DAY TWENTY

Breathing and Exchange of Gases

Learning & Revision for the Day

- Respiration
- Human Respiratory System
- Mechanism of Breathing
- Respiratory Volumes and Capacities
- Exchange of Gases
- Transport of Gases in Blood
- Regulation of Respiration
- Disorders of Respiratory System

Respiration

- It 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 released energy is temporarily stored as ATP.

$$\underset{\text{(Glucose)}}{C_6H_{12}O_6} + \underset{\text{(Oxygen)}}{6O_2} \longrightarrow \underset{\text{(Carbon dioxide)}}{6CO_2} + \underset{\text{(Water)}}{6H_2O} + \text{Energy}$$

- 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**.
- This process is carried out through specialised structures called respiratory organs, which differ among organisms.

Respiratory Organs in Different Animals

Respiratory Organs	Examples
Plasma membrane	External respiration in protists.
Body wall	Sponges, cnidarians, platyhelminthes, annelids.
Gills	Aquatic animals like crustaceans (prawns), fishes and tadpole.
Tracheae	Insects, e.g. cockroach and other terrestrial arthropods.
Book lungs	Arachnids like scorpion and spider.
Lungs	All vertebrates except fishes.

- Respiration may be of two types, i.e. anaerobic respiration (the respiration without oxygen) and aerobic respiration (respiration that requires oxygen).

(i) **In anaerobic respiration**, food is oxidised without using molecular oxygen, e.g. anaerobic bacteria, yeast, parasitic worms like *Ascaris, Taenia, Fasciola,* etc.

In microorganisms, the term 'fermentation' is more commonly used in place of anaerobic respiration, which is defined as the anaerobic breakdown of carbohydrates and other organic compounds into alcohols, organic acids, CO_2, etc., with the help of enzymes.

(ii) **In aerobic respiration**, oxygen is used for complete oxidation of food in cells, e.g. most plants and animals,

- In higher animals, whole process of respiration includes external respiration, internal respiration and cellular respiration.

Human Respiratory System

The respiratory system of humans is derived from embryonic endoderm. The mammalian respiratory system consists of two parts, namely respiratory tract and respiratory organs.

Respiratory Tract

Different components of respiratory tracts are as follows

(i) **Nostril** (nares) is one of the two channels of the nose, from the point where they bifurcate to the external opening.

In birds and mammals, they contain branched bones or cartilages called turbinates, whose function is to warm air on inhalation and remove moisture on exhalation.

(ii) **Nasal cavity** is divided into two nasal chambers by the nasal septum.

- Each nasal chamber consists of three regions, i.e. vestibular, respiratory and olfactory regions.
- It produces mucus, filtres, moistens and warms incoming air and acts as resonance chamber for speech.

(iii) **Pharynx** is a passageway that connects nasal cavity to larynx and oral cavity to oesophagus. It has three subdivisions, namely, nasopharynx, oropharynx and laryngopharynx.

(iv) **Larynx** contains vocal cords, the sound producing elastic fibres called **voice box**.

- There is a little difference in the size of the larynx in man and woman, it grows larger and becomes prominent in man, therefore, it is called **Adam's apple** in man.
- Human larynx consists of glottis, cartilages, hyoid bone, thyrohyoid membrane, vocal cords, laryngeal ligaments and muscles.
- Glottis is an opening in the floor of pharynx leading to larynx. There are nine pieces of cartilages (3 are single and 3 are paired).
- Epiglottis is a leaf-like structure that prevents the entry of food into respiratory tract during swallowing.

