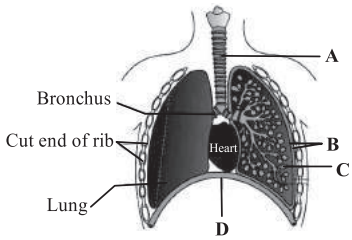
CHAPTER 17

Breathing and Exchange of Gases

17.1 Respiratory Organs

1. The figure shows a diagrammatic view of human respiratory system with labels A, B, C and D. Select the option which gives correct identification and main function and / or characteristic.



(a) C - Alveoli - Thin walled vascular bag like structures for exchange of gases.
(b) D - Lower end of lungs - Diaphragm pulls it down during inspiration.
(c) A - Trachea - Long tube supported by complete cartilaginous rings for conducting inspired air.
(d) B - Pleural membrane - Surround ribs on both sides to provide cushion against rubbing.
(NEET 2013)

2. Lungs are enclosed in
(a) periosteum (b) perichondrium
(c) pericardium (d) pleural membrane.
(1996)

3. Skin is an accessory organ of respiration in
(a) humans (b) frog
(c) rabbit (d) lizard. *(1990)*

17.2 Mechanism of Breathing

4. Select the correct events that occur during inspiration.
(1) Contraction of diaphragm
(2) Contraction of external inter-costal muscles
(3) Pulmonary volume decreases
(4) Intra pulmonary pressure increases
(a) (1) and (2)
(b) (3) and (4)
(c) (1), (2) and (4)
(d) only (4) *(NEET 2020)*

5. Tidal volume and expiratory reserve volume of an athlete is 500 mL and 1000 mL respectively. What will be his expiratory capacity if the residual volume is 1200 mL?
(a) 2700 mL (b) 1500 mL
(c) 1700 mL (d) 2200 mL *(NEET 2019)*

6. Select the correct statement.
(a) Expiration occurs due to external intercostal muscles.
(b) Intrapulmonary pressure is lower than the atmospheric pressure during inspiration.
(c) Inspiration occurs when atmospheric pressure is less than intrapulmonary pressure.
(d) Expiration is initiated due to contraction of diaphragm. *(Odisha NEET 2019)*

7. Match the items given in column I with those in column II and select the correct option given below.

Column I	**Column II**
(A) Tidal volume	(i) 2500 – 3000 mL
(B) Inspiratory reserve volume	(ii) 1100 – 1200 mL
(C) Expiratory reserve volume	(iii) 500 – 550 mL
(D) Residual volume	(iv) 1000 – 1100 mL

	(A)	**(B)**	**(C)**	**(D)**
(a)	(iii)	(ii)	(i)	(iv)
(b)	(iii)	(i)	(iv)	(ii)
(c)	(i)	(iv)	(ii)	(iii)
(d)	(iv)	(iii)	(ii)	(i)

(NEET 2018)

8. Lungs are made up of air-filled sacs, the alveoli. They do not collapse even after forceful expiration, because of
(a) inspiratory reserve volume
(b) tidal volume
(c) expiratory reserve volume
(d) residual volume. *(NEET 2017)*

9. Lungs do not collapse between breaths and some air always remains in the lungs which can never be expelled because
(a) there is a negative pressure in the lungs
(b) there is a negative intrapleural pressure pulling at the lung walls
(c) there is a positive intrapleural pressure
(d) pressure in the lungs is higher than the atmospheric pressure.
(NEET-II 2016)

10. Which one of the following is a possibility for most of us in regard to breathing, by making a conscious effort?
(a) One can breathe out air totally without oxygen.
(b) One can breathe out air through Eustachian tube by closing both nose and mouth.
(c) One can consciously breathe in and breathe out by moving the diaphragm alone, without moving the ribs at all.
(d) The lungs can be made fully empty by forcefully breathing out all air from them. *(Mains 2011)*

