Chapter No 17

BREATHING AND EXCHANGE OF GASES

Very short and short answer type questions:-

1. **Define vital capacity. What is its significance?**

Ans. **Vital capacity**. It is volume of air that can be expired from the lungs with maximum effort after filling the lungs to the maximum. Its value is equal to VC = TV + IRV + ERV or 3.4 – 4.8 liters.

Significance. Vital capacity indicates the ability of a person to provide energy to the body for doing strenuous work. Vital capacity is higher in athletes and mountain dwellers. Young persons would possess more vital capacity as compare to children or older persons.

2. **State the volume of air remaining in the lungs after a normal breathing.**

Ans. Volume of air remaining in the lungs after a normal breathing is called residual capacity (FRC). It is equal to ERV + RV or about 2300ml.

3. **Diffusion of gases occurs in the alveolar region only and not in the other parts of respiratory system. Why?**

Ans. Diffusion of gases between the external air and blood occurs at a specific region called respiratory surface. Respiratory surface must be extremely thin (not more than 2-3 cells thick), moist, richly supplied with blood capillaries having a large surface area and in direct contact with environment.

4. **What are the major transport mechanisms for CO2? Explain ?**

CO2 is produced in tissues by cell respiration it diffuses into interstitial fluid and from there into blood, it is transported by blood by three forms – physical solution chemical solution and as carbaminohaemoglobin.

(a) **Physical Solution.** About 7% of CO2 dissolves in plasma of blood, just as it gets dissolved in water.

(b) Chemical Solution. About 70% of CO2 is transported in the form so chemical solution in the plasma. For this CO2 from plasma enters cytoplasm of red blood corpuscles, RBCs possess a zinc containing enzyme called **carbonic anhydrase.** It catalyses reaction between

(c) water and CO2 to produce carbonic acid. Carbonic acid dissociates to form hydrogen and bicarbonate ions. v

$$H_2O + CO_2 \xrightarrow[Zn]{\text{Carbonic anhydrese}} H_2CO_3$$

$$H_2CO_3 \longrightarrow H^+ + HCO_3^-$$

Bicarbonate ion now passé out of erythrocytes while chloride ion from plasma passes into the red blood corpuscles with the help of bicarnonate-chloride carrier protein located in erythrocyte membrane. The phenomenon is called **chloride shift** or **Hamburger phenomenon.** Chloride ion combines with K^+ to from potassium chloride (KCI). In plasma, bicarbonate ion gers associated with Na^+ ion.

$$H CO_3^- + CO_2 \longrightarrow C1^-$$

$$K^+ + HCO_3 \longrightarrow KCI$$

$$Na^+ + HCO_3 - \longrightarrow Na^+ + HCO_3-$$

(c) **Carbaminohaemoglobin.** About 23% (20-25%) of CO2 combines with amino groups of globin part of haemoglobin. This combination also occurs with other proteins present in the plasma.

$$H_2Nb + CO_2 \longrightarrow Hb.NCOOH + H^+$$

Formation of carbamino bond in haemoglobin does not reduce its O2 carrying capacity because O2 combines with haem group while CO2 attaches to amino group of globin.

5. What will be the *p*O2 and *p*CO2 in the atmospheric air compared to those in the alveolar air (i) *p*O2 lesser, *p*CO2 higher (ii) *p*O2 higher, *p*CO2 lesser (iii) *p*O2 higher, *p*CO2 higher (iv) *p*O2 lesser, *p*CO2 lesser.

Ans. At low *p*CO2, blood can carry the maximum amount of oxygen as oxyhaemoglobin. At high *p*CO2, the affinity for oxygen deceases (Bohr effect: Bohar, 1904) and oxyhaemoglobin dissociates to free oxygen.

6. What happens to the respiratory process in man going up a hill?

Ans. There is faster breathing accompanied by breathlessness. Breathlessness occurs due to reduced oxygen content of air that results in slower diffusion of oxygen into blood and reduced formation of oxyhaemoglobin. The requirement of energy and hence oxygen is higher while going up a hill. Therefore along with breathlessness and fast breathings,

muscular weakness, fatigue, cyanosis, nausea, vomiting and headache occur. The phenomenon is called **mountain sickness.** The symptoms of mountain sickness would subside after some time upto height of 3000-4500m due to physiological changes like increased haemoglobin synthesis, increased erythrocyte count and increased level of 2,3 diphosphoglycerate (DAG) in RBCs.

7. What is the site of gaseous exchange in an insect?

Ans. Respiration is direct in insects where oxygen is brought to the living cells by a tracheal system. Therefore, site of gaseous exchange are living cells.

