17 Breathing and Exchange of Gases

Question: Select the sequence of steps in Respiration.

(A) Diffusion of gases (O_2 and CO_2) across alveolar membrane.

(B) Diffusion of O_2 and CO_2 between blood and tissues.

(C) Transport of gases by the blood

(D) Pulmonary ventilation by which atmospheric air is drawn in and CO_2 rich alveolar air is released out.

(E) Utilisation of O_2 by the cells for catabolic reactions are resultant release of CO_2

Choose the correct answer from the options given below:

NEET 2023 Manipur

A (D), (A), (C), (B), (E)

B (C), (B), (A), (E), (D)

C (B), (C), (E), (D), (A)

D (A), (C), (B), (E), (D)

Answer: A

Explanation

The correct answer is Option A : (D), (A), (C), (B), (E).

Here's the reasoning behind this order :

(D) Pulmonary ventilation by which atmospheric air is drawn in and CO_2 rich alveolar air is released out.

Respiration begins with pulmonary ventilation (breathing), which allows the atmospheric air to enter the lungs and CO_2-rich air to be exhaled.

(A) Diffusion of gases (O_2 and CO_2) across the alveolar membrane.

Inside the lungs, oxygen diffuses from the alveoli into the blood, and carbon dioxide diffuses from the blood into the alveoli across the alveolar membrane.

(C) Transport of gases by the blood.

Once in the bloodstream, oxygen and carbon dioxide are transported to and from the body's tissues.

(B) Diffusion of O_2 and CO_2 between blood and tissues.

Oxygen diffuses from the blood into the body's tissues, and carbon dioxide diffuses from the tissues into the blood.

(E) Utilisation of O_2 by the cells for catabolic reactions and resultant release of CO_2.

Finally, oxygen is used by cells for metabolic processes, creating carbon dioxide as a byproduct.

Therefore, the sequence is (D), (A), (C), (B), (E).

Question: Vital capacity of lung is _____.

NEET 2023

A IRV + ERV + TV + RV

B IRV + ERV + TV − RV

C IRV + ERV + TV

D IRV + ERV

Answer: C

Explanation

The vital capacity (VC) of the lung is the maximum amount of air a person can expel from the lungs after a maximum inhalation. It is equal to the sum of inspiratory reserve volume (IRV), tidal volume (TV), and expiratory reserve volume (ERV).

inspiratory reserve volume (IRV) is the amount of air that can be inhaled beyond a normal breath.

Expiratory reserve volume (ERV) is the amount of air that can be exhaled beyond a normal breath.

Tidal volume (TV) is the amount of air that is inhaled and exhaled during a normal breath.

Therefore, vital capacity (VC) = IRV + ERV + TV.

2022

MCQ (Single Correct Answer)

Q.1. Identify the region of human brain which has pneumotaxic centre that alters respiratory rate by reducing the duration of inspiration.

A Cerebrum

B Medulla

C Pons

D Thalamus

NEET 2022 Phase 2

Ans. (C)

Explanation

Option (c) is the correct answer as pneumotaxic centre is present in the pons region of the brain, that can moderate the functions of the respiratory rhythm centre.

Option (b) is incorrect as medulla oblongata possesses respiratory rhythm centre and a chemosensitive area.

Option (a) and (d) are incorrect as cerebrum and thalamus does not possess any specialised centre to moderate the respiratory rhythm to suit the demands of the body tissues.

Q.2. Which of the following statements are correct with respect to vital capacity?

(a) It includes ERV, TV and IRV

(b) Total volume of air a person can inspire after a normal expiration.

(c) The maximum volume of air a person can breathe in after forced expiration.

(d) It includes ERV, RV and IRV.

(e) The maximum volume of air a person can breath out after a forced inspiration.

Choose the most appropriate answer from the options given below :

A (a) and (e)

B (b), (d) and (e)

C (a), (c) and (d)

D (a), (c) and (e)

NEET 2022 Phase 2

Ans. (D)

Explanation

Option (d) is the correct answer because statements (a), (c) and (e) are correct.

Vital capacity includes ERV, TV and IRV.

Vital capacity is the maximum volume of air a person can breathe in after a forced expiration or the maximum volume of air a person can breathe out after a forced inspiration.

