CHAPTER > 17

Breathing and Exchange of Gases

NEET KEY NOTES

- **Respiration** is an oxidative process involving the oxidation of food substances such as carbohydrates, fats and proteins within the tissues to form CO_2, water and consequent release of energy.
- The respiratory system provides the route by which the oxygen present in our environment gains entry into the body and the carbon dioxide is excreted. This whole process of exchange of gases is called **breathing**.

Respiratory Organs

- Different animal groups have evolved different mechanism of breathing for the exchange of gases.
- Lower animal like sponges, cnidarians, platyhelminthes and free-living roundworms exhange O_2 by simple diffusion through body surface.
- Earthworms respire through moist cuticle and insects have a network of tubes (tracheal tubes) to transport atmospheric air within the body.
- Special vascularised structures called **gills** (branchial respiration) are used by most of the aquatic arthropods and molluscs.
- The highly vascularised bags called **lungs** (pulmonary respiration) are used by the terrestrial forms for the exchange of gases, e.g. reptiles, birds and mammals.
- Amphibians (frog) respire through their skin (cutaneous respiration) as well as lungs.

Human Respiratory System

Our respiratory system begins with external nostrils which lead to nasal chamber. The nasal chamber then proceeds to following structures tabulated below

Structure	Characteristics
Pharynx	• Common passage for food and air.
Larynx	• Cartilaginous, sound box which helps in sound production. • Entry of food into larynx during swallowing is prevented by **epiglottis**. It is a thin cartilaginous flap which covers the glottis of larynx.
Trachea	• Pharynx opens into it through larynx region. • Straight tube extending up to mid thoracic cavity. • Bifurcates at the level of 5th thoracic vertebra.
Bronchi	• Two in number, undergo repeated divisions to form secondary, tertiary bronchi and terminal **bronchioles**. These are formed by the bifurcation of trachea.
Alveoli	• Thin, irregular-walled, vascularised bag-like structure at the terminal ends of bronchioles.
Lungs	• Constitute branching network of bronchi, bronchioles and alveoli. • Covered by double-layered pleura with pleural fluid between them. • Air tight chamber, formed dorsally by vertebral column, ventrally by sternum, laterally by ribs and on lower side, diaphragm is present.

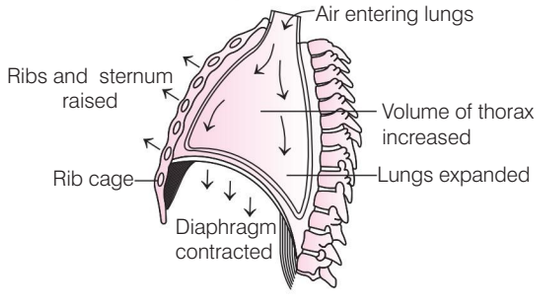
- The human respiratory system consists of two parts, i.e. **conducting** and **exchanging portions**. The former helps to transport atmospheric air to the alveoli, cleaning and humidifying.

- The latter is the actual site of O_2 and CO_2 diffusion between blood and atmospheric air.
- The conducting portion consists of **nostrils, pharynx, larynx, trachea** and **bronchi**, while exchanging portion consists of **alveoli** and **their ducts**.

Mechanism of Breathing

- Breathing or Pulmonary ventilation occurs in two stages, i.e. **inspiration** and **expiration**.
- During **inspiration** (active process), air enters in lungs from the atmosphere and during **expiration** (passive process), air is released out from the lungs. Both these processes are carried out by creating a pressure gradient of between lungs and atmosphere.
- During **inspiration**, diaphragm and intercostal muscles contract, causing an increase in the volume of thoracic chamber.
- This overall increase in the thoracic volume, causes a similar increase in pulmonary volume. As a result, there occurs a decrease in the intrapulmonary pressure. The greater atmospheric pressure outside the body now causes air to flow rapidly into lungs.

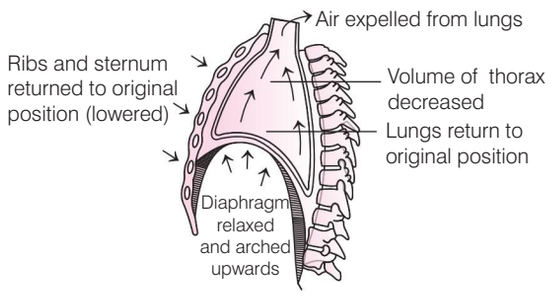
Contraction of diaphragm and external intercostal muscles



Inspiration

- During **expiration**, diaphragm and intercostal muscles relax and decrease the volume of thoracic chamber and thereby pulmonary volume. At this moment, the intrapulmonary pressure is slightly above the atmospheric pressure.
- This in turn causes the expulsion of the air from the lungs. The process of expiration is simpler than inspiration.

Relaxation of diaphragm and external intercostal muscles



Expiration

Respiratory Volumes and Capacities

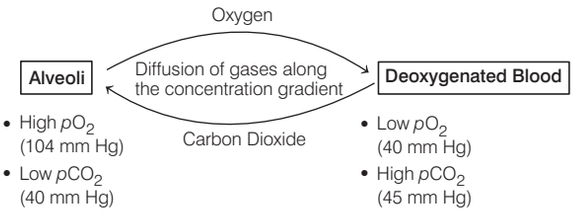
- The quantity of air, the lungs can receive, hold or expel under different conditions are called **respiratory** (or pulmonary) **volumes.** Combination of two or more pulmonary volumes are called **respiratory** (pulmonary) **capacities.**
- Different types of respiratory volumes and respiratory capacities are tabulated below

Respiratory Volumes		
Tidal volume	Volume of air inspired or expired during a normal respiration	500 mL
Inspiratory Reserve Volume (IRV)	Additional volume of air, a person can inspire by a forcible inspiration	2500-3000 mL
Expiratory Reserve Volume (ERV)	Additional volume of air, a person can expire by a forcible expiration	1000-1100 mL
Residual Volume (RV)	Remaining volume of air in lungs after a forcible expiration	1100-1200 mL
Respiratory Capacity		
Inspiratory Capacity (IC)	Total volume of air, a person can inspire after normal expiration	TV + IRV = 3500 mL
Expiratory Capacity (EC)	Total volume of air, a person can expire after normal inspiration	TV + ERV = 1600 mL
Functional Residual Capacity (FRC)	Volume of air that will remain in lungs after normal expiration	ERV + RV = 2300 mL
Vital Capacity (VC)	Maximum volume of air, a person can breathe after forced expiration	ERV + TV + IRV = 4600 mL
Total Lung Capacity (TLC)	Total volume of air accommodated in the lungs at the end of a forced inspiration	VC + RV or RV + ERV + TV + IRV = 5800 mL

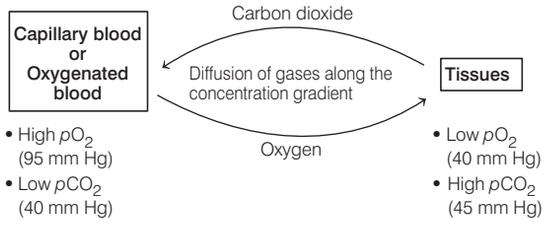
Exchange of Gases

- The primary site for **gaseous exchange** is **alveoli**.
- Gaseous exchange takes place by **simple diffusion** mainly based on pressure concentration gradient.
- Solubility of gases and thickness of membranes affect the rate of diffusion. Pressure contributed by individual gas in mixture of gases is called **partial pressure**.
- The solubility of CO_2 is 20-25 times higher than that of O_2, therefore CO_2 diffuses faster than O_2 across diffusion membrane.
- Diffusion membrane (less than 1 mm thick) is made up of three layers
  - Thin squamous epithelium of alveoli
  - Endothelium of alveloar capillary
  - Basement membrane

- Gaseous exchange occurs at two levels, i.e. (i) between alveoli and blood (external respiration) and (ii) between blood and tissue cells (internal respiration).
  - Exchange of gases between alveoli and blood.



  - Exchange of gases between blood and tissue cells.



Transport of Gases

- Blood carries oxygen from the lungs to tissue cells for oxidation and carbon dioxide from the tissue cells to the respiratory surface for elimination.
- Blood is the medium of transport for O_2 and CO_2.

Transport of Oxygen

- About 97% of O_2 is transported as **oxyhaemoglobin** by RBCs in the blood. The remaining 3% of O_2 is carried in a dissolved state through the plasma.
- The percentage of haemoglobin that is bound with O_2 is called **percentage saturation of haemoglobin**.
- The relationship between percentage saturation of haemoglobin in blood and oxygen tension is called **Oxygen Dissociation Curve** (ODC). This curve is always sigmoid in shape.
- In the alveoli, high pO_2, low pCO_2, less H^+ and low temperature favour the formation of oxyhaemoglobin (the curve shifts to right).
- In the tissues, reverse of above conditions, favour the dissociation of O_2 from oxyhaemoglobin (shifting the curve to left). Every 100 mL of oxygenated blood deliver around 5 mL O_2 to tissues under normal conditions.

Transport of Carbon Dioxide

- CO_2 is transported from the tissues to blood mainly as
  - Bicarbonate ion in plasma and erythrocytes (about 70%).
  - Partly as **carbaminohaemoglobin**, which is formed in the RBCs by combination of CO_2 and reduced haemoglobin (about 20-25%).
  - 7% CO_2 is carried in dissolved state through plasma.
- High pCO_2 and low pO_2 (as in tissues) favours binding of CO_2 to Hb while low pCO_2 and high O_2 in alveoli favours dissociation of CO_2 from carbaminohaemoglobin. These reactions are favoured by the enzyme carbonic anhydrase.

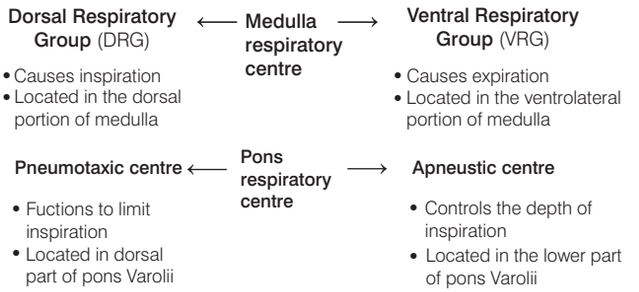
$$CO_2 + H_2O \underset{\text{anhydrase}}{\overset{\text{Carbonic}}{\rightleftharpoons}} \underset{\text{Carbonic acid}}{H_2CO_3} \underset{\text{anhydrase}}{\overset{\text{Carbonic}}{\rightleftharpoons}} HCO_3^- + H^+$$

- Carbonic acid breaks into HCO_3^- and H^+. The bicarbonates diffuse into blood plasma along the concentration gradient.
- During transport of CO_2, exit of bicarbonate ions considerably changes ionic balance between the **plasma** and the **erythrocytes**.
- To restore the ionic balance chloride ions diffuses from plasma into erythrocytes. This movement of Cl^- ions is called as chloride shift or H**amburger'**s p**henomenon**.
- Every 100 mL of deoxygenated blood delivers 44 mL of CO_2 to the alveoli.

