory disorders.

[NCERT(2024-25) Class 11th Page No. 191]

Q20 Text Solution:

Carbon monoxide (CO) is a colorless, odorless gas produced by the incomplete burning of fuels



(like in cars, furnaces, fires). When inhaled, CO binds very strongly to hemoglobin in red blood cells, forming carboxyhemoglobin. This prevents hemoglobin from carrying oxygen, leading to oxygen deprivation in the body and causing symptoms like headache, dizziness, and fatigue. Elevated carboxyhemoglobin levels in a non-smoker strongly indicate CO poisoning from combustion fumes.

Q21 Text Solution:

Respiratory Gas	Atmospheric Air	Alveoli	Blood (Deoxygenated)	Blood (Oxygenated)	Tissues
O ₂	159	104	40	95	40
CO ₂	0.3	40	45	40	45

Partial Pressures (in mm Hg) of Oxygen and Carbon dioxide at Different Parts Involved in Diffusion in Comparison to those in Atmosphere.

[NCERT(2024-25) Class 11th Page No. 188]

Q22 Text Solution:

(2)

- Every 100 ml of oxygenated blood can deliver around 5 ml of O₂ to the tissues under normal physiological conditions.
- So 500 mL of oxygenated blood can deliver 25 mL of O₂ to the tissue.

[New NCERT Class 11th Page No. 185]

Video Solution:



Q23 Text Solution:

Irritation of the nasal mucosa typically triggers reflexes like sneezing, which involves a forceful expulsion of air to clear the nasal passages, not yawning.

Q24 Text Solution:

Apnea is defined as the temporary cessation of breathing, especially during sleep. It is characterized by pauses in breathing, not necessarily labored or painful breathing. Labored

or difficult breathing is termed **dyspnea**. Painful breathing is referred to as **pleurodynia** or can be a symptom of various respiratory conditions, but it is not the defining characteristic of apnea.

Rhinitis is indeed the inflammation of the mucous membrane lining the nasal passages. This inflammation can be caused by various factors, including allergies (allergic rhinitis), viral or bacterial infections (infectious rhinitis), and irritants. Common symptoms of rhinitis include nasal congestion, runny nose, sneezing, and itching.

Q25 Text Solution:

Inspiratory Capacity	3000-3500 ml
Expiratory Capacity	1500-1600 ml
Functional Residual Capacity	2100-2200 ml
Vital Capacity	4000-4600 ml

[NCERT(2024-25) Class 11th Page No. 187]

Q26 Text Solution:

Tracheal cilia beat in a coordinated manner to move mucus (which traps dust and pathogens) upward toward the pharynx to be expelled or swallowed.

Actually, **tracheal rings are dorsally incomplete**, not ventrally. They are C-shaped with the open part at the back (posterior), adjacent to the oesophagus, to allow expansion of the oesophagus during swallowing (**deglutition**).

Expansion of the chest (due to diaphragm and intercostal muscle contraction) leads to air entry by creating negative pressure in the lungs. The chest expands **first**, not as a result of air entry.

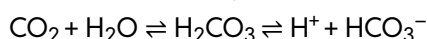
Pulmonary ventilation = total air moved in and out of lungs per minute. Alveolar ventilation = only the air that reaches the alveoli and is



involved in gas exchange. Since some air fills the **dead space**, pulmonary ventilation is **always greater** than alveolar ventilation.

Q27 Text Solution:

When a person experiences **fear or excitement**, they often **breathe rapidly** — a condition known as **hyperventilation**. During this **CO₂ is expelled rapidly** from the lungs, CO₂ levels in the blood drop. CO₂ in the blood normally combines with water to form **carbonic acid (H₂CO₃)**, which dissociates into hydrogen ions (H⁺) and bicarbonate (HCO₃⁻).



When CO₂ levels fall, **less carbonic acid is formed**, leading to **fewer H⁺ ions**. Due to decrease in H⁺ ions blood becomes more alkaline. Thus, the **pH of blood increases**.

Q28 Text Solution:

Human trachea is a **single unbranched tube** that bifurcates into bronchi, which then branch further. In cockroaches, tracheae open to the outside via **spiracles** whereas in human's trachea ends in **bronchi → bronchioles → alveoli**, but **alveoli do not open outside**; air enters through the nose/mouth. In **cockroach** tracheal tubes have spiral thickenings to prevent collapse whereas **human** trachea has **C-shaped cartilage rings** for the same purpose — to **keep the airway open**. In **cockroach tracheoles** directly exchange gases with tissues.