8. Define oxygen dissociation curve. Can you suggest any reason for its sigmoidal pattern?

Ans. **Oxygen Haemoglobin Dissociation Curve.** It is graphic representation of relationship between partial pressure of oxygen of *p*O2 and oxygen saturation of haemoglobin. The graph is sigmoid as at low *p*O2, there is reduced synthesis of oxyhaemoglobin. Percentage of oxyhaemoglobin rises with higher *p*O2 till at about *p*O2 100 mm Hg, the haemoglobin becomes fully saturated with O2. Further rise in *p*O2 cannot increase the value of oxyhaemoglobin as the blood is already saturated with it.

9. Have you heard about hypoxia? Try to gather information about it and discuss with your friends.

Ans. **Hypoxia.** Its is the condition of reduced supply of oxygen to tissue despite availability of adequate blood to them. Several types : **1.Anaemic hypoxia. 2.Cytotoxic** (impaired utilization as in cyanide poisoning). **3.Hypoxic hypoxia.** Insufficient oxygen in air as at high altitudes. **4. CO Poisoning.** Carbon monoxide binds to haemoglobin irreversibly. Oxygen transport is correspondingly reduced. **5. Stagnant Hypoxia.** Due to heart failure or reduced pumping activity of heart.

10. Distinguish between (*a*) IRV and ERV (*b*) Inspiratory capacity and Expiratory capacity (*c*) Vital capacity and Total lung capacity.

Ans. (*a*) IRV and ERV

(*b*) Inspiratory and Expiratory Capacity.

(*c*) Vital Capacity and Total Lung Capacity.

11. What is tidal volume? Find out the tidal volume (approximate value) for a healthy human in an hour.

Ans. **Tidal volume (TV).** It is the volume of air inhaled or exhaled in one breath without any extra effort.

For a normal healthy adult, the tidal volume is about 500 ml. Number of breaths per minute is 12-16

Tidal volume per minute = 500 x 12 to 16 = 6000 – 8000 ml or 6 – 8 liters.

Tidal volume per hour = 6 to 8 x 60 =360 – 480 liters

12. Define the following terms: (*a*) Tidal volume (*b*) Residual volume (*c*) Asthma.

Ans. **(*a*) Tidal volume (TV).** It is the volume of air inhaled or exhaled effortlessly with each breathing. Its value is 500 ml.

(*b*) Residual volume (RV). Its is the volume of air left in the lungs after maximum forceful expiration. Its volume is 1100-1200 ml.

(*c*) Asthma. It is spastic contraction of bronchiolar muscles during expiration so that expiration becomes difficult while inspiration is normal.

13. A fluid-filled double membranous surrounds the lungs. Name it and mention its important functions.

Ans. **Fluid.** Pleural fluid. **Double Membrane Layer (Sac).** Pleural sac. **Function.** Frictionless movement of lungs and development of negative pressure.

14. Name the primary site of exchange of gases in our body.

Ans. Alveoli.

15. Cigarette smoking causes emphysema. Give reason.

Ans. Smoking introduces ciliotoxic and carcinogenic substances into respiratory tract that results in accumulation destructive changes in them. It is emphysema.

16. What is the amount of O2 supplied to tissues through every 100 ml of oxygenated blood under normal physiological conditions?

Ans. 5 ml of oxygen (19.4 ml in oxygenated blood and 14.4 ml in deoxygenated blood)

17. A major percentage (97%) of oxygen is transported by RBCs in blood. How does the remaining percentage (3%) of O2 transported?

Ans. Dissolved in plasma of blood.

18. Arrange the following terms based on their volumes in aa ascending order (*a*) Tidal volume (TV) (*b*) Residual Volume (RV) (*c*) Inspiratory Reserve Volume (IRV) (*d*) Expiratory Capacity (EC).

Ans. Tidal volume (500 ml) → Residual Volume (110-1200 ml) → Expiratory Capacity (1500-1600 ml) → Inspiratory Reserve Volume (2500-3000 ml)

19. Complete the missing terms:

***(a)* Inspiratory Capacity (IC) = …… + 1RV**

***(b)* …….. = TR + ERV.**

***(c)* Functional Residual Capacity (FRC) = ERV + ……..**

Ans. (*a*) TV (*b*) EC (Expiratory Capacity) (*c*) RV

20. Name of the organs of respiration in the following organisms:

(*a*) Flatworm (*b*) Birds (*c*) Frog (*d*) Cockroach.

Ans. **(*a*) Flatworm.** Absent. Cell surface gaseous exchange.

(*b*) Birds. Lungs and distensible air sacs.

***(c)* Frog.** Skin, buccoupharyngeal lining and lungs.

(*d*) Cockroach. Tracheae connecting living cells with external air directly.

21. Name the important parts involved in creating pressure gradient between lungs and atmosphere during normal respiration.

Ans. Expansion of thoracic cavity decreases partial pressure in lungs to 754-758 mm Hg as compared to 760 mm Hg in atmosphere so that air rushes from outside to inside of lungs in inspiration. Contraction of thoracic cavity increases partial pressure inside the lungs to more that that of atmosphere so that air passes out in expiration.