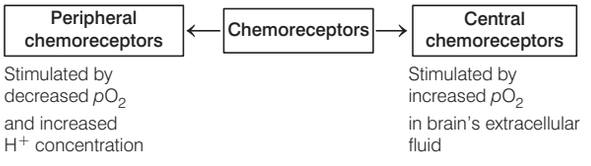
Regulation of Respiration

Process of respiration is under both nervous and chemical controls

- **Neural regulation** The group of neurons located in the medulla oblongata and pons Varolii acts as the respiratory centre which is composed of groups of neurons. Hence, respiratory centre is divided into the m**edullar**y r**espiratory centre** and **pons respiratory centre**.



- **Chemical regulation** It includes the effect of CO_2, O_2 and H^+ concentration in blood. Its receptors are located in **carotid bodies** (largest number), **aortic bodies** and in brain. Carotid bodies and aortic bodies are the **peripheral chemoreceptors**, whereas these located in brain are called **central chemoreceptors**.



Disorders of Respiratory System

Common respiratory disorders are tabulated below

Disorder	Characteristics
Asthma	• Difficulty in breathing • Wheezing due to the inflammation of bronchi and bronchioles.
Emphysema	• Decreased respiratory surface due to damaged alveolar walls. • Mainly caused due to cigarette smoking.
Occupational respiratory disorder	• Mainly caused due to long exposure to grinding or stone breaking. • Inflammation leading to fibrosis of lungs • Protective marks can reduce the risk.

Mastering NCERT

MULTIPLE CHOICE QUESTIONS

TOPIC 1 ~ *Respiratory Organs*

1 Oxygen (O_2) is utilised by an organism to
(a) directly breakdown the nutrient molecules
(b) indirectly breakdown the nutrient molecules
(c) obtain nourishment from the food
(d) burn the organic compounds indirectly

2 Process of exchange of O_2 from the atmosphere with CO_2 produced by the cells is called
(a) breathing (b) respiration
(c) Both (a) and (b) (d) exhalation

3 Mechanism of breathing and the organs involved varies among different groups of animals. This difference depends on
(a) habitats (b) shape and size
(c) levels of organisation (d) Both (a) and (c)

4 The organ in reptiles, which can be considered as analogous to the gills of fishes is/are
(a) spiracles (b) dry skin
(c) lungs (d) trachea

5 Correct sequence of the air passage in humans is
(a) Nose → Larynx → Pharynx → Bronchioles → Alveoli
(b) Nose → Pharynx → Larynx → Bronchioles → Bronchi
(c) Nose → Pharynx → Larynx → Bronchioles → Trachea
(d) External nostril → Nasal passage → Internal nostril → Pharynx → Larynx → Trachea → Bronchi → Bronchiole → Alveoli

6 Nasopharynx opens through the larynx region into the
(a) trachea (b) glottis
(c) lungs (d) sound box

7 Which portion of the human respiratory system is called sound box?
(a) Larynx (b) Trachea
(c) Nasopharynx (d) Glottis

8 Larynx is present in between
(a) epiglottis and glottis (b) trachea and bronchiole
(c) epiglottis and trachea (d) bronchus and epiglottis

9 A thin, elastic cartilaginous flap which prevents the entry of food into larynx during swalloing is
(a) epiglottis (b) glottis (c) bronchi (d) prethoracic

10 At which thoracic vertebra does trachea divide into right and left primary bronchi?
(a) 5 (b) 6 (c) 9 (d) 4

11 Bronchioles are formed by
(a) protoplasmic extension of trachea
(b) structural modification of pleural membrane
(c) repeated division of bronchi
(d) calcification of pleural membrane

12 The function of incomplete cartilaginous rings in human respiratory system is to
(a) protect alveoli from foreign molecules
(b) support trachea, bronchi and initial bronchioles
(c) harden the terminal ends of bronchioles
(d) interconnect bronchioles and alveoli

13 Alveoli in human lungs are
(a) thick-walled, terminal ends of bronchioles
(b) polygonal, thin, non-vascularised bag-like structure
(c) not supplied by blood and are non-functional
(d) thin-walled, vascularised irregular walled structures

14 The lungs of human comprises
(a) bronchi (b) bronchioles
(c) alveoli (d) All of these

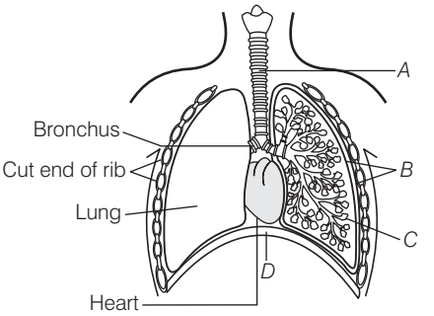
15 The fluid which reduces the friction on the lungs surface is present
(a) in between double-layered pleura
(b) within single-layered pleura
(c) in between cuticle layer over lungs
(d) within mucous membrane surrounding the lungs

16 Conducting part of the respiratory system comprises
(a) external nostrils up to the terminal bronchioles
(b) internal nostrils up to trachea
(c) epiglottis up to trachea
(d) larynx up to bronchi

17 Respiratory or exchange part of the respiratory system comprises
(a) lungs and pleural membrane
(b) alveoli and their ducts
(c) bronchus and their protecting covering
(d) diaphragm and alveoli

18 The dorsal, ventral, lateral and lower side of thoracic chamber is bounded by
(a) vertebral column, sternum, ribs, diaphragm
(b) vertebral column, ribs, sternum, diaphragm
(c) diaphragm, ribs, sternum, vertebral column
(d) ribs, diaphragm, sternum, vertebral column

19 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. ***NEET 2013***



(a) A–trachea–long tube supported by complete cartilaginous rings for conducting inspired air
(b) B–pleural membrane–surround ribs on both sides to provide cushion against rubbing
(c) C–alveoli–thin-walled vascular bag-like structures for exchange of gases
(d) D–lower end of lungs–diaphragm pulls it down during inspiration

20 In humans, which of the following is not a step in respiration?
(a) Alveolar diffusion of O_2 and CO_2
(b) Transport of gases by blood
(c) Diffusion of O_2 and CO_2 between blood and tissues
(d) Utilisation of CO_2 by cells for catabolic reactions

TOPIC 2 ~ *Mechanism of Breathing and Pulmonary Volumes*

21 Movement of the air into and out of the lungs is carried out by
(a) imbibition (b) pressure gradient
(c) osmosis (d) diffusion

22 Inspiration is initiated by
(a) the extension of diaphragm
(b) the contraction of diaphragm
(c) decrease in volume of thoracic chamber
(d) the contraction of lungs

23 Decreased intrapulmonary pressure during inspiration is caused due to
(a) increased pulmonary volume and thoracic volume
(b) contraction of intercostal muscles
(c) upliftment of ribs and sternum
(d) All of the above

24 Expiration occurs when
(a) intrapulmonary pressure is less than the atmospheric pressure
(b) intrapulmonary pressure is greater than the atmospheric pressure
(c) intrapulmonary pressure is equal to the atmospheric pressure
(d) intrapleural pressure becomes more than the intra-alveolar pressure

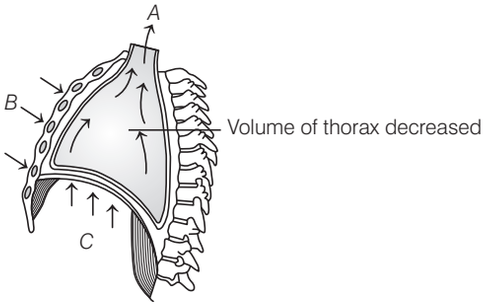
25 Which of the following changes occurs in diaphragm and intercostal muscles when expiration of air takes place?
(a) External intercostal muscles relax and diaphragm contracts
(b) External intercostal muscles contract and diaphragm relaxes
(c) External intercostal muscles and diaphragm relax
(d) External intercostal muscles and diaphragm contract

26 During expiration,
(a) thoracic volume increases and diaphragm contracts
(b) intrapulmonary pressure increases above atmospheric pressure
(c) sternum is present at normal position
(d) Both (b) and (c)

27 Additional muscles which impact the ability of humans to increase the strength of inspiration and expiration are found in

(a) chest (b) diaphragm
(c) abdomen (d) lungs

28 In the given diagram of mechanism of breathing, what does *A*, *B* and *C* depict?



(a) A–Air goes inside to lungs, B–Ribs and sternum returned to original position, C– Diaphragm contracted
(b) A–Air expelled from lungs, B–Ribs and sternum returned to original position, C–Diaphragm relaxed and arched upward
(c) A–Air expelled from lungs, B–Ribs and sternum go upward, C–Diaphragm relaxed and arched upward
(d) A–Air goes inside to lungs, B–Ribs and sternum go upward, C–Diaphragm relaxed and arched upward

29 Tidal volume is

(a) volume of air inspired or expired in normal breathe
(b) additional volume of air, a person can inspire by a forcible inspiration
(c) additional volume of air, a person can expire by a forcible expiration
(d) remaining volume of air in the lungs even after a forcible expiration

30 Approximate volume of air, a healthy man can inspire or expire per minute is

(a) 5000 to 6000 mL (b) 6000 to 7000 mL
(c) 6000 to 8000 mL (d) 7000 to 9000 mL

31 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? ***NEET (National) 2019***

(a) 1700 mL (b) 2200 mL
(c) 2700 mL (d) 1500 mL

32 Additional volume of air, a person can inspire and expire by forcible inspiration and expiration, respectively is called

(a) TV (b) IRV and ERV
(c) IC and EC (d) FRC

33 Lungs are made up of air-filled sacs, the alveoli. They do not collapse even after forceful expiration, because of ***NEET 2017***

(a) Residual Volume (RV)
(b) Inspiratory Reserve Volume (IRV)
(c) Tidal Volume (TV)
(d) Expiratory Reserve Volume (ERV)