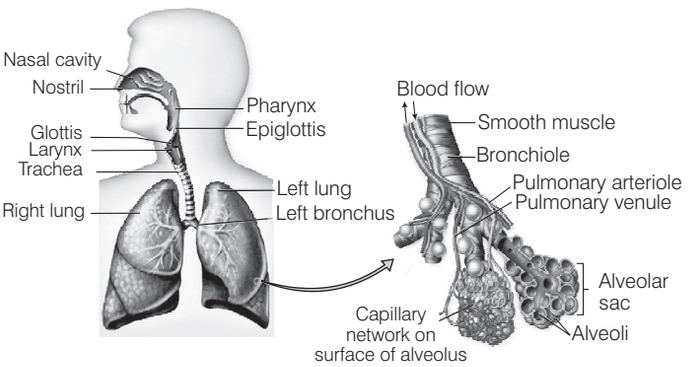
(v) **Trachea or windpipe** is a continuation of the larynx, which is supported by incomplete (C-shaped) rings of hyaline cartilages. The mucosa of trachea is lined with a ciliated pseudostratified epithelium containing mucus secreting Goblet cells, which help in pushing mucus out.

(vi) **Bronchi** are one pair of small, thin-walled tubular structures formed by the division of trachea at the level of 5th thoracic vertebra.

(vii) **Bronchioles** are formed by the subdivision of the tertiary bronchi into smaller branches. After repeated branching one of the smaller bronchiole enters a lung lobule called **lobular bronchiole**.

Lungs

- In human, lungs are main respiratory organs.
- Each **lung** is covered by double membrane called **pleurae**. The outer covering membrane of lung is called **parietal pleura**, while the inner covering membrane of lung is called **visceral pleura**.
- In human, the right lung has three lobes and left lung has two lobes.
- The **alveoli** are the ultimate structural and physiological units of lung. They are lined by flattened, non-ciliated squamous cells.
- Special alveolar cells produce surfactant that reduces surface tension and help to prevent lung collapse.
- These provide great surface area for gaseous exchange by diffusion.



Human respiratory system

- The **diaphragm** is a dome-shaped muscular structure separating the thoracic and abdominal cavities, which helps in breathing by changing volume of lungs.
- It is the characteristic of mammals. The diaphragm is supplied by the phrenic nerves.

Mechanism of Breathing

The process of respiration mainly includes two phases

1. External Respiration

It is the process by which gases are exchanged between the blood and the air. It is a physical process, which involves the intake of oxygen and giving out of carbon dioxide. Respiratory movement during external respiration involves two phases

(i) **Inspiration** is a process by which fresh air enters in the lungs.
- In this, diaphragm becomes flat and gets lowered by the contraction of its muscle fibres and increases the volume of thoracic cavity.
- The external intercostal muscles contract and pull the ribs and sternum upwards and outwards direction and thus the volume of thoracic cavity is increased.

(ii) **Expiration** is a process by which CO_2 is expelled out from the lungs.
- In this, muscle fibres of the diaphragm relax and make it convex, decreasing the volume of the thoracic cavity.
- External intercostal muscles relax and pull the ribs downwards and inwards direction, thus decreasing the size of the thoracic cavity.

2. Internal Respiration

It is the process in which gases are exchanged between blood and tissue fluid and between tissue fluid and cells.

Cellular respiration is the process by which cells use oxygen (O_2) for metabolism and give off carbon dioxide (CO_2) as a waste.

Respiratory Volumes and Capacities

- The quantities of air, that lung can receive, hold or expel under different conditions are called pulmonary or respiratory volumes and combination of two or more pulmonary volumes are called **pulmonary capacities**.
- The apparatus commonly used to measure the pulmonary volumes is a spirometer or respirometer and the recording of breathing is known as **spirogram**.
- There are four respiratory volumes, i.e. Tidal Volume (TV), Inspiratory Reserve Volume (IRV), Expiratory Reserve Volume (ERV), Residual Volume (RV) and four respiratory capacities, i.e. Inspiratory Capacity (IC), Functional Residual Capacity (FRC), Vital Capacity (VC) and Total Lung Capacity (TLC).

