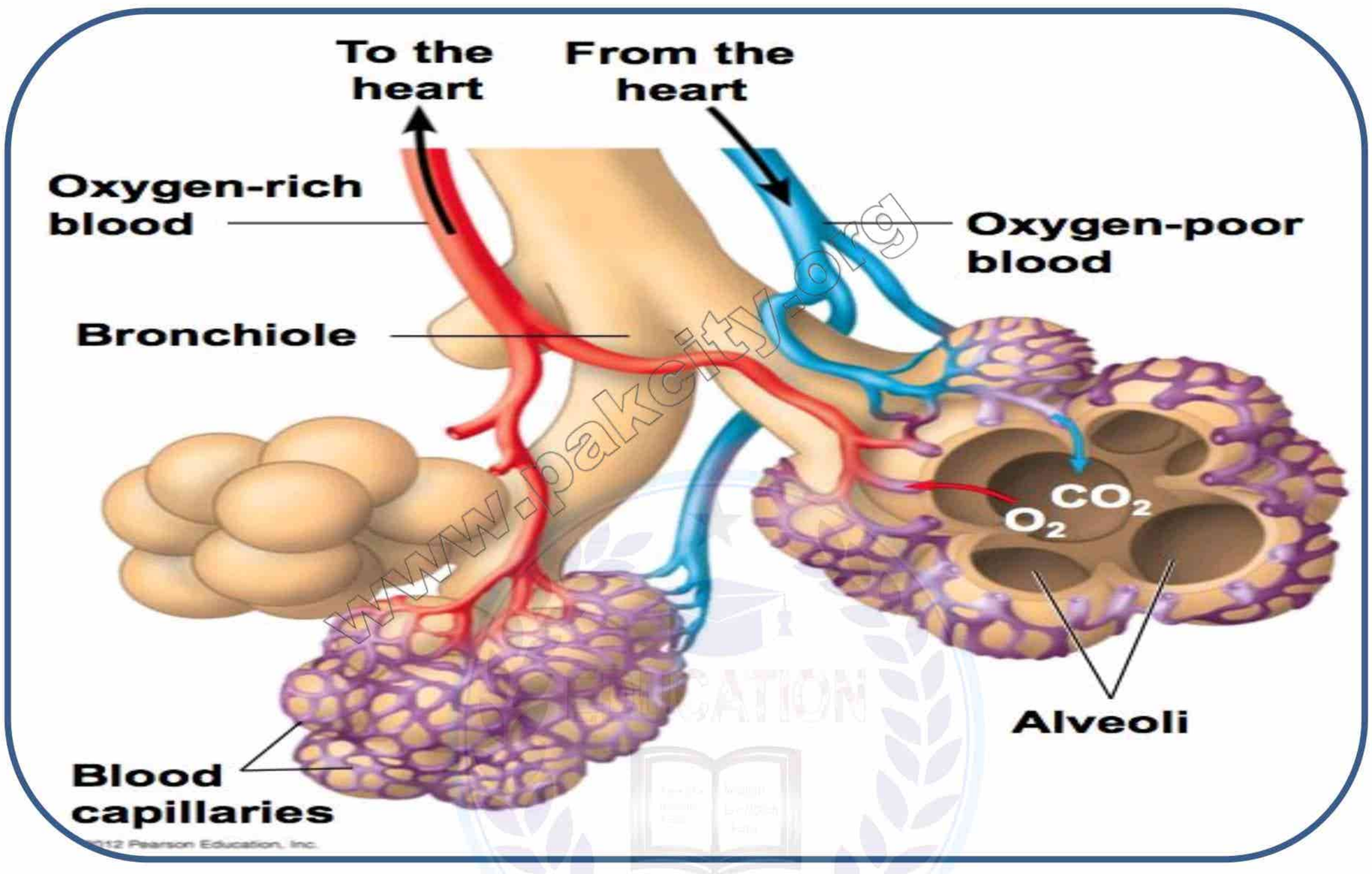
CHAPTER 13

Gaseous Exchange



- **Exercise short answers**
- **Important Short Answers**
- **Exercise MCQ's**
- **Important additional MCQ's**
- **Past MDCAT MCQ's**

Exercise MCQ's

❖ **Encircle the correct answer from the multiple choices.**

1) Air spaces between mesophyll cells of a leaf comprise …… of the total volume:

a) 20% b) 30% c) 40% d) 50%

2) The respiratory system is most efficient in ……

a) Man b) Bird c) Fish d) Snake

3) Respiratory pigment present in muscles is called:

a) Myoglobin b) Globin c) Haemoglobin d) Haemocyanins

4) Blood contains …… oxygen per 100ml of blood when haemoglobin is 98% saturated:

a) 19.6ml b) 18.6ml c) 17.6ml d) 16.6ml

5) How much air can lungs hold when they are fully inflated:

a) 5 liters b) 4 liters c) 4.5 liters d) 3.5 liters

Answer Key:

1	c	**2**	b	**3**	a	**4**	a	**5**	a

Prof. Ijaz Ahmed Khan Abbasi ((Lecturer Biology PGC)

Additional Important MCQ's

❖ **Encircle the correct answer from the multiple choices.**

Respiration and Water/Air Respiratory

1) Exchange of gases during organismic respiration is carried out by:

a) Diffusion
b) Osmosis
c) Active transport
d) Facilitated Diffusion

2) ……. respiration is directly involved in the production of energy, necessary for all living activities:

a) Organismic
b) Cellular
c) Both of these
d) None of these

3) ……. respiration is the process by which cell utilized oxygen and produces CO_2:

a) Cellular
b) Organismic
c) Both of these
d) None of these

4) Of the following, which one is better respiratory medium?

a) Air b) Water c) Soil d) None of these

5) A liter of water contains ……. ml of oxygen:

a) 10 b) 20 c) 30 d) 40

6) Oxygen contents of fresh air are:

a) 200ml/liter b) 100ml/liter c) 10ml/liter d) 150ml/liter

7) Water is more viscous than air by:

a) 25 times b) 150 times c) 75 times d) 50 times

8) Oxygen diffuses many times more quickly in air than in water:

a) 4000 times b) 7000 times c) 6500 times d) 8000 times

Gaseous Exchange in Plants

9) Air spaces between mesophyll cells of leaves comprise up to the total volume of the leaf:

a) 20% b) 30% c) 40% d) 50%

10) Carbon dioxide enters the leaves through:

a) Plasmodesmata b) Pits c) Hydathodes d) Stomata

11) The main sites of exchange of gases in plants are:

a) Stomata b) Lenticels c) Cuticles d) Epidermis

12) There are ……. stomata per square cm of leaf surface in Tobacco plants:

a) 1200 b) 12000 c) 100,000 d) 1000

Photorespiration

13) Respiratory activity which occurs in plants during day times is called:

a) Photosynthesis
b) Photorespiration
c) Respiration
d) Fermentation

14) Rubisco fixes oxygen instead of CO_2:

a) Glycolysis
b) Photorespiration
c) Krebs' Cycle
d) Respiration

15) During photorespiration Glycine is converted into serine in the:

a) Mitochondria b) Golgi bodies c) Chloroplast d) Ribosome

16) During photorespiration glycine after is formation diffuses into:

a) Ribosome b) Mitochondria c) Peroxisomes d) Glyoxisome

17) Active site of Rubisco is evolved to bind:

a) CO_2 b) O_2 c) Both of these d) $H2_O$

18) During photorespiration glycolate diffuses into the membrane bound organelle named as:

a) Mitochondria b) Ribosome c) Peroxisome d) Golgi bodies

19) The pathway in which RuBP is converted into serine is called:

a) Breathing
b) Photophosphoryation
c) Photorespiration
d) Electron Transport Chain

20) Rubisco is the most abundant protein in:

a) Ribosome b) Mitochondria c) Nucleus d) Chloroplast

21) The most abundant protein in chloroplast and probably the most abundant protein in nature is:

a) Haemoglobin b) Insulin c) Globulin d) Rubisco

22) A process in which rubisco-bisphosphate / carboxylase / oxygenase (Rubisco) fixes oxygen instead of CO_2 is called:

a) Respiration
b) Photorespiration
c) Glycolysis
d) Krebs' Cycle

Gaseous Exchange in Invertebrates (Hydra, Earthworm, Cockroach)