11. Listed below are four respiratory capacities (i–iv) and four jumbled respiratory volumes of a normal human adult.

Respiratory capacities	Respiratory volumes
(i) Residual volume	2500 mL
(ii) Vital capacity	3500 mL
(iii) Inspiratory reserve volume	1200 mL
(iv) Inspiratory capacity	4500 mL

Which one of the following is the correct matching of two capacities and volumes?
(a) (ii) 2500 mL, (iii) 4500 mL
(b) (iii) 1200 mL, (iv) 2500 mL
(c) (iv) 3500 mL, (i) 1200 mL
(d) (i) 4500 mL, (ii) 3500 mL *(2010)*

12. What is vital capacity of our lungs?
(a) Inspiratory reserve volume plus expiratory reserve volume
(b) Total lung capacity minus residual volume
(c) Inspiratory reserve volume plus tidal volume
(d) Total lung capacity minus expiratory reserve volume *(2009)*

13. Which one of the following statements is incorrect?
(a) The principle of countercurrent flow facilitates efficient respiration in gills of fishes.
(b) The residual air in lungs slightly decreases the efficiency of respiration in mammals.
(c) The presence of non-respiratory air sacs, increases the efficiency of respiration in birds.
(d) In insects, circulating body fluids serve to distribute oxygen to tissues. *(2006)*

14. When 1500 mL air is in the lungs, it is called
(a) residual volume
(b) inspiratory reserve volume
(c) vital capacity
(d) tidal volume. *(1996)*

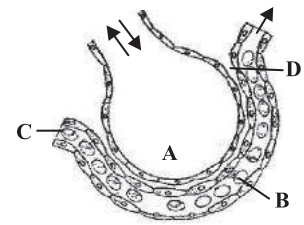
15. The ventilation movements of the lungs in mammals are governed by
(a) muscular walls of lung
(b) diaphragm
(c) intercostal muscles
(d) both (b) and (c). *(1995)*

16. In man and mammals, air passes from outside into the lungs through
(a) nasal cavity, larynx, pharynx, trachea, bronchi, alveoli
(b) nasal cavity, larynx, pharynx, trachea, bronchioles, alveoli
(c) nasal cavity, pharynx, larynx, trachea, bronchioles, bronchi, alveoli
(d) nasal cavity, pharynx, larynx, trachea, bronchi, bronchioles, alveoli. *(1994)*

17.3 Exchange of Gases

17. The partial pressure of oxygen in the alveoli of the lungs is
(a) equal to that in the blood
(b) more than that in the blood
(c) less than that in the blood
(d) less than that of carbon dioxide. *(NEET-II 2016)*

18. The figure given below shows a small part of human lung where exchange of gases takes place. Select the option which represents labelled part (A, B, C or D) correctly identified along with its function.



(a) C : Arterial capillary - Passes oxygen to tissues
(b) A : Alveolar cavity - Main site of exchange of respiratory gases
(c) D : Capillary wall - Exchange of O_2 and CO_2 takes place here
(d) B : Red blood cells - Transport of CO_2 mainly
(2011)

19. The exchange of gases in the alveoli of the lungs takes place by
(a) passive transport (b) active transport
(c) osmosis (d) simple diffusion.
(1998)

20. In lungs, the air is separated from the venous blood through
(a) transitional epithelium + tunica externa of blood vessel
(b) squamous epithelium + endothelium of blood vessel
(c) squamous epithelium + tunica media of blood vessel
(d) none of the above. *(1997)*

21. The alveolar epithelium in the lung is
(a) non-ciliated columnar
(b) non-ciliated squamous
(c) ciliated columnar
(d) ciliated squamous. *(1990)*

17.4 Transport of Gases

22. Identify the wrong statement with reference to transport of oxygen.
(a) Binding of oxygen with haemoglobin is mainly related to partial pressure of O_2.
(b) Partial pressure of CO_2 can interfere with O_2 binding with haemoglobin.
(c) Higher H^+ conc. in alveoli favours the formation of oxyhaemoglobin.
(d) Low pCO_2 in alveoli favours the formation of oxyhaemoglobin. *(NEET 2020)*