Respiratory Volume and Capacity for Males and Females

Measurement	Adult Male Average Value	Adult Female Average Value	Description
Respiratory Volumes			
Tidal Volume (TV)	500 mL	500 mL	Amount of air inhaled or exhaled with each breath under resting conditions.
Inspiratory Reserve Volume (IRV)	3100 mL	1900 mL	Amount of air that can be forcefully inhaled after a normal tidal volume inhalation.
Expiratory Reserve Volume (ERV)	1200 mL	700 mL	Amount of air that can be forcefully exhaled after a normal tidal volume exhalation.
Residual Volume (RV)	1200 mL	1100 mL	Amount of air remaining in the lungs after a forced exhalation.
Respiratory Capacities			
Total Lung Capacity (TLC)	6000 mL	4200 mL	Maximum amount of air contained in lungs after a maximum inspiratory effort, TLC = TV + IRV + ERV + RV
Vital Capacity (VC)	4800 mL	3100 mL	Maximum amount of air that can be expired after a maximum inspiratory effort, VC = TV + IRV + ERV (should be 80% TLC)
Inspiratory Capacity (IC)	3600 mL	2400 mL	Maximum amount of air that can be inspired after a normal expiration; IC = TV + IRV
Functional Residual Capacity (FRC)	2400 mL	1800 mL	Volume of air remaining in the lungs after a normal tidal volume expiration, FRC = ERV + RV

NOTE
- Respiratory quotient is the ratio of volume of CO_2 produced to volume of oxygen consumed.
- $RQ = \frac{\text{Volume of } CO_2 \text{ evolved}}{\text{Volume of } O_2 \text{ absorbed}}$

Exchange of Gases

- Breathing (pulmonary ventilation) is the process of moving air into and out of the lungs.
- Alveoli acts as the primary sites of pulmonary exchange of gases.
- Exchange of gases also occurs between blood and tissues.
- Solubility of gases as well as the thickness of the membranes involved in diffusion are important factors that can affect the rate of diffusion.
- Partial pressure of O_2 and CO_2 in the atmospheric air and the two sites of diffusion are given below

Partial Pressure (in mmHg) **of Oxygen and Carbon Dioxide**

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

- As the solubility of CO_2 in blood is 20-25 times higher than that of O_2, 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.
- The diffusion membrane is made up of three major layers, i.e. thin squamous epithelium of alveoli, the endothelium of alveolar capillaries and the basement substance in between them.
- All these factors are favourable for diffusion of O_2 from alveoli to tissues and that of CO_2 from tissues to alveoli.

Transport of Gases in Blood

- The respiratory membrane has a limit of gaseous exchange between alveoli and pulmonary blood. It is called **diffusing capacity.**
- Blood transport oxygen from the respiratory organs to the tissue cells and also transports carbon dioxide from the tissue cells to the respiratory membrane.

1. Oxygen Transport

- 98.5% of oxygen (O_2) is transported by blood with the help of the respiratory pigment haemoglobin present in erythrocytes (RBCs).
- One molecule of haemoglobin can carry as much as 4 oxygen molecules.
- 1 g of haemoglobin binds about 1.34 mL of oxygen (O_2). Thus, 100 mL of pure blood carries about 20 mL of oxygen.
- Oxygen-Haemoglobin (O_2 - Hb) dissociation curve is a graph plotted between per cent saturation of haemoglobin and oxygen tension.
- At normal condition that is on pCO_2 of 40 mmHg concentration, this curve is **sigmoid** and **normal**.
- Due to increase in concentration of CO_2, i.e. decreased pH, acidity of blood increases and curve is shifted towards right side.
- Due to decrease in concentration of CO_2, pH increase, i.e. acidity of blood decreases and curve is shifted towards left side. Rise in temperature and low pH promote dissociation of oxyhaemoglobin.