23) In earthworm, the exchange of gases occur mainly through:

a) Lungs b) Gills c) Skin d) Anus

24) Main tracheal trunk in Cockroach communicates with exterior by?

a) 100 spiracles b) 10 pairs c) Oxygen d) Sulphur

25) Blood is not involved in transport of gas in:

a) Fish b) Cockroach c) Frog d) Man

26) Spiracles are found in:

a) Hydra b) Cockroach c) Birds d) Both a & b

27) Which of the following does not have specialized respiratory organs?

a) Hydra b) Cockroach c) Birds d) Both a & b

Gaseous Exchange in vertebrates (Fishes, Frog, Birds)

28) Respiratory organs in fish are:

a) Lungs b) Air sacs c) Gills d) Tracheae

29) The organ which is most efficient and highly modified for gaseous exchange in aquatic animals are:

a) Skins b) Vocal cord c) Lungs d) Gills

30) Gaseous exchange occur in Fro through lungs is called:

a) Photorespiration
b) Cutaneous respiration
c) Pulmonary respiration
d) Cellular respiration

31) In the lungs of birds instead of alveoli tiny thin walled ducts are present, which are called:

a) Bronchi b) Bronchioles c) Air sac d) Parabronchi

32) The respiratory system is most efficient in:

a) Man b) Birds c) Fish d) Snake

33) The number of air sacs in birds are:

a) 6 b) 7 c) 8 d) 9

34) Gaseous exchange through the skin is known as _____ respiration:

a) Cuticular b) Cutaneous c) Skin d) Pulmonary

35) When abdomen expands, the number of spiracles open is:

a) 2 b) 3 c) 6 d) 8

36) In most birds 9 in numbers are:

a) Lungs b) Bronchi c) Parabronchi d) Air Sacs

37) Parabronchi are open at _____ end/s:

a) Single
b) Both
c) Do not have opening
d) None of these

Respiration in Man and Breathing Mechanism

38) Functional units of lungs are called:

a) Alveoli b) Air sacs c) Parabronchi d) None of these

39) Vocal cords are stretched across:

a) Larynx b) Pharynx c) Golttis d) None of these

40) The structure in the mouth that prevents food from entering the nasal cavities is the:

a) Epiglottis b) Soft palate c) Tongue d) Pharynx

41) Which one is the structure of respiratory system of man:

a) Esophagus b) Syrinx c) Duodenum d) larynx

42) Opening in the oral cavity (throat) through which air enters the wind pipe is called:

a) Glottis b) Larynx c) Bronchus d) Pharynx

43) The complex cartilaginous structure at the upper end of the trachea is called:

a) Larynx b) Glottis c) Epiglottis d) Soft palate

44) Voice box is another name used for:

a) Buccal cavity b) Pharynx c) Larynx d) Chest Cavity

45) All of the following contain cartilage except:

a) Larynx b) Trachea c) Bronchioles d) Bronchi

46) Bronchioles are made up of ……:

a) Epithelial tissue
b) Circular smooth muscles
c) Connective tissues
d) Longitudinal smooth muscles

47) The diameter of bronchiole is:

a) 3 mm b) 2 mm c) 1 mm d) 0.1 mm

48) The lungs are covered by double layered thin membranous sacs called:

a) Pleura b) Scrotum c) Pericardium d) Diaphragm

49) What does not happen during inspiration in man?

a) Ribs move upward
b) Diaphragm becomes more dome-shaped
c) Ribs move forward
d) Outward and upward movement of ribs

50) During rest breathing rate in humans is …… times/minutes:

a) 10-15 b) 15-20 c) 20-25 d) 25-30

51) Lungs are spongy due to the presence of millions of:

a) Air sacs b) Alveoli c) Bronchioles d) Parabronchi

Transport of Gases (O_2 and CO_2)

52) When oxygen tension is 115 mm of mercury then haemoglobin saturation:

a) 100% b) 98% c) 78% d) 68%

53) Blood contains …….. oxygen per 100 ml of blood when haemoglobin is 98% saturated:

a) 19.6 ml b) 20 ml c) 21 ml d) 10 ml

54) Maximum amount of oxygen which normal human blood absorbs and carries at sea-level is about …….. of blood:

a) 20L/100ml b) 20ml/200ml c) 200ml/100ml d) 20ml/100ml

55) When carbon dioxide pressure increases the capacity of haemoglobin to hold oxygen:

a) Decrease
b) Increase many folds
c) Remains constant
d) Is doubled

56) Transportation of oxygen from lungs to the tissue cells is by means of:

a) Complete blood
b) Red blood cells
c) Lymph
d) White blood cells

57) In which form most of the carbon dioxide is transported from tissues towards lungs?

a) As carboxyhaemoglobin
b) By plasma protein in blood
c) As bicarbonate ion in plasma
d) In dissolved form through blood

58) Percentage of carbon dioxide carried in the form of bicarbonate in plasma is:

a) 65 b) 70 c) 75 d) 80

59) Plasma protein carries about …….. % CO_2 from body fluid to lungs:

a) 1% b) 2% c) 4% d) 5%

60) The normal alveolar ventilation is regulated by …… (is more important regulator of breathing process):

a) Haemoglobin b) Oxygen c) Iron d) Carbon dioxide

61) Arterial blood contains _____ of CO_2 per 100 ml of blood:

a) 54 ml b) 60 ml c) 64 ml d) 50 ml

Respiratory Disorders

62) More than the compounds of tar of tobacco smoke are included in causing:

a) Cancer b) Tuberculosis c) Asthma d) Emphysema

63) Emphysema is breakdown of:

a) Trachea b) Bronchi c) Alveoli d) Bronchioles

64) More than …… compounds of tar of tobacco smoke are involved to cause cancer:

a) 5 b) 90 c) 15 d) 10

65) Breakdown of alveoli is called:

a) Asthma b) Emphysema c) Tuberculosis d) Lung cancer

66) Asthma is associated with sever paroxysm of difficult:

a) Sleeping b) Speaking c) Sneezing d) Breathing

67) A person with emphysema must consciously contract muscles in order to breathe out. What makes this muscles contraction necessary?

a) Constriction of bronchioles
b) Excess mucus blocking air passages
c) Loss of elasticity in alveolar walls
d) Paralysis of cilia in air passages

68) The respiratory distress syndrome is common in infants with a gestation age of less than …… months:

a) 2 b) 4 c) 7 d) 6

69) A disease of longs in which inside of the lungs is damaged resulting in cough and fever:

a) Lung cancer
b) Asthma
c) Emphysema
d) Pulmonary tuberculosis

70) Of the following, which one is a contagious disease?

a) Tuberculosis b) Lungs cancer c) Asthma d) Emphysema

Role of Respiratory Pigments

71) An iron containing protein respiratory pigment occurring in muscle fibers is (Respiratory pigment present in muscles):

a) Actin b) Myosin c) Globulin d) Myoglobin

72) How many molecules of oxygen can bind with a molecule of myoglobin:

a) 4 b) 3 c) 2 d) 1

73) Myoglobin occurs in:

a) RBCs b) Plasma c) WBCs d) Muscles

74) In human beings the respiratory pigment is:

a) Bilirubin b) Haemocyanin c) Haemoglobin d) Myoglobin

75) Haemoglobin in man increase the oxygen carrying capacity of the blood to about:

a) 75 times b) 50 times c) 60 times d) 100 times

Lung Capacities and Diving Reflex

76) Total inside capacity of human lungs (How much air lungs can hold), when fully inflated:

a) 5 liters b) 7 liters c) 7.2 liters d) 7.5 liters

77) The volume of air taken inside the lungs and expelled during exercise is about:

a) 2.5 liters b) 3.5 liters c) 1.5 liters d) 4.5 liters

78) What is the residual volume of air which always remains inside the lungs of humans?

a) 2.5 liters b) 5 liters c) 0.5 liters d) 1.5 liters

Answer Key:

1	a	**2**	b	**3**	a	**4**	a	**5**	a	**6**	a	**7**	d	**8**	d	**9**	c	**10**	d
11	a	**12**	b	**13**	b	**14**	b	**15**	a	**16**	c	**17**	c	**18**	c	**19**	c	**20**	d
21	d	**22**	b	**23**	c	**24**	b	**25**	b	**26**	b	**27**	a	**28**	c	**29**	d	**30**	c
31	d	**32**	b	**33**	d	**34**	b	**35**	d	**36**	d	**37**	b	**38**	b	**39**	c	**40**	b
41	d	**42**	a	**43**	a	**44**	c	**45**	c	**46**	b	**47**	c	**48**	a	**49**	b	**50**	b
51	b	**52**	b	**53**	a	**54**	d	**55**	a	**56**	b	**57**	c	**58**	b	**59**	d	**60**	d
61	d	**62**	a	**63**	c	**64**	d	**65**	b	**66**	d	**67**	a	**68**	c	**69**	c	**70**	a
71	d	**72**	D	**73**	d	**74**	c	**75**	a	**76**	a	**77**	b	**78**	d				

Prof. Ijaz Ahmed Khan Abbasi ((Lecturer Biology PGC)

Past MDCAT MCQ's

pakcity.org

2008

1) When carbon dioxide pressure increases the capacity of haemoglobin to hold oxygen:

a) Increases many folds
b) Remains constant
c) Decreases
d) Is doubled

2) The total inside capacity of lungs of adult human beings when fully inflated is:

a) 5 ml b) 500 ml c) 50 ml d) 5000 ml

2009

3) During photorespiration, the glycolate is converted into glycine in a structure of cell called:

a) Golgi Bodies b) Mitochondria c) Glyoxisome d) Peroxisome

4) The respiratory pigment, which has much higher affinity to combine with oxygen, is:

a) Myoglobin b) Haemoglobin c) Globin d) Hemocyanin

5) Most of the carbon dioxide is carried in the blood in the form of:

a) Bicarbonate
b) CO_2
c) Carboxyhemoglobin
d) Blood plasma protein

2010

6) Which one of the following acts as functional unit of lungs in man?

a) Air sac b) Trachea c) Larynx d) Bronchioles

7) Which one of following factors is directly proportional to oxygen carrying capacity of haemoglobin?

a) Carbon dioxide b) pH c) Temperature d) Light

8) Expiration in human beings is carried out by:

a) Contraction of lungs
b) Relaxation of intercostal and diaphragm muscles
c) Contraction of intercostal membrane
d) Contraction of diaphragm muscles

2012

9) What is the residual volume of air which always remains inside the lungs of human?

a) 3.5 Liters b) 5.0 Liters c) 0.5 Liters d) 1.5 Liters

2013

10) The total inside capacity of lungs is ……. for man:

a) 6.7 liters b) 7 liters c) 2.5 liters d) 5 liters

2015

11) About 70-85% CO2 in blood is carried:

a) As carboxylase myoglobin
b) Freely as CO2
c) With proteins in plasma
d) As bicarbonate

2016

12) Carboxyhaemoglobin (10-20%) is formed when CO2 combines with:

a) Amino group of haemoglobin
b) Haem portion of haemoglobin
c) Iron part of haemoglobin
d) Plasma proteins

13) Breathing consists of:

a) Four phases b) One phase c) Three phases d) Two phases

2017

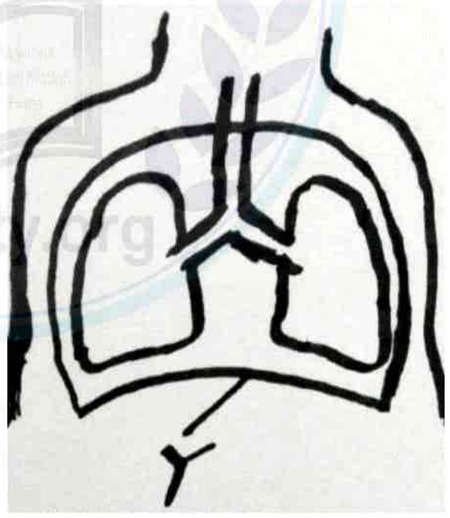
14) Low partial pressure of oxygen in tissues favors …… of oxyhaemoglobin:

a) Dissociation b) Stability c) Formation d) Transformation

15) Respiratory tubules are termed as bronchioles when they attain the diameter…… or lesser:

a) 1.2cm b) 1mm c) 1cm d) 1.2mm

16) Label the part 'Y' in the following diagram:



a) Pleura
b) Chestcavity
c) Diaphragm
d) Intercoastalmuscles

17) W.O.F is a respiratory disorder related to malnutrition:

a) Cancer b) Emphysema c) Asthma d) Tuberculosis

Answer key:

1	c	**2**	a	**3**	d	**4**	a	**5**	a	**6**	a	**7**	b	**8**	b	**9**	d	**10**	d
11	d	**12**	a	**13**	d	**14**	a	**15**	d	**16**	c	**17**	d						

Prof. Ijaz Ahmed Khan Abbasi ((Lecturer Biology PGC)

Exercise Short Answer

Q:1 How does breathing differ from respiration?

Ans: Respiration: Respiration is one of the most important metabolic activities of all organisms. Cellular respiration is the process whereby cell utilizes oxygen, produces carbon dioxide, extract and conserves the energy from food molecules in biologically useful form, such as ATP.

Breathing: Organismic respiration is also known as breathing or ventilation. During which oxygen is taken from atmosphere and carbon dioxide is released. Breathing provides the basis of cellular respiration.

Q:2 How much CO_2 is present in venous and arterial blood?

Ans: Arterial blood contains 50 ml of carbon dioxide per 100 ml of blood whereas venous blood has 54 ml of carbon dioxide per 100 ml of blood.

Q:3 How does air always remain in the lungs of Human beings?

Ans: 1.5L air always remains in the lungs of human beings even during exercise which cannot be expelled due to difference in the concentration gradient of carbon dioxide and oxygen in the lungs.

Q:4 What are the products which are produced during photorespiration?

Ans: The products of respiration are:

1) Glycolate
2) Glycine
3) Serine

Q:5 How much denser is a water medium than air medium for exchange of respiratory gases?

Ans:

Water is 8000 times denser than air medium for exchange of respiratory gases.

Prof. Ijaz Ahmed Khan Abbasi ((Lecturer Biology PGC)

Important Short Answers

Q:1 Why air is better medium than water for the exchange of gases?

Ans: Following are some reasons why air is better medium than water for exchange of gases:

- The oxygen content of air is much higher than the oxygen content of the equal volume of water. A litter of water cannot contain even 10 ml of oxygen, whereas oxygen content to fresh air is about 200 ml per litter.
- Oxygen diffuses about 8000 times more quickly in air than in water. So air is better medium for the exchange of gases.
- Water is 8000 times denser than air. Therefore exchange of gases in water is very difficult than the exchange of gases in air.
- Water is 50 times more viscous than the air. Therefore exchange of gases in water is very difficult than the exchange of gases in air.

Q:2 Describe briefly as to how gaseous exchange takes place in plants.

Ans: Gaseous Exchange in Plants: Gaseous exchange is plants takes place through three methods:

1) **Through Stomata:** In most cells of mesophyll which are specialized for photosynthesis, there are present large spaces. Theses air spaces are directly involved in gaseous exchange. Stomata are the main sites of exchange of gases in plants. Stomata are largely present in the leaves and in young stem. These stomata lead to intercellular spaces of mesophyll tissue.
2) **Through Lenticels:** In older stems, cork tissue is present which is formed of dead cells. The cork tissue has special pores called lenticels which are involved in gaseous exchange.
3) **Through Roots:** The roots of the land plants get their oxygen from the air existing in the spaces between the soil particles.

Q:3 Define photo-respiration.

Ans: Photo-respiration: Respiratory activity which occurs in plants during daytime is called photorespiration.

- Photorespiration is a light dependent process during which oxygen is absorbed and carbon dioxide is released. This oxygen is derived from the early reaction of photosynthesis. The pathway in which RuBP (Ribulose Biphosphala) is converted into serine is called photorespiration.

Q:4 How the rate of carbon dioxide fixation is lowered?

Ans: The photorespiration is a process in which ribulose biphosphala carboxylase / oxygenase fixes oxygen instead of carbon dioxide which results in lowering the overall rate of carbon dioxide fixation and plant growth.

Q:5 What is Rubisco? What is its function?

Ans: Photorespiration is a process in which ribulose bisphosphate carboxylate/oxygenase (rubisco) fixes oxygen instead of carbon dioxide.

Function of Rubisco:

- The rubisco is a carboxylase as well as oxygenase.
- When the rubisco act as carboxylase, it adds carbon dioxide to RuBP, which is an acceptor molecule.
- On the other hand when rubisco is oxygenase, it adds oxyen to RuBP. Both these reaction complete with each other.
- The first step of photorespiration durin which RuBP react with oxygen is carried out by Rubisco, the most abundant protein in chloroplasts and probably the most abundant protein in the world.

