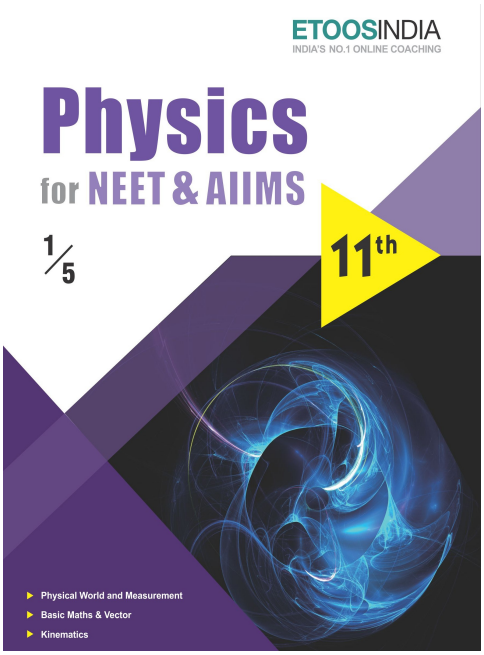
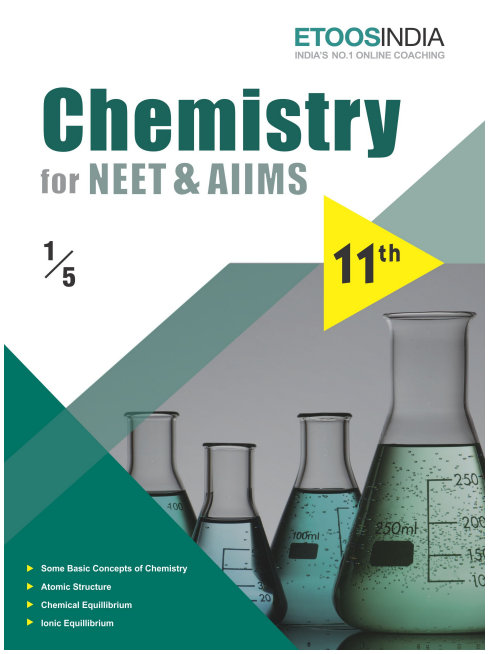
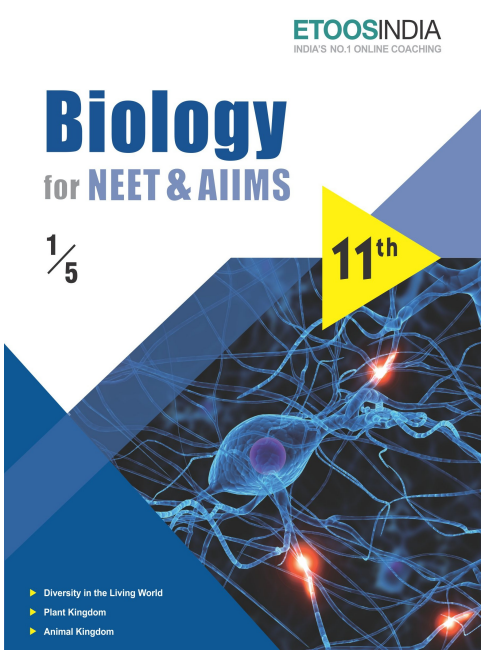
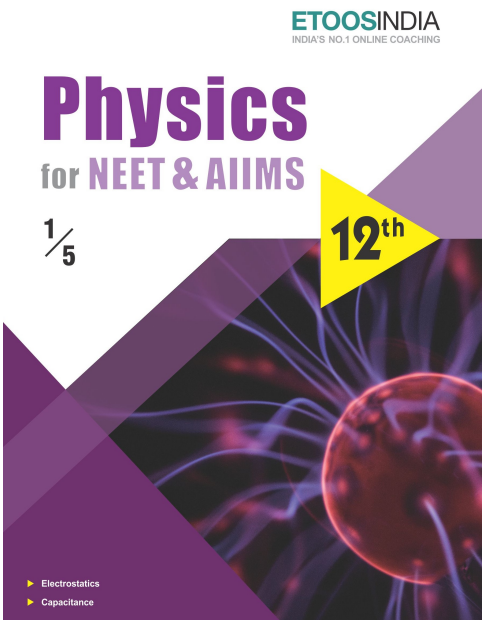
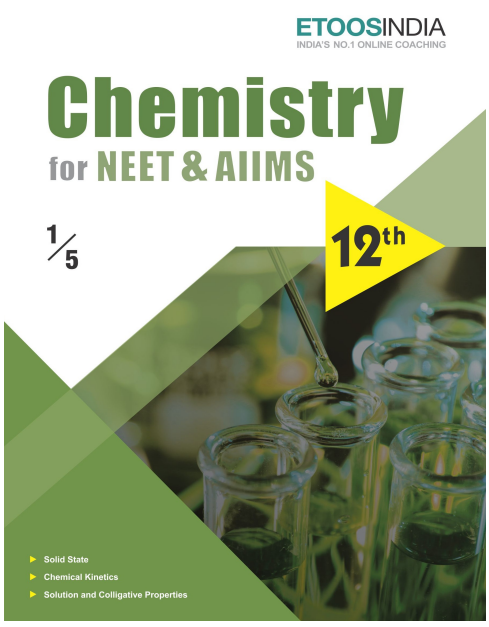
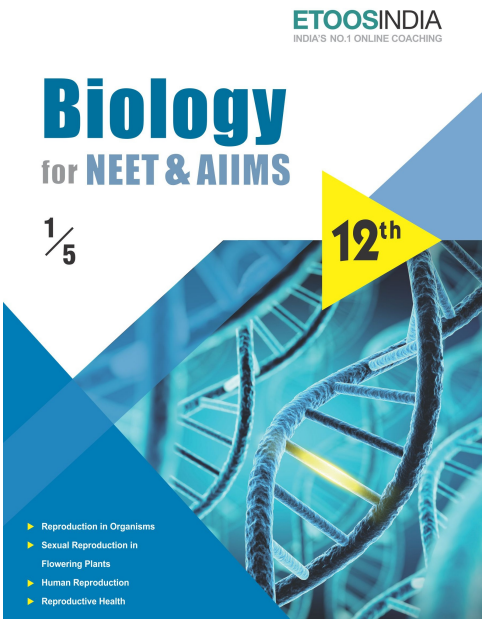