22. State the different modes of CO_2 transport in blood.

Ans. Three states: (i) Physical solution in blood plasma (as carbonic acid)–7%

(ii) Chemical solution in plasma (as bicarbouote)-70%

(iii) As carbaminohaemoglobin -23%

23. Compared to O_2 diffusion rate of CO_2 across diffusion membrane per unit difference in partial pressure is much higher. Explain.

Ans. At the same partial pressure difference, CO_2 diffuses 20 times faster than O_2. It is because of higher **solubility of** CO_2 as compared to that of O_2. Partial pressure of alveolar oxygen is 100 mm Hg while that of deoxygenated blood in blood vessels reaching lungs in 40 mm Hg. Both the gases move along their pressure gradient almost in equal quantity, CO_2 faster for the small difference.

24. For completion of respiration process, write the given steps in sequential manner.

(*a*) Diffusion of gases (O2 and CO2) across alveolar membrane.

(*b*) Transport of gases by blood.

(*c*) Utilization of O2 by the cells for catabolic reactions and result

(*d*) Pulmonary ventilation by which atmospheric air is drawn in and CO2. rich alveolar air is released out.

Ans. C → e → b → a → d.

25. Differentiate between.

(*a*) Inspiratory and expiratory reserve volume.

(*b*) Vital capacity and total lung capacity.

(*c*) Emphysema and occupational respiratory disorder.

Ans. (*a*) Inspiratory and Expiratory Reserve Volumes. See text

(*b*) Vital capacity and total lung capacity. See text

(*c*) Emphysema and occupational respiratory disorder.

	Emphysema	Occupational Respiratory Disorder
1. **Effect.**	It is reduction in alveolar	1. It is disfunctioning of a part of lung.
2. Result.	There is loss of alveolar elasticity, distension of alveolar sacs and bronchioles.	2. A part of lung is unable to perform exchange.
3. Changes	A number of obstructive and destructive changes occur in the lungs.	3. There is destructive proliferation of fibrous connective tissue, deposition of particulate matter and inflammation.
4. Cause.	It is caused by chronic bronchitis, excessive smoking, infection and irritating substances.	4. It is caused by inhalation of dusts of the work place carrying particulate matter and toxins that connot be metabolised.

Multiple Choice Questions

1. Respiration in insects is called direct because (a) The tissues 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 exchanges with tissues.
2. Regarding the functions of our respiratory system, mark the wrong entry (a) Humidifies the air (b) Warms up the air (c)Diffusion of gases (d) Cleans up the air.
3. A person suffers punctures in his chest cavity in an accident without any damage to the lungs. Its effect could be (a) Reduced breathing rate (b)
4. Rapid increase in breathing rate (c) No change in respiration (d) Cessation of breathing.
5. It is known that exposure to carbon monoxide is harmful because (a) It reduces CO_2 transport (b) It reduces O_2 transport (c) It increases CO_2 transport (d) It destroys haemoglobin.
6. Mark the true statement among the following with reference to normal breathing (a) Inspiration is a passive process whereas expiration is active (b) Inspiration is an active process whereas expiration is passive (c) Inspiration and expiration are active processes (d) Inspiration and expiration are passive processes.
7. A person breathes in some volume of air by forced inspiration after having a forced expiration. This quantity of air taken in is (a) Total lung capacity (b) Total volume (c) Vital capacity (d) Inspiratory capacity.
8. Mark the incorrect statement in context of O_2 binding the Hb (a) Higher pH (b) Lower temperature (c) Lower pO_2 (d) High pO_2.
9. Mark the correct pair of muscles involved in the normal breathing in humans (a) External and internal intercostals muscles. (b) Diaphragm and abdominal muscles (c) Diaphragm and external intercostals muscles (d) Diaphragm and internal intercostals muscles.
10. Incidence of emphysema, a respiratory disorder, is high in cigarette smokers. In such cases (a) The bronchioles are found damaged (b) The alveolar walls are found damaged (d) The respiratory muscles are found damaged.
11. The respiratory process is regulated by certain specialized centre in the brain. One of the following listed centre can reduce the inspiratory duration upon stimulation (a) Medullary inspiratory centre (b) Pneumotaxic centre (c) Apneustic centre (d) Chemosenitive centre.
12. CO_2 dissociates from carbaminohaemoglobin when (a) pCO_2 is high and pO_2 low (b) pO_2 is high and pCO_2 is low (c) pCO_2 and pO_2 are equal (d) None of the above.
13. In breathing movements, air volume can be estimated by (a) Stethoscope (b) Hygrometer (c) Sphygmomanometer (d) Spirometer.
14. Identity the correct and incorrect match about 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) Reserve Volume (RV) = Vital Capacity (IC) – Inspriratory Reserve Volume (IRV)

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

OPTIONS : (a) (i) Incorrect (ii) Incorrect (iii) Incorrect (iv) correct (d) (i) Correct (ii) incorrect (iii) Correct (iv) Incorrect.