Q:6 How glycolate is produced?

Ans: When RuBP react with oxygen, a two carbon compound glycolate is produced:

RuBP +O_2 ----------> Glycolate

That glycolate thus produced diffuses into membrane bounded by organelles known as peroxisomes.

Q:7 What is glycine? How it is converted to serine?

Ans: In the peroxisomes the glycolate is converted into glycine, through a series of reactions.

Glycolate ----------> Glycine

The glycine is the simplest amino acid which soon after its formation diffuses into the mitochondria where two glycine molecules are converted into serine and a molecule of carbon dioxide is formed.

2 Glycine ----------> Serine + CO_2

Q:8 What are the properties of respiratory surfaces?

Ans: The respiratory surfaces in most animals exhibit the following features:

1) **Large Surface and Moisture:** The surface area should be large and kept moist as is in lungs and gills.
2) **Thin Epithelium:** The distance for diffusion must be short. In animals, the epithelium is only two cells thick which separates blood and air.
3) **Ventilation:** There should be the difference is the gases at two points which bring about diffusion.
4) **Capillary Network:** The respiratory site should possess steps diffusion gradient and extensive network of capillaries through which blood should flow all the time at an adequate speed.

Q:9 If photorespiration is inhibited chemically, the plant can still grow. Then why does photorespiration exist?

Ans: The active site of rubisco is evolved to bind both carbon dioxide and oxygen together. Originally it was not a problem as there was little oxygen in the atmosphere and the carbon dioxide binding activity was the only one used. The photorespiration started when the quantity of oxygen became more.

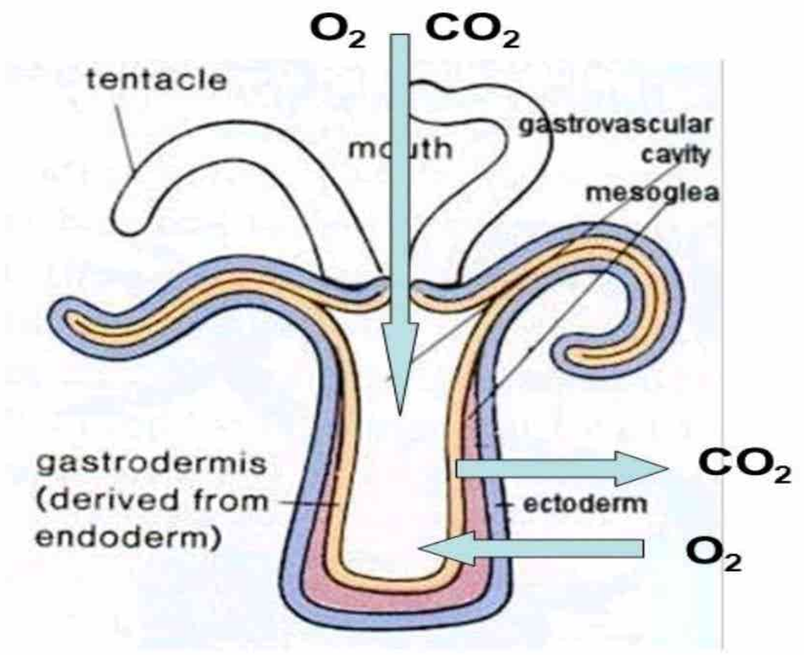
Q:10 What are respiratory surfaces? What are respiratory surfaces in hydra?

Ans: Respiratory surfaces:

Respiratory surfaces in animals are the sites where gaseous exchange takes place.

Respiratory surfaces in hydra:

Hydra has no specialized organs for respiration. Exchange of gases i.e., intake of oxygen and removal of carbon dioxide, occurs through entire general surface in contact with water.



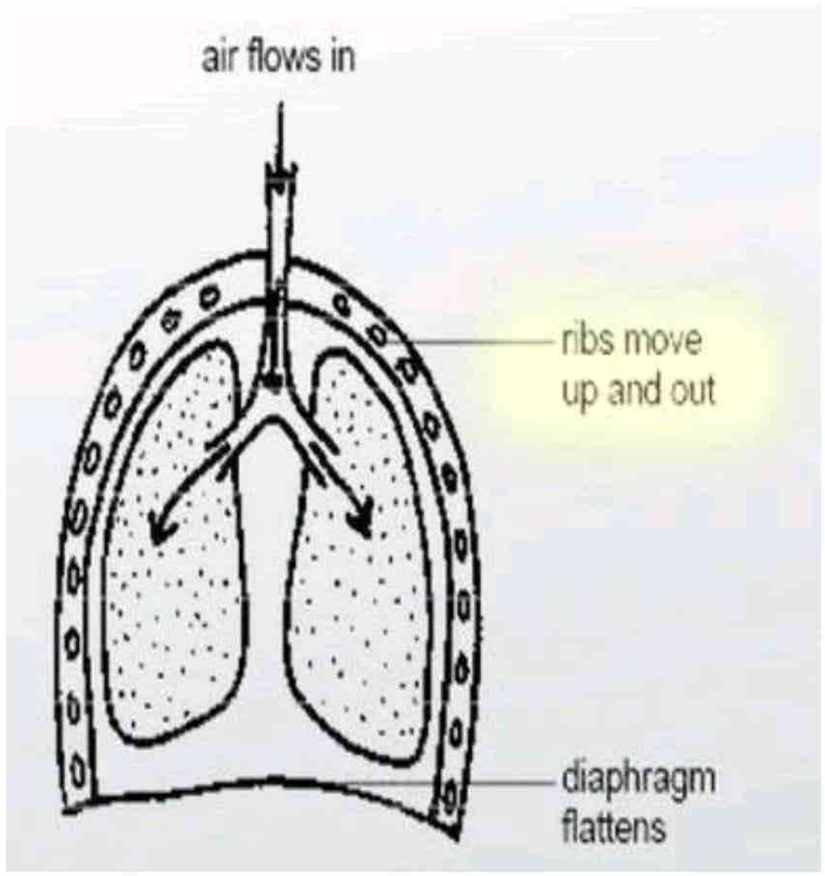
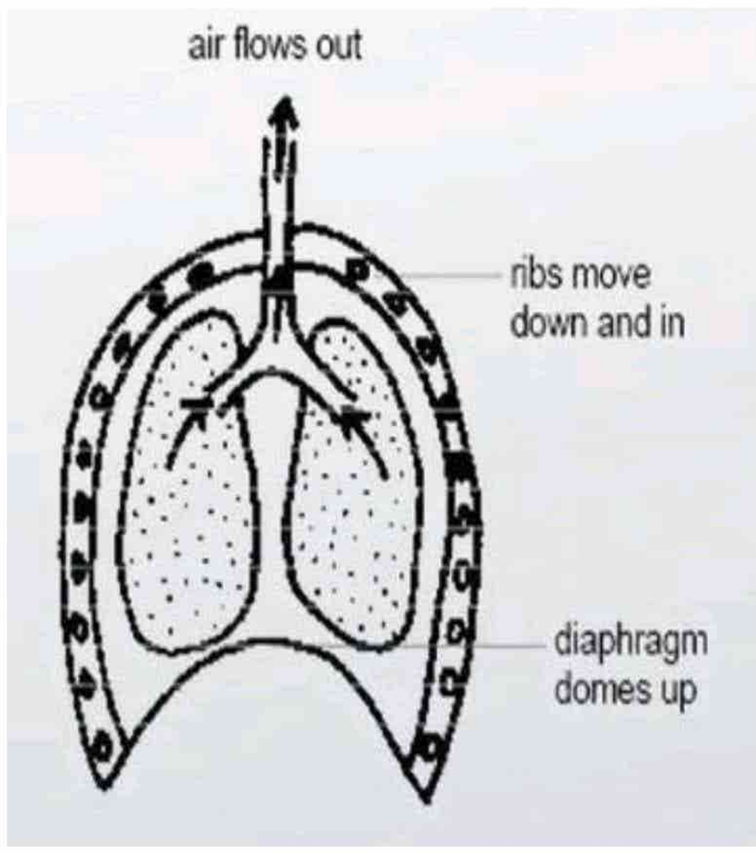
Respiration in Hydra

Q:11 Differentiate between External respiration and Cellular respiration.