In **humans** gas exchange occurs in **alveoli**, not tracheoles.

Q29 Text Solution:

In normal (quiet) breathing, the **diaphragm** plays a major role. This movement causes the abdomen to expand and contract; hence the term **abdominal breathing** is often used.

Ribs are **bones**, and their function is to **protect thoracic organs** and aid in respiration by allowing expansion and contraction of the chest. They themselves **do not exchange gases**, so they are **not respiratory organs**.

Blood **must remain slightly alkaline**, with a pH around **7.35–7.45**, to ensure **optimal binding of oxygen to haemoglobin** and proper enzyme function. **Acidic blood (low pH)** impairs oxygen transport and can lead to **respiratory or metabolic acidosis**, which is harmful.

CO₂ forms carbonic acid in blood, which can dissociate into H⁺. However, **buffers like bicarbonate ions (HCO₃⁻)**, **haemoglobin**, and **proteins** help **maintain pH** and prevent acidosis.

Q30 Text Solution:

Hypoxia means reduced oxygen availability to body tissues.

Emphysema is characterized by the **destruction of alveolar walls**, reducing surface area for gas exchange.

Acidic blood (low pH) reduces the affinity of haemoglobin for oxygen. This causes a **rightward shift** in the oxygen dissociation curve (Bohr effect), promoting **oxygen release**.

A **leftward shift** happens when:

- **PCO₂ decreases**
- **pH increases** (alkaline)
- Temperature decreases
- O₂ affinity increases

Air pollutants worsen **respiratory diseases** like **bronchitis**.

Q31 Text Solution:

The **residual volume** is the air remaining in lungs after maximal exhalation.

This **prevents the lungs from collapsing** but also means **fresh air mixes with stale air**, reducing the **oxygen concentration gradient** in alveoli. As a result, the **efficiency of gas exchange** is **slightly decreased** compared to systems with continuous fresh oxygen (e.g., fish gills with counter-current flow).

Insects **do not use blood (haemolymph) to transport oxygen**. Instead, they rely on a **tracheal system** — a network of air-filled tubes that **directly delivers oxygen to tissues**. The



circulatory system in insects is not involved in gas exchange.

Q32 Text Solution:

Haemoglobin is a **tetramer**, made of **four subunits**, each capable of binding one oxygen molecule.

When **one O₂ molecule binds to the first haem group**, it **changes the conformation** of the haemoglobin molecule slightly. This change makes it **easier for the second O₂** to bind, and so on. This is called **positive cooperativity**.

As a result:

- The **first O₂ binds slowly** (steep initial part),
- The **next ones bind more easily** (steep middle slope),

But as Hb becomes nearly saturated, the **last oxygen molecules bind more slowly**, flattening the curve at the top.

Q33 Text Solution:

Under normal physiological conditions, the partial pressure of oxygen at the tissue level is about 40 mm Hg, which matches Point B in the graph.

Q34 Text Solution:

X - Pulmonary vein (oxygen-rich)

Y - Systemic vein (~40 mm Hg, deoxygenated)

Z - Systemic vein during exercise (very low O₂, high O₂ extraction)

Q35 Text Solution:

The **larynx** (voice box) is made of cartilage and is involved in the production of sound (phonation).

Mammals use **negative pressure breathing**, where air is drawn into the lungs by lowering pressure through diaphragm contraction.

As mammals have negative breathing, they can eat and breathe at the same time. **Carbon monoxide (CO)** binds tightly to haemoglobin, reducing oxygen release to tissues. This causes a **leftward shift**, not rightward, in the **oxygen-haemoglobin dissociation curve**.

Q36 Text Solution:

When individuals move from low-altitude areas (the plains) to **high-altitude regions** (such as **Rohtang Pass**, which is ~3,978 meters above sea level), they are exposed to **lower atmospheric pressure** and consequently **lower partial pressure of oxygen (pO₂)**. This causes **less oxygen to be available for diffusion into the blood**, leading to **hypoxia** (oxygen deficiency in tissues).

However, after spending **several months** at high altitude, the body undergoes **physiological adaptations** to improve oxygen delivery and maintain performance. These adaptations are part of the **acclimatization process**.

- **Altitude sickness symptoms** typically occur in the **first few days** of arrival. After six months, people are generally well-adapted and no longer exhibit such symptoms.
- **Normal RBC count & high haemoglobin affinity for O₂** would be **counterproductive**, as high affinity **prevents oxygen release** at the tissues — not suitable for survival at high altitude.