15. The oxygen –haemoglobin dissociation curve will show a righ shift in case of (a) High *p*CO2 (b) High *p*CO2 (c) Low *p*CO2 (d) Less H+ concerntration.
16. Math the following and mark the correct options

Animal	**Respiratory Organ**
A. Earthworm	(i) Moist Cuticle
B. Terrestrial Arthropods	(ii) Gills
C. Fishes	(iii) Lungs
D. Birds/Reptiles	(iv) Trachea.

Options: (a) A-ii, B-i, C-iv, D-iii.

(b) A-i, B-iv, C-ii, D-iii. (c) A-i, B-iii, C-ii, D-iv. (d) A-i, B-ii, C-iv, D-iii.

17. The greatest quantity of air that can be expired after a maximum inspiratory effort is its (a) Residual volume (b) Tidal volume (c) Vital capacity (d) lung volume.
18. In humans the number of lobes in right and left lungs in (a) 2 and 3 (b) 2 and 2 (c) 3 and 2 (d) 4 and 2.
19. In expiration, the diaphragm becomes (a) Flattened (b) Relaxed (c) Straightened (d) Dome-shaped.
20. Carbonic anhydrase is mostly active in (a) RBC (b) WBC (c) Blood plasma (d) Blood platelets.
21. At high, altitude, RBCs of human blood will (a) Increase in number (b) Decrease in number (c) Decrease in size (d) Increase in size.
22. 70-75% of CO2 transport ocuurs as (a) Dissolved in plasma (b) Carbanminohaemoglobin (c) Bicarbonate (d) None of the above.
23. Which structure of lungs is directly involved in O2/CO2 exchange between air and blood capillaries (a) Bronchi (b) Trachea (c) Alveolar wall degradation (d) Pain in lungs.
24. Asthma is characterized by (a) Spasm in bronchial muscle (b) Damage in diaphragm (c) Alveolar wall degradation (d) Pain in lungs.

25. Amount of CO_2 in expired air is about (a) 0.04% (b) 0.03% (c) 21% (d) 405%
26. Dead air space in man is (a) 1.51 (b) 500 ml (c) 250 ml (d) 150 ml.
27. Which can bind several hundred times more strongly to haemoglobin than oxygen (a) CO_2 (b) CO (c) H_2CO_3 (d) SO_2
28. A large proportion of oxygen is left unused in the human blood even after uptake by the body tissues. This oxygen (a) Is enough to keep oxyhaemoglobin saturation at 96% (b) Helps in releasing more O_2 to the epithelial tissues (c) Acts as a reserve during muscular exercise (d) Raise pCO_2 of blood to 75 mm Hg.

Answers:

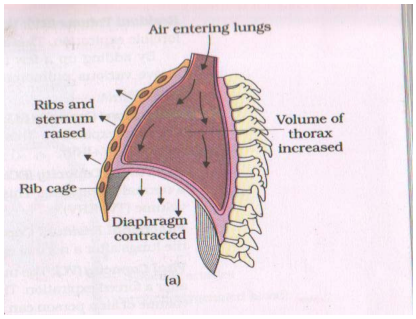
1.(d), 2.(d), 3.(d), 4.(d), 5.(b), 6.(a), 7.(a), 8.(c), 9.(b), 10.(b), 11.(b), 12.(d), 13.(b), 14.(a), 15.(b), 16.(c), 17.(c), 18.(d), 19.(a), 20.(a), 21.(c), 22.(c), 23.(a), 24.(d), 25.(d), 26.(b), 27.(c)

LONG ANSWER TYPE QUESTIONS.

1. Explain the process of inspiration under normal conditions.

Ans ;Breathing involves two stages : inspiration during which atmospheric air is drawn in and expiration by expiration by which the alveolar air is released out The movement of air into and out of the lungs and the atmosphere .inspiration pressure gradient between the lungs and the atmosphere. Inspiration can occur if the pressure within the lungs (intra-pulmonary pressure) is less than the atmospheric pressure, i.e., there is a negative pressure in the lungs with respect to atmospheric pressure. similarly, expiration takes place when the intra-pulmonary pressure is higher than the atmospheric pressure. The diaphragm and a specialised set of muscles – external and internal intercostals between the ribs, help in generation of such gradients. inspiration is initiated by the contraction of diaphragm which 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 voume. An increase in pulmonary volmume decreases the intra-pulmonary pressure to less than the atmospheric pressure which forces the air from outside to move into the lungs, i.e., inspiration (figure 17.2a). Relaxation of the diaphragm and the inter-costal muscles returns the diaphragm and sternum to their normal positions and reduce the the thoracic volume and thereby the pulmonary volume.This leads to an increase in intra-pulmonary pressure to slightly above the at