34 The maximum volume of air, a person can breathe in after a forced expiration is known as ***NEET (Odisha) 2019***

(a) expiratory capacity
(b) vital capacity
(c) inspiratory capacity
(d) total lung capacity

35 After forceful inspiration, the amount of air that can be breathed out by maximum forced expiration is equal to

(a) IRV + ERV + TV + RV
(b) IRV + RV +ERV
(c) IRV +TV + ERV
(d) TV + RV + ERV

36 Total lung capacity is

(a) total volume of air accommodated in lungs at the end a forced inspiration
(b) RV + ERV + TV+ IRV
(c) vital capacity + residual volume
(d) All of the above

TOPIC 3 ~ *Exchange of Gases*

37 Primary site of the gaseous exchange in humans is

(a) lungs
(b) alveoli
(c) bronchus
(d) diaphragm

38 In humans, exchange of gases occurs

(a) by diffusion
(b) between blood and tissue
(c) between alveoli and pulmonary blood capillary
(d) All of the above

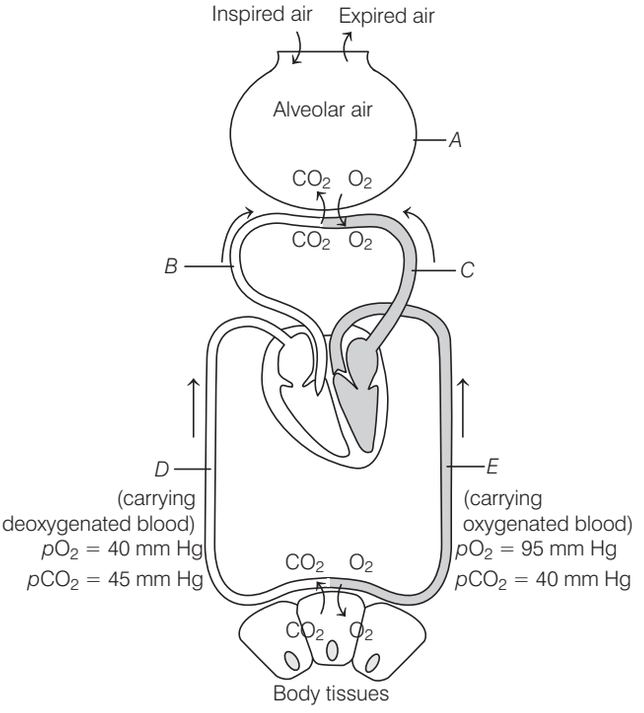
39 Factors affecting the rate of diffusion is/are

(a) pressure gradient (b) solubility of gases
(c) thickness of membranes (d) All of these

40 The partial pressure of oxygen in the alveoli of the lungs is ***NEET 2016***

(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

41 Identify *A* to *E* in the given diagram and choose the correct option accordingly.



(a) A–Alveolus, B–Pulmonary artery, C–Pulmonary vein, D–Systemic vein, E–Systemic arteries

(b) A–Alveolus, B–Pulmonary vein, C–Pulmonary artery, D–Systemic vein, E–Systemic arteries

(c) A–Alveolus, B–Pulmonary vein, C–Pulmonary artery, D–Systemic arteries, E–Systemic vein

(d) A–Alveolus, B–Pulmonary vein, C–Pulmonary artery, D–Systemic arteries, E–Portal vein

42 Which vein contains the oxygenated blood in humans?

(a) Cardiac vein (b) Hepatopancreatic

(c) Portal vein (d) Pulmonary vein

43 Name the artery which carries deoxygenated blood.

(a) Pulmonary artery

(b) Pulmonary trunk

(c) Systemic artery

(d) Vena cava

44

Pressure of Gases	Systemic Veins	Systemic Arteries
O_2	40 mm Hg	95 mm Hg
CO_2	*A*	*B*

Choose the correct option for *A* and *B* to complete the given data.

(a) A– 45 mm Hg; B– 40 mm Hg

(b) A– 45 mm Hg; B– 45 mm Hg

(c) A– 45 mm Hg; B– 50 mm Hg

(d) A– 45 mm Hg; B– 55 mm Hg

45 Partial pressure of O_2 and CO_2 in atmospheric air as compared to that in alveolar air is

pO_2	pCO_2
(a) Higher	Lower
(b) Higher	Higher
(c) Lower	Lower
(d) Lower	Higher

46 Almost same pCO_2 in humans is found in

(a) oxygenated blood and tissues

(b) deoxygenated blood and oxygenated blood

(c) deoxygenated blood and tissues

(d) All of the above

47 Almost same pO_2 in humans is found in

(a) alveoli and tissues

(b) oxygenated blood and deoxygenated blood

(c) alveoli and oxygenated blood

(d) tissues and deoxygenated blood

48 Which of the following would have the same O_2 content?

(a) Blood entering the lungs – Blood leaving the lungs

(b) Blood entering the right side of the heart – Blood leaving the right side of the heart

(c) Blood entering the right side of the heart – Blood leaving the left side of the heart

(d) Blood entering the tissue capillaries – Blood leaving the tissue capillaries

49 The solubility of CO_2 in the blood is

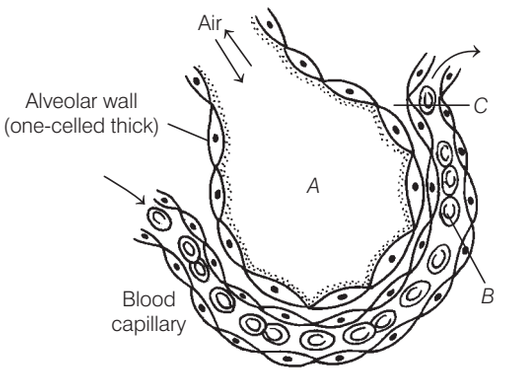
(a) 10-15 times higher than that of O_2

(b) 20-25 times higher than that of O_2

(c) slightly higher than that of O_2

(d) slightly lower than that of O_2

50 Identify *A*, *B* and *C* in the given diagram and choose the correct option accordingly.



(a) A–Alveolar cavity, B–WBC, C–Capillary wall

(b) A–Alveolar cavity, B–RBC, C–Systemic wall

(c) A–Alveolar cavity, B–RBC, C–Basement membrane

(d) A–Alveolar cavity, B–WBC, C–Systemic wall

51 How many layers are present in the diffusion membrane of alveolus capillary?
(a) 5
(b) 3
(c) 2
(d) 4

52 Alveoli of the lungs are lined by
(a) simple epithelium
(b) squamous epithelium
(c) cuboidal epithelium
(d) ciliated epithelium

53 After its uptake by the body tissues, a large proportion of oxygen still remain unused. This oxygen is used for/as
(a) raising the pCO_2 of alveoli to 40 mm Hg
(b) reserve to compensate O_2 during heavy exercise
(c) releasing O_2 to body tissues
(d) maintaining oxyhaemoglobin saturation

54 The total thickness of the diffusion membrane of alveolus capillary is
(a) less than 1 cm (b) less than 2 cm
(c) less than 1 mm (d) more than 1 mm

TOPIC 4~ *Transport of Gases*

55 What percentage of O_2 is transported by RBCs and plasma, respectively in human body?
(a) 50, 50
(b) 97, 3
(c) 90, 10
(d) 80, 20

56 Approximately 70% of carbon dioxide absorbed by the blood will be transported to the lungs
CBSE-AIPMT 2014
(a) as bicarbonate ions
(b) in the form of dissolved gas molecules
(c) by binding to RBC
(d) as carbaminohaemoglobin

57 Blood carries the CO_2 in three forms. The correct percentages of CO_2 in these forms are

	As carbamino haemoglobin in RBC	As bicarbonates	Dissolved form in plasma
(a)	20–25%	70%	7%
(b)	70%	20–25%	7%
(c)	20–25%	7%	70%
(d)	7%	20–25%	70%

58 Each haemoglobin molecule can carry
(a) two molecules of O_2
(b) three molecules of O_2
(c) four molecules of O_2
(d) one molecule of O_2

59 The shape of oxygen dissociation curve plotted between % saturation of Hb with O_2 and pO_2 is
(a) sigmoid
(b) J-shaped
(c) exponential, consisting of three phases
(d) hyperbolic

60 Oxyhaemoglobin dissociation at the tissues occurs under
(a) low pO_2 and low pCO_2
(b) low pO_2, high pCO_2 and high H^+
(c) high pO_2, low H^+ and low pCO_2
(d) low pO_2, low H^+ and high pCO_2

61 Which situation would result in the greatest degree of O_2 saturation for haemoglobin, if pO_2 remains constant?
(a) Increased CO_2 level, decreased temperature
(b) Decreased CO_2 level, decreased temperature
(c) Increased CO_2 level, increased temperature
(d) Decreased CO_2 level, increased temperature

62 Under normal conditions, what amount of O_2 is delivered by 100 mL of the oxygenated blood?
(a) 5 mL (b) 4 mL (c) 3 mL (d) 2 mL

63 When you hold your breathe, which of the following gas changes in blood would first lead to the urge to breathe?
(a) Falling CO_2 concentration
(b) Rising O_2
(c) Falling O_2 concentration
(d) Rising CO_2 concentration

64 What will be the pO_2 and pCO_2 in the atmospheric air compared to those in the tissue fluid when not breathing?
(a) pO_2 lesser, pCO_2 higher (b) pO_2 higher, pCO_2 lesser
(c) pO_2 higher, pCO_2 higher (d) pO_2 lesser, pCO_2 lesser

65 Transport of CO_2 by the blood is primarily dependent upon
(a) solubility of CO_2 in blood
(b) carbonic anhydrase
(c) binding of haemoglobin to CO_2
(d) binding of haemoglobin to O_2

66 $CO_2 + H_2O \overset{A}{\rightleftharpoons} H_2CO_3 \overset{B}{\rightleftharpoons} HCO_3^- + H^+$

Name the enzymes *A* and *B* in the above equation.