CHAPTER 16

BREATHING AND EXCHANGE OF GASES

"To be a Christian without prayer is no more possible than to be alive without breathing."

" MARTIN LUTHER (1712-1778)"

INTRODUCTION

All animals to perform function like breathing require energy which is derived from the breakdown of nutrients molecules like glucose. Carbon dioxide which is harmful is also released during the catabolic reactions, also energy is released in the form of ATP. Now, this ATP is utilised by various animals to carry out their body functions readily.

Therefore it is an evident that O_2 Has to be continuosly provided to the cells, CO_2 released by the cells.This process of exchange of O_2 from the atmosphere with CO_2 produced by the cells is known as **Breathing**, which is commonly called as **Respiration.**

Breathing includes expiration and inhalation. **Inspiration** means to inhale prior to breathe in and **Expiration** means to exhale or to breathe out.

RESPIRATORY SYSTEM

INTRODUCTION

Definition

Respiration is the physiological catabolic process in which gaseous exchange occurs to oxidise food. The energy generated is utilized and by products, CO_2 and H_2O are given out.

So, respiration is a physio-chemical process. The surface at which exchange of gases occurs is called respiratory surface, and the compounds oxidised in respiration are called respiratory substrate.

TYPES OF RESPIRATION

Following are the types of respiration.

Direct and Indirect respiration

Aerobic and Anaerobic respiration

Direct and Indirect respiration

Direct respiration

(i) In this type of respiration, there is direct exchange of gases in between body cells and respiratory medium.

(ii) Exchange of gases occurs on the principle of diffusion, through moist body surface.