2. Carbon Dioxide Transport

- Transport of carbon dioxide by blood is much easier than that of the oxygen due to the high solubility of CO_2 in water.
- About 7% of CO_2 is transported as dissolved in plasma, 23% as carbaminohaemoglobin and 70% as bicarbonates.
- Most of the CO_2 is transported by blood in the form of **sodium bicarbonate** (buffer of blood) in plasma.
- **Bohr's effect** states that Hb-O_2 dissociation curve shifts to right, when CO_2 tension in the blood is high. Deoxygenation of oxyhaemoglobin is directly proportional to the pCO_2 of blood. CO_2 of tissue fluid and alveoli does not exert Bohr's effect.
- **Haldane's effect** is important for promoting CO_2transport. Oxyhaemoglobin behaves as a strong acid. As more and more oxyhaemoglobin forms in the lungs, it releases more and more H^+ ions thus, increasing the acidity of blood.
- **Chloride shift or Hamburger's phenomenon** occurs when many chloride ions diffuse from plasma into RBCs and bicarbonate ions pass out so as to maintain the electrostatic neutrality of the plasma. Due to this, the chloride content of RBCs increases and oxygenated blood becomes deoxygenated. Entering of Cl^- ions into RBCs is known as **positive chloride shift**. Shifting of Cl^- ions from RBCs into plasma is known as **negative chloride shift**.

Regulation of Respiration

- Respiratory movements are under the control of **medulla oblongata** of brain.
- The basic rhythm of respiration is controlled by the respiratory centre present in brain stem (medulla and pons). The medullary rhythmic area can be divided into a Dorsal Respiratory Group (DRG) and a Ventral Respiratory Group (VRG).
- The receptors for chemical regulation are located in carotid bodies, aortic bodies and in brain.
- The carotid and aortic bodies are situated in association with heart. The carotid and aortic bodies are responsible for the detection of O_2 concentration in blood and its effect on breathing. These are considered as peripheral chemoreceptors. Thus, the blood oxygen does not have direct effect on the respiratory centre of brain.

$$\text{Breathing rate} \propto \frac{1}{O_2 \text{ concentration}}$$

- Along with nervous and chemical coordination, temperature also affects breathing rate. Increased temperature up to certain extent, increases metabolic activities thus increases the breathing rate.

NOTE Artificial respiration is required when person drowns, comes under electric shock, met an accident or exposed to gas poisoning or anesthesia.

Disorders of Respiratory System

(i) **Bronchitis** is caused by the permanent swelling in bronchi. As a result of bronchitis, cough is caused and thick mucus with pus cells is spitted out.

(ii) **Bronchial asthma** is an allergic attack of breathlessness associated with bronchial obstruction, characterised by coughing and difficult breathing.

(iii) **Emphysema** is a condition, in which the walls separating the alveoli break, resulting in the reduction of surface area for the exchange of respiratory gases. Heavy cigarette smoking leads to emphysema.

(iv) **Pneumonia** is an acute infection or inflammation of the alveoli. The most common cause of pneumonia is the pneumococcal bacterium *Streptococcus pneumoniae*.

(v) **Lung cancer** is caused by excessive smoking. The tissue increases limitlessly, which is called malignancy. The blood capillaries are ruptured, blood starts flowing and death is caused by excessive bleeding.

(vi) **Hay fever** is an allergic disorder of nasal lining. It develops due to hypersensitivity of the lining to pollen grains or other foreign particles. There is an nasal episode of sneezing that begins following allergy.

Some of the other diseases affecting respiratory system are pulmonary TB caused by *Mycobacterium tuberculosis*, diphtheria caused by *Corynebacterium diphtheriae*, *Coryza* caused by rhinovirus, influenza by influenza virus and SARS caused by HCV.

NOTE Altitude sickness is caused when a person moves to higher altitudes due to the decrease in atmospheric pressure and pO_2. It leads to hypoxia which results in the release of erythropoietin from JGA cells and hence, RBC production increases. The size of RBCs may also increase.

Occupational Respiratory Disorders

(i) **Anthracosis** which is pneumoconiosis of coal workers, deposition of fibrous tissue in the lungs causing bronchitis and emphysema.