(a) A–Carbonic anhydrase; B–Carbonic hydratase
(b) A–Carbonic hydratase; B–Carbonic anhydrase
(c) A–Carbonic anhydrase; B–Carbonic anhydrase
(d) A–Carbonic hydratase; B–Carbonic hydratase

67 Which of the following equations is correct?

(a) $KHbO_2 + H^+ \underset{RBC}{\rightleftharpoons} Hb + K + H_2O$

(b) $Hb + O_2 \underset{\text{Dissociation in lungs}}{\overset{\text{Association in tissues}}{\rightleftharpoons}} HbO_2$

(c) $Na^+ + HCO_3^- \underset{\text{Erythrocyte}}{\rightleftharpoons} NaHCO_3$

(d) $HbO_2 \underset{\text{Association in lungs}}{\overset{\text{Dissociation in tissues}}{\rightleftharpoons}} Hb + O_2$

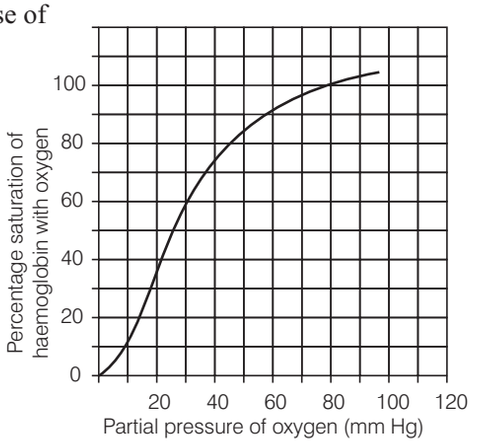
68 People who have migrated from the planes to an area adjoining Rohtang pass about six months back ***CBSE-AIPMT 2012***

(a) have more RBCs and their haemoglobin has a lower binding affinity to O_2
(b) are not physically fit to play games like football
(c) suffer from altitude sickness with symptoms like nausea, fatigue, etc
(d) have the usual RBC count but their haemoglobin has very high binding affinity to O_2

69 What is Bohr's effect?

(a) A rise in levels of pCO_2 or fall in pH decreases the oxygen affinity of haemoglobin
(b) Decrease in levels of pCO_2 or fall in pH decreases the oxygen affinity of haemoglobin
(c) A rise in levels of pCO_2 or increase in pH decreases the oxygen affinity of haemoglobin
(d) Shifting of the oxygen-haemoglobin curve to left

70 Shifting of the given curve to right takes place in the case of



(a) raise in pCO_2 (b) fall in pH
(c) raise in temperature (d) All of these

71 When you hold your breathe which of the following gas changes in blood would first lead to the urge to breathe? ***CBSE-AIPMT 2015***

(a) Falling O_2 concentration
(b) Rising CO_2 concentration
(c) Falling CO_2 concentration
(d) Rising CO_2 and falling O_2 concentration

72 Blood does not become acidic although it carries CO_2 because

(a) CO_2 is continuously diffused through tissues
(b) CO_2 combines with H_2O to form H_2CO_3
(c) in CO_2 transport, buffer plays an important role
(d) CO_2 is absorbed by WBC

73 Reduction of pH of blood will ***NEET 2016***

(a) reduce the blood supply to the brain
(b) decrease the affinity of haemoglobin with oxygen
(c) release bicarbonate ions by the liver
(d) reduce the rate of heartbeat

TOPIC 5 ~ *Regulation of Respiration and Disorder of Respiratory System*

74 Human beings have a significant ability to maintain and moderate the respiratory rhythm to suit the demands of the body tissues. This is achieved by

(a) arterial system
(b) systemic vein system
(c) neural system
(d) cardiac system

75 Which part of the brain is called respiratory rhythm centre?

(a) Cerebellum region (b) Brain stem region
(c) Medulla region (d) Temporal region

76 Pneumotaxic centre of the brain, i.e. pons region can

(a) moderate the function of respiratory system
(b) decrease the heart rate
(c) increase the heart rate
(d) increase the flow of blood

77 A chemosensitive area found adjacent to the rhythm centre in the brain is highly sensitive to the increased concentration of

(a) CO_2
(b) O_2
(c) H^+
(d) Both (a) and (c)

78 Receptors in aortic arch and carotid arch recognise the changes in the concentration of
(a) OH^- and H^+
(b) O_2 and CO_2
(c) CO_2 and H^+
(d) blood circulation

79 Which of the following gases is quite insignificant for the regulation of respiration rhythm?
(a) SO_2 (b) N_2 (c) CO (d) O_2

80 Due to increasing airborne allergens and pollutants, many people in urban areas are suffering from respiratory disorder causing wheezing due to
NEET (National) 2019
(a) inflammation of bronchi and bronchioles
(b) proliferation of fibrous tissues and damage of the alveolar walls
(c) reduction in the secretion of surfactants by pneumocytes
(d) benign growth on mucous lining of nasal cavity

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

82 Name the chronic respiratory disorder caused mainly by cigarette smoking ***NEET 2016***
(a) asthma (b) respiratory acidosis
(c) respiratory alkalosis (d) emphysema

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

84 Occupational respiratory disorders can be prevented by
(a) the intake of antihistamine tablets daily
(b) avoid areas with increased levels of dust and smoke areas
(c) wearing protective masks
(d) All of the above

NEET

SPECIAL TYPES QUESTIONS

I. Assertion and Reason

■ **Direction** (Q. No. 85-94) *In each of the following questions, a statement of Assertion (A) is given by corresponding statement of Reason (R). Of the statements, mark the correct answer as*
(a) If both A and R are true and R is the correct explanation of A
(b) If both A and R are true, but R is not the correct explanation of A
(c) If A is true, but R is false
(d) If A is false, but R is true

85 **Assertion** (A) Trachea and bronchioles are supported by cartilaginous ring.
Reason (R) Trachea can collapse during expiration.

86 **Assertion** (A) Mammals perform negative pressure breathing.
Reason (R) Using muscular movement, mammals create a pressure gradient so that they can perform inspiration and expiration.

87 **Assertion** (A) CO_2 transport occurs very fast through RBCs.
Reason (R) Enzyme carbonic anhydrase is absent in the blood plasma.

88 **Assertion** (A) The higher amount of CO_2 can diffuse through diffusion membrane per unit difference in partial pressure as compared to O_2.
Reason (R) Solubility of CO_2 is 20-25 times higher than that of O_2.

89 **Assertion** (A) Humans can swin and breathe inside water.
Reason (R) Respiratory organ of humans is lungs.

90 **Assertion** (A) pO_2 is the highest in alveoli.
Reason (R) Partial pressure of a gas is the pressure contributed by individual gas in a mixture.

91 **Assertion** (A) Blood oxygen does not have significant effect on the respiratory centre of brain.
Reason (R) Increased pCO_2 and H^+ levels detected by chemoreceptors activate the respiratory centres to mediate the necessary adjustments.

92 **Assertion** (A) Bohr's effect occurs at the level of alveoli of lungs.
Reason (R) It occurs when high concentration of CO_2 decreases the affinity of haemoglobin to oxygen.

93 **Assertion** (A) High carbon monoxide (CO) levels can kill a person.
Reason (R) CO has greater affinity for haemoglobin.

94 **Assertion** (A) In normal breathing, inspiration is an active process.

Reason (R) Inspiration is facilitated by contraction of diaphragm and external intercostal muscles.

II. Statement Based Questions

95 Which of the following statement is correct about respiratory organs of different animals?

(a) The exchange of O_2 and CO_2 *via* simple diffusion across body surface occurs in aquatic arthropods

(b) A complex system of air tubes called trachea is present in earthworm for respiration

(c) Fishes have lungs for respiration

(d) Cutaneous respiration occurs in amphibians

96 Which of the following statement is incorrect about nasopharynx?

(a) Internal nostrils open into nasopharynx

(b) It is the passage for air only

(c) It is a portion of pharynx

(d) Nasopharynx opens through the glottis of the larynx region into the trachea

97 Which of the following statement(s) is/are correct?

(a) The conducting part of the respiratory system transports the atmospheric air to alveoli

(b) Conducting part of the respiratory system clears the air from foreign particles, humidifies and brings it to the body temperature

(c) Exchange part of the respiratory system is the actual site at which O_2 and CO_2 exchange takes place

(d) All of the above

98 Read the following statements.

I. The Intrapulmonary pressure is less than the atmospheric pressure.

II. Increased thoracic volume and pulmonary volume.

In which of the above two situations inspiration takes place?

Choose the correct option accordingly.

(a) Only I (b) Only II (c) I and II (d) I or II

99 Select the correct statement. ***NEET (Odisha) 2019***

(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

100 Which of the following statement(s) is/are true for pleural membrane of lungs?

(a) It is double-layered with outer layer is in contact with throracic wall and inner layer is in contact with lungs

(b) Fluid contained in it reduces the friction on the lung surface

(c) Both (a) and (b)

(d) None of the above

101 Which of the following statement(s) is/are correct for features of diaphragm in the respiratory tract?

(a) Found in mammals

(b) Highly muscular and fibrous partition, elevated towards the thorax like a dome

(c) Separates thoracic and abdominal cavity

(d) All of the above

102 Which of following option is not true?

(a) The partial pressure of oxygen in deoxygenated blood is 40 mm Hg

(b) The partial pressure of oxygen in oxygenated blood is 95 mm Hg

(c) The partial pressure of oxygen in alveolar air is 104 mm Hg

(d) The partial pressure of CO_2 in atmospheric air is 40 mm Hg

103 Which statement correctly suggests that most of the oxygen is transported from the lungs to the tissues, combined with the haemoglobin rather than dissolved in the blood plasma?