(iii) Direct respiration is found in unicellular organisms like, aerobic bacteria, amoeba, ssponges, hydra, flatworm, roundworm etc.

Indirect respiration

(i) In this type of respiration, their is no direct contact in between the body cells and respiratory medium.

(ii) Indirect respiration is found in complex and higher form of organism.

(iii) Higher organism have some specialized, structure for gaseous exchange which are called **respiratory organs**.

e.g.

(a) Skin - Skin is respiratory organ in annelida and amphibians.

(b) Gills - Most of crustaceans, mollusca, all fishes and some amphibians the exchange of gases in gills is called branchial respiration.

(c) Lungs - Lungs is respiratory organ in snails, some amphibians, all reptiles, birds and mammals.

(d) Trachea - Trachea is respiratory organ in insects.

AEROBIC AND ANAEROBIC RESPIRATION

Aerobic respiration

(i) Respiration which occurs in presence of oxygen is called aerobic respiration.

(ii) The oxygen completely oxidises the food to CO_2 and H_2O releasing large amount of energy. This process can be shown by following way.

$C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O + 2880$ KJ Energy

(iii) Such type of respiration (aerobic respiration) found in most animals and plants.

Phases of aerobic respiration

There are two phases of aerobic respiration.

A- External respiration

B- Internal respiration

Etoos Tips & Formulas

→ The process of exchange of O_2 from the atmosphere with CO_2 produced by the cells is called breathing, commonly known as respiration.

S.No.	Respiratory organs	Examples
1.	General body surface	Sponges, Coelenterates, Flat worms
2.	Moist skin	Earthworms, Frogs
3.	Tracheal tubes	Insects
4.	Gills	Aquatic arthropods, Molluscs, Fishes
5.	Lungs	Reptiles, Birds, Mammals

→ Pharynx is the common passage for food and air.

→ In human, path of air is :

External nostrils → Nasal chamber → Nasopharynx → Larynx → Trachea → Primary Bronchi ↵

Alveoli ← Bronchioles network ← Tertiary bronchi ← Secondary Bronchi

→ Inspiration can occur if the pressure within the lungs (intra-pulmonary pressure) is less than the atmospheric pressure. Inspiration is initiated by the contraction of diaphragm and external inter costal muscles (EICM). Expiration takes place when the intrapulmonary pressure more than the atmospheric puressure. In this diaphragm and EICM are relaxed.

→ Alveoli are the primary sites of exchange of gases. Exchange of gases also occur between blood and tissues.

→ O_2 and CO_2 are exchanged in these sites by simple diffusion mainly based on pressure/concentration gradient.

→ Partial pressures (in mm Hg) of oxygen and carbon dioxide.

Resiratory Gas	Atmosheric Air	Alveoli	Deoxygenated blood	Oxygenated blood	Tissues
O_2	159	104	40	95	40
CO_2	0.3	40	45	40	45

S.No.	Respiratory volumes and capacities	Value
1.	Tidal volume (TV)	500 ml
2.	Inspiratory reserve volume (IRV)	2500 - 3000 ml
3.	Expiratory reserve volume (ERV)	1000 - 1100 ml
4.	Residual volume (RV)	1100 - 1200 ml
5.	Inspiratory capacity (TV + IRV)	3500 ml
6.	Expiratory capacity (TV + ERV)	1600 ml
7.	Functional residual capa city (ERV+ RV)	2300 ml
8.	Vital capacity (TV + IRV + ERV)	4600 ml
9.	Total lung capacity (TV + IRV + ERV + RV)	5800 ml

→ Blood transport O_2 in the form of oxyhaemoglobin. O_2 can bind with heamoglobin in a reversible manner to form oxyhaemoglobin. Each haemoglobin molecule can carry a maximum of four molecules of O_2. Binding of oxygen with haemoglobin is primarily related to partial pressure of O_2.

SOLVED EXAMPLE

Ex.1 Respiratory pigment in cockroach is

(A) Haemozoin **(B)** Haemocyanin

(C) Haemoglobin **(D)** Absent

Sol. **(D)** : Haemolymph is found in insect blood which is colourless.