Statement (b) is incorrect as total volume of air a person can inspire after a normal expiration is termed as inspiratory capacity (IC).

Statement (d) is incorrect as ERV, RV, IRV and TV comprise total lung capacity.

Q.3. Under normal physiological conditions in human being every 100 ml of oxygenated blood can deliver _____ ml of O_2 to the tissues.

A 2 ml

B 5 ml

C 4 ml

D 10 ml

NEET 2022 Phase 1

Ans. (B)

Explanation

Option (b) is the correct answer because every 100 ml of oxygenated blood can deliver around 5 ml of O_2 to the tissues under normal physiological conditions.

Option (c), (d) and (a) are incorrect because every 100 ml of deoxygenated blood delivers approximately 4 ml of CO_2 to the alveoli.

Q.4. Which of the following is not the function of conducting part of respiratory system?

A It clears inhaled air from foreign particles

B Inhaled air is humidified

C Temperature of inhaled air is brought to body temperature

D Provides surface for diffusion of O_2 and CO_2

NEET 2022 Phase 1

Ans. (D)

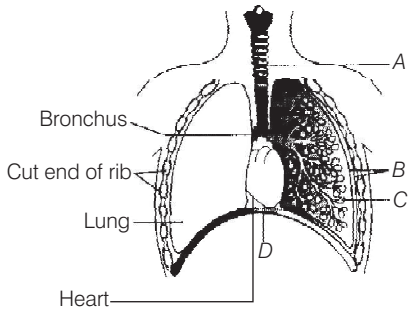
Explanation

Option (d) is correct because the part starting with the external nostrils upto the terminal bronchioles constitute the conducting part; whereas the alveoli and their ducts form the respiratory or exchange part of the respiratory system.

The conducting part transports the atmospheric air to the alveoli, clears it from foreign particles, humidifies and also bring the air to body temperature. Exchange part is the site of actual diffusion of O_2/CO_2 between blood and atmospheric air.

TOPIC 1
Human Respiratory System: Structure

01 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

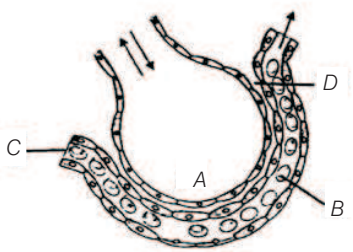
(d) *D*-lower end of lungs-diaphragm pulls it down during inspiration

Ans. *(c)*

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

A-trachea or wind pipe is an air conducting tube through which transport of gases takes place. *B*-pleural membrane is double layered which reduces friction on the lung surface. *D*-diaphragm is involved in the inspiration and expiration process of breathing.

02 The figure given below shows a small part of human lung where exchange of gas takes place. In which one of the options given below, the one part A, B, C or D is correctly identified along with its function. **[CBSE AIPMT 2011]**



(a) A — Alveolar cavity — main site of exchange of respiratory gases

(b) D — Capillary wall — exchange of gases takes place here

(c) B — Red blood cell — transport of mainly haemoglobin

(d) C — Arterial capillary — passes oxygen to tissues

Ans. *(a)*

Option (a) is correctly mentioned as alveoli which are the primary sites of exchange of gases. The exchange of gases (O_2 and CO_2) between the alveoli and the blood occurs by simple diffusion.

03 Which one of the following organs in the human body is most affected due to shortage of oxygen? **[CBSE AIPMT 1999]**

(a) Intestine (b) Skin
(c) Kidney (d) Brain

Ans. *(d)*

The brain cells are highly specialised. They cannot regenerate and respire without O_2. Therefore, the shortage of O_2 leads to death of brain cells.

04 In alveoli of the lungs, the air at the site of gas exchange, is separated from the blood by **[CBSE AIPMT 1997]**

(a) alveolar epithelium only

(b) alveolar epithelium and capillary endothelium

(c) alveolar epithelium, capillary endothelium and tunica adventitia

(d) alveolar epithelium, capillary endothelium, a thin layer of tunica media and tunica adventitia

Ans. *(b)*

The wall of the capillaries consists of only tunica internae which is made up of simple squamous endothelium. The wall of alveoli is also very thin, consisting of squamous epithelium.