(ii) **Silicosis** which is caused due to long exposure to dust containing silicon compounds. Workers of glass industry, potters, gold and copper miners develop progressive fibrosis.

DAY PRACTICE SESSION 1

FOUNDATION QUESTIONS EXERCISE

1 Aerobic respiration increases the body's supply of
(a) CO_2 (b) water
(c) ATP (d) All of these

2 Pharyngeal tonsils are located in the
(a) nasopharynx (b) oral cavity
(c) nasal cavity (d) oropharynx

3 Which of the following is not a structural feature of the left lung?
(a) Superior lobe (b) Cardiac notch
(c) Inferior lobe (d) Middle lobe

4 If the thoracic wall but not lungs, is punctured the
(a) lungs get inflated
(b) man dies as the lungs get collapsed
(c) breathing rate decreases
(d) breathing rate increases

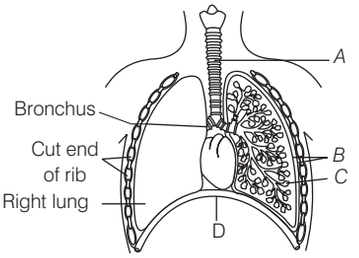
5 Which is not a structure of the respiratory system?
(a) Pharynx (b) Bronchus
(c) Larynx (d) Hyoid

6 The pharynx is divided into three parts. Which among the following is not a part of pharynx?
(a) Nasopharynx
(b) Bronchiopharynx
(c) Oropharynx
(d) Laropharynx

7 The cartilages, upon which the vocal cords are attached are the
(a) thyroid and arytenoid cartilages
(b) thyroid and cricoid cartilages
(c) cuneiform and cricoid cartilages
(d) thyroid and corniculate cartilages

8 The serous membrane in contact with the lung is the
(a) parietal pleura
(b) pulmonary mesentery
(c) pulmonary peritoneum
(d) visceral pleura

9 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–surrounds 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

10 Respiration involves which one of the following sets of processes?
(a) Inspiration, exchange of gases and expiration
(b) Aspiration, inspiration and expiration
(c) External, internal and expiration
(d) None of the above

11 In human beings, rib cage and sternum move upwardly and outwardly during
(a) exercise (b) sudden back injury
(c) expiration (d) inspiration

12 Expiratory muscles contract at the time of
(a) deep inspiration
(b) normal inspiration and expiration
(c) forceful expiration
(d) normal expiration

13 In mammals, ventilation movements of lungs are governed by
(a) muscular wall of lungs (b) intercostal muscles
(c) diaphragm (d) Both (b) and (c)

14 Expiration involves
(a) relaxation of diaphragm and intercostal muscles
(b) contraction of diaphragm and intercostal muscles
(c) contraction of only diaphragm muscles
(d) contraction of intercostal muscles and relaxation of diaphragm muscles

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

16 The maximum amount of air that can be inspired after a maximum expiration is called the
(a) forced expiratory volume (b) maximum expiratory flow
(c) tidal volume (d) vital capacity

17 The amount of air that is moved in and out of the lungs during quiet normal breathing is called the
(a) vital capacity (b) tidal volume
(c) residual volume (d) vital volume

18 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)

19 Residual air can be traced in
(a) alveoli (b) bronchi
(c) nasal chambers (d) trachea

20 Anatomical dead space is
(a) upper respiratory tract
(b) space between alveoli and capillaries
(c) lower respiratory tract
(d) in nasal sacs

21 Arrange the following in the order of increasing volume
I. Tidal volume II. Residual volume
III. Expiratory reserve volume IV. Vital capacity
(a) I < II < III < IV (b) I < III < II < IV
(c) I < IV < III < II (d) I < IV < II < III

22 Cells, which help in the transportation of O_2 are
(a) WBCs (b) leucocytes
(c) RBCs (d) thrombocytes

23 When blood CO_2 level rises
(a) only the rate of breathing decreases
(b) respiratory acidosis may occur
(c) peripheral pressure receptors respond
(d) both the rate and depth of breathing decrease