Ex.2 Carbon dioxide is transported via blood to lungs mostly

(A) As carbaminohaemoglobin and as carbonic acid

(B) In the form of carbonic acid only

(C) In combination with haemoglobin only

(D) Dissolved in blood plasma

Sol. **(A)**

Ex.3 The diagram represents the human larynx. Choose the correct combination of labelling from the option given :

(A) A - Larynx, B - Parathyroid, C - Tracheal cartilage, D - Trachea

(B) A - Naso Larynx, B - Thyroid, C - Tracheal cartilage, D - Trachea

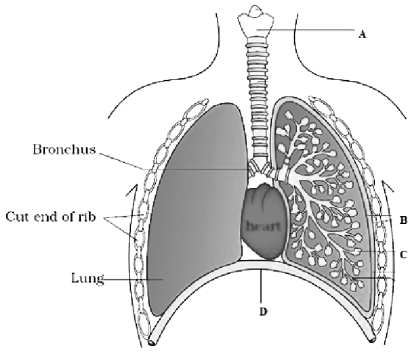
(C) A - Trachea, B - Thyroid, C - Bronchiole, D - Tracheal cartilage

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

(E) A - Epiglottis, B - Parathyroid, C - Trachea, D - Tracheal cartilage

Sol. **(D)**

Ex.4 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.



(A) D – Lower end of lungs – diaphragm pulls it down during inspiration

(B) A – Trachea – long tube supported by complete cartilaginous rings for conducting inspired air

(C) B – Pleural membrane – surround ribs on both sides to provide cushions against rubbing

(D) C – Alveoli – thin walled vascular bag like structures for exchange of gases

Sol. **(D)**

Ex.5 What is vital capacity of our lungs

(A) Inspiratory reserve volume plus expiratory reserve volume

(B) Total lung capacity minus residual volume

(C) Inspiratory reserve volume plus tidal volume

(D) Total lung capacity minus expiratory reserve volume

Sol. **(B)**

Ex.6 The largest quantity of air that can be expired after a maximum inspiratory effort is

(A) Residual volume **(B)** Tidal volume

(C) Vital capacity of lungs **(D)** Lung volume

Sol. **(C)** : Vital capacity of lungs to expire maximum volume of air after a deep inspiration. The largest qunatity of air that can be expired after a maximal inspiratory. Vital capacity is equal the sum of the tidal complemental and supplemental air (500 + 3100 + 1200 = 4800 ml).

Ex.7 The volume of air which remains in the conducting airways and is not available for gas exchange is called

(A) Vital capacity

(B) Functional residual capacity

(C) Forced expiratory volume

(D) Anatomic dead space

Sol. **(D)**

Exercise # 1 SINGLE OBJECTIVE NEET LEVEL

1. The maximum amount of air that our lung can normally hold is-
(A) Vital capacity
(B) Pulmonary capacity
(C) Tidal capacity
(D) Total lung capacity

2. The blood leaving the lungs has all its haemoglobin oxygenated and gives up oxygen to the tissue, because-
(A) The tissue can absorb O_2 from oxyhaemoglobin
(B) O_2 concentration in tissues is higher and CO_2 concentration lower than in lungs
(C) O_2 concentration in tissues is lower and CO_2 concentration higher than in lungs
(D) Oxyhaemoglobin undergoes reduction

3. Which of the following increases the oxygen affinity of Hb-
(A) High body temperature
(B) Low pCO_2
(C) High blood pH
(D) Both B and C

4. Haemoglobin has least affinity for-
(A) Carbon dioxide
(B) Carbon monoxide
(C) Oxygen
(D) Same affinity for all above

5. When a frog is completely submerged in water it can respire only through-
(A) Lungs
(B) Skin
(C) Branchial chamber
(D) Buccopharyngeal cavity

6. Respiratory mechanism is controlled by-
(A) Sympathetic nervous system
(B) Central nervous system
(C) Autonomic nervous system
(D) Parasympathetic nervous system

