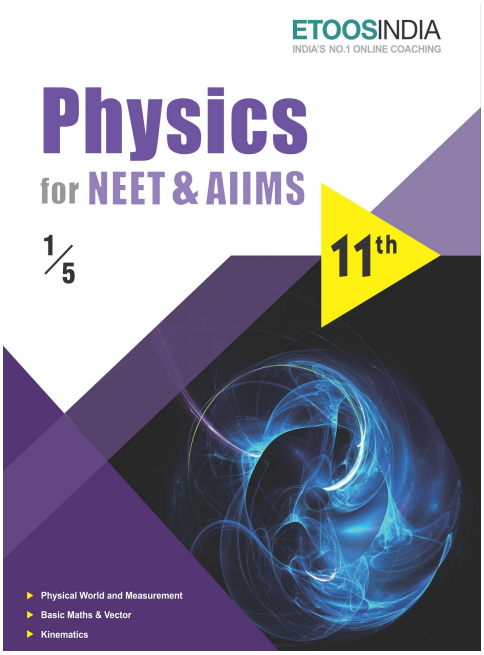
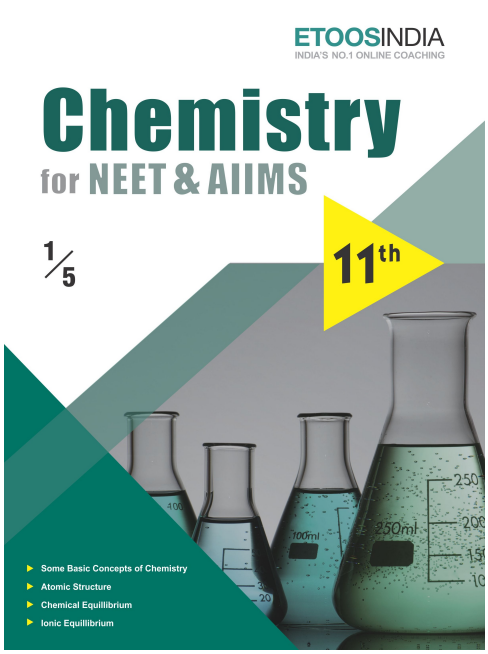
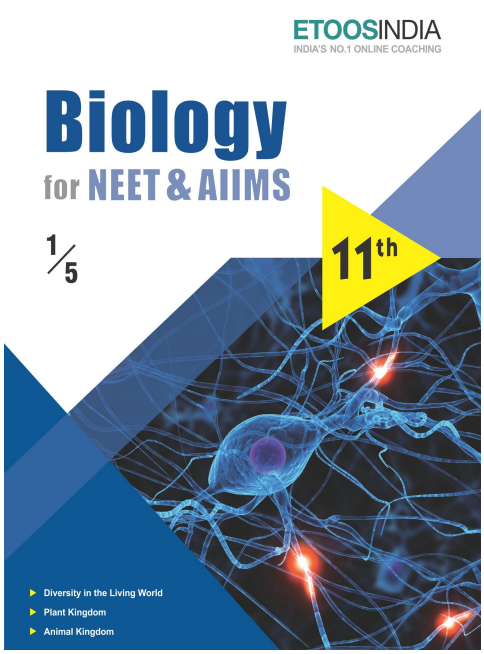
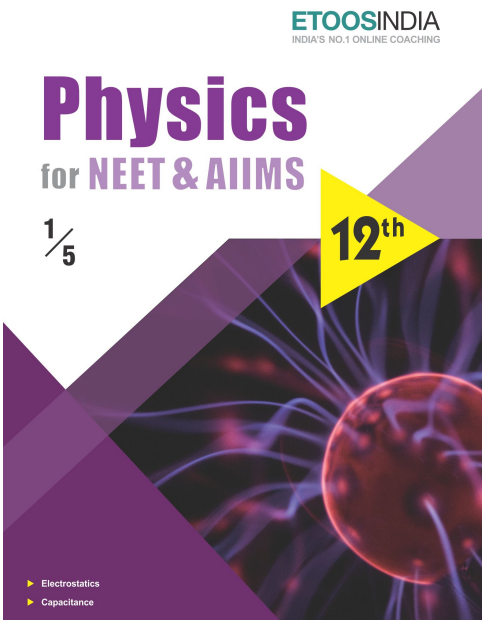
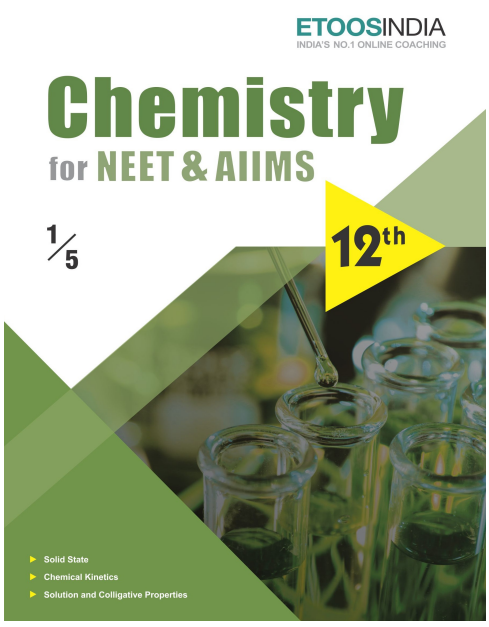
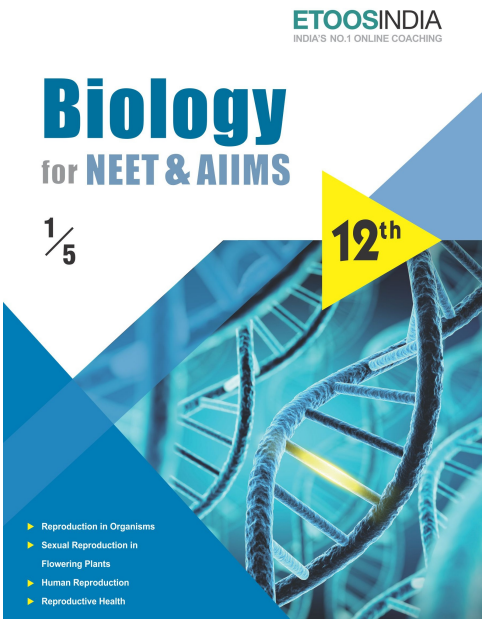