TOPIC 2
Mechanism of Breathing

05 Select the correct events that occur during inspiration.
[NEET (Sep.) 2020]

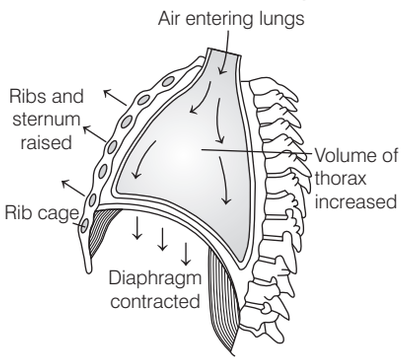
I. Contraction of diaphragm.
II. Contraction of external inter-costal muscles.
III. Pulmonary volume decreases.
IV. Intra pulmonary pressure increases.

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

Ans. *(d)*

Statement I and II are correct as during inspiration, the contraction of diaphragm occurs which pulls it downward, while the external intercostal muscles contract and lifts up the ribs and sternum. This increases the size of the thoracic cavity and decreases the pressure inside. As a result, air rushes in and fills the lungs.

Statement III and IV are incorrect because during inspiration, the volume of the thoracic cavity increases. This causes a similar increase in pulmonary volume. An increase in pulmonary volume decreases the intrapulmonary pressure to less than the atmospheric pressure which forces the air from outside to move into the lungs.



Mechanism of inspiration

06 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

Ans. *(b)*

Statement (b) is correct as intrapulmonary pressure is lower than the atmospheric pressure during inspiration. Other statements can be corrected as

(a) Inspiration occurs due to external intercoastal muscles.
(c) Inspiration occurs when atmospheric pressure is more than intrapulmonary pressure.
(d) Inspiration is initiated due to contraction of diaphragm.

07 Air is breathed through
[CBSE AIPMT 1994]

(a) trachea—lungs—larynx—pharynx—alveoli
(b) nose—larynx—pharynx—bronchus—alveoli—bronchioles
(c) nostrils—pharynx—larynx—trachea—bronchi—bronchioles—alveoli
(d) nose—mouth—lungs

Ans. *(c)*

In mammalian respiratory system, air is breathed through nostrils, from nostrils air passes through pharynx (common passage for food and air)→ larynx (voice box)→ trachea (wind pipe)→ bronchi (2 for each side lungs)→ bronchioles→ alveoli (small sacs or pouches for exchange of gases).

TOPIC 3
Respiratory Volumes and Capacities

08 The Total Lung Capacity (TLC) is the total volume of air accommodated in the lungs at the end of a forced inspiration. This includes **[NEET (Oct.) 2020]**

(a) RV, IC (Inspiratory Capacity), EC (Expiratory Capacity) and ERV
(b) RV, ERV, IC and EC
(c) RV, ERV, VC (Vital Capacity) and FRC (Functional Residual Capacity)
(d) RV (Residual Volume), ERV (Expiratory Reserve Volume), TV (Tidal Volume) and IRV (Inspiratory Reserve Volume)

Ans. *(d)*

The Total Lung Capacity (TLC) is the total volume of air accommodated in the lungs at the end of a forced inspiration. This includes Residual Volume (RV), Expiratory Reserve Volume (ERV), Tidal Volume (TV) and Inspiratory Reserve Volume (IRV).

TLC is also equals to vital capacity of residual volume. Thus, option (d) is correct.

09 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

Ans. *(b)*

Vital Capacity (VC) is the maximum volume of air a person can breathe in after a forced expiration. This includes ERV, TV and IRV or the maximum volume of air a person can breathe out after a forced inspiration.

10 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

Ans. *(d)*

The Expiratory Capacity of athlete will be 1500 mL.

It can be calculated as

Given, Tidal Volume (TV) = 500 mL

Expiratory Reserve Volume (ERV) = 1000 mL

Expiratory Capacity = TV+ERV

= 500 + 1000 = 1500 mL

11 Match the items given in Column I with those in Column II and select the correct option given below
[NEET 2018]

	Column I	Column II
1.	Tidal volume	(i) 2500–3000 mL
2.	Inspiratory reserve volume	(ii) 1100–1200 mL
3.	Expiratory reserve volume	(iii) 500–550 mL
4.	Residual volume	(iv) 1000–1100 mL

	1	2	3	4
(a)	i	iv	ii	iii
(b)	iii	i	iv	ii
(c)	iii	ii	i	iv
(d)	iv	iii	ii	i

Ans. *(b)*

Tidal Volume (TV) is the volume of air inspired or expired during normal breath. It is about 500–550 mL.