23. Reduction in pH of blood will
(a) decrease the affinity of haemoglobin with oxygen
(b) release bicarbonate ions by the liver
(c) reduce the rate of heartbeat
(d) reduce the blood supply to the brain.
(NEET-I 2016)

24. Approximately seventy percent of carbon dioxide absorbed by the blood will be transported to the lungs
(a) as bicarbonate ions
(b) in the form of dissolved gas molecules
(c) by binding to RBC
(d) as carbamino - haemoglobin. *(2014)*

25. A large proportion of oxygen remains unused in the human blood even after its uptake by the body tissues. This O_2
(a) acts as a reserve during muscular exercise
(b) raises the pCO_2 of blood to 75 mm of Hg
(c) is enough to keep oxyhaemoglobin saturation at 96%
(d) helps in releasing more O_2 to the epithelial tissues. *(2011)*

26. Bulk of carbon dioxide (CO_2) released from body tissues into the blood is present as
(a) bicarbonate in blood plasma and RBCs
(b) free CO_2 in blood plasma
(c) 70% carbamino-haemoglobin and 30% as bicarbonate
(d) carbamino-haemoglobin in RBCs. *(Mains 2011)*

27. What is true about RBCs in humans?
(a) They carry about 20-25 percent of CO_2.
(b) They transport 99.5 percent of O_2.
(c) They transport about 80 percent oxygen only and the rest 20 percent of it is transported in dissolved state in blood plasma.
(d) They do not carry CO_2 at all. *(2010)*

28. The haemoglobin of a human fetus
(a) has only 2 protein subunits instead of 4
(b) has a higher affinity for oxygen than that of an adult
(c) has a lower affinity for oxygen than that of the adult
(d) its affinity for oxygen is the same as that of an adult. *(2009)*

29. The majority of carbon dioxide produced by our body cells is transported to the lungs as
(a) attached to haemoglobin
(b) dissolved in the blood
(c) as bicarbonates
(d) as carbonates. *(2006)*

30. Haemoglobin is a type of
(a) carbohydrate (b) respiratory pigment
(c) vitamin (d) skin pigment. *(1999)*

31. How the transport of O_2 and CO_2 by blood happens?
(a) With the help of WBCs and blood serum
(b) With the help of platelets and corpuscles
(c) With the help of RBCs and blood plasma
(d) With the help of RBCs and WBCs *(1996)*

32. At high altitude, the RBCs in the human blood will
(a) increase in number (b) decrease in number
(c) increase in size (d) decrease in size. *(1995)*

33. Although much CO_2 is carried in blood, yet blood does not become acidic, because
(a) CO_2 is continuously diffused through the tissues and is not allowed to accumulate
(b) in CO_2 transport, blood buffers play an important role
(c) CO_2 is absorbed by the leucocytes
(d) CO_2 combines with water to form H_2CO_3 which is neutralised by $NaCO_3$. *(1995)*

34. The carbon dioxide is transported *via* blood to lungs mostly
(a) in combination with haemoglobin only
(b) dissolved in blood plasma
(c) in the form of bicarbonate ions
(d) as carbamino-haemoglobin and as carbonic acid. *(1995)*

35. Carbon dioxide is transported from tissues to respiratory surface by only
(a) plasma and erythrocytes
(b) plasma
(c) erythrocytes
(d) erythrocytes and leucocytes. *(1993)*

17.5 Regulation of Respiration

36. When you hold your breath, which of the following gas changes in blood would first lead to the urge to breathe?
(a) Falling CO_2 concentration
(b) Rising CO_2 and falling O_2 concentration
(c) Falling O_2 concentration
(d) Rising CO_2 concentration *(2015 Cancelled)*

37. The respiratory centres, which control inspiration and expiration, are located in
(a) diencephalon (b) medulla oblongata
(c) cerebellum (d) spinal cord. *(1999)*