External respiration	Cellular respiration
• The exchange of the gases i.e. O2 and CO2 through respiratory surface is called breathing or ventilation.	• The step by step breakdown of the C-chain molecules and the release of energy within the cell are called cellular respiration.
• It occurs in respiratory surfaces like lungs, gills etc.	• It occurs inside the cells.
• ATP is not produced directly in this process.	• ATP is produced directly in this process.
• It exchanges oxygen and carbon dioxide gases.	• In this process oxygen is utilized and carbon dioxide is released.

Q:12 Differentiate between Inspiration and Expiration.

Inspiration (Inhalation)	Expiration (Exhalation)
• Inspiration is the intake of air (oxygen) inside the lungs.	• Expiration is the expulsion of air (oxygen) from the lungs.
• During inspiration the space inside the chest cavity is raised or increased.	• During expiration from the sides of chest cavity the space becomes less.
• Muscles of ribs contract and elevate the rib upwards and forwards.	• The muscles of ribs and relaxed and ribs move downward and inward.
• The muscles of diaphragm contract and become less dome-like.	• The muscles of diaphragm relax becoming more dome-like.
• Pressure from the lungs is removed and they expand and vacuum is created due to which air	• The lungs are pressed and the air moves

rushes inside the lungs.	outside the lungs.
• It is an active process.	• It is a passive process.
	

Q:13 Differentiate between Pulmonary & Cutaneous Respiration?

Pulmonary Respiration	Cutaneous Respiration
• Respiration taking place through lungs is called pulmonary respiration.	• Respiration takin place through skin is called cutaneous respiration.
• In it lungs are involved.	• In it surface of skin is involved.
• In it lungs inflate and deflate.	• In it no such exchanges occur in skin.
• Gases exchange involves pressure mechanism.	• Gases exchange involves no pressure mechanism.
• For example: Man including all mammals, birds, reptiles and even in amphibians.	• For example: Earthworms and amphibians also.

Q:14 How skin is kept moist in earthworm?

Ans: Skin is richly supplied with blood capillaries and is always kept moist by the secretion of epidermal mucous gland cells and also by coelomic fluid exuding out through the dorsal pores. Oxygen dissolved on the wet surfaces passes through the cuticle and epidermal cells into the blood.

Q:15 How much CO2 is present in venous and arterial blood?

Ans: Arterial blood contains 50 ml of carbon dioxide per 100 ml of blood whereas venous blood has 54 ml of carbon dioxide per 100 ml of blood. In this way each 100 ml of blood takes up just 4 ml of carbon dioxide as it passes through the tissues and gives off 4 ml of CO_2 per 100 ml of blood as it passes through the lungs.

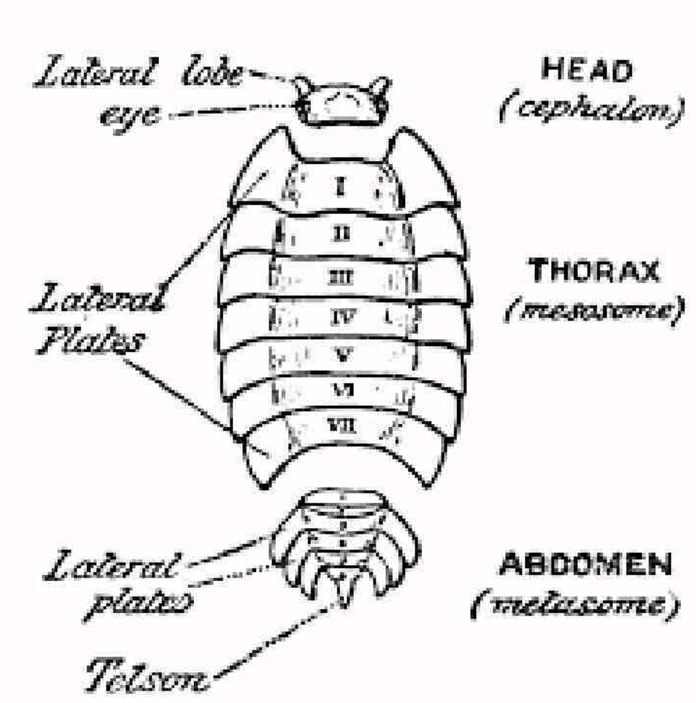
Q:16 What are spiracles? How many pairs of spiracles are present in cockroach?

Ans: Spiracles:

The main tracheal trunk communicates with exterior by 10 pairs of apertures called spiracles.

Pairs of spiracles present in cockroach:

- There are 10 pairs of spiracles in cockroach. These are present on lateral sides of the body.
- 2 pairs are in thorax while 8 pairs are in abdominal segments.



Q:17 What happens when abdominal muscles of cockroach expand and contract?

Ans:

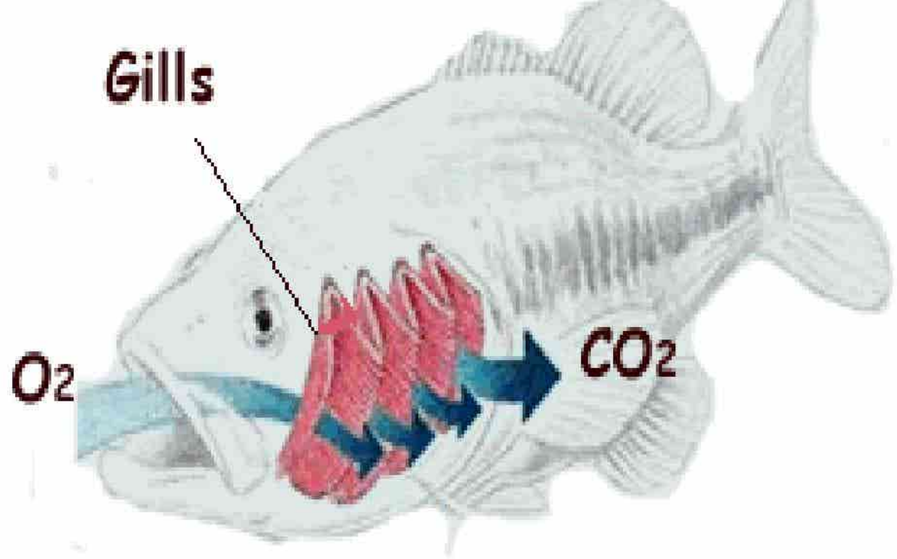
- When abdomen muscles expands, the first four pairs of spiracles open, air rushes in through these spiracles into tracheoles.
- When abdomen muscles contracts, the anterior four pairs of spiracle close and posterior six pairs of spiracle open.

Q:18 What are gills?

Ans: Gills:

Fish respires through the gills which are paired structures present on either side of the body almost at the junction of head and trunk.

- Gills are most effective and highly modified for gaseous exchange in aquatic animals.
- They are in four to five pairs which may open through gill slits and are visible on the surface of pharynx or are placed in bronchial cavities which are covered by operculum.
- Gills have great surface area for gaseous exchange. The gill surface is all the time ventilated by constant flow of water.

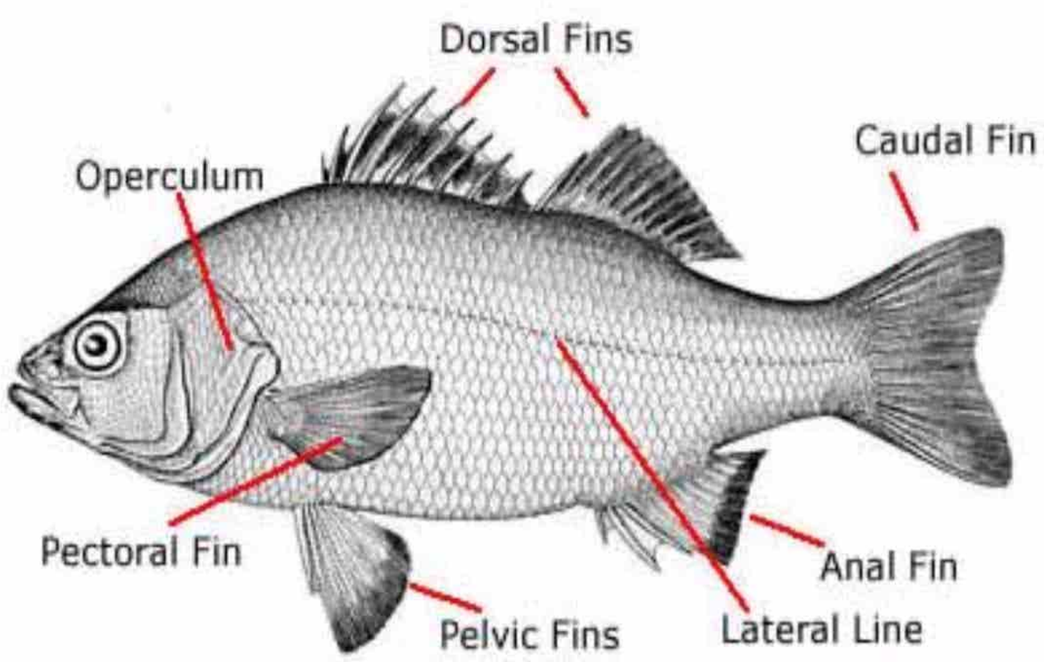


Q:19 What is Operculum?