Inspiratory Reserve Volume (IRV) is the extra amount of air that can be inspired directly after a normal inspiration. It is about 2500–3000 mL.

Expiratory Reserve Volume (ERV) is the extra amount of air that can be expired forcibly after a normal expiration. It is about 1000-1100 mL.

Residual Volume (RV) is the volume of air which remains still in the lung after the most forceful expiration. It is about 1100-1200 mL.

Therefore, option (b) is correct.

12 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)

Ans. *(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 -1200 mL.

13 Lungs do not collapse between breaths and some air always remains in the lungs which can never be expelled because **[NEET 2016, Phase II]**

(a) there is a negative pressure in the lungs
(b) there is a negative intrapleural pressure pulling at the lung walls
(c) there is a positive intrapleural pressure
(d) pressure in the lungs in higher than the atmospheric pressure

Ans. *(b)*

Lungs do not collapse between breaths and some air always remains in the lungs which can be never expelled because there is a negative intrapleural pressure pulling at the lung walls. Alveoli are basic functional unit of lungs.

The outer alveolar wall surface has cells which secrete DPPC also called as **lipid surfactant.**

The surfactant expands the alveoli due to which the negative pressure inside the alveoli increases. This prevents the alveoli from collapsing. Since, in this question both options (a) and (b) are correct and option (b) provides more appropriate explanation, therefore, it must be chosen.

14 Listed below are four respiratory capacities (1- 4) and four jumbled respiratory volumes of a normal human adult

Respiratory Capacities	Respiratory Volumes
1. Residual volume	2500 mL
2. Vital capacity	3500 mL
3. Inspiratory reserve volume	1200 mL
4. Inspiratory capacity	4500 mL

Which one of the following is the correct matching of two capacities and volumes? **[CBSE AIPMT 2010]**

(a) (2) 2500 mL, (3) 4500 mL
(b) (3) 1200 mL, (4) 2500 mL
(c) (4) 3500 mL, (1) 1200 mL
(d) (1) 4500 mL, (2) 3500 mL

Ans. *(c)*

Inspiratory Capacity (IC) is the maximum amount of air that can be inspired after a normal expiration, IC = TV + IRV. It is 3500 mL in adult male and 2400 mL in adult female.

Residual Volume (RV) is the amount of air remaining in the lungs after a forced exhalation. Its average value is 1200 mL and 1100 mL in adult male and female respectively.

15 What is the vital capacity of our lungs? **[CBSE AIPMT 2008]**

(a) Inspiratory reserve volume plus tidal volume
(b) Total lung capacity minus expiratory reserve volume
(c) Inspiratory reserve volume plus expiratory reserve volume
(d) Total lung capacity minus residual volume

Ans. *(d)*

Vital capacity is the sum of inspiratory reserve volume, tidal volume and expiratory reserve volume. It is about 4800 mL.

Total lung capacity is the sum of vital capacity and residual volume, i.e., vital capacity of our lungs is total lung capacity minus residual volume.

Tidal volume is the amount of air which normally passes into and out of the lungs during each cycle of quite breathing. It is about 800 mL in adult person.

Inspiratory reserve volume is the extra volume of air that can be inhaled into lungs during deepest possible inspiration.

16 The quantity 1500 mL in the respiratory volumes of a normal human adult refers to **[CBSE AIPMT 1996]**

(a) maximum air that can be breathed in and breathed out
(b) residual volume
(c) expiratory reserve volume
(d) total lung capacity

Ans. *(b)*

Residual air is the volume of air that remains in the lungs after the most forceful expiration. It equals to 1500 mL. Residual air mostly occurs in alveoli.

Maximum air that can be breathed in and breathed out is vital capacity (3500–4500 mL) while the air that can be expired over and above the tidal air by most forceful expiration is the expiratory reserve volume (1200 mL).