Key Adaptations Observed After 6 Months at High Altitude:

1. Increased RBC Count:

- The kidneys release **erythropoietin**, a hormone that stimulates **bone marrow** to produce more red blood cells.
- More RBCs mean **more haemoglobin**, enhancing the **oxygen-carrying capacity** of the blood.

2. Reduced Haemoglobin-Oxygen Affinity:

- The body increases production of **2,3-Bisphosphoglycerate (2,3-BPG)** in red blood cells.
- This molecule **reduces haemoglobin's affinity** for oxygen, making it **easier to release oxygen** at the tissue level, which is crucial under low oxygen conditions.

3. Improved Physical Fitness:



- Over time, individuals become **better adapted** and can **perform physical activities efficiently**, often with **enhanced endurance** due to improved oxygen delivery mechanisms.

• **Physical unfitness is not expected** after 6 months of acclimatization. In fact, many athletes **train at high altitudes** to enhance their performance.

Q37 Text Solution:

The binding of oxygen (O_2) to haemoglobin (Hb) to form oxyhaemoglobin (HbO_2) is a reversible physical process, not a chemical oxidation reaction. No electrons are lost or gained — hence, not a true redox reaction. Oxygen binds (not oxidizes) via coordination bonds to the iron in haem.

Q38 Text Solution:

Carbon monoxide is a colourless, odourless gas that is extremely dangerous when inhaled. CO has an affinity for haemoglobin (Hb) that is approximately 200–250 times greater than that of oxygen (O_2). When CO is inhaled, it **binds tightly to haemoglobin**, forming **carboxyhaemoglobin ($HbCO$)**. This binding is **reversible**, but **very slow**, and **blocks the oxygen-binding sites** on haemoglobin. It reduces **the total number of sites** available for oxygen binding. This reduces oxygen carrying capacity of Hb resulting in lowered oxygen delivery to the tissues, leading to hypoxia. CO does not interfere significantly with CO_2 transport mechanisms (mainly bicarbonate ions in plasma). CO has no effect on enhancing CO_2 transport. CO **reduces O_2 transport** by blocking haemoglobin binding.

Q39 Text Solution:

Respiration involves the breakdown (catabolism) of glucose and other substrates to produce ATP. It is a catabolic and exergonic process. Low CO_2 reduces the stimulation of central chemoreceptors in the medulla. This leads to reduced respiratory drive, resulting in slower and

shallower breathing. A drop in pH (i.e., increased H^+ ions) — commonly due to CO_2 accumulation — is detected by chemoreceptors. This stimulates the respiratory centers in the medulla to increase breathing rate and depth (hyperventilation) to expel CO_2 and restore pH. So, reduction in pH absolutely does alter the breathing rate. Atmospheric $pO_2 \approx 159$ mm Hg Alveolar $pO_2 \approx 104$ mm Hg

Q40 Text Solution:

For efficient exchange of gases respiratory surface must have certain characteristics such as (i) it must be thin. Moist and permeable to respiratory gases (ii) it must be very large (iii) it must be highly vascular. Only alveolar region has these characteristics. Thus, diffusion of gases occurs in this region only.

Q41 Text Solution:

Stretch receptors located in the walls of the bronchi and bronchioles detect excessive expansion and trigger reflex signals to the brain, which inhibit further inhalation, thereby preventing over-inflation of the lungs.

Also true — this describes the Hering–Breuer inflation reflex, which is a protective reflex mediated by pulmonary stretch receptors. When lungs expand too much, these receptors send inhibitory signals via the vagus nerve to the medullary respiratory center, stopping further inspiration.

Q42 Text Solution:

The lungs are enclosed in a double-layered membrane called the pleura, consisting of: Visceral pleura (inner layer): adheres to the lung surface Parietal pleura (outer layer): lines the thoracic cavity Pleural cavity: the thin space between them, normally filled with a small amount of fluid to allow smooth lung movement and maintain negative pressure. What happens if this membrane is torn? A hole in the pleural membrane (due to injury or trauma) allows air to enter the pleural cavity from the atmosphere. The negative pressure that normally keeps the lungs



inflated is lost, causing the lung on the affected side to collapse. This leads to difficulty in breathing and reduced oxygen exchange. There's no "expulsion of air" from this space — air enters, not exits, the pleural cavity. Surfactant is secreted by alveolar cells, not pleural membranes, and it prevents alveolar collapse — not relevant to pleural injury. Cortisol and lecithin are not directly involved in this mechanical injury and its immediate consequences.