Ans: Operculum:

Gills are placed in bronchial cavities which are covered by operculum (in bony fish only).

- It protects the gills and also serves a role respiration.
- Operculum are attached to muscles that on movement pump/draw the water inside over to the gills.
- Fish can acquire dissolved oxygen through pumping water over their gills by opening and closing their jaws and opercula. The water is flushed from the fish's mouth over the gills where blood inside capillaries is able to absorb the dissolved oxygen and out the body behind the opercula.



Q:20 What is diving reflex? Write down four changes which take place in the body of diving mammals when diving reflex is activated.

Ans:

Aquatic mammals especially Cetaceous can stay in the depth of the ocean for about two hours without coming up for air. When a mammal dives to its limit, the diving reflex is activated. Following changes occur in their bodies:

- The breathing stops.
- The rate of heart slows down to one tenth of the normal rate.
- The consumption of oxygen and energy is reduced.
- The blood is redistributed but most of the blood goes to the brain and heart which can least withstand anoxia.
- Skin muscles and digestive organs and other internal organs receive very little blood while an animal is submerged because these areas can survive with less oxygen.
- Muscles shift from aerobic to anaerobic respiration.

Q:21 How diving mammals differ from the other animals?

Ans:

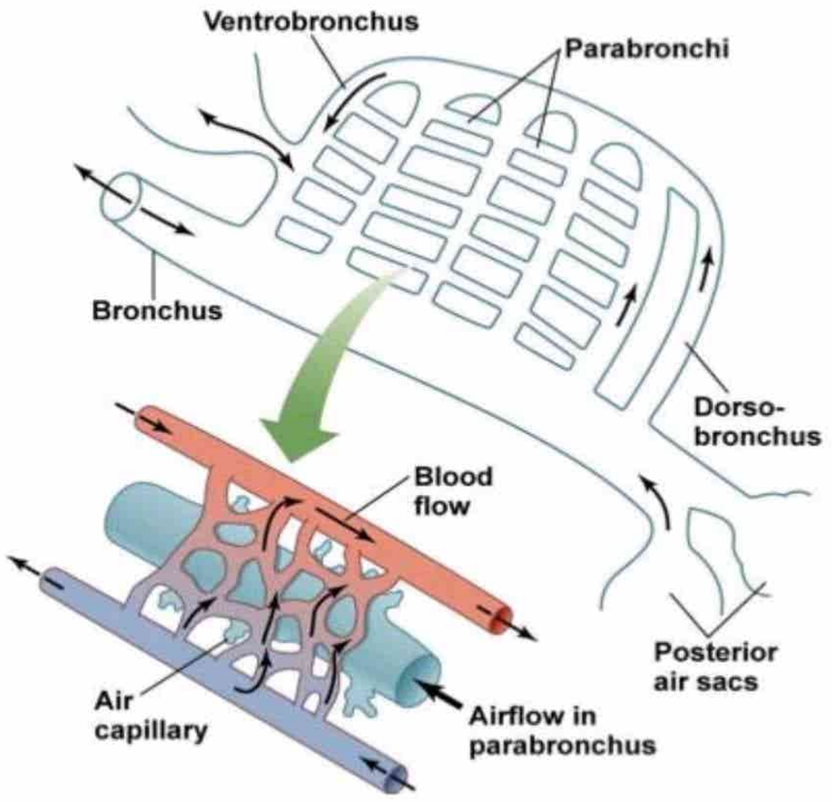
Diving mammals have almost twice the volume of blood in relation to their body weight as compared to non-divers. Most of the diving mammals have high concentration of myoglobin in their muscles. Myoglobin binds extra oxygen and stores it.

Q:22 What are parabronchi?

Ans: Parabronchi:

In the lungs of birds, tiny thin walled ducts called parabronchi are present instead of alveoli.

- These parabronchi are open at both ends and the air is constantly ventilated.
- The walls of parabronchi are chief sites of gaseous exchange.
- The direction of the blood flow in the lungs is opposite to the air flow through the parabronchi. This counter current exchange increases the amount of oxygen which enters the blood.
- Lungs in the birds are very efficient in this respect as well because no stale air remains in the parabronchi.



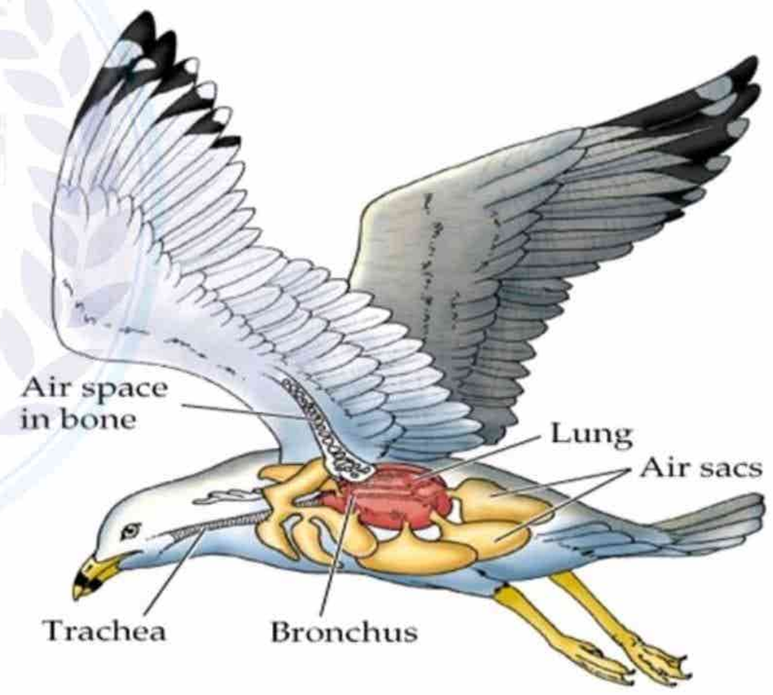
Q:23 Why respiration in birds is specialized than any other animal?

Ans: Respiratory system in birds is the most efficient and elaborate. The birds are very active animals with high metabolic rates, and thus need large amount of oxygen. The respiratory system in the birds is so arranged there is one way flow of air through the lungs and the air is renewed after inspiration.

Q:24 What are air sacs?

Ans: Air Sacs:

The lungs have developed several extensions known as air sacs which reach all parts of the body and even penetrate some of the bones. In most birds, air sacs are nine in number which become inflated by air at atmospheric pressure when the rib articulation is rotated forward and upward. The inflated air sacs act as bellows and send air into the parabronchi for gaseous exchange.



Q:25 What air passage consists of? What is functional unit of lungs?

Ans: Air passage ways consist of nostrils, nasal cavities, pharynx, larynx, trachea, bronchi, bronchioles and alveolar ducts which ultimately lead into alveolar sacs.

Functional unit of lungs:

Air sac is the functional unit of lungs.

Q:26 What is the function of mucous membrane?

Ans: Air enters the nasal cavity through nostril and the larger dust particles are trapped by the hair and mucus in the nostrils. Air, while passing through the nasal cavity, becomes moist, warm and filtered of smaller foreign particles by mucous membrane.

Q:27 Define the following terms Pharynxs, Larynxs, Glottis and Alveoli.

Ans: Pharynx:

The pharynx is a muscular passage lined with mucous membrane. The air is channelized from the pharynx into the larynx.

Larynx:

The larynx or voice box is a complex cartilaginous structure surrounding the upper end of the trachea.