TOPIC 4
Exchange and Transport of Gases

17 **Assertion** (A) A person goes to high altitude and experiences 'altitude sickness' with symptoms like breathing difficulty and heart palpitations.

Reason (R) Due to low atmospheric pressure at high altitude, the body does not get sufficient oxygen.

In the light of the above statements, choose the correct answer from the options given below. **[NEET 2021]**

(a) Both A and R are true and R is the correct explanation of A
(b) Both A and R are true, but R is not the correct explanation of A
(c) A is true, but R is false
(d) A is false, but R is true

Ans. *(a)*

Both A and R are true and R is the correct explanation of A.

A person goes to the high altitude and experiences altitude sickness like heavy breathing and heart palpitation. It is due to low atmospheric pressure at high altitude, the body does not get sufficient oxygen.

18 Select the favourable conditions required for the formation of oxyhaemoglobin at the alveoli. **[NEET 2021]**

(a) High pO_2, low pCO_2, less H^+, lower temperature

(b) Low pO_2, high pCO_2, more H^+, higher temperature

(c) High pO_2, high pCO_2, less H^+, higher temperature

(d) Low pO_2, low pCO_2, more H^+, higher temperature

Ans. *(a)*

The favourable conditions for the formation of oxyhaemoglobin is high pO_2, lesser H^+ concentration and lower temperature found in alveoli, whereas low pO_2, high H^+ concentration and high temperature are favourable for dissociation of oxygen from the oxyhaemoglobin found in tissues.

19 The partial pressures (in mm Hg) of oxygen (O_2) and carbon dioxide (CO_2) at alveoli (the site of diffusion) are **[NEET 2021]**

(a) $pO_2 = 104$ and $pCO_2 = 40$

(b) $pO_2 = 40$ and $pCO_2 = 45$

(c) $pO_2 = 95$ and $pCO_2 = 40$

(d) $pO_2 = 159$ and $pCO_2 = 0.3$

Ans. *(a)*

Partial pressures of oxygen(in mm Hg) and carbon dioxide at alveoli are $pO_2 = 104$ and $pCO_2 = 40$.

Respiratory gas	Atmospheric air	Alveoli	Blood (deoxygenated)	Blood (oxygenated)	Tissue
O_2	159	104	40	95	40
CO_2	0.3	40	45	40	45

20 Match the following columns and select the correct option from the codes given below. **[NEET (Oct.) 2020]**

	Column I		Column II
A.	Pneumotaxic centre	1.	Alveoli
B.	O_2 dissociation curve	2.	Pons region of brain
C.	Carbonic anhydrase	3.	Haemoglobin
D.	Primary site of exchange of gases	4.	RBC

Codes

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

Ans. *(b)*

Option (b) is correct match, which is as follows. Pneumotaxic centre is present in the pons region of the brain.

O_2 dissociation curve is useful in studying the effect of factors like pCO_2, H^+ concentration, etc., on binding of O_2 with haemoglobin.

Carbonic anhydrase is an enzyme present on the surface of RBC.

Primary site of exchange of gases is the alveoli of the lungs.

21 Identify the wrong statement with reference to transport of oxygen. **[NEET (Sep.) 2020]**

(a) Partial pressure of CO_2 can interfere with O_2 binding with haemoglobin

(b) Higher H^+ concentration in alveoli favours the formation of oxyhaemoglobin

(c) Low pCO_2 in alveoli favours the formation of oxyhaemoglobin

(d) Binding of oxygen with haemoglobin is mainly related to partial pressure of O_2

Ans. *(b)*

Statement in option (b) is incorrect with reference to transport of oxygen. It can be corrected as

In alveoli high pO_2, low pCO_2, low H^+ concentration and lower temperature are the factors that favour the formation of oxyhaemoglobin.

22 Reduction in pH of blood will **[NEET 2016, Phase I]**

(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

Ans. *(b)*

Reduction in pH of blood, i.e. increase in acidity favours the dissociation of oxyhaemoglobin thereby giving upmore O_2. When this phenomenon occurs due to increase in CO_2 concentration then it is called Bohr effect.