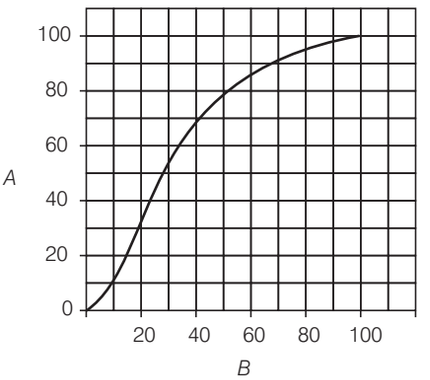
(a) Oxygen carrying capacity of the whole blood is much higher than that of plasma and oxygen content of the blood after leaving the lungs is greater than that of the blood entering the lungs

(b) Haemoglobin can combine with oxygen

(c) Oxyhaemoglobin can dissociate into haemoglobin and oxygen

(d) Increase in the CO_2 concentration decrease the oxygen affinity of haemoglobin

104 Which of the following statement is incorrect about the given graph?



(a) The curve is called oxygen dissociation curve

(b) The part A represents percentage saturation of haemoglobin with oxygen

(c) The part B represents partial pressure of carbon dioxide

(d) This curve is highly useful in studying the effect of factors like pCO_2, H^+ concentration, etc

105 Read the following statements and select the correct one.

(a) The H^+ released from carbonic acid combines with haemoglobin to form haemoglobinic acid

(b) Oxyhaemoglobin of erythrocytes is alkaline

(c) More than 70% of CO_2 is transferred from the tissue to the lungs in the form of carbamino compounds

(d) In a healthy person, the haemoglobin content is more than 25 gm per 100 mL

106 Read the following statements and identify the incorrect statement.

(a) pO_2 is the major factor which affects the binding of CO_2 with haemoglobin

(b) pCO_2 is low and $p\ O_2$ is high in tissues

(c) RBC contains a very high concentration of carbonic anhydrase

(d) Every 100 mL of deoxygenated blood delivers approximately 4 mL of CO_2 to alveoli

107 Which one of the following options correctly represents the lung conditions in asthma and emphysema, respectively? ***NEET 2018***

(a) Increased respiratory surface; Inflammation of bronchioles

(b) Increased number of bronchioles; Increased respiratory surface

(c) Inflammation of bronchioles; Decreased respiratory surface

(d) Decreased respiratory surface; Inflammation of bronchioles

108 Which one of the following is the correct statement for respiration in humans? ***CBSE-AIPMT 2012***

(a) Cigarette smoking may lead to the 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 carbaminohaemoglobin

109 Which of the following statements is incorrect regarding respiratory system?

(a) Each terminal bronchiole gives rise to a network of bronchi

(b) the alveoli are highly vascularised

(c) the lungs are covered by a double-layered membrane

(d) the pleural fluid reduces friction on the lung surface

110 Arrange the given steps of expiration in the sequence of event occurring first.

I. Relaxation of the diaphragm and sternum.

II. Reduction of the pulmonary volume.

III. Expulsion of air from the lungs.

IV. Increase in intrapulmonary pressure.

Choose the correct option.

(a) I → II → III → IV (b) I → II → IV → III

(c) IV → III → II → I (d) IV → II → III → I

111 Consider the following statements.

I. Thoracic chamber which contain lungs is anatomically an air-tight chamber.

II. Change in the volume of thoracic cavity does not affect the pulmonary cavity.

Select the correct option.

(a) I is true, II is false (b) Both I and II are true

(c) I is false, II is true (d) Both I and II are false

112 Consider the following statements.

I. Red coloured iron containing pigment in RBCs is haemoglobin.

II. O_2 binds with haemoglobin irreversible to form oxyhaemoglobin.

Select the correct option.

(a) I is true, II is false (b) Both I and II are true

(c) I is false, II is true (d) Both I and II are false

113 Blood carbon dioxide levels determine the pH of other body fluids as well as blood, including the pH of cerebrospinal fluid. How does this enable the organism to control breathing?

(a) The brain directly measures and monitors carbon dioxide and causes breathing changes accordingly

(b) The medulla, which is in contact with cerebrospinal fluid, monitors pH and uses this measure to control breathing

(c) The brain alters the pH of the cerebrospinal fluid to force the animal to retain more or less carbon dioxide

(d) Stretch receptors in the lungs cause the medulla to speed up or slow breathing

114 Read the following statements.

I. On an average a healthy human breathes 12-16 times/minute.

II. The volume of air involved in the breathing movements can be estimated by spirometer.

III. Diaphragm is very useful in both inspiration and expiration.

Which of the above statements are incorrect?

(a) I and II (b) II and III

(c) I and III (d) None of these

115 Arrange the following components of pulmonary volume in the order of their increasing values.

I. Tidal volume

II. Residual volume

III. Expiratory reserve volume

IV. Vital capacity

Choose the correct option.

(a) I < II < III < IV (b) I < IV < III < II

(c) I < III < II < IV (d) I < IV < II < III

116 Arrange the given steps of respiration in the sequence of event they occur.

I. Diffusion of gases O_2 and CO_2 acrosses the alveolar membrane.
II. Transport of gases by the blood.
III. Utilisation of O_2 by the cells for catabolic reactions and the resultant release of CO_2.
IV. Pulmonary ventilation by which atmospheric air is drawn in and CO_2 rich alveolar air is released out.
V. Diffusion of O_2 and CO_2 between the blood and tissue.

Choose the correct option.

(a) IV → I → II → V → III
(b) III → II → V → I → IV
(c) V → IV → III → II → I
(d) All of the above

117 Binding of O_2 with haemoglobin is primarily depended upon

I. partial pressure of O_2.
II. partial pressure of CO_2.
III. hydrogen ion concentration.
IV. temperature.

Choose the correct option.

(a) I, II and IV (b) II, III and IV
(c) I, III and IV (d) All of these

118 Adult human RBCs are enucleate. Which of the following statement(s) is/are most appropriate explanation for this feature? ***NEET 2017***

I. They do not need to reproduce.
II. They are somatic cells.
III. They do not metabolise.
IV. All their internal space is available for oxygen transport.

Choose the correct option.

(a) Only IV (b) Only I
(c) I, III and IV (d) II and III

119 Consider the following statements.

I. The pCO_2 level at the tissue is high due to catabolism.
II. At the alveolar site, pCO_2 is low due to which CO_2 and H_2O are formed.

Select the correct option.

(a) I is true, II is false
(b) I is false, II is true
(c) Both I and II are true
(d) Both I and II are false

120 Which of the following statements are true/false?

I. The blood transports CO_2 comparatively easily due to its high solubility.
II. Approximately 8.9% of CO_2 is transported being dissolved in the plasma of blood.
III. The CO_2 produced by the tissues diffuses passively into the blood stream and passes in the red blood corpuscles and reacts with water to form H_2CO_3.
IV. The oxyhaemoglobin (HbO_2) in erythrocytes is basic in nature.
V. The chloride ions diffuse from the plasma into the erythrocytes to maintain the ionic balance.

Choose the correct option.

	True	**False**
(a)	I, III and V	II and IV
(b)	II and IV	I, III and V
(c)	I, II and IV	III and V
(d)	III and V	I, II and IV

121 Consider the following statements.

I. Neural signals from pneumotaxic centre can reduce the duration of inspiration and thus, alter the respiratory rate.
II. Occupational respiratory disorder can result in the proliferation of fibrous tissue in lungs.

Select the correct option.

(a) I is false, II is true (b) Both I and II are true
(c) I is true, II is false (d) Both I and II are false

III. Matching Type Questions

122 Match the following columns.

Column I (Animals)	**Column II** (Types of Breathing)
A. Frog	1. Network of tubes
B. Fishes	2. Pulmonary respiration through lungs
C. Insects	3. Branchial respiration through gills
D. Birds and mammals	4. Cutaneous respiration

Codes

	A	B	C	D		A	B	C	D
(a)	1	2	3	4	(b)	4	3	1	2
(c)	4	3	2	1	(d)	4	2	3	1

123 Match the following columns.

Column I (Respiratory capacity)	**Column II** (Description)
A. Inspiratory Capacity (IC)	1. Total air, a person can inspire after normal expiration.
B. Expiratory Capacity (EC)	2. Maximal volume of the air, a person can breathe in after a forced expiration.
C. Functional Residual Capacity (FRC)	3. Volume of the air that will remain in lungs after a normal expiration.
D. Vital Capacity (VC)	4. Total volume of air, a person can expire after a normal inspiration.

Codes

	A	B	C	D		A	B	C	D
(a)	1	2	3	4	(b)	1	4	3	2
(c)	1	4	2	3	(d)	4	1	3	2

124 Which one of the following are the correct matching of respiratory capacities and respiratory volumes?

	Column I (Respiratory capacity)		Column II (Respiratory volume)
A.	Residual volume	1.	3000 mL
B.	Vital capacity	2.	3500 mL
C.	Inspiratory reserve volume	3.	1200 mL
D.	Inspiratory capacity	4.	4600 mL

Codes

	A	B	C	D		A	B	C	D
(a)	4	3	2	1	(b)	1	2	3	4
(c)	3	4	1	2	(d)	2	1	4	3

125 Match the items given in Column I with those in Column II and select the correct option given below.

NEET 2018

	Column I (Lung volume)		Column II (Value)
A.	Tidal volume	1.	2500-3000 mL
B.	Inspiratory reserve volume	2.	1100-1200 mL
C.	Expiratory reserve volume	3.	500 mL
D.	Residual volume	4.	1000-1100 mL

Codes

	A	B	C	D
(a)	1	4	2	3
(b)	3	1	4	2
(c)	3	2	1	4
(d)	4	3	2	1

126 Match the following columns.

	Column I (% of CO_2 in blood)		Column II (Transported by)
A.	20-25%	1.	Bicarbonates
B.	70%	2.	RBC
C.	About 7%	3.	Plasma

Codes

	A	B	C
(a)	1	2	3
(b)	3	2	1
(c)	2	1	3
(d)	2	3	1

127 Match the following columns.

	Column I (Respiratory disorder)		Column II (Feature)
A.	Asthma	1.	Inflammation of nasal tract
B.	Bronchitis	2.	Spasm of smooth of respiratory tract muscle
C.	Rhinitis	3.	Fully blown out alveoli
D.	Emphysema	4.	Inflammation of bronchi

Codes

	A	B	C	D
(a)	4	2	5	1
(b)	5	3	2	1
(c)	3	1	5	4
(d)	2	4	1	3

128 Match the following columns.

	Column I (Respiratory disorder)		Column II (Feature)
A.	Hypopnea	1.	Difficult breathing with lying down
B.	Hyperpnea	2.	Painful breathing
C.	Apnea	3.	No breathing
D.	Dyspnea	4.	Rapid breathing
E.	Orthopnea	5.	Slow breathing

Codes

	A	B	C	D	E
(a)	5	3	4	2	1
(b)	5	3	1	2	4
(c)	5	4	3	2	1
(d)	5	4	2	3	1

NCERT Exemplar

MULTIPLE CHOICE QUESTIONS

129 Respiration in insects is called direct because
(a) the cells exchange O_2 /CO_2 directly with the air in the tubes
(b) the tissues exchange O_2 /CO_2 directly with coelomic fluid
(c) the tissues exchange O_2 /CO_2 directly with the air outside through body surface
(d) tracheal tubes exchange O_2 /CO_2 directly with the haemocoel which then exchange with tissues

130 Mark the correct pair of muscles involved in the normal breathing in humans.
(a) External and internal intercostal muscles
(b) Diaphragm and abdominal muscles
(c) Diaphragm and external intercostal muscles
(d) Diaphragm and intercostal muscles

131 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) rapid increase in breathing rate
(c) no change in respiration
(d) cessation of breathing

132 It is known that exposure to carbon monoxide is harmful to animals because
(a) it reduces CO_2 transport
(b) it reduces O_2 transport
(c) it increases CO_2 transport
(d) destroys haemoglobin