Glottis:

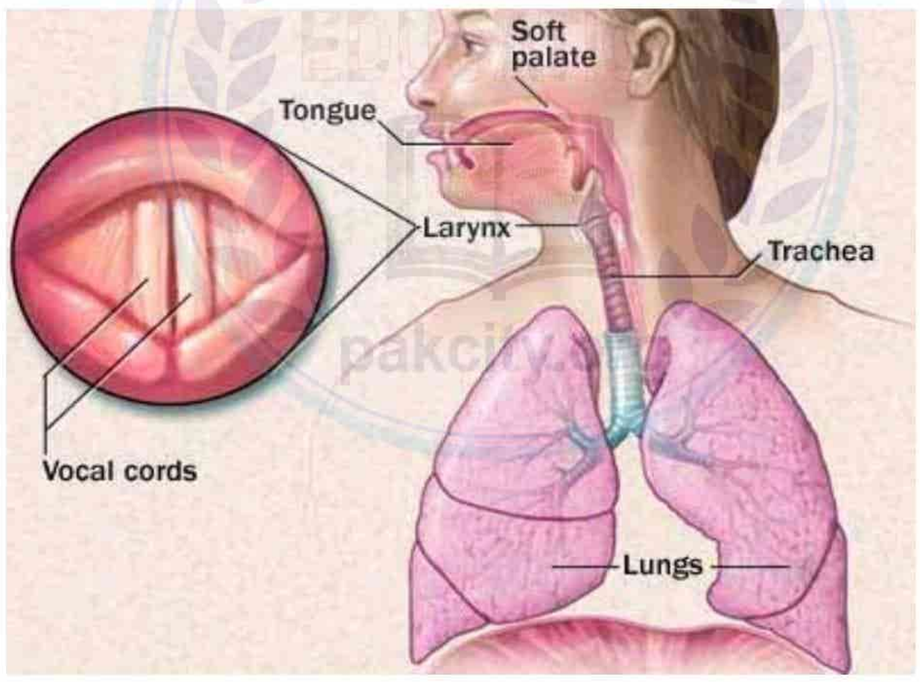
The opening of larynx is called glottis is also lined with mucous membrane.

Alveoli:

Each air sac consists of several microscopic single structures called alveoli.

Q:28 What are vocal cords? What is their purpose?

Ans: In the glottis, the mucous membrane is stretched across into two thin edged fibrous bands called vocal cords, which help in voice production, when vibrated by air.



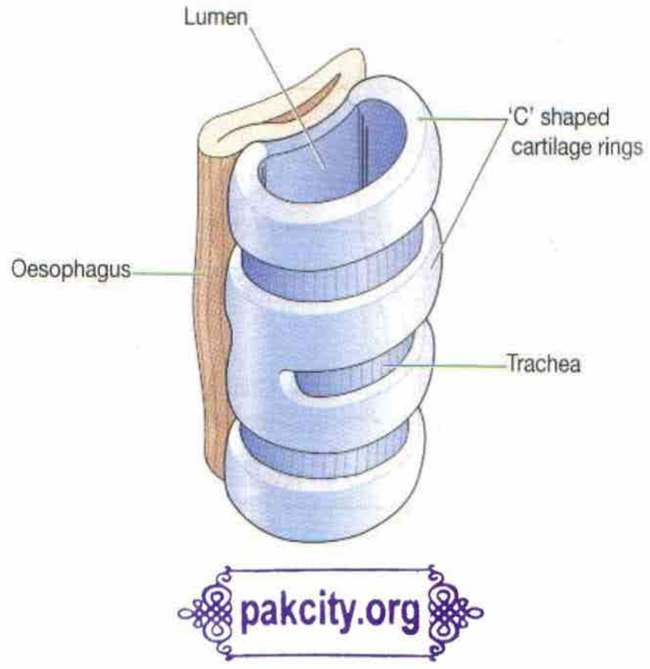
Q:29 How food is prevented from going into respiratory track?

Ans: One of the cartilages, the epiglottis has a muscularly controlled, hinge-like action and serves as a lid which automatically covers the opening of the larynx during the act of swallowing so as to prevent the entry of food or liquids into the larynx.

Q:30 What is trachea? What is the function of cartilage rings in trachea?

Ans: Trachea:

The trachea or wind pipe is a tubular structure lying ventral to the esophagus and extends to the chest cavity or thorax where it is divided into right and left bronchi.

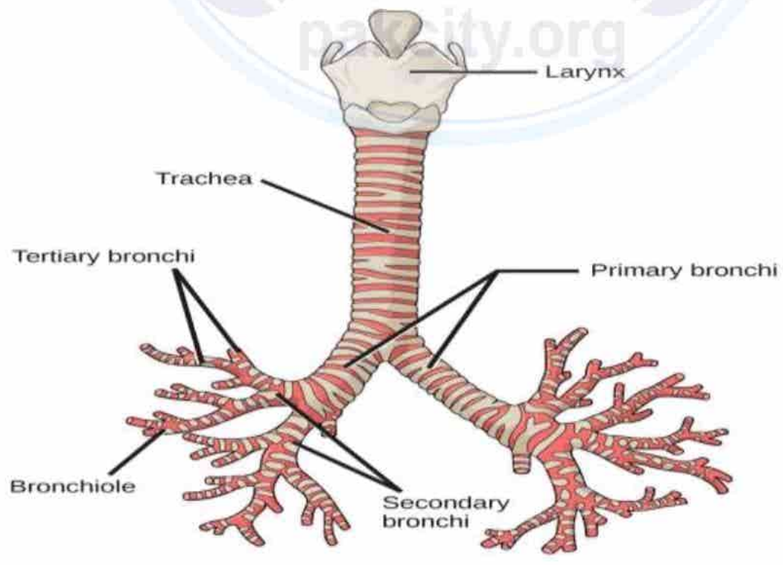


Function of cartilage rings in trachea:

In the wall of trachea there are series of C shaped cartilage rings which prevent the trachea from collapsing and keep the passage of air open.

Q:31 What is the difference between Bronchi and Bronchioles?

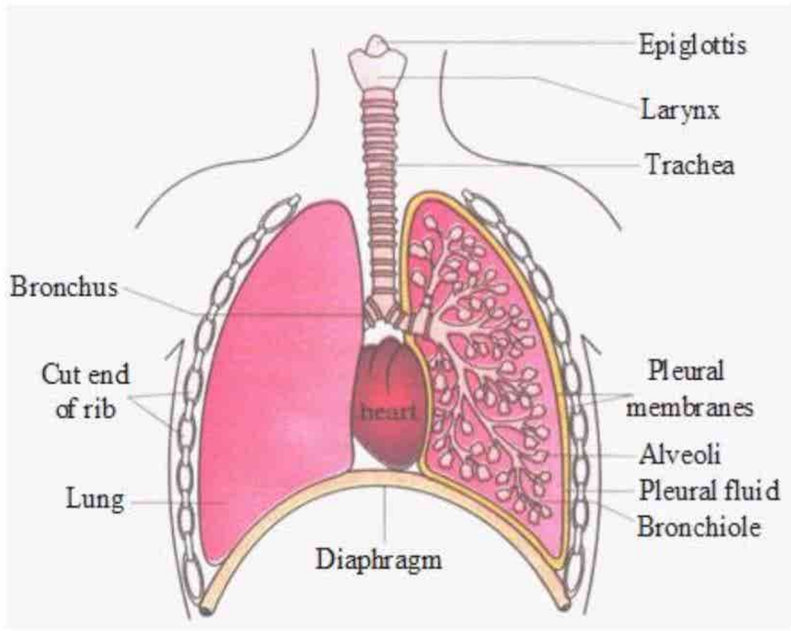
Bronchi	Bronchioles
• Each bronchus on entering the lung divides and subdivides progressively into smaller and smaller bronchi.	• When the smaller bronchi attain a diameter of one mm or less, then they are called bronchioles.
• Bronchi have the same cartilage rings as the trachea, but the rings are progressively replaced by irregularly distributes cartilage plates.	• Bronchioles totally lack cartilages. Bronchioles are made up of mainly circular smooth muscles.
• Bronchi are formed from the primary bronchi.	• Bronchioles are formed from bronchioles.
• Bronchi form bronchioles.	• Bronchioles form alveoli.
• Conducting, warming, and cleaning the air in the respiratory passageway are the major functions of bronchi.	• Conduction, as well as the gas exchange, are the main functions of bronchioles.