24 Increase of oxyhaemoglobin leads to increase in acidic nature. This is
(a) Bohr's effect (b) Hamburger phenomenon
(c) Chloride shift (d) Haldane's effect

25 Oxygen dissociation curve is
(a) sigmoid (b) parabolic
(c) hyperbolic (d) straight line

26 Oxyhaemoglobin dissociates into oxygen and deoxyhaemoglobin at
(a) low O_2 pressure in tissue
(b) high O_2 pressure in tissue
(c) equal O_2 pressure inside and outside tissue
(d) all times irrespective of O_2 pressure

27 Mammalian lungs have an enormous number of minute alveoli (air sacs). This is to allow
(a) more space for increasing the volume of inspired air
(b) more surfaces are for diffusion of gases
(c) more spongy texture for keeping lungs in proper sliape
(d) more nerve supply to keep the lungs working

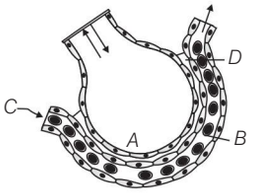
28 Approximately seventy per cent of carbon dioxide absorbed by the blood will be transported to the lungs
(a) as bicarbonate ions → CBSE-AIPMT 2014
(b) in the form of dissolved gas molecules
(c) by binding to RBC
(d) as carbaminohaemoglobin

29 Partial pressure of oxygen in the inspired and expired air is respectively
(a) 158 and 116 mm Hg (b) 158 and 40 mm Hg
(c) 100 and 95 mm Hg (d) 40 and 95 mm Hg

30 In human beings, partial pressure of carbon dioxide in the inspired and expired air is respectively
(a) 0.3 and 40 mm Hg (b) 0.3 and 32 mm Hg
(c) 40 and 46 mm Hg (d) 40 and 0.3 mm Hg

31 Oxygen dissociation curve of myoglobin is
(a) hypobolic (b) hyperbolic (c) linear (d) sigmoid

32 The figure given below shows a small part of human lung where exchange of gases 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

33 The partial pressure of oxygen in the alveoli of the lungs is → NEET-II 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

34 Reduction in pH of blood will → NEET-II 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

35 If 100 mL of blood has 15 g haemoglobin and 1 g of haemoglobin carries about 1.34 mL of O_2. Then, 135 mL of same blood will carry how much oxygen?
(a) 24 mL (b) 27 mL (c) 26 mL (d) 25 mL

36 Consider the following statements regarding carbon dioxide transport.
I. About 7% of CO_2 is transported as dissolved in plasma. 23% as carbamino haemoglobin and 70% as bicarbonates.
II. The CO_2 dissolved in plasma forms carbonic anhydrase.
III. The concentration of carbonic acid remains constant due to potassium.
Choose the correct option.
(a) Only II (b) Only III
(c) Only I (d) I, II and III

37 As CO_2 produced in the tissues combines with H_2O in the blood
(a) carbonic acid is formed
(b) Cl^- enters the blood
(c) most of the HCO_3^- from the carbonic acid leave the RBCs for the blood plasma
(d) All of the preceding occur

38 The basic inspiratory and expiratory centres are located in the
(a) lungs (b) medulla oblongata
(c) carotid and aortic bodies (d) pons

39 Pneumatic and inhibitory centres are associated with
(a) respiration (b) breathing
(c) inspiration (d) expiration

40 Inflammation of the lung covering causing severe chest pain is
(a) emphysema (b) pleurisy
(c) asphyxia (d) hypoxia

41 When the oxygen supply to the tissues is inadequate, the condition is
(a) hypoxia (b) asphyxia
(c) pleurisy (d) anoxia

42 Name the chronic respiratory disorder caused mainly by cigarette smoking → NEET-I 2016
(a) asthma (b) respiratory acidosis
(c) respiratory alkalosis (d) emphysema

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

44 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

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 carbaminohaemoglobin

46 Blood analysis of a patient reveals an unusually high quantity of carboxyhaemoglobin content. Which of the following conclusions is most likely to be correct?