38. The respiratory centre which regulates respiration is located in
(a) cerebellum (b) medulla oblongata
(c) cerebral peduncle (d) the vagus nerve. *(1994)*

17.6 Disorders of Respiratory System

39. Due to increasing air-borne allergens and pollutants, many people in urban areas are suffering from respiratory disorder that cause wheezing due to
(a) reduction in the secretion of surfactant by pneumocytes
(b) benign growth on mucous lining of nasal cavity
(c) inflammation of bronchi and bronchioles
(d) proliferation of fibrous tissues and damage of the alveolar walls. *(NEET 2019)*

40. Which of the following options correctly represents the lung conditions in asthma and emphysema, respectively?
(a) Inflammation of bronchioles; Decreased respiratory surface
(b) Increased number of bronchioles; Increased respiratory surface
(c) Increased respiratory surface; Inflammation of bronchioles
(d) Decreased respiratory surface; Inflammation of bronchioles *(NEET 2018)*

41. Which of the following is an occupational respiratory disorder?
(a) Anthracis (b) Silicosis
(c) Botulism (d) Emphysema *(NEET 2018)*

42. Name the chronic respiratory disorder caused mainly by cigarette smoking.
(a) Respiratory acidosis (b) Respiratory alkalosis
(c) Emphysema (d) Asthma *(NEET-I 2016)*

43. Asthma may be attributed to
(a) inflammation of the trachea
(b) accumulation of fluid in the lungs
(c) bacterial infection of the lungs
(d) allergic reaction of the mast cells in the lungs. *(NEET-I 2016)*

44. Name the pulmonary disease in which alveolar surface area involved in gas exchange is drastically reduced due to damage in the alveolar walls.
(a) Pneumonia (b) Asthma
(c) Pleurisy (d) Emphysema *(2015)*

45. Which one of the following is the correct statement for respiration in humans?
(a) Cigarette smoking may lead to inflammation of bronchi.
(b) Neural signals from pneumotoxic centre in pons region of brain can increase the duration of inspiration.
(c) Workers in grinding and stone-breaking industries may suffer from lung fibrosis.
(d) About 90% of carbon dioxide (CO_2) is carried by haemoglobin as carbamino-haemoglobin. *(2012)*

46. Blood analysis of a patient reveals an unusually high quantity of carboxyhaemoglobin content. Which of the following conclusions is most likely to be correct?
The patient has been inhaling polluted air containing unusually high content of
(a) carbon disulphide (b) chloroform
(c) carbon dioxide (d) carbon monoxide. *(2004)*

47. When CO_2 concentration in blood increases breathing becomes
(a) shallower and slow
(b) there is no effect on breathing
(c) slow and deep
(d) faster and deeper. *(2004)*

ANSWER KEY

1.	(a)	**2.**	(d)	**3.**	(b)	**4.**	(a)	**5.**	(b)	**6.**	(b)	**7.**	(b)	**8.**	(d)	**9.**	(b)	**10.**	(b)
11.	(c)	**12.**	(b)	**13.**	(b)	**14.**	(a)	**15.**	(d)	**16.**	(d)	**17.**	(b)	**18.**	(b)	**19.**	(d)	**20.**	(b)
21.	(b)	**22.**	(c)	**23.**	(a)	**24.**	(a)	**25.**	(a)	**26.**	(a)	**27.**	(a)	**28.**	(b)	**29.**	(c)	**30.**	(b)
31.	(c)	**32.**	(a)	**33.**	(b)	**34.**	(c)	**35.**	(a)	**36.**	(d)	**37.**	(b)	**38.**	(b)	**39.**	(c)	**40.**	(a)
41.	(b)	**42.**	(c)	**43.**	(d)	**44.**	(d)	**45.**	(c)	**46.**	(d)	**47.**	(d)						

Hints & Explanations

1. (a) : In the given figure, A is trachea. It is supported by incomplete cartilaginous rings which prevent its collapse during inspiration. B is pleural membrane and it encloses lungs. C is alveoli that are thin walled sacs having extensive network of capillaries for gaseous exchange. D is diaphragm.