Q:32 What are Diaphragm and Pleura?

Ans: Diaphragm:

The floor of the chest is called diaphragm. Diaphragm is a sheet of skeletal muscles that contract and relax for gaseous exchange in lungs.



Pleura:

Lungs are covered with double layered thin membranous sacs called pleura.

Q:33 What are three aspects related to lungs and associated structures?

Ans:

The three aspects related to lungs and associated structures are:

- Lungs are spongy in nature. The lungs themselves neither pull air in nor can they push it out. During inspiration passive expansion of elastic lungs occurs and expiration is due to a passive contraction of lungs.
- The floor of the chest cavity is diaphragm, which is a muscular sheet. The shape of the diaphragm is more domelike when its muscles are relaxed. On the other hand when the muscles of diaphragm contract its shape becomes less domelike.
- Walls of chest cavity are composed of ribs and intercostal muscles. When muscles between ribs contract, the ribs are elevated and when muscles between ribs are relaxed the ribs settle down.

Q:34 Explain respiratory distress syndrome in premature infant.

Ans: In premature infant, respiratory distress syndrome is common, especially for infant with a gestation age of less than 7 months. This occurs because enough infant surfactant is not produced to reduce the tendency of the lungs to collapse.

Q:35 On which factors transport of gases depend?

Ans: Intake of oxygen and release of carbon dioxide by blood passing through capillaries of alveoli is brought by the following factors:

- Diffusion of oxygen in and carbon dioxide out occurs because of difference in partial pressure of these gases.
- Within the rich network of capillaries surrounding the alveoli, blood is distributed in extremely thin layers and, therefore, exposed to large alveolar surface.
- Blood in the large is separated from the alveolar air by extremely thin membranes of the capillaries and alveoli.

Q:36 Differentiate between Haemoglobin and Myoglobin?

Haemoglobin	Myoglobin
• It consists of four polypeptide chains.	• It consists of one polypeptide chain.
• Each molecule possesses four iron containing haem groups.	• Each molecule possesses one iron containing haem groups.
• Four oxygen molecules can bind to each haemoglobin molecule.	• Only one oxygen molecule can bind to each myoglobin molecule.
• It is found in RBCs.	• It is found in muscles.
• It transports oxygen.	• It stores oxygen.
• It has less affinity with oxygen.	• It has more affinity with oxygen.
• It loses oxygen at PO_2 60 mmHg.	• It loses oxygen at PO2 20 mmHg.

Q:37 What adaptations a diver adopt when he descends in the sea?

Ans: As a scuba diver descends in the sea, the pressure of the water on his body prevents normal expansion of the lungs. To compensate, the diver breaths pressurized air from air cylinders, which has a greater pressure than sea level air pressure.

Q:38 What are important factors which affect capacity of haemoglobin to combine with oxygen gas?

Ans: There are three factors which affect the capacity of haemoglobin to combine with oxygen.

- **Carbon Dioxide:** When carbon dioxide pressure increases, the oxygen tension decreases, the capacity of haemoglobin to hold oxygen becomes less. In this way increased carbon dioxide tension favors the greater liberation of oxygen from the blood to the tissue.
- **Temperature:** Rise in temperature also causes a decrease in the oxygen carrying capacity of blood. e.g., in the increased muscular activity.
- **pH:** As the pH of the blood declines, the amount of oxygen bound to haemoglobin also declines. This occurs because of decreased pH results from an increase in hydrogen ions, and the hydrogen ions combine with the protein part of the haemoglobin molecules, causing a decrease in the ability of haemoglobin to bind oxygen, conversely, an increase in blood pH results in an increased ability of haemoglobin to bind oxygen.

Q:39 What is carboxyhaemoglobin? How much percentage of carbon dioxide is carried as carboxyhaemoglobin?

Ans: Carboxyhaemoglobin is formed when carbon dioxide combines with amino group of haemoglobin.

- About 20% of the carbon dioxide is carried as carboxyhaemoglobin.

Q:40 How carbon dioxide is carried as bicarbonate ion?

Ans: About 70% carbon dioxide is carried as bicarbonate ion with sodium in plasma. As carbon dioxide from tissue fluid enters the capillaries it combines to form carbonic acid.

$$CO_2 + H_2O \xrightarrow{\text{Carbonic anhydrase}} H_2CO_3$$

The carbonic acid spits quickly and ionized to produce hydrogen ions and bicarbonate ions.

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

When blood leaves the capillary bed most of the carbon dioxide is in the form of bicarbonate ions. In the lungs bicarbonate ions combine with hydrogen ions to form carbonic acid which splits into water and carbon dioxide. It is this carbon dioxide which diffuses out from the capillaries of the lungs into the space of alveolar sac.

Q:41 What is metastasis? What is malignant tumor? What is cancer?

Ans: Metastasis:

Metastasis is a process that involves the spread of a tumor or cancer to different parts of the body from its original site.

Malignant tumor:

Malignant tumor is a tumor in which cancerous cells transport by means of circulatory system.

Cancer:

Cancer or carcinoma is basically malignant tumor of potentially unlimited growth that expands locally by invasion and systematically by metastasis.

Q:42 What is tuberculosis? How it is caused?

Ans: Tuberculosis: Tuberculosis is a disorder of respiratory system; In fact, it is the general name of a group of diseases caused by Mycobacterium tuberculosis. Pulmonary tuberculosis is a disease of lungs in which inside of the lung is damaged resulting in cough and fever. It is more common in poor people. Malnutrition and poor living conditions facilitate Mycobacterium to grow. The disease is curable with proper medical attention. It is a contagious disease.

Q:43 What is asthma?

Ans: Asthma is a serious respiratory disease associated with severe paroxysm of difficult breathing, usually followed by a period of complete relief, with recurrence of attack at more or less frequent intervals. It is an allergic reaction to pollen, spores, cold, humidity, pollution etc., which manifests itself by spasmodic contraction of small bronchiole tubes. Asthma results in the release of inflammatory chemicals such as histamines into circulatory system that cause severe contraction of the bronchiole.

Q:44 Why there is an increased rate and depth of breathing during exercise?

Ans: At rest we inhale and exhale 15 - 20 times per minute. During exercise breathing rate may rise to 30 times per minute. The increased rate and depth of breathing during exercise allows more oxygen to dissolve in blood and be supplied to the active muscles. The extra carbon dioxide which the muscles put into the blood is removed by deep and fast breathing.

Q:45 What is emphysema?

Ans: Emphysema: Emphysema is a breakdown of alveoli.

- This respiratory problem is more common among smokers.
- The substances present in the smoke of tobacco weaken the alveoli wall.
- The irritant substances of smoke generally cause bursting of weakened of alveoli.
- In the result of constant coughing the absorbing surface of the lung is greatly reduced.
- The person suffering from emphysema cannot oxygenate his blood properly and least exertion makes him breathers and exhausted.
- Emphysema produces increased airway resistance because the bronchioles are abstracted as a result and inflammation and because damaged bronchioles collapse during expiration, trapping air within alveolar sacs.

Q:46 Why the amount of oxygen increase in the blood of birds during gaseous exchange?

Ans: The direction of blood flow in capillaries around the lungs is opposite to that of the airflow through the parabronchi. This counter current exchange increases the amount of oxygen which enters the blood.

Q:47 What are the roles of nasal cavity?

Ans: Nose hairs, mucus and cilia serve as a defense mechanism against the harmful pathogens and solid particulate matter present in air.

1) **Filtration:** When the air enters the nasal cavity trough nostril, the foreign larger dust particles are trapped by the hair/cilia and mucus in the nostrils.
2) **Moistening:** When air passes through the nasal cavity, it becomes moist.
3) **Temperature regulation**: As the air passes through the nasal cavities and lined by the mucus membrane containing blood capillaries the temperature is regulated and becomes closer to the body temperature 30°C depending external temperature. In its functions mucus membrane is also involved.

Q:48 What are the various means of transport of CO_2 in man?

Ans: Means of transport of CO_2:

- As Carboxyhaemogobin: 20 % CO_2 is carried in this form.
- Plasma Protein: 5% of CO_2 is carried by reaction with plasma proteins.
- Potassium: Small amount is carried with potassium.
- As bicarbonate ions: 70 % CO_2 is carried as bicarbonate.