7. Carbon monoxide combines with haemoglobin to form-
(A) Carboxyhaemoglobin
(B) Oxyhaemoglobin
(C) Carbaminohaemoglobin
(D) None

8. The percentage of haemoglobin saturated with oxygen will increase if-
(A) The arterial pH is decreased
(B) The arterial pO_2 is increased
(C) The haemoglobin concentration is increased
(D) The temperature is increased

9. Which mammal lacks true vocal cords-
(A) Hippopotamus (B) Man
(C) Elephant (D) Monkey

10. Expiration involves-
(A) Contraction of diaphragm muscles
(B) Contraction of intercostal muscles
(C) Relaxation of diaphragm and intercostal muscles
(D) Contraction of diaphragm and intercostal muscles

11. During inspiration, air passes into lungs due to-
(A) Fall in pressure inside the lungs
(B) Increased volume of thoracic cavity
(C) Muscular expansion of lungs
(D) Increase in volume of thoracic cavity and fall in lung pressure

12. In human beings, CO_2 concentration in the inspired and expired air is respectively-
(A) 0.04 % and 4.0 %
(B) 0.03 % and 5.3 %
(C) 0.4 % and 5.0 %
(D) 0.04 % to 3.0 %

13. Pneumotaxic centre is associated with-
(A) Movement (B) Closure of glottis
(C) Respiration (D) Breathing

14. In mammals, the tracheal cartilaginous rings are-
(A) Complete rings
(B) Incomplete rings
(C) Incomplete dorsally
(D) Incomplete laterally

Exercise # 2 SINGLE OBJECTIVE AIIMS LEVEL

1. Even when there is no air in it, human trachea does not collapse due to presence of -
(A) Chitinous rings (B) Bony rings
(C) Cartilaginous rings (D) Turgid pressure

2. Speciality common in the alveoli of lungs and villi of intestine in mammals is that both -
(A) Have rich supply of blood vessels and lymph ducts
(B) Are suited for diffusion of gases
(C) Have ciliated epithelium
(D) Provide a large surface area

3. The structure which does not contribute to the breathing in mammals is -
(A) Diaphragm
(B) Larynx
(C) Intercostal muscles
(D) Ribs

4. C - shaped cartilaginous rings supporting the trachea are made of -
(A) Fibrous cartilage
(B) Elastic cartilage
(C) Calcified cartilage
(D) Hyaline cartilage

5. Which of the following is the smallest structure in the lung of rabbit.
(A) Tracheae (B) Alveoli
(C) Broncheoles (D) Hilum

6. Rate of breathing in an adult human is -
(A) 25 - 30/min (B) 20-25/min
(C) 14-18/min (D) 10-12/min

7. Glottis is opening in the floor of -
(A) Trachea
(B) Diaphragm
(C) Bucco- pharyngeal cavity
(D) None of the above

8. In mammals ventilation movements of lungs are governed by -
(A) Diaphragm and intercostal muscles
(B) Diaphragm
(C) Intercostal muscles
(D) Muscular wall of lungs

9. Which type of respiration appeared first in the primitive organism and why
(A) Aerobic respiration as no harmful waste products are formed
(B) Anaerobic respiration because small organism can only do it
(C) Anaerobic respiration as there was no O_2
(D) Aerobic respiration as it releases more energy

10. Oxyhaemoglobin is an unstable compound because -
(A) One molecule of haemoglobin combines with four molecules of oxygen
(B) There is a chemical bonding between oxygen and haemoglobin
(C) There is a physical bonding between oxygen and haemoglobin
(D) Haemoglobin is a complex pigmented protein

11. Percentage of O_2 present in inhaled air in man is about -
(A) 43% (B) 78% (C) 21% (D) 1%

12. Food does not normally enter the trachea because during swallowing of food-
(A) The circular muscles at the end of trachea contract and close its opening
(B) The cartilage called arytenoids lie between the larynx and the glottis
(C) The nodule called cartilage of Santorini plug the larynx
(D) The epiglottis and tongue cover the glottis