2. (d) : Each lung is enclosed in two membranes, the pleura. The inner membrane is called the visceral pleuron and the outer membrane is called parietal pleuron. A very narrow space exists between the two pleura. It is called the pleural cavity and contains a watery fluid called the pleural fluid that lubricates the pleura. Periosteum is the outer membrane of the bone.

Perichondrium is a layer that surrounds the cartilage and pericardium is the membrane that encloses the pericardial cavity, containing the vertebrate heart.

3. (b) : In addition to lungs, skin is also an organ of respiration in frog. It is practically the only mode of respiration when the frog is under water or hibernating. Skin is richly supplied with blood and is permeable to gases. That is why frogs always stay near water to keep their skin moist. It is further kept moist by secretion of mucus from its glands and does not become dry out of water.

4. (a) : Inspiration is initiated by the contraction of diaphragm that increases the volume of thoracic chamber in the antero-posterior axis. The contraction of external inter-costal muscles lifts up the ribs and the sternum causing an increase in the volume of the thoracic chamber in the dorso-ventral axis. The overall increase in the thoracic volume causes a similar increase in pulmonary volume. An increase in pulmonary volume decreases the intra-pulmonary pressure to less than the atmospheric pressure which forces the air from outside to move into the lungs.

5. (b) : Expiratory capacity is the total volume of air a person can expire after normal inspiration. It includes tidal volume (TV) and expiratory reserve volume (ERV).
EC = TV + ERV = 500 mL + 1000 mL = 1500 mL

6. (b)

7. (b)

8. (d) : Residual volume is the volume of air which remains in the lungs after the most forceful expiration. This residual air enables the lungs to continue exchange of gases even after maximum exhalation. Due to this, lungs do not collapse even after forceful expiration.

9. (b) : Intrapleural pressure is the pressure of air within the pleural cavity. Intrapleural pressure is always negative, which acts like a suction to keep the lungs inflated and prevent them from collapsing. The negative intrapleural pressure is due to three main factors: surface tension of the alveolar fluid; elasticity of lungs; elasticity of thoracic wall. Normally, there is a difference between intrapleural and intrapulmonary pressure, which is called transpulmonary pressure. This transpulmonary pressure creates the suction to keep the lungs inflated. If there is no pressure difference, there is no suction and lungs will collapse.

10. (b)

11. (c) :

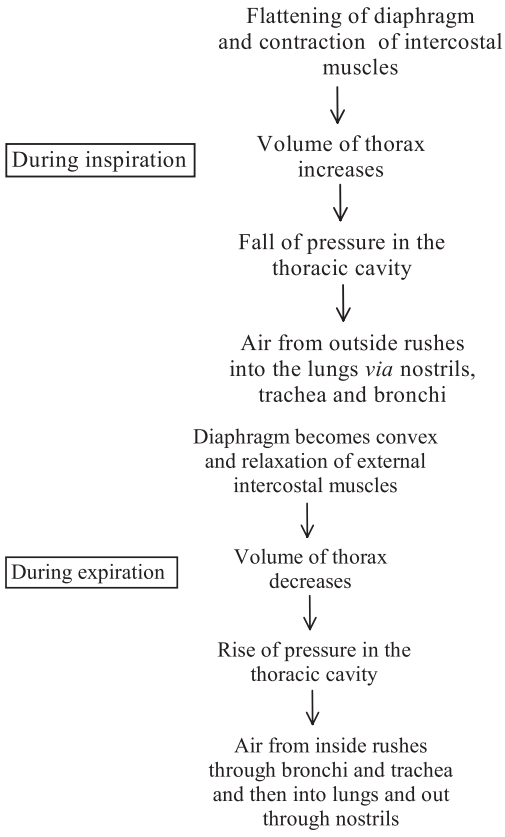
Respiratory capacities	Respiratory volumes
Residual volume	1200 mL
Vital capacity	4500 mL
Inspiratory reserve volume	2500 mL
Inspiratory capacity	3500 mL