(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

47 Which of the following diseases and their target parts are matched correctly?

I. Emphysema — Nasal lining
II. Asthma — Bronchioles
III. Hay fever — Alveolar sac
IV. Pleurisy — Pleural membrane

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

48 Which two of the following changes (I-IV) usually tend to occur in the plain dwellers when they move to high altitudes (3,500 m or more)? ➞ CBSE-AIPMT 2010

I. Increase in red blood cell size
II. Increase in red blood cell production
III. Increase breathing rate
IV. Increase in thrombocyte amount

Changes occurring are

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

49 Match the following columns.

	Column I (Animals)		Column II (Respiratory organ)
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)	2	1	4	3
(b)	1	4	2	3
(c)	1	3	2	4
(d)	1	2	4	3

50 Match the following columns. ➞ NEET 2018

	Column I		Column II
A.	Tidal volume	1.	2500-3000 mL
B.	Inspiratory reserve volume	2.	1100-1200 mL
C.	Expiratory reserve volume	3.	500-550 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

51 Match the following columns.

	Column I		Column II
A.	Lung irritation	1.	Coal workers
B.	Black lung	2.	Metallurgical occupation
C.	CBD	3.	Exposure to asbestos
D.	Brown lung	4.	Poor ventilation to textile workers

Codes

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

Directions (Q. Nos. 52-53) *In each of the following questions a statement of Assertion is given followed by a corresponding statement of Reason just below it. Of the statements, mark the correct answer as*

(a) If both Assertion and Reason are true and Reason is the correct explanation of Assertion

(b) If both Assertion and Reason are true, but Reason is not the correct explanation of Assertion

(c) If Assertion is true, but Reason is false

(d) If both Assertion and Reason are false

52 **Assertion** Carbonic anhydrase is present in the erythrocytes.
Reason In erythrocytes, the carbon dioxide combines with water and is transported.

53 **Assertion** Breathing process is controlled by medulla and pons.
Reason Medulla and pons are part of chemical regulation.

DAY PRACTICE SESSION 2

PROGRESSIVE QUESTIONS EXERCISE

1 A person met with an accident and died instantly without any injury to heart, brain, stomach and kidney. Which one of the following is a reason for his death?
(a) Intestine got twisted
(b) RBCs became coagulated
(c) Stomach stopped digestion
(d) Diaphragm got punctured

2 Two friends are eating together on a dining table. One of them suddenly starts coughing while swallowing some food. This coughing would have been due to improper movement of
(a) diaphragm (b) neck (c) tongue (d) epiglottis

3 Incidence of emphysema, a respiratory disorder is high in cigarette smokers.
The main symptoms of the disease is
(a) the bronchioles are found damaged
(b) the plasma membrane is found damaged
(c) the alveolar walls are found damaged
(d) the respiratory muscles are found damaged

4 Volume of air left after maximum forceful expiration in human lung is
(a) total lung capacity (b) residual volume
(c) vital capacity (d) tidal volume

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

6 Although much CO_2 is carried in blood, yet blood does not become acidic, because
(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

7 Carbonic anhydrase occurs in
(a) lymphocytes (b) blood plasma
(c) RBC (d) leucocytes

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

9 In human beings, CO_2 concentration in the inspired and expired air is respectively
(a) 0.03% and 5.3% (b) 0.4% and 5.0%
(c) 0.04% and 3.0% (d) 0.03% and 4.0%

10 The roof of the nasal cavity is formed primarily by the
(a) hard palate
(b) cribriform palate of the ethmoid bone
(c) superior concha
(d) vomer

11 During inspiration, air passes into lungs due to
(a) increase in volume of thoracic cavity and fall in lung pressure
(b) fall in pressure inside the lungs
(c) increased volume of thoracic cavity
(d) muscular expansion of lungs