23 The partial pressure of oxygen in the alveoli of the lungs is **[NEET 2016, Phase II]**

(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

Ans. *(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 to the blood vessels of lung alveoli.

24 Approximately seventy percent 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

Ans. *(a)*

The largest fraction of carbon dioxide, i.e. about 70% is converted to bicarbonates (HCO_3^-) and transported in the plasma.

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

About –23% of CO_2 is carried by haemoglobin as carbaminohaemoglobin

$CO_2 + Hb$ (haemoglobin) $\rightleftharpoons HbCO_3$

Carbo amino haemoglobin

25 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

Ans. *(a)*

As a person moves up a hill the pO_2 and total atmospheric pressure decreases. Decrease in pO_2 due to the increasing altitude, stimulates the Juxtaglomerular cells of kidney to secrete erythropoietin hormone which increases the number of RBCs (polycythemia) to compensate the supply of O_2. 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.

26 Which two of the following changes (1 - 4) usually tend to occur in the plain dwellers when they move to high altitudes (3,500 m or more)? **[CBSE AIPMT 2010]**

1. Increase in red blood cell size
2. Increase in red blood cell production
3. Increased breathing rate
4. Increase in thrombocyte count

Changes occurring are **[CBSE AIPMT 2010]**

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

Ans. *(a)*

When a person moves to higher altitudes, the pO_2 and total atmospheric pressure decrease. Hypoxia stimulates the Juxtaglomerular cells of the kidney to release erythropoietin hormone which stimulates erythropoesis in bone marrow causing polycythemia (increase in RBCs production). Hypoxia will also increase breathing rate. Initially the size of RBCs will also increase but with increase in number of RBCs, the size of RBCs becomes normal.

27 The haemoglobin of a human foetus **[CBSE AIPMT 2008]**

(a) has a lower affinity for oxygen than that of the adult
(b) its affinity for oxygen is the same as that of an adult
(c) has only 2 protein sub-units instead of 4
(d) has a higher affinity for oxygen than that of an adult

Ans. *(d)*

Haemoglobin is the protein that makes red blood corpuscles appear red, binds easily and reversibly with oxygen. Normal values for haemoglobin are 14–20 g/100 mL of blood in infants, 13–18 g/100 mL in adult male and 12–16 g/100 mL in adult females. Foetal red blood cells are not sickle-shaped even in that destined to have sickle-cell anaemia, i.e. haemoglobin of foetus has higher affinity of oxygen than that an adult.

28 People living at sea level have around 5 million RBC per cubic millimeter of their blood whereas those living at an altitude of 5400 metre have around 8 million. This is because at high altitude **[CBSE AIPMT 2006]**

(a) atmospheric O_2 level is less and hence, more RBCs are needed to absorb the required amount of O_2 to survive
(b) there is more UV radiation which enhances RBC production
(c) people eat more nutritive food, therefore, more RBCs are formed
(d) people get pollution-free air to breathe and more oxygen is available

Ans. *(a)*

At high altitudes, the atmospheric O_2 level is less and hence, more RBCs are needed to absorb the required amount of O_2 to survive. That is why, the people living at sea level have around 5 million RBC/mm^3 of their blood whereas, those living at an altitude of 5400 meter have around 8 million RBC/mm^3 of their blood.

29 Blood analysis of a patient reveals an unusually high quantity of carboxyhaemoglobin content. Which of the following conclusions is most likely to be correct? **[CBSE AIPMT 2004]**

(a) The patient has been inhaling polluted air containing unusually high content of carbon disulphide
(b) The patient has been inhaling polluted air containing unusually high content of chloroform
(c) The patient has been inhaling polluted air containing unusually high content of carbon dioxide
(d) The patient has been inhaling polluted air containing unusually high content of carbon monoxide

Ans. *(d)*

Inhalation of polluted air causes increase in CO in the blood of a person. Carbon monoxide forms a stable compound with haemoglobin called carboxy-haemoglobin as affinity of Hb for CO is 210 times greater than its affinity for O_2. In this form haemoglobin does not carry oxygen resulting in death due to hypoxia.

$$\underset{\text{Haemoglobin}}{Hb} + CO \rightleftharpoons \underset{\text{Carboxy haemoglobin}}{Hb\,CO}$$

30 When CO_2 concentration in blood increases, breathing becomes **[CBSE AIPMT 2004]**

(a) shallower and slow
(b) there is no effect on breathing
(c) slow and deep
(d) faster and deeper

Ans. *(d)*

When CO_2 concentration in blood increases breathing becomes faster and deeper. The effect of increased CO_2 is to decrease the affinity of haemoglobin for O_2.