Q43 Text Solution:

Central chemoreceptors, located in the medulla oblongata, are primarily responsible for detecting changes in carbon dioxide (CO_2) levels in the body — but indirectly through changes in pH (H^+ concentration) in the cerebrospinal fluid (CSF). Central chemoreceptors detect this H^+ concentration and send signals to the respiratory centers to increase the breathing rate to expel more CO_2 and restore normal pH. Central chemoreceptors are not directly exposed to blood H^+ due to the blood-brain barrier. Peripheral chemoreceptors (in carotid and aortic bodies) respond to blood pH. Oxygen is monitored by peripheral chemoreceptors, not central ones. The trachea does not contain receptors that regulate ventilation based on O_2 levels.

Q44 Text Solution:

Asthma is a chronic respiratory condition characterized by:

- Spasms of the bronchi and bronchioles
- Airway inflammation and narrowing
- Symptoms: wheezing, breathlessness, coughing

Emphysema is a form of COPD (Chronic Obstructive Pulmonary Disease) caused primarily by smoking. It leads to:

- Destruction of alveolar walls
- Loss of elasticity
- Overinflation and impaired gas exchange

Silicosis is an occupational lung disease caused by inhaling silica dust.

It leads to fibrosis (scarring) in the upper lobes of the lungs and progressive and irreversible damage.

Atelectasis refers to the collapse of alveoli, which reduces the lung's ability to exchange gases. It may occur due to:

- Blockage of airways
- Pressure from outside the lung
- Lack of surfactant

Q45 Text Solution:

Pneumotaxic Centre: Located in the pons, which is part of the brainstem. It modulates the activity of the respiratory centers in the medulla oblongata, especially the inspiratory center. **Function:** The pneumotaxic center inhibits inspiration by: Limiting the duration of inspiration Promoting the onset of expiration Hyperactivation of this center: Shortens inspiration time Decreases the depth (volume) of each breath Increases breathing rate indirectly (since breaths are shorter and quicker While hyperactivation may increase the breathing rate, it does so by reducing the depth of each breath, which is the primary effect.

Q46 Text Solution:

Pulmonary Ventilation Rate (PVR) is calculated using the formula: $\text{Pulmonary Ventilation Rate} = \text{Tidal Volume (TV)} \times \text{Breathing Rate}$ Tidal Volume (TV) = 500 mL (amount of air inhaled or exhaled in one breath) Normal Breathing Rate in an adult = 12–16 breaths per minute Using the standard average of 16 breaths/min: $\text{PVR} = 500\text{mL} \times 16 \text{ breaths/min} = 8000\text{mL}$

Q47 Text Solution:

Smoking is a well-established cause of emphysema, a chronic lung disease.

Cigarette smoke does contain toxic chemicals and free radicals, which trigger inflammation and cause breakdown of elastin fibres. Elastin breakdown reduces elasticity, not increases it.



This loss of elasticity causes alveoli to collapse or rupture, impairing gas exchange.

Q48 Text Solution:

Reductionist Biology is an approach in which:

Complex biological systems and phenomena are broken down into simpler components, such as molecules and chemical reactions, to understand the whole system.

It emphasizes studying life at the molecular and physicochemical level — i.e., DNA, proteins, enzymes, cellular reactions, etc.

The physico-chemical approach looks at biological processes in terms of physics and chemistry, such as: Enzyme kinetics, DNA replication, ion transport and thermodynamics in metabolism.

This is the foundation of molecular biology and biochemistry, and hence, core to reductionist thinking.

Q49 Text Solution:



Q50 Text Solution:

One gram of fully saturated haemoglobin carries **approximately 1.34 mL of O₂**.

Under normal conditions, haemoglobin releases about **25%** of its oxygen at the tissues (i.e., 75% saturation remains). **During strenuous exercise**, more O₂ is extracted from the blood, and **up to 75%** or more can be **released** so, **only 25% may remain bound**.

The path **starts in systemic arteriole** (right thumb) → **enters a systemic capillary bed** → CO₂ diffuses into blood, Travels to **lungs** → enters **pulmonary capillary bed** → diffuses into alveoli → exhaled. Therefore, **minimum number of capillary beds** encountered: **2** (Systemic + Pulmonary)



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