12. (b) : Vital capacity is the amount of air which one can inhale or exhale with maximum effort. It is the sum of tidal volume, inspiratory reserve volume and expiratory reserve volume, while total lung capacity (TLC) is the total amount of air present in the lungs and the respiratory passage after a maximum inspiration. It is the sum of the vital capacity (VC) and the residual volume (RV). TLC = VC + RV. So, vital capacity is also total lung capacity (TLC) – residual volume (RV).

13. (b)

14. (a) : Residual volume is the amount of air that remains in the lungs after forcible expiration. It is about 1500 mL. It enables the lungs to continue exchange of gases even after maximum exhalation or holding the breath. Inspiratory reserve volume is the extra amount of air which can be inhaled forcibly after a normal inspiration. It is about 2000 to 2500 mL. Vital capacity is the amount of air which one can inhale and also exhale with maximum effort. It is about 3.5 - 4.5 litres. Tidal volume (500 mL) is the volume of air normally inspired or expired in one breath without any effort.

15. (d) : The ventilation movements of the lungs in mammals are governed by diaphragm and intercostal muscles (between the ribs). The method is as follows:



16. (d) : Air passes from the external nares into the nasal cavity where the dust particles are trapped. From nasal cavity, the air moves into pharynx which is a short, vertical tube. It further leads into two tubes, trachea and oesophagus. Larynx is the upper part of trachea. Besides forming a part of the respiratory tract, it also serves as the voice box. Trachea is a thin walled tube that extends downward through the neck. It divides into two primary bronchi which on entering the lungs divide into fine branches called bronchioles which enter the alveoli. Exchange of gases occur in alveoli.

17. (b) : The partial pressure of oxygen in alveolar air is 104 mmHg whereas it is 40 mmHg in deoxygenated blood and 95 mmHg in oxygenated blood.

18. (b)

19. (d) : Diffusion is the net flow of a substance from a region of higher concentration to a region of lower concentration. The exchange of gases between the alveoli and blood in the lung is the result of difference in partial pressure of respiratory gases. The partial pressure of oxygen (pO_2) of the alveolar air is higher than the pO_2 of blood in alveolar capillaries, thus O_2 diffuses rapidly from the alveolar air into the blood of alveolar capillaries. The pCO_2 of blood reaching the alveolar capillaries is higher than the pCO_2 of alveolar air. Therefore, CO_2 diffuses into the alveolar air.

20. (b) : In lungs, the air is separated from the venous blood through squamous epithelium and endothelium of blood vessel. As a result, the barriers between the air in an alveolus and the blood in its capillaries is only about 0.5 mm.

21. (b) : The alveoli have a very thin (0.0001 mm thick) wall composed of simple moist, nonciliated, squamous epithelium. The number of alveoli is countless and their surface area enormous. This further accelerates the gaseous exchange in the alveoli.

22. (c) : Binding of oxygen with haemoglobin is related to partial pressure of O_2,partial pressure of CO_2, hydrogen ion concentration and temperature. In the alveoli, high pO_2, low pCO_2, lesser H^+ concentration and lower temperature are factors favourable for the formation of oxyhaemoglobin, whereas in the tissues, low pO_2, high pCO_2, high H^+ concentration and high temperature are favourable for dissociation of oxygen from the oxyhaemoglobin.

23. (a) : Reduction in pH of blood causes oxygen-haemoglobin dissociation curve to shift to right which indicates dissociation of oxygen from haemoglobin. This decreases affinity of haemoglobin for oxygen.

24. (a) : About 70% of CO_2 (about 2.5 mL per 100 mL of blood), received by blood from the tissues, enters the RBCs where it reacts with water to form carbonic acid (H_2CO_3).