133 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

134 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

135 Mark the incorrect statement in context to O_2 binding to Hb.
(a) Higher pH
(b) Lower temperature
(c) Lower pCO_2
(d) Higher pO_2

136 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

137 Respiratory process is regulated by certain specialised 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

138 CO_2 dissociates from carbaminohaemoglobin when
(a) pCO_2 is high and pO_2 is low
(b) pO_2 is high and pCO_2 is low
(c) pCO_2 and pO_2 are equal
(d) None of the above

139 In breathing movements, air volume can be estimated by
(a) stethoscope
(b) hygrometer
(c) sphygmomanometer
(d) spirometer

140 From the following relationships between respiratory volume and capacities, mark the correct relationship.
I. Inspiratory Capacity (IC) = Tidal Volume (TV) +Residual Volume (RV)
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)
Choose the correct option.
(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

141 The oxygen haemoglobin dissociation curve will show a right shift in case of
(a) high pCO_2
(b) high pO_2
(c) low pCO_2
(d) less H^+ concentration

142 Match the following columns.

	Column I		Coulmn II
A.	Earthworm	1.	Moist cuticle
B.	Aquatic arthropods	2.	Gills
C.	Fishes	3.	Lungs
D.	Birds/reptiles	4.	Trachea

Codes

	A	B	C	D		A	B	C	D
(a)	2	1	4	3	(b)	1	4	2	3
(c)	1	3	2	4	(d)	1	2	4	3

Answers

Mastering NCERT with MCQs

1 (b)	2 (c)	3 (d)	4 (c)	5 (d)	6 (a)	7 (a)	8 (c)	9 (a)	10 (a)
11 (c)	12 (b)	13 (d)	14 (d)	15 (a)	16 (a)	17 (b)	18 (a)	19 (c)	20 (d)
21 (b)	22 (b)	23 (d)	24 (b)	25 (c)	26 (d)	27 (c)	28 (b)	29 (a)	30 (c)
31 (d)	32 (b)	33 (a)	34 (b)	35 (c)	36 (d)	37 (b)	38 (d)	39 (d)	40 (b)
41 (a)	42 (d)	43 (a)	44 (a)	45 (a)	46 (c)	47 (d)	48 (b)	49 (b)	50 (c)
51 (b)	52 (b)	53 (b)	54 (c)	55 (b)	56 (a)	57 (a)	58 (c)	59 (a)	60 (b)
61 (b)	62 (a)	63 (d)	64 (b)	65 (b)	66 (c)	67 (d)	68 (a)	69 (a)	70 (d)
71 (b)	72 (c)	73 (b)	74 (c)	75 (c)	76 (a)	77 (d)	78 (c)	79 (d)	80 (a)
81 (b)	82 (d)	83 (b)	84 (d)						

NEET Special Types Questions

85 (c)	86 (b)	87 (c)	88 (a)	89 (b)	90 (b)	91 (a)	92 (d)	93 (a)	94 (b)
95 (d)	96 (b)	97 (d)	98 (c)	99 (b)	100 (c)	101 (d)	102 (d)	103 (a)	104 (c)
105 (a)	106 (b)	107 (c)	108 (c)	109 (a)	110 (b)	111 (a)	112 (a)	113 (b)	114 (d)
115 (c)	116 (a)	117 (d)	118 (a)	119 (c)	120 (a)	121 (b)	122 (b)	123 (b)	124 (c)
125 (b)	126 (c)	127 (d)	128 (c)						

NCERT Exemplar Questions

129 (d)	130 (d)	131 (d)	132 (b)	133 (b)	134 (c)	135 (a)	136 (b)	137 (b)	138 (b)
139 (d)	140 (b)	141 (a)	142 (b)						

Answers & Explanations

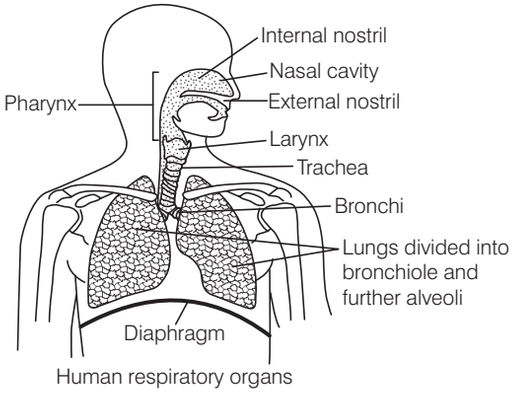
1 (*b*) Oxygen (O_2) is utilised by the living entities to indirectly breakdown the nutrients like glucose and derive energy for performing various physiological activities.

2 (*c*) The process of exchange of oxygen from the atmosphere with carbon dioxide produced by the cells is called breathing, commonly known as respiration.

3 (*d*) Mechanism of breathing vary among different groups of animals depending mainly on their habitats and levels of organisation. This can be explained as

Lower invertebrates like sponges, coelenterates, flatworms, etc., exchange O_2 with CO_2 by simple diffusion over their entire body surface. Earthworms use their moist cuticle and insects have a network of tubes called trachea. Specialised vascular structures called gills are used by most aquatic arthropods and molluscs, whereas vascularised bags called lungs are used by terrestrial forms.

5 (*d*) The correct sequence of air passage in humans is represented by option (d). The passage can be explained by the figure given below.



Human respiratory organs

7 (*a*) Larynx is the portion of human respiratory system called as sound box. It is a cartilaginous box present in the neck region which helps in sound production in mammals.

10 (*a*) Trachea is a straight tube extending up to the mid thoracic cavity. It divides at the level of 5th thoracic vertebra into the right and left primary bronchi.

13 (*d*) Alveoli in human lungs are thin-walled, vascularised irregular walled bag-like structure at the terminal ends of bronchioles. These are the functional unit of lungs and are supplied with blood.

15 (*a*) Humans have two lungs, which are covered by a double membrane called pleura, with pleural fluid between them. Pleural fluid reduces the friction on the lung surface. The outer pleural membrane is in close contact with the thoracic lining whereas the inner pleural membrane is in the contact with the lung surface.

16 (*a*) The conducting portion of the respiratory system consists of nasopharynx, larynx, trachea, bronchi, bronchioles and terminal bronchioles, i.e. all structures from external nostrils up to terminal bronchioles. It provides a passage for the air. It conducts the incoming air by warming, moistening and cleaning it.

17 (*b*) Respiratory or exchange part of the respiratory system consists of alveoli and their ducts. These serve to get rid of the body CO_2 and pick up oxygen from the atmosphere. This system is derived from the endoderm.

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

19 (*c*) Option (c) is correct description of part C in the figure.

C–**Alveoli** are thin-walled vascular bag-like structures for exchange of gases.

Other options are incorrect and can be corrected as follows

- A–**Trachea** or Windpipe is a long tube supported by incomplete cartilaginous rings for conducting inspired air.
- B–**Pleural membrane** is double-layered which reduces friction on the lung surface.
- D–**Diaphragm** is pulled upwards during inspiration.

20 (*d*) Option (d) is not a step of respiration. In humans, respiration involves following steps

- Breathing or pulmonary ventilation by which atmospheric air is drawn in and CO_2 rich alveolar air is released out.
- Diffusion of gases (O_2 and CO_2) acrosses alveolar membrane.
- Transport of gases by the blood.
- Diffusion of O_2 and CO_2 between blood and tissue.
- Utilisation of O_2 by the cells for catabolic reactions and release of CO_2.

21 (*b*) The movement of the air into and out of the lungs is carried out by creating a pressure gradient between the lungs and the atmosphere.

23 (*d*) Option (d) is correct and can be explained as Inspiration is initiated by the contraction of diaphragm. It is achieved by the contraction of the external intercostal muscles which up lift the ribs and the sternum. The overall increase in the thoracic volume causes a similar increase in the pulmonary volume. This decreases the intrapulmonary pressure forcing the air from outside to move into the lungs (i.e. inspiration).

24 (*b*) Expiration takes place when the intrapulmonary pressure is higher than the atmospheric pressure, i.e. there is positive pressure in the lungs with respect to the atmospheric pressure.

25 (*c*) Expiration is the process by which CO_2 is expelled out from the lungs. During expiration, muscle fibres of the diaphragm and external intercostal muscles get relaxed. The diaphragm becomes convex and dome-shaped so, as to decrease the volume of the thoracic cavity.

26 (*d*) During expiration, decreased volume of thoracic capacity and pulmonary capacity increases the intrapulmonary pressure above atmospheric pressure.

The sternum and diaphragm which were elevated during inspiration acquire their normal position, causing the air to be expelled from the lungs.

27 (*c*) Additional muscles which impact the ability of humans to increase the strength of respiration are found in the abdomen. This is due to the fact that we can voluntarily take deep breathe by an effort. In the process of deep inspiration or expiration, chest distention is brought about by the external intercostal muscles and the abdominal muscles.

29 (*a*) Volume of the air inspired or expired during normal breathe is called tidal volume. It is about 500 mL of air in average young adult man.

31 (*d*) The expiratory capacity of athlete will be 1500 mL.

It can be calculated as

Expiratory capacity = TV+ ERV

Given, Tidal Volume (TV) = 500 mL

Expiratory Reserve Volume (ERV) = 1000 mL

$= 500 + 1000 = 1500$ mL.

33 (*a*) In lungs, even after the most forceful expiration some of the volume of air remains. This volume is termed Residual Volume (RV). Due to this, lungs do not collapse even after the most forceful expiration. RV is about 1100 mL to 1200 mL.

35 (*c*) Vital Capacity (VC) includes ERV, TV and IRV. It can also be defined as the maximum volume of air a person can breathe out after a forced inspiration.

39 (*d*) Pressure/concentration gradient, solubility of gases as well as the thickness of the membranes involved in diffusion affects the rate of diffusion. For example, CO_2 is 20-25% more soluble than O_2 due to which the former diffuses faster across diffusion membrane.

40 (*b*) The partial pressure of oxygen (pO_2) in alveoli of lungs is 104 mm Hg, which is more than that of blood in the blood capillaries of lung alveoli (40 mm Hg).

This difference allows passive diffusion of O_2 from air-filled in the lungs into the blood vessel of lung alveoli.

42 (*d*) Pulmonary vein is the only vein in body, which carries oxygenated blood rather than deoxygenated blood. It carries the blood from the lungs to the left auricle of heart. From left auricle, blood goes to the left ventricle, which then distributes that blood all over the body.