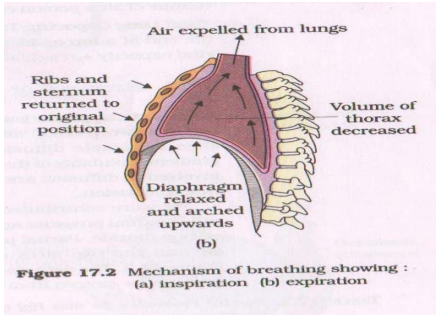


Figure 17.2 Mechanism of breathing showing : (a) inspiration (b) expiration

mospheric pressure causing the the expulsion of air from the lungs.i.e.,expiration (17.2b). we have the ability to increase the strength of inspiration and expiration with the help of additional muscles in the abdomen .on an average,a healthy human breathes 12-16 times/minute. The volume of air involved in breathing movements can be estimated by using a spirometer which helps in clinical assessment of pulmonary functions

2. How is respiration regulated?

Ans; Human beings have a significant ability to maintain and moderate the respiratory rhythm to suit the demands of the body tissues. This is done by the neural system. A specialised centre present in the medulla region of the brain called respiratory rhythm centre is primarily responsible for this regulation.another centre present in the pons region of the brain called pneumotaxic centre can moderate the functions of the respiratory rhythm centre. Neural signal from this centre can reduce the duration of inspiration and thereby alter the respiratory rate. A chemosensitive area is situated adjacent to the rhythm centre which is highly sensitive to CO2 and hydrogen ions. Increase in these substances can activate this centre, which in turn can signal the rhythm centre to make necessary adjustments in the respiratory process by which these substances can be eliminated. Receptors associated with aortic arch and carotid artery also can recognise changes in co2 and H+ concentration and send necessary signals to the rhythm centre for remedial actions.The role of oxygen in the regulation of respiratory rhythm is quite insignificant.

3. What are pulmonary volumes and capacities? Discuss and give their apporoximate volumes.

Ans ; Respiratory volumes and capacities :

a) Tidal volume (TV) it is the volume of air inspired or expired/breathed during a normal respiration and about 500 mL of air per minute.
b) Inspiratory Reserve volume (IRV): it is the additional volume of air, a person may inspire by a forcible inspiration. It is app. 2500 mL to3000mL
c) Expiratory Reserve volume (ERV): it is the additional volume of air, a person can expire by a forcible expiration It app. Average 1000 mL to1100 mL.
d) Functional Residual capacity FRC: volume of air that will remain in the lungs after a normal expiration.FRC+RV.

e) Vital capacity (VC) Maximum volume of air a person can breathe in after a forced expiration is total of ERV+Tv+IRV.it is the maximum volume of air a person can breathe out after a forced inspiration.
f) Total Lung capacity (TLC): Total volume of air accommodated in the lungs at end of a forced inspiration is called TLC.TLC=RV ERV+TV+IRV
TLC = vital capacity +residual volume (RV)
g) Expiratory capacity (EC): it is the total volume of air a person can expire after a normal inspiration EC= Tv+ERV.
h) Residual volume (RV) : it is the volume of air remaining in lungs even after a forcible expiration. It is app. 1100 mL to 1200 mL
i) Inspiratory capacity (IC): It is total volume of air a person can inspire after a normal expiration IC = TV + IRV.

4.Explain how our heart muscles get a continuous supply of atmospheric oxygen.

Ans : Supply of o2 heart muscles is continuous : when inspiration occurs, the o2 is taken in into lungs. O2 mixes with the air already present in alveoli and becomes alveolar air, whose pO2 is 100mm Hg. As pO2 of blood in the vessels is 40 mm Hg, oxygen diffuses into the blood vessels from alveoli and the OXYHAEMOGLOBIN is formed when oxygen combines loosely with the Fe++ ions of haemoglobin.

Oxygenated blood from the lungs reaches the Left auricle through pulmonary vein; to left ventricle and is pumped out through aorta also. The brach supplying blood to heart muscles, is coronary artery. In the heart muscles. As the pO2 is lower than that of the blood in the branches of coronary artery, oxyhaemoglobin dissociates and releases o2 to cardiac muscles.

5. Define the following terms:

a) Anaerobic respiration, b) Breathing, c)vital capacity, d) Tidal volume, e)Respiratory centre.

Ans ; a)Anaerobic Respiration : cellular respiration taking place in the absence of oxygen is called anaerobic respiration.

b) Breathing: Exchange of gases between the lungs the environment is called breathing. It is also called external respiration.

c) Vital capacity : it is the volume of air breathed out by a maximum forceful expiration.

d) Tidal volume: the volume of air which man at rest inspires and expires is called tidal volume.(It is a about 500 millilitres).

e)Respiratory centre : It controls and regulates respiration. It is located int medulla oblongata of brain and has three groups.