Carbonic anhydrase, exclusively found in RBCs, speeds up the formation of H_2CO_3 and rapidly converts it back to carbon dioxide and water when blood reaches the lungs. Almost as rapidly as formed, all carbonic acid of RBCs dissociates into hydrogen (H^+) and bicarbonate ions (HCO_3^-).

25. (a)

26. (a) : At the tissue site where partial pressure of CO_2 is high due to catabolism, CO_2 diffuses into blood (RBCs and plasma) and forms HCO_3^- and H^+. At the alveolar site where pCO_2 is low, the reaction proceeds in the opposite direction leading to the formation of CO_2 and H_2O. Thus, CO_2 trapped as bicarbonate at the tissue level and transported to the alveoli is released out as CO_2.

27. (a) : Blood is the medium of transport for O_2 and CO_2. About 97 percent of O_2 is transported by RBCs in the blood. The remaining 3 percent of O_2 is carried in a dissolved state through the plasma. Nearly 20-25 percent of CO_2 is transported by RBCs whereas 70 percent of it is carried as bicarbonate. About 7 percent of CO_2 is carried in a dissolved state through plasma.

28. (b) : Oxygen is needed for aerobic respiration and diffuses from a region of high to low concentration from the mother's blood to the blood of the fetus. The haemoglobin of the fetus has a higher affinity for oxygen than that of adult haemoglobin and so the efficiency of exchange is increased. Carbon dioxide, a waste product of aerobic respiration diffuses in the opposite direction.

29. (c) : When systemic arterial blood flows through capillaries, carbon dioxide diffuses from the tissues into the blood. Some carbon dioxide is dissolved in the blood. Some carbon dioxide reacts with haemoglobin to form carbaminohaemoglobin. The remaining carbon dioxide is converted to bicarbonate and hydrogen ions. Most carbon dioxide is transported through the blood in the form of bicarbonate ions.

30. (b) : Haemoglobin (Hb) is a conjugated protein. It consists of a basic protein globin joined to a nonprotein group heme. Heme is an iron-porphyrin ring. A mammalian Hb molecule is a complex of 4 heme molecules joined with 4 globin molecules. It is present in RBC and carries O_2 from the lungs to the tissues and transports CO_2 from the tissues to the lungs.

31. (c) : The transport of O_2 and CO_2 occurs with the help of RBCs and blood plasma. 97% of O_2 is transported by RBCs and 3% of O_2 is carried by plasma. About 7% of CO_2 is transported in plasma and rest by RBCs (23%) by binding with Hb and 70% reacts with water to form carbonic acid in RBCs.

32. (a)

33. (b) : Buffer is a solution that resists change in pH when an acid or alkali is added or when the solution is diluted. Acidic buffers consists of a weak acid with a salt of the acid. The salt provides the negative ion A, which is the conjugate base of the acid HA. An example is carbonic acid and sodium hydrogen carbonate in which molecules H_2CO_3 and ions HCO_3^- are present. About 70% of CO_2 released combines with water in the RBCs to form carbonic acid. Carbonic acid dissociates into bicarbonate and hydrogen ions. Addition of H^+ ions would make the blood acidic. However, most of the hydrogen ions are neutralized by combination with Hb, forming acid haemoglobin. This reduces the acidity of the blood and also releases additional O_2.

$$HbO_2^- + H^+ \rightleftharpoons HHb + O_2$$

34. (c) : About 70% of CO_2 released diffuses into the plasma and then into the RBCs. Here, it combines with water to form carbonic acid. Carbonic acid dissociates into bicarbonate and hydrogen ions. Hydrogen ions are picked up by proteins and a small amount of bicarbonate ions is transported in the RBCs, whereas most of them diffuse into the plasma to be carried by it. About 7% of CO_2 is transported as dissolved in plasma and 23% of CO_2 combines with Hb to form carbaminohaemoglobin.