43 (*a*) Pulmonary artery carries deoxygenated blood from the right ventricle to the lungs for the oxygenation of deoxygenated blood.

45 (*a*) Partial pressure of O_2 in the atmosphere is 159 mm Hg and in the alveolar air is 104 mm Hg. Also, the partial pressure of CO_2 in the atmosphere is 0.3 mm Hg and in the alveolar air is 40 mm Hg.

Thus, we can say that pO_2 is higher in the atmosphere as compared to alveoli and pCO_2 is lower in the atmosphere as compared to alveoli.

46 (*c*) Deoxygenated blood and tissues, both have the same partial pressure of CO_2, i.e. 45 mm Hg.

47 (*d*) pO_2 is same in between tissues and deoxygenated blood, i.e. 40 mm Hg.

48 (*b*) Same O_2 content is present in blood entering the right side of the heart through systemic vein (i.e. $pO_2 = 40$ mm Hg, deoxygenated blood) and the blood leaving the right side of the heart through pulmonary artery (i.e. $pO_2 = 40$ mmHg, deoxygenated blood) which goes into the lungs for oxygenation.

49 (*b*) The solubility of CO_2 is 20-25 times higher than that of O_2. Therefore, the amount of CO_2 that can diffuse through the diffusion membrane per unit difference in partial pressure is much higher as compared to that of O_2.

51 (*b*) The diffusion membrane is made up of three major layers, namely the thin squamous epithelium of alveoli, the endothelium of alveolar capillaries and the basement substance (composed of a thin basement membrane supporting the squamous epithelium and basement membrane surrounding the single layer endothelial cells of capillaries) in between them.

52 (*b*) Squamous epithelium consists of a flat disc-like cells with a centrally located and oval or spherical nucleus (polygonal in surface).

It looks like the tiles of floor. It forms inner lining of the lung alveoli, because it allows efficient diffusion of gases across it.

55 (*b*) About 97% of O_2 is transported by RBCs in the blood. The remaining 3% of O_2 is carried in a dissolved state through the plasma.

56 (*a*) The largest fraction of carbon dioxide (about 70%) is converted to bicarbonates ions (HCO_3^-) and transported in the plasma.

$$CO_2 + H_2O \underset{\text{anhydrase}}{\overset{\text{Carbonic}}{\rightleftharpoons}} H_2CO_3 \underset{\text{anhydrase}}{\overset{\text{Carbonic}}{\rightleftharpoons}} HCO_3^- + H^+$$

58 (*c*) Each haemoglobin (Hb) molecule can carry a maximum of four molecules of O_2.

$$Hb_4 + 4O_2 \rightarrow Hb_4O_8$$

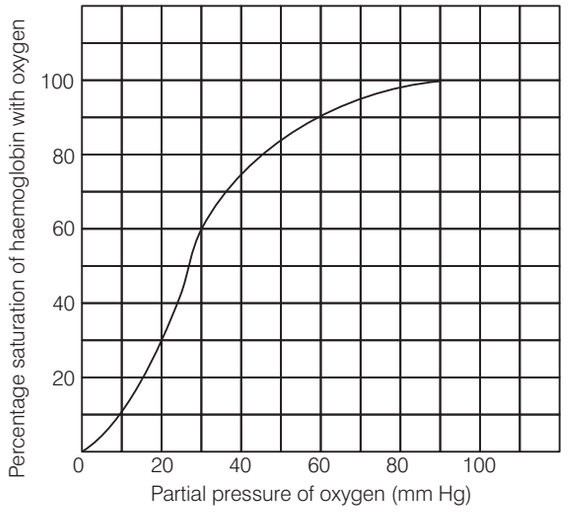
Haemoglobin is a red coloured iron containing pigment in the RBCs. Oxygen can bind with haemoglobin in a reversible manner to form oxyhaemoglobin (Hb O_2).

59 (*a*) Oxygen haemoglobin dissociation curve is sigmoid-shaped.

The relationship between the pO_2 and the per cent saturation of haemoglobin when represented on a graph is termed as oxygen haemoglobin dissociation curve.

The pO_2 in the arterial blood is about 95 mm Hg and the per cent saturation of haemoglobin at this partial pressure is 97%.

100% saturation of haemoglobin with O_2 takes place at pO_2 of 140 mm Hg.



60 (*b*) In the tissues, there is low pO_2, high pCO_2, high H^+ ion concentration and high temperature.

All these conditions are favourable for the dissociation of oxygen from oxyhaemoglobin.

61 (*b*) Decreased level of CO_2 and temperature conditions along with lesser H^+, high pO_2, etc., would result in greatest degree of O_2 saturation for haemoglobin, if pO_2 is constant. These conditions favour the binding of O_2 to haemoglobin. While low pO_2, high CO_2, high H^+, etc, favour dissociation of oxyhaemoglobin.

63 (*d*) Rising CO_2 concentration will lead to urge to breathe,this is because CO_2 is toxic to human body and needs to be excreted.

64 (*b*) pO_2 in tissue fluid measures 40 mm Hg and pCO_2 measures 45 mm Hg. In comparison the pO_2 and pCO_2 in atmospheric air measures at 159 mm Hg and 0.3 mm Hg, respectively. Thus, option (b) will correct as pO_2 will be higher and pCO_2 will be lowered in the atmospheric air.

66 (*c*) Both labels A and B are carbonic anhydrase. Transport of CO_2 by blood is much easier than oxygen due to high solubility of CO_2. About 70% of CO_2 reacts with water to form carbonic acid in erythrocytes in the presence of enzyme carbonic anhydrase (fastest enzyme known so far). This carbonic acid (H_2CO_3) then dissociates into H^+ and HCO_3^- ions by the action of same enzyme.

67 (*d*) Option (d) with equation is correct as Oxyhaemoglobin (HbO_2) dissociates in the tissue to provide oxygen in the tissues. And HbO_2 formation or association occurs in lungs (alveoli) when oxygen is inspired through breathing.

68 (*a*) As a person moves up a hill, the pO_2 and total atmospheric pressure decreases. It stimulates the juxta glomerular cells of kidney to secrete erythropoietin hormone which increases the number of RBCs (polycythemia) to compensate the supply of O_2.

Thus, the people who have migrated from planes to Rohtang pass will have more RBCs. At higher altitude, haemoglobin has lower binding affinity to O_2 because the primary factor responsible for binding is pO_2 which decreases at higher altitude.

69 (*a*) Bohr's effect is described as a rise in pCO_2 (or fall in pH) which decreases the oxygen affinity of haemoglobin thus, raising the P_{50} value and shifts the curve to the right. Conversely, a fall in pCO_2 and rise in the pH increases oxygen affinity of haemoglobin (P_{50} value is the value of pO_2 at which haemoglobin is 50% saturated with oxygen to form haemoglobin).

70 (*d*) The relationship between the pO_2 and the per cent saturation of haemoglobin when represented on a graph is called as oxygenhaemoglobin dissociation curve. It is sigmoid in shape. Rise in pCO_2, H^+ ions (fall in pH), and rise in temperature shifts the HbO_2 dissociation curve to the right (as more O_2 dissociate from the oxyhaemoglobin).

71 (*b*) Rising levels of CO_2 concentration in blood would first create an urge to breathe. When the concentration

of CO_2 becomes equal in lungs and blood, it no longer leaves blood and keep rising till the next breath. As we breathe in, CO_2 diffuses out of lungs and oxygen is taken in. Thus, neutralising the acidity caused by high CO_2 levels.

72 (*c*) Blood does not become acidic even after carrying CO_2 due to the buffering action of bicarbonates.

$$H_2O + CO_2 \rightleftharpoons H_2CO_3 \rightleftharpoons H^+ + HCO_3^-$$

73 (*b*) Reduction of pH of blood will decrease the affinity of haemoglobin with oxygen. As the pH reduces, i.e. increase in H^+ concentration or increase in acidity.

This favours the dissociation of oxyhaemoglobin thereby giving up more O_2.

74 (*c*) Neural system in humans regulates and moderate the respiratory rhythm. A specialised respiratory centre is located in the medulla oblongata and another in pons Varoli.

These centres regulate the rate and the depth of breathing by controlling the contraction of diaphragm and other respiratory muscles.

76 (*a*) Respiratory centre present in the pons region of the brain is called pneumotaxic centre. It can moderate the functions of respiratory rhythm centre. Neural signal from this centre can reduce the duration of inspiration and thereby, alter the respiratory rate.

77 (*d*) A chemosensitive area is situated near the respiratory centre, medulla. It is highly sensitive to the change of CO_2 concentration or change in blood pH (H^+). Blood CO_2 concentration influences the pH by forming HCO_3^-, within the RBCs using the enzyme, carbonic anhydrase.

80 (*a*) Wheezing occurs due to the inflammation of bronchi and bronchioles. It is one of the most significant feature of asthma in which people face difficulty in breathing. It is usually caused due to increasing airborne allergens and pollutants. The allergens stimulate the release of histamine from the mast cells which in turn contract the smooth muscles of bronchioles.

83 (*b*) Silicosis is an occupational respiratory disorder caused by excessive inhalation of silica dust. It usually affects the workers of grinding or stone breaking industries. The long term exposure can cause lung fibrosis (stiffening), leading to breathing difficulties.

85 (*c*) Assertion is true, but Reason is false and this can be corrected as

Trachea and initial bronchioles are supported by incomplete cartilaginous rings. These support the trachea and prevent it from being collapsed during breathing.

86 (*b*) Both Assertion and Reason are true, but Reason is not the correct explanation of Assertion.

The correct explaination would be

The negative pressure (–5mm Hg), which is lower than atmospheric pressure allows air to move from atmosphere (high pressure) to lungs (low pressure zone) during inspiration.

87 (*c*) Assertion is true, but Reason is false. Reason can be corrected as

RBCs contain high concentration of carbonic anhydrase and minute quantity of same is present in plasma too. About 70% of CO_2 is transported through RBCs. CO_2 enters the RBCs where it reacts with water to form carbonic acid in the presence of zinc containing enzyme, carbonic anhydrase.

89 (*b*) Both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.

Humans resort to repeat deep inhalations and exhalations in rapid succesion to store oxygen, so that they can swim underwater.

90 (*b*) Both Assertion and Reason are true, but Reason is not the correct explanation of Assertion.

The pO_2 is the highest in the alveoli, i.e. 104 mm Hg because inspiration of oxygen from the atmosphere is by the lungs. Also pO_2 of the blood capillaries around the alveoli is minimum, thus oxygen diffuse into the blood capillaries.