6. List the five steps in respiration.

Ans ; Steps in Respirtaion:

a) Breathing/pulmonary ventilation: by which atmospheric air is drawn in and co2 rich alveolar air is given out.
b) Diffusion of gases: o2and co2 across alveolar membrane occurs.
c) Transport of gases: it occurs by blood.
d) Diffusion of o2 and co2 between the blood and the tissues.
e) Utilization of o2 by cells for catabolic reactions in body and Resultant in body and resultant of co2. It is called cellular respiration

7.Explain the transport of O2 & CO2 between alveoli and tissue with diagram (Exchange of Gases)

Alveoli are the primary sites of exchange of gases. Exchange of gases also occur between blood and tissues. O2 and CO2 are exchanged in the these sites by simple diffusion mainly based on pressure/concentration gradient. Solubility of the gases as well as the thickness of the membrances involved in diffusion are also some important factors that can affect the rate of diffusion.

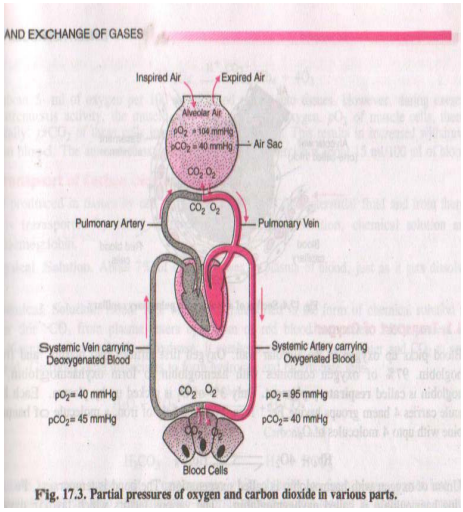


Fig. 17.3. Partial pressures of oxygen and carbon dioxide in various parts.

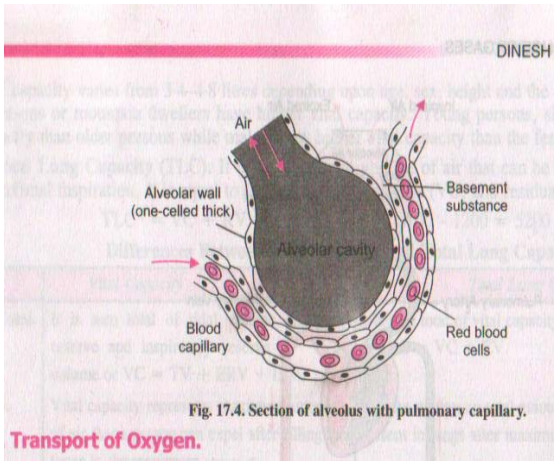


Fig. 17.4. Section of alveolus with pulmonary capillary.
Transport of Oxygen.

Partial pressures (in mm hg) of oxygen and carbon dioxide at Different Parts inwolved in Diffusion in Comparison to those in Atmosphere

Respiratory Gas	Atmospheric Air	Alveoli	Blood (Deoxygenated)	Blood (Oxygenated)	Tissues
O2	159	104	40	95	40
CO2	0.3	40	45	40	45

Pressure contributed by an individual gas in a mixture of gases is called partial pressure and is represented as pO2 for oxygen and PCO2 for carbon dioxide. partial pressures of these two gases in the atmospheric air and the two sites of diffusion are given in Table 17.1 and in figure 17.3 The data given in the table clearly indicates a concentration gradient for oxygen from alveoli to blood and blood to tissues. Similarly

a gradient is present for CO2 in the opposite direction i.e., from tissues to blood and blood to alveoli. As the solubility of CO2 is 20-25 times higher than that of O2, the amount of CO2 that can diffuse through the diffusion membrane per unit difference in partial pressure is much higher compared to that of o2 the diffusion membrane is made up of there major layers (figure17.4) namely , the thin squamous epithelium of alveoli, the endothelium of alveolar capillaries and the basement substance in between them. However, its total thickness is much less than a millimetre. Therefore, all the factors in our body are favourable for diffusion of O2 from alveoli to tissues and that of CO2 from tissues to alveoli

8. Describe in brief the respiratory organs of man.

Ans . Human respiratory system. The following are the main respiratory organs : i) Nostrils. These are the paired openings situated at the anterior and posterior ends of the nasal chambers. They are lined up with ciliated epithelium and mucus cells. These cells prevent the entrance of dust into the lungs and help in warming and moistening and help in warming and moistening the air. The nasal chamber opens anteriorly by external nostril and posteriorly by internal nostril into the pharynx.

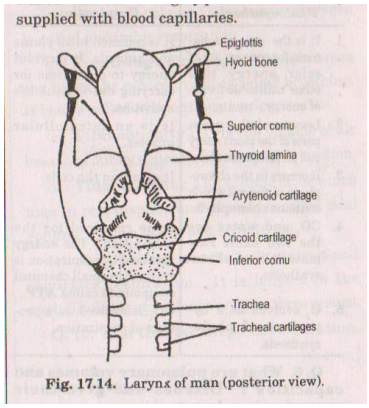


Fig. 17.14. Larynx of man (posterior view).