$$CO_2 + H_2O \underset{\text{anhydrase}}{\overset{\text{Carbonic}}{\rightleftharpoons}} \underset{\text{Carbonic acid}}{H_2CO_3}$$

$$H_2CO_3 \rightleftharpoons H^+ + \underset{\text{Bicarbonate ion}}{HCO_3^-}$$

35. (a) : Carbon dioxide is carried by the blood in three forms : physical solution, bicarbonate ions and carbamino-haemoglobin. A very small amount of carbon dioxide dissolves in the plasma and is carried as a physical solution. About 70% of carbon dioxide released by respiring tissue cells diffuses into the plasma and then into the erythrocytes (red blood corpuscles). Here, CO_2 combines with water to form carbonic acid. Carbonic acid dissociates into bicarbonate and hydrogen ions.

36. (d) : Excess CO_2 mainly stimulates the respiratory centre of the brain and increases the inspiratory and expiratory signals to the respiratory muscles. O_2 does not have a significant direct effect on the respiratory centre of the brain in controlling respiration.

37. (b) : The respiratory centre is located in the medulla oblongata, that regulates the rate and depth of breathing. The dorsal group of neurons located in the dorsal portion of medulla oblongata regulates inspiration and ventral group of neurons located in the ventrolateral part of medulla oblongata regulates both inspiration and expiration.

38. (b) : *Refer to answer 37.*

39. (c) : Allergens cause bronchial asthma that stimulates release of histamine from mast cells. Symptoms of bronchial asthma are coughing, wheezing (breathing noisily), difficulty in breathing due to inflammation of bronchi and bronchioles.

40. (a) : Asthma is a difficulty in breathing causing wheezing due to inflammation of bronchi and bronchioles. Emphysema is a chronic disorder in which abnormal distension of the bronchioles or alveolar sacs of the lungs occurs due to which respiratory surface is decreased for the exchange of oxygen and carbon dioxide.

41. (b) : Occupational respiratory disorders are due to the occupation of the individual. Silicosis is an occupational disease that occurs due to the excessive inhalation of silica dust by the workers of mining industry. Long exposure can cause proliferation of fibrous connective tissue (fibrosis) of upper part of lungs causing inflammation. Anthrax and botulism are bacterial diseases of humans caused by *Bacillus anthracis* and *Clostridium botulinum* respectively. Emphysema is an abnormal distension of the bronchioles or alveolar sacs of the lungs.

42. (c) : Emphysema is a chronic obstructive pulmonary disease (COPD) caused due to cigarette smoking. It is an inflation or abnormal distention of the bronchioles or alveolar sacs of the lungs which causes irreversible distension and loss of elasticity in the walls of alveolar sacs of the lungs.

43. (d) : Asthma is an allergic condition in which the tissue surrounding the bronchioles of the lungs swell up and compress the bronchioles thus causing difficulty in breathing. This allergy mainly involves IgE antibodies and chemicals like histamine and serotonin from the mast cells.

44. (d) : *Refer to answer 40.*

45. (c) : In certain industries, especially those involving grinding or stone breaking so much dust is produced that the defense mechanism of the body cannot fully cope with the situation. Long exposure can give rise to inflammation leading to fibrosis (proliferation of fibrous tissues) and thus causing serious lung damage. Workers in such industries should wear protective masks.

46. (d) : Carboxyhaemoglobin, a stable compound, is formed when haemoglobin readily combines with carbon monoxide. Carbon monoxide converts iron (II) to iron (III) in its reaction with haemoglobin. In this form haemoglobin does not carry oxygen resulting in its (oxygen) starvation and leads to asphyxiation and in extreme cases to death. The affinity of haemoglobin for CO is 250 times its affinity for O_2 and COHb liberates CO very slowly and also due to that compound the dissociation curve of the remaining HbO_2 shifts to the left, decreasing the amount of O_2 released.

47. (d) : The effect of rising CO_2 tension is to decrease the affinity of Hb for O_2. Thus, when CO_2 concentration in blood increases, breathing becomes faster and deeper.

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