13. If O_2 concentration in tissue was almost as high as at the respiratory surface -
(A) Oxyhaemoglobin would not dissociate to supply O_2 to the tissue
(B) CO_2 will interfere the O_2 transport
(C) Oxyhaemoglobin would dissociate to supply O_2 to the tissue
(D) Haemoglobin would combine with more O_2 at respiratory surface

14. Ratio of oxyhaemoglobin and haemoglobin in the blood is based upon-
(A) Bicarbonate tension (B) CO_2 tension
(C) Carbonate tension (D) O_2 tension

Exercise # 3 PART - 1 MATRIX MATCH COLUMN

1. Match Column - I with Column - II and select the correct option from the codes given below.

Column - I (Animals)	**Column - II (Respiratory structures)**
A. Pigeon	**(i)** Books gills
B. Scorpion	**(ii)** Pharyngeal wall
C. *Planaria*	**(iii)** Lungs
D. Earthworm	**(iv)** Gills
E. Spiders	**(v)** Book lungs
F. King crab	**(vi)** Body surface
G. Prawn	**(vii)** Skin
H. *Labeo*	

(A) A-(iii), B-(v), C-(vi), D-(vii), E-(v), F-(i), G-(iv), H-(iv)

(B) A-(v), B-(ii), C-(vi), D-(vii), E-(vi), F-(iv), G-(i), H-(iii)

(C) A-(vi), B-(iv), C-(vii), D-(v), E-(i), F-(ii), G-(iii), H-(vii)

(D) A-(i), B-(v), C-(vii), D-(iii), E-(vii), F-(ii), G-(iv), H-(vi)

2. Match Column - I with Column - II and select the correct option from the codes given below.

Column - I	**Column - II**
A. TV + ERV	**(i)** Expiratory capacity
B. RV + ERV + TV + IRV	**(ii)** Total lung capacity
C. ERV + RV	**(iii)** Functional residual capacity

(A) A-(i), B-(ii), C-(iii) **(B)** A-(iii), B-(i), C-(ii)

(C) A-(iii), B-(ii), C-(i) **(D)** A-(ii), B-(iii), C-(i)

3. Match Column-I with Column-II and select the correct option from the codes given below.

Column - I	**Column - II**
A. Tidal volume	**(i)** 2500-3000 mL of air
B. Inspiratory reserve volume	**(ii)** 1000 mL of air
C. Expiratory reserve volume	**(iii)** 500 mL of air
D. Residual volume	**(iv)** 3400-4800 mL of air
E. Vital capacity	**(v)** 1200 mL of air

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

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

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

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

Exercise # 4

PART - 1 PREVIOUS YEAR (NEET/AIPMT)

1. 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

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

3. People living at sea level have around 5 million RBC per cubic millimeter of their blood whereas those living at an altitude of 5400 metres 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

4. What is 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

5. The haemoglobin of a human foetus: [CBSE AIPMT 2008]
(A) has a lower affinity for oxygen than that of an adult
(B) its affinity for oxygen is the same as that of an adult
(C) has only 2 protein subunits instead of 4
(D) has a higher affinity for oxygen than that of an adult

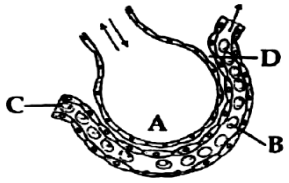
6. Which two of the following changes (1-4) usually tend to occur in the plain dwellers when they move to high altitudes (3,500 m or more) ? [CBSE AIPMT 2010]
1. Increase in red blood cell size
2. Increase in red blood cell production
3. Increased breathing rate
4. Increase in thrombocyte count
Changes occurring are ?
(A) (2) and (3) (B) (3) and (4)
(C) (1) and (4) (D) (1) and (2)

7. Listed below are four respiratory capacities (1-4) and four jumbled respiratory volumes of a normal human adult: [CBSE AIPMT 2010]

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?
(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

8. 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

MOCK TEST

1. Bowman's glands are found in
   (A) olfactory epithelium (B) external auditory canal
   (C) cortical nephrons only (D) juxtamedullary nephrons

2. The entry of food into the larynx is prevented by
   (A) mitral valve (B) diaphragm (C) epiglottis (D) hyoid
   (E) frenulum

3. 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.