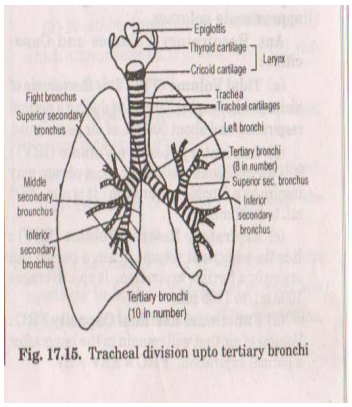


Fig. 17.15. Tracheal division upto tertiary bronchi

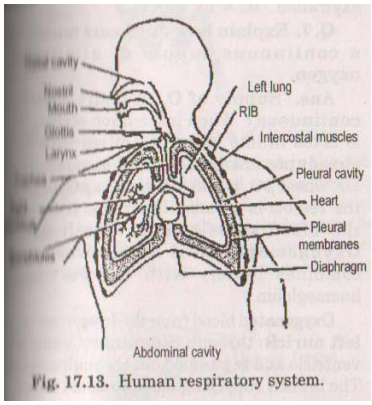


Fig. 17.13. Human respiratory system.

ii) Larynx. It is situated at the anterior part of trachea and communicates with the pharynx. The glottis is protected by stiff cartilage called epiglottis. The larynx contains pairs of vocal cords which sets into vibrations when air enters into it and produces the sound.

iii) Trachea. It is a long ringed tube. It is supported by c-shaped elastic cartilaginous ring to prevent its collapsing. It is lined intenally with mucous membrane to hold the dust particles, bacteria and other foreign bodies. It also warms the air.

Iv) Bronchi. Inside the thorax. The trachea bifurcates into two bronchi and each of which again redivides into one lung. In each lung, the bronchus again redivides into numerous small branches known as bronchioles. These bronchiles furher redivide at its ends to from respiratory bronchioles.

v) lungs. There are two large bag like spongy structures which are the main respiratory argans. thes are enclosed by **double pleural membranes**. The lungs are divided externally by lobes. The right lungs consists of four lobes and left by two lobes. The lungs, the **respiratory bronchioles** give rise to alveolar ducts, alveolar sac

and finally smaller alveoli, Each lung contains millions of alveoli, Each alveolus is exceptionally thin walled. Its walls are highly permeable and richly supplied with blood capillaries. The blood is supplied to the lungs by a pair of **pulmonary arteries.** These bring blood which is poor in oxygen and rich in co2. the exchange of gases occur in the alveoli of the lungs. The oxygenated blood from **alveolar capillaries** is collected by pair of pulmonary vein to be converyed to the heart.,

9. Distinguish between respiration and photosynthesis.

Ans : distinguish between photosynthesis and respiration :

Photosynthesis	Respiraton
1.It is the sole mechanism for conversion of solar energy into other utilizable forms of energy.	It is common to all plants and animals. It provides energy to organisms for carrying out various life activities.
2. leaves and other green parts of the plant carry out photosynthesis.	It is an intracellular process.
3.it occurs in the chloroplasts of the cell which contains chlorophyll.	It occurs in the cells.
4. co2 and water are the two basic raw materials of photosynthesis.	O2 is required for the respiration. The energy respiration. The energy released by respiration is trapped in small chemical compounds called ATP
5. o2 evolves as a byproduct of photosynthesis.	Co2 is evolved as a product of respiration.

10. What happens to the respiratory process in man going up a hill ?

Ans . There is faster breathing accompanied by breathlessness. Breathlessness occurs due to reduced oxygen content of air that results in slower diffusion of oxygen into blood and reduced formation of oxyhaemoglobin. The requirement of energy and hence oxygen is higher while going up a hill Therefore alongwith breathlessness and fast breathing, muscular weakness, fatigue, cyanosis, nausea, vomiting and headache occur. The phenomenon is called mountain sickness. The symptoms of mountain sickness would subside after some time upto height of 3000-4500 m due to physiological changes like increased haemoglobin synthesis, increased erythrocyte count and increased level of 2, 3-diphosphoglycerate (DAG) in RBCs.

OBJECTIVE TYPE QUESTIONS

Multiple choice questions

Choose only one correct option:

And .d) Tracheal tubes exchange O2/CO2 directly with the haemocoel which then exchange with tessues.