Thus, due to Bohr's effect the CO_2 released in respiring tissue accelerates the delivery of oxygen by faster and deeper breathing.

31 The process of migration of chloride ions from plasma to RBC and of carbonate ions from RBC to plasma is **[CBSE AIPMT 1999]**

(a) chloride shift
(b) ionic shift
(c) atomic shift
(d) Na^+ pump

Ans. *(a)*

To maintain electrostatic neutrality of plasma, many chloride ions diffuse from plasma into RBCs and bicarbonate ions pass out.

The chloride content of RBCs increases when oxygenated blood becomes deoxygenated. This is termed as chloride shift or Hamburger shift.

32 The exchange of gases in the alveoli of the lungs takes place by **[CBSE AIPMT 1998]**

(a) simple diffusion
(b) osmosis
(c) active transport
(d) passive transport

Ans. *(a)*

Oxygen diffuses from alveoli to deoxygenated blood and CO_2 diffuses from deoxygenated blood to alveoli by simple diffusion. Diffusion is defined as, the flow of the substance (gases) from a region of their higher concentration to a region of lower concentration.

33 Which one of the following statements about blood constituents and transport of respiratory gases is most accurate? **[CBSE AIPMT 1996]**

(a) RBCs transport oxygen whereas WBCs transport CO_2
(b) RBCs transport oxygen whereas plasma transports only CO_2
(c) RBCs as well as WBCs transport both oxygen and CO_2
(d) RBCs as well as plasma transport both oxygen and CO_2

Ans. *(d)*

RBCs and plasma both transport O_2 and CO_2 either in chemically bonded state or in dissolved state.

34 At high altitude, the RBCs in the human blood will **[CBSE AIPMT 1995]**

(a) increase in size
(b) decrease in size
(c) increase in number
(d) decrease in number

Ans. *(c)*

At high altitude there is low O_2 concentration, so RBCs increase in number, i.e. O_2 supply can be maintained to organs.

35 The carbon dioxide is transported *via* blood to lungs as **[CBSE AIPMT 1995]**

(a) dissolved in blood plasma
(b) in the form of carbonic acid only
(c) in combination with haemoglobin only
(d) carbaminohaemoglobin and as carbonic acid

Ans. *(d)*

Most of the CO_2 (70%) that dissolves in plasma reacts with water forming carbonic acid. This reaction occurs rapidly inside RBCs because of the presence of an enzyme carbonic anhydrase. Moreover, above 23% of total blood CO_2 is transported by loosely binding with haemoglobin forming an unstable compound called carbaminohaemoglobin.

36 Although much CO_2 is carried in blood, yet blood does not become acidic, because **[CBSE AIPMT 1995]**

(a) it is absorbed by the leucocytes
(b) blood buffers play an important role in CO_2 transport
(c) it combines with water to form H_2CO_3 which is neutralised by Na_2CO_3
(d) it is continuously diffused through tissues and is not allowed to accumulate

Ans. *(b)*

Buffer of the blood is sodium bicarbonate which play an important role in CO_2 transport. During CO_2 transportation, carbonic acid dissociates into H^+ and HCO_3^- (bicarbonate ions). This bicarbonate combines with sodium forming sodium bicarbonate. Thus, concentration of carbonic acid does not increase in blood due to the presence of sodium and thus blood does not become acidic. About 70% of CO_2 released during cellular respiration is transported by blood in the form of sodium bicarbonate in plasma.

37 Oxygen dissociation curve of haemoglobin is **[CBSE AIPMT 1994]**

(a) sigmoid (b) hyperbolic
(c) linear (d) hypobolic

Ans. *(a)*

Oxygen haemoglobin dissociation curve gives the relationship between the saturation of haemoglobin and oxygen tension. The curve obtained by plotting the percent saturation of Hb against time is sigmoid, at 38°C and pH 7.4. Dissociation of oxyhaemoglobin can be promoted by rise in the body temperature and low pH (high CO_2).