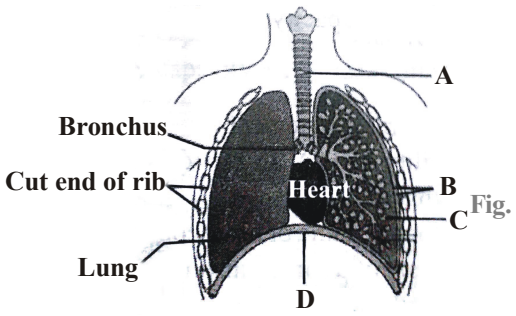


Fig.

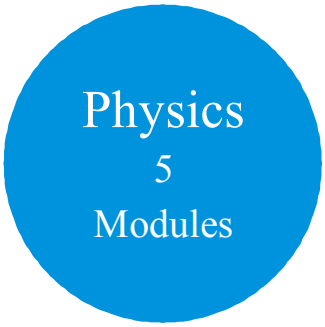
   (A) C-Alveoli - Thin walled vascular bag like structures for exchange of gases
   (B) D- Lower end of lungs - Diaphragm pulls it down during inspiration
   (C) A- Trachea - Long tube supported by complete cartilaginous rings for conducting inspired air
   (D) B - Pleural membrane - Surrounds ribs on both sides to provide cushion against rubbing

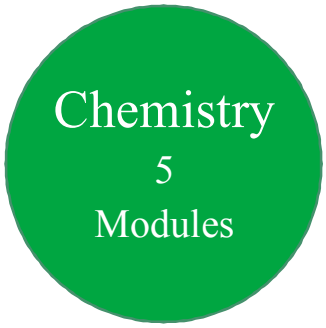
4. Lungs do not collapse between breaths and some air always remains in the lungs which can never be expelled because
   (A) there is a negative pressure in the lungs
   (B) there is a negative intrapleural pressure pulling at the lung walls.
   (C) there is a positive intrapleural pressure.
   (D) pressure in the lungs is higher than the atmospheric pressure.

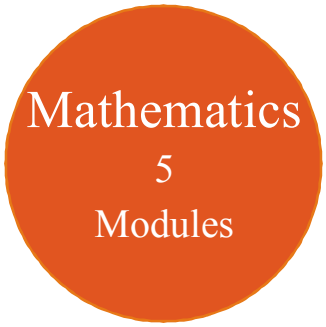
5. Hiccups can be best described as
   (A) forceful sudden expiration
   (B) forceful contraction of intercostal muscles during deep breathing
   (C) vibration of the soft palate during breathing while sleeping
   (D) jerky incomplete inspiration.

6. Which one of the following is a possibility for most of us in regard to breathing, by making a conscious effort?
   (A) One can breathe out air totally without oxygen.
   (B) One can breathe out air through Eustachian tube by closing both nose and mouth.
   (C) One can consciously breathe in and breathe out by moving the diaphragm alone, without moving the rib sat all.
   (D) The lungs can be made fully empty by forcefully breathing out all air from them.