12 Surfactant
(a) reduces the surface tension in pulmonary alveoli
(b) increases the pCO_2 levels in blood
(c) is a mucous secreted by goblet cells
(d) reduces friction in the pleural cavity

13 People living at sea level have around 5 million RBCs per cubic millimetre of their blood, whereas those living at an altitude of 5400 metres have around 8 million. This is because at high altitude
(a) people get pollution free air to breathe and more oxygen is available
(b) atmospheric O_2 level is less and hence more RBCs are needed to absorb the required amount of O_2 to survive
(c) there is more UV radiation, which enhances RBCs production
(d) people eat more nutritive food, therefore more RBCs are formed

14 In alveoli of the lungs, the air at the site of gas exchange, is separated from the blood by
(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

15 Which one of the following statements about blood constituents and transport of respiratory gases is most accurate?
(a) RBCs transport oxygen whereas WBCs transport CO_2
(b) RBCs transport oxygen whereas plasma transport 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

16 When you hold your breath which of the following gas changes in blood would first lead to the urge to breathe?

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

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

	Respiratory Capacities	Respiratory Volumes
I.	Residual volume	2500 mL
II.	Vital capacity	3500 mL
III.	Inspiratory reserve volume	1200 mL
IV.	Inspiratory capacity	4500 mL

Which one of the following is the correct matching of two capacities and volumes?

(a) (II) 2500 mL, (III) 4500 mL
(b) (III) 1200 mL, (IV) 2500 mL
(c) (IV) 3500 mL, (I) 1200 mL
(d) (I) 4500 mL, (II) 3500 mL

18 Identify the correct and incorrect match about respiratory volume and capacities and mark the correct answer.

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].

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

19 Match the following columns.

	Column I		Column II
A.	Dyspnea	1.	In lower part of pons
B.	Anoxia	2.	Bicarbonates
C.	Apneustic centre	3.	No oxygen at tissue level
D.	Alkali reserve of blood	4.	Carotid bodies
		5.	Distressed breathing

Codes

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

20 Match the following columns.

	Column I		Column II
A.	Vestibule	1.	Prevents entry of food in trachea
B.	Epiglottis	2.	Contraction of diaphragm
C.	Inspiration	3.	Relaxation of diaphragm
D.	Expiration	4.	Inside the nose

Codes

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

21 Match the following columns.

	Column I		Column II
A.	Larynx	1.	Lid of larynx
B.	Trachea	2.	Air sacs
C.	Alveoli	3.	Voice box
D.	Epiglottis	4.	Windpipe
		5.	Common passage

Codes

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

ANSWERS

SESSION 1

1 (d)	**2** (a)	**3** (d)	**4** (b)	**5** (d)	**6** (b)	**7** (a)	**8** (d)	**9** (c)	**10** (a)
11 (d)	**12** (c)	**13** (d)	**14** (a)	**15** (b)	**16** (d)	**17** (b)	**18** (a)	**19** (a)	**20** (a)
21 (b)	**22** (c)	**23** (b)	**24** (d)	**25** (a)	**26** (a)	**27** (b)	**28** (a)	**29** (a)	**30** (c)
31 (b)	**32** (a)	**33** (b)	**34** (b)	**35** (b)	**36** (c)	**37** (d)	**38** (b)	**39** (b)	**40** (b)
41 (a)	**42** (d)	**43** (b)	**44** (c)	**45** (c)	**46** (d)	**47** (a)	**48** (a)	**49** (b)	**50** (b)
51 (d)	**52** (a)	**53** (c)							

SESSION 2

1 (d)	**2** (d)	**3** (c)	**4** (b)	**5** (b)	**6** (b)	**7** (c)	**8** (a)	**9** (d)	**10** (b)
11 (a)	**12** (a)	**13** (b)	**14** (b)	**15** (d)	**16** (b)	**17** (c)	**18** (b)	**19** (d)	**20** (b)
21 (d)									