1. Aerobic respiratory pathway is appropriately termed:
   a)catabolic b) parabolic
   c)Amphibolic d) anabolic

Ans . c)Amphibolic

2. What is the correct order of the stages of cellular respiration?
   a)kreb's cycle electron ----- transport ---chain glycolysis
   b) Electron transport chain ---kreb's cycle—glycolysis
   c)glycolysis ------kreb's cycle ----- electron transport chain
   d)glycolys ------electron transport chain ---- kreb's cycle

Ans .c) glycolysis ------kreb's cycle----- electron transport chain

4. which of the following respiratory organs are present in spiders and scorpions?

a)Book lungs b)gills

c)gill books d) lungs

Ans. Book lungs

5. The haemoglobin of a human foetus :

a) Has only 2 protein subunits instead of4

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

Ans. Has a higher affinity for oxygen than that of an adult

6) The diagram represents the human larynx.choose the correct combination of labeling from the options given

a) A ----larynx, B -----parathyroid, C -----Tracheal cartiage, D ---Trachea

b)A----Naso larynx, B-----Thyroid, C-----Tracheal cartilage, D-----Trachea

c)A------Trachea, B ------Thyroid , C------Bronchiole, D ---- Tracheal cartilage

d)A------Epiglottis, B------Thyroid, C------Tracheal cartilage, D--- Trachea

Ans . d)A------Epiglottis, B------Thyroid, C------Tracheal cartilage, D--- Trachea

7) Regarding the functions of our respiratory system, mark the wrong entry:

A) Humidifies the air

b) warms up the air

c)Diffusion of gases

d)cleans up the air.

Ans . d)cleans up the air

8)A person suffers punctures in his chest cavity in an accident, without any damage to the lungs its effect could be:

a) Reduced breathing tate

b) Rapid increase in breathing rate

c) No change in respiration

d)cessation of breathing.

Ans . d)cessation of breathing.

9) It is known that exposure to carbon monoxide is harmful to animal because:

a) It reduce CO2 transport

b) It reduce O2 transport

c) It increase CO2 transport

d) It destroys haemoglobin

Ans. d) It destroys haemoglobin

10) Mark the true statement among the following with reference to normal breathing :

a) Inspiration is a passive process whereas expiration is active

b) Inspiration is active process where as expiration is passive

c) Inspiration and expiration are active processes

d) Inspiration and expiration are passive processes.

Ans . b) Inspiration is active process where as expiration is passive

11) A person breathes in some volume of air by forced inspiration after having a forced expiration. This quantity of air taken in is:

a) Total lung capacity

b) Tidal volume

c) vital capacity

d) Inspiratory capacity.

Ans . a) Total lung capacity

12) Mark the incorrect statement in context to O2 binding to Hb:

a) Higher pH

b) lower temperature

c) lower pCO2

d) Higher po2.

Ans . d) Higher po2

13) Mark the correct pair of muscles involved in the normal breathing in humans:

a) External and internal intercostals muscles

b) Diaphragm and abdominal muscles

c) Diaphragm and external intercostal muscles

d) Diaphragm and internal intercostals muscles.

Ans . d) Diaphragm and internal intercostals muscles

14. Incidence of Emphysema-a respiratory disorder is high in cigarette smokers. In such cases :

a) the bronchioles are found damaged
b) the alveolar walls are found damaged
c) the plasma membrane is found damaged
d) the respiratory muscles are found damaged

ans. (b) the alveolar walls are found damaged.

15. co2 dissociates from car amino hemoglobin when :

a) pco2 is high and po2 is low
b) po2 is higher and pco2 is low
c) pCo2 and pO2 are equal
d) None of the above.

Ans . po2 is higher and pco2 is low

16. In breathing movements, air volume can be estimated by:

a) Stethoscope

b) Hygrometer

c) sphignomanometer

d) spirometer

Ans. Spirometer.

17. Identify the correct and incorrect match about respiratory volume and capacities and mark th 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

Ans . b) (I) Incorrect, (ii) correct, (iii) incorrect, (iv) correct

18) The oxygen- haemoglobin dissociation curve will show a right shift in case of:

a) High pCO2 b) High pO2

c) low pCO2

d) less H+ conecetration.

Ans . b) High pO2

19) Match the following and mark the correct options:

A. Earthworm (i) Moist cuticle

B. Aquatic Arthropods (ii) gills

C. Fishes (iii) Lungs

D. Birds/Reptiles (iv) Trachea

(a)A-(ii), B-(i), C-(iv), D-(iii)

(b) A-(i), B-(iv), C-(ii), D-(iii)

(c) A-(i), B-(iii), C-(ii), D-(iv)

(d) A-(i), B-(ii), C-(iv), D-(iii)

Ans . (b) A-(i), B-(iv), C-(ii), D-(iii)

20) 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.

Ans . b) Total lung capacity minus residual volume

21) Respiratory process is regulated by certain specialized centres in the brain. One of the following listed centres can reduce the inspiratory duration upon stimulation:

a) Medullary inspiratory centre

b) pneumotaxic centre

c) Apneustic centre

d) chemosensitive centre.

Ans . b) pneumotaxic centre

22) Residual volume is:

a) lesser than tidal volume

b) Greater than inspiratory volume

c) Greater than vital capacity

d) Greater than tidal volume.

Ans . d) Greater than tidal volume.

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