11th Class Modules Chapter Details

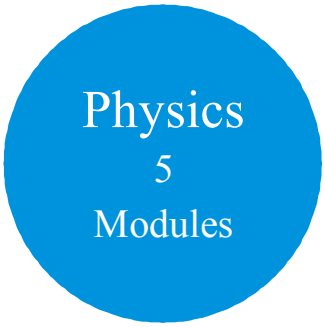


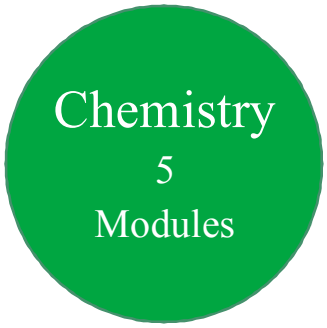


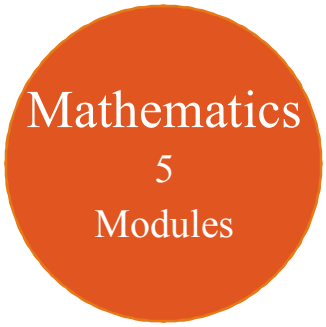


PHYSICS	CHEMISTRY	BIOLOGY
Module-1 1. Physical World & Measurements 2. Basic Maths & Vector 3. Kinematics **Module-2** 1. Law of Motion & Friction 2. Work, Energy & Power **Module-3** 1. Motion of system of particles & Rigid Body 2. Gravitation **Module-4** 1. Mechanical Properties of Matter 2. Thermal Properties of Matter **Module-5** 1. Oscillations 2. Waves	**Module-1(PC)** 1. Some Basic Conceps of Chemistry 2. Atomic Structure 3. Chemical Equilibrium 4. Ionic Equilibrium **Module-2(PC)** 1. Thermodynamics & Thermochemistry 2. Redox Reaction 3. States Of Matter (Gaseous & Liquid) **Module-3(IC)** 1. Periodic Table 2. Chemical Bonding 3. Hydrogen & Its Compounds 4. S-Block **Module-4(OC)** 1. Nomenclature of Organic Compounds 2. Isomerism 3. General Organic Chemistry **Module-5(OC)** 1. Reaction Mechanism 2. Hydrocarbon 3. Aromatic Hydrocarbon 4. Environmental Chemistry & Analysis Of Organic Compounds	**Module-1** 1. Diversity in the Living World 2. Plant Kingdom 3. Animal Kingdom **Module-2** 1. Morphology in Flowering Plants 2. Anatomy of Flowering Plants 3. Structural Organization in Animals **Module-3** 1. Cell: The Unit of Life 2. Biomolecules 3. Cell Cycle & Cell Division 4. Transport in Plants 5. Mineral Nutrition **Module-4** 1. Photosynthesis in Higher Plants 2. Respiration in Plants 3. Plant Growth and Development 4. Digestion & Absorption 5. Breathing & Exchange of Gases **Module-5** 1. Body Fluids & Its Circulation 2. Excretory Products & Their Elimination 3. Locomotion & Its Movement 4. Neural Control & Coordination 5. Chemical Coordination and Integration

12th Class Modules Chapter Details







PHYSICS

Module-1

1. Electrostatics
2. Capacitance

Module-2

1. Current Electricity
2. Magnetic Effect of Current and Magnetism

Module-3

1. Electromagnetic Induction
2. Alternating Current

Module-4

1. Geometrical Optics
2. Wave Optics

Module-5

1. Modern Physics
2. Nuclear Physics
3. Solids & Semiconductor Devices
4. Electromagnetic Waves

CHEMISTRY

Module-1(PC)

1. Solid State
2. Chemical Kinetics
3. Solutions and Colligative Properties

Module-2(PC)

1. Electrochemistry
2. Surface Chemistry

Module-3(IC)

1. P-Block Elements
2. Transition Elements (d & f block)
3. Co-ordination Compound
4. Metallurgy

Module-4(OC)

1. HaloAlkanes & HaloArenes
2. Alcohol, Phenol & Ether
3. Aldehyde, Ketone & Carboxylic Acid

Module-5(OC)

1. Nitrogen & Its Derivatives
2. Biomolecules & Polymers
3. Chemistry in Everyday Life

BIOLOGY

Module-1

1. Reproduction in Organisms
2. Sexual Reproduction in Flowering Plants
3. Human Reproduction
4. Reproductive Health

Module-2

1. Principles of Inheritance and Variation
2. Molecular Basis of Inheritance
3. Evolution

Module-3

1. Human Health and Disease
2. Strategies for Enhancement in Food Production
3. Microbes in Human Welfare

Module-4

1. Biotechnology: Principles and Processes
2. Biotechnology and Its Applications
3. Organisms and Populations

Module-5

1. Ecosystem
2. Biodiversity and Conservation
3. Environmental Issues