38 Carbon dioxide is transported from tissues to respiratory surface by only **[CBSE AIPMT 1993]**

(a) plasma and erythrocytes
(b) plasma
(c) erythrocytes
(d) erythrocytes and leucocytes

Ans. *(a)*

Carbon dioxide is transported from tissues to respiratory surface by only plasma and erythrocytes. Carbon dioxide (CO_2) transportation by blood is much easier than oxygen due to the high solubility of CO_2 in water. During transport of CO_2, 7% of CO_2 is dissolved in plasma, 23% as carbaminohaemoglobin and 70% transported as bicarbonates (HCO_3^-).

39 Carbonic anhydrase occurs in **[CBSE AIPMT 1991]**

(a) lymphocytes (b) blood plasma
(c) RBC (d) leucocytes

Ans. *(c)*

The erythrocyte (RBC) contains sufficient amount of carbonic anhydrase enzyme which catalyses the reaction between CO_2 and H_2O and helps in transportation of CO_2 from tissues to the lungs.

TOPIC 5
Disorders of Respiratory System

40 According to Central Pollution Control Board (CPCB) what size (in diameter) of particulate is responsible for causing greater harm to human health? **[NEET (Oct.) 2020]**

(a) 3.5 micrometers
(b) 2.5 micrometers
(c) 4.0 micrometers
(d) 3.0 micrometers

Ans. *(b)*

According to Central Pollution Control Board (CPCB), particulate size 2.5 micrometers or less in diameter (PM 2.5) are responsible for causing the greatest harm to human health. These fine particulates can be inhaled deep into the lungs and can cause breathing and respiratory symptoms, irritation, inflammation and damage to the lungs and premature deaths.

41 Which of the following is an occupational respiratory disorder? **[NEET 2018]**

(a) Botulism (b) Silicosis
(c) Anthracis (d) Emphysema

Ans. *(b)*

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

Anthracis or Anthrax is a bacterial infection caused by *Bacillus anthracis.*

Botulism is food poisoning infection caused by *Clostridium botulinum.* Its symptoms include diarrhoea, vomiting, abdominal distention, etc.

Emphysema is a lung disease, that damages the air sacs and causes shortness of breathe. It may be caused by smoking, deficiency of enzymes alpha-1-antitrypsin and air pollution.

42 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

Ans. *(c)*

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 get greatly reduced.

43 Name the chronic respiratory disorder caused mainly by cigarette smoking **[NEET 2016, Phase I]**

(a) asthma
(b) respiratory acidosis
(c) respiratory alkalosis
(d) emphysema

Ans. *(d)*

Emphysema is characterised by inflation or distension of alveoli by dissolution of wall of the two adjacent lung alveoli. It generally occurs due to chronic cigarette smoking.

44 Name the pulmonary disease in which alveolar surface area involved in gas exchange is drastically reduced due to damage in the alveolar walls. **[CBSE AIPMT 2015]**

(a) Pleurisy
(b) Emphysema
(c) Pneumonia
(d) Asthma

Ans. *(b)*

Empysema is a chronic respiratory disease where there is over-inflation of the air sacs (alveoli) in the lung, causing a decrease in lung function and often, breathlessness.

In this disease, the alveolar walls are damaged leading to drastic reduction in gas exchange.

45 Which one of the following is the correct statement for respiration in humans? **[CBSE AIPMT 2012]**

(a) Cigarette smoking may lead to inflammation of bronchi
(b) Neural signals from pneumotoxic centre in pons region of brain can increase the duration of inspiration
(c) Workers in grinding and stone breaking industries may suffer, from lung fibrosis
(d) About 90% of carbon dioxide (CO_2) is carried by haemoglobin as carbamino haemoglobin

Ans. *(c)*

Irritating gases, fumes, dusts, etc., present in the work place result in lung disorders.

This is because the defence mechanism of the body cannot fully cope with this situation of so much dust.

Long exposure can give rise to inflammation leading to fibrosis (proliferation of fibrous tissue) and thus causing serious lung damage.