Partial pressure of a gas is the pressure contributed by individual gas in a mixture.

91 (*a*) Both Assertion and Reason are correct and Reason is the correct explanation of Assertion.

Respiratory rhythm centres present in the medulla and pons of the brain are responsible for neural regulation of respiration.

Chemical regulation is mediated by highly senisitive chemoreceptors, i.e. carotid and aortic bodies that detect changes in pCO_2 and H^+ levels. If changes are detected, they send necessary signals to rhythm centres in brain for remedial actions. Thus, O_2 has almost no or insignificant role in regulation of respiratory rhythm.

92 (*d*) Assertion is false, but Reason is true. Assertion can be corrected as

Bohr's effect occurs at tissue level not at the level of alveoli of lungs. It refers to the decrease in the affinity of haemoglobin to oxygen with decreasing pH (increased acidity) due to higher or increasing concentration of CO_2 in the body tissues.

93 (*a*) Both Assertion and Reason are true and Reason is the correct explanation of Assertion.

Carbon monoxide combines with haemoglobin far readily as compared to oxygen, since, it has 200 times greater affinity for Hb. As a result, carboxyhaemoglobin is formed which causes reduced transport of O_2 in body. As a result, nausea, suffocation and even death occurs.

94 (*b*) Both Assertion and Reason are true, but Reason is not the correct explanation of Assertion.

Inspiration is an active process whereas expiration is a passive process. During inspiration, diaphragm and external intercostal muscles contract to increase the overall volume of the thoracic cavity. As a result, the pressure inside the lungs is less as compared to atmospheric pressure. Also, for this inspiration muscle uses energy for contraction, thus it is referred to as an active process.

95 (*d*) Statement in option (d) is correct.

The correct form of rest incorrect statements is as follows

- The exchange of O_2 with CO_2 by simple diffusion over entire body surface occurs in lower invertebrates like sponges, coelenterates, etc.
- Earthworms respire cutaneously, tracheal respiration occurs in insects (cockroaches).
- Fishes have gills for respiration.

96 (*b*) Statement in option (b) is incorrect. It can be corrected as

Nasopharynx is a portion of pharynx. It is the common passage for food and air.

Rest other statements are correct.

98 (*c*) Both statements I and II will cause inspiration. Inspiration occurs when there is increase in the thoracic volume, which causes similar increase in pulmonary volume.

An increase in pulmonary volume decreases the intrapulmonary pressure to less than atmospheric pressure which forces the air from outside to move into the lungs, i.e. inspiration.

99 (*b*) Statement in option (b) is correct.

Rest other statements are incorrect and can be corrected as

- Inspiration occurs due to external intercostal muscles.
- Inspiration occurs when atmospheric pressure is more than intrapulmonary pressure.
- Inspiration is initiated due to the contraction of diaphragm.

100 (*c*) Statements in option (a) and (b) are correct for pleural membrane of lungs.

Humans have two lungs, which are covered by a double-layered pleura with pleural fluid between them. Pleural fluid reduces the friction on the lung surface. The outer pleural membrane is in close contact with the thoracic lining whereas, the inner pleural membrane is in the contact with the lung surface.

102 (*d*) Statement in option (d) is not true. It can be corrected as

The partial pressure of CO_2 in atmospheric air is 0.3 mm/Hg. It is 40 mm/Hg in alveoli and oxygenated blood.

104 (*c*) Statement in option (c) is incorrect about the given graph. It can be corrected as

The part B represents partial pressure of oxygen.

105 (*a*) Statement in option (a) is correct.

Rest other statements are incorrect and can be corrected as follows

- Oxyhaemoglobin present in erythrocytes is acidic due to low H^+ concentration.
- More than 70% of CO_2 is transported as bicarbonate and only 20-25% is carried as carbaminohaemoglobin.
- In a normal/healthy person, the haemoglobin content per 100 mL blood is below 20 gm.

106 (*b*) Statement in option (b) is incorrect.

The correct form of this statement is

In tissues, pCO_2 is high and pO_2 is low.

pCO_2 in tissues – 45 mm of Hg.

pO_2 in tissues – 40 mm of Hg.

107 (*c*) Statement in option (c) is correctly represents the lung condition in asthma and emphysema, respectively.

- Asthma is inflammation of bronchioles. Its symptoms include wheezing, coughing and difficulty in breathing mainly during expiration.
- Emphysema is an inflation or abnormal distension of the bronchioles or alveolar sacs of the lungs. Many of the septa between the alveoli are destroyed and much of the elastic tissue of the lungs is replaced by connective tissue. As a result, alveolar septa collapse and the surface area gets greatly reduced.

108 (*c*) Statement in option (c) is correct.

Rest other statements are incorrect and can be corrected as

- Cigarette smoking damages the alveolar walls.
- Neural signals from pneumotaxic centre reduce the rate of inspiration.
- About 20-25% of CO_2 is carried as carbaminohaemoglobin.

109 (*a*) Statement in option (a) is incorrect and can be corrected as

Each terminal bronchiole gives rise to a network of alveoli.

111 (*a*) Statement I is true, but II is false. It can be corrected as

The any change in the volume of thoracic cavity is reflected in the pulmonary (lung) cavity. This arrangement is essential for breathing as we cannot alter the pulmonary volume directly.

112 (*a*) Statement I is true, but II is false. The corrected form of statement II is

The binding of O_2 with haemoglobin (Hb) is reversible. O_2 binded with Hb in blood is transported to various body tissues where the complex structure, i.e. oxyhaemoglobin dissociates to release O_2.

115 (*c*) Tidal Volume = 500 mL

ERV = 1000-1100 mL

RV = 1100 -1200 mL

VC = ERV+ TV+ IRV

= 4600 mL

Thus, the sequence of pulmonary volumes in order of their increasing values will be

TV < ERV < RV < VC.

118 (*a*) Statement IV is most appropriate explanation about adult human RBCs.

The absence of nucleus in RBC is an adaptation that allows it to contain more haemoglobin and carry more oxygen by providing empty space. This adaptation also aids in effective diffusion of oxygen.

RBCs are initially produced in bone marrow with a nucleus. They then undergo enucleation at maturity, in which their nucleus is removed.

120 (*a*) Statements I, III and V are true.

Statements II and IV are false. The corrected forms of these statements are

- Approximately 7% of CO_2 is transported in a dissolved state through plasma.
- The oxyhaemoglobin (HbO_2) is a strong acid formed when O_2 reacts with Hb (reversibly).

129 (*d*) Insects have a network of tubes (tracheal tubes) to transport atmospheric air within the body. These openings lead to trachea.

The tracheal tubes exchange O_2/CO_2 directly with the haemocoel which then exchange with tissues. Thus, respiration in insects is called direct.

130 (*d*) The diaphragm and a specialised set of muscles, called intercostal muscles present between the ribs are involved in the normal breathing in humans. They are involved in generating pressure gradient between air in the lungs and the atmosphere, so as to facilitate the intake of air.

131 (*d*) The movement of air into and out of the lungs is carried out by creating a pressure gradient between the lungs and the atmosphere.

The pressure within the lungs is less than the atmospheric pressure so there is a negative pressure in the lungs with respect to atmospheric pressure. The puncture in the chest affects this pressure gradient maintained by the lungs and thus may cause cessation of breathing.

132 (*b*) Carbon monoxide is harmful as it reduces O_2 transport in animals. This can be explained as

Haemoglobin binds with oxygen in a reversible reaction to form oxyhaemoglobin.

$$Hb + O_2 \rightleftharpoons HbO_2$$

Whereas, the complex formed by the reaction of carbon monoxide and haemoglobin is incredibly strong and irreversible.

$$\underset{\text{(Haemoglobin)}}{Hb} + CO \longrightarrow \underset{\text{(Carboxyhaemoglobin)}}{HbCO}$$

As a result of this haemoglobin looses its affinity to oxygen. Thus, exposure to CO is considered harmful to animals as it hinders and reduces the O_2 transport in body.

133 (*b*) Inspiration is an active process whereas expiration is a passive process because inspiration occurs when the muscles of diaphragm contract by using energy to increase the overall volume of thoracic cavity.

Whereas, during the expiration diaphragm muscles relax without the use of energy as there is high intrapulmonary pressure than the atmospheric pressure, thus the air rushes out. Thus, it is a passive process.

134 (*c*) The maximum volume of air that a person can breathe in after forced expiration or the maximum volume of air that a person can breathe out after forced inspiration is called vital capacity

$$VC = \underset{\substack{\text{Inspiratory Reserve}\\\text{Volume}}}{IRV} + \underset{\substack{\text{Expiratory Reserve}\\\text{Volume}}}{ERV} + \underset{\text{Tidal Volume}}{TV}$$

The value of vital capacity varies from 3400 to 4800 mL.

135 (*a*) O_2 binding affinity with Hb is more when there is high pO_2, low pCO_2, low temperature and low pH. Thus, option (a) was incorrect in context to O_2 binding to Hb.

136 (*b*) Emphysema is a chronic disorder in which alveolar walls gets damaged. It is a respiratory disorder caused by cigarette smoking and inhalation of other smoke or toxic substances over a long, continuous period of time.

137 (*b*) Pneumotaxic centre is a specialised centre located in the dorsal part of pons Varolii of the brain. It can reduce the duration of inspiration and thus alter the respiratory rate.

138 (*b*) When the pCO_2 is low and pO_2 is high (as in the lung alveoli), dissociation of CO_2 from carbaminohaemoglobin takes place. CO_2 which is bound to haemoglobin from the tissue is delivered at the alveoli, to maintain the concentration of CO_2 thus increasing pCO_2.

139 (*d*) Spirometer is the device used to measure the volume of air involved in breathing movements and it also helps in clinical assessment of pulmonary functions.

140 (*b*) The correct option is (b).

- Inspiratory Capacity (IC) = Tidal Volume + Inspiratory Reserve Volume (TV + IRV).
- Vital Capacity (VC) = Tidal Volume + Inspiratory Reserve Volume + Expiratory Reserve Volume (TV + IRV + ERV)
- Residual Volume (RV) of air remaining in the lungs after a forcible expiration.
- Tidal Volume (TV) of air inspired or expired during a normal respiration.

141 (*a*) The oxygen haemoglobin dissociation curve is shifted to right under following conditions

- Decrease in partial pressure of oxygen (pO_2).
- Increase in partial pressure of carbon dioxide (pCO_2).
- Increase in hydrogen concentration (H^+).
- Decrease in pH activity.
- Increased body temperature.

Thus, option (a) is correct.