CHAPTER 08

BIOMOLECULES

"Scientific research is one of the most exciting and rewarding of occupations."

" FREDERICK SANGER (1919-2013)"

INTRODUCTION

There is a wide range of variety in living organisms in our biosphere. All living organisms are made up of the same chemicals, i.e. elements and compounds. If we analyse animals or plant tissue or a microbial waste, we will obtain elements like carbon, oxygen, hydrogen, etc. Is the same analysis is performed on a peice of earth's crust as an example of non-living matter. All elements present in a sample of earth's crust are also present in a sample of living tissue. But when examined closely it is observed that in living organisms the relative abundance of carbon and hydrogen with respect to othere elements is higher than in earth's crust.

BIO-MOLECULES

ORGANIC COMPOUNDS :

1.	Proteins	=	7–14%
2.	Lipids	=	1–3%
3.	Carbohydrates	=	1–2%
4.	Nucleic acids, enzymes and other	=	1-3%

INORGANIC COMPOUNDS :

1.	Water	=	70–90%
2.	Salts, acids, bases, gases	=	1– 3%

WATER :

(1) Water in human body - 65-70% of total body weight.

(2) Of total water, 95% water is free water and 5% water occurs as bound water.

(3) It causes streaming or cyclosis in protoplasm transportation of solutes from one part to the others.

(4) Having a high specific heat, it minimizes temperature variations and thus protects protoplasm against ill effects of sudden rise or fall of temperature in the environment.

(5) Being an ideal dispersion medium, it causes Brownian movement of colloid particles, resulting into their collision and mutual bombardment. This facilitates reactivity between the various compounds necessory for maintaining protoplasm in live state.

(7) It is a best solvent in nature, it forms the fluid matrix of protoplasm. All other constituents of protoplasm are its solutes.

(8) Human body ≈ 40 litre :

55% (22 litre) – intracellular fluid 45% (18 litre) – extracellular fluid

(9) It itself participates in certain types of chemical reactions, particularly in the hydrolytic breakdown of complex compounds.

(10) In plant kingdom - Hardest material : Sporopollenin

(11) In animal kingdom - Hardest material : Enamel

SALT :

(1) Salts in protoplasm occur in ionised form. These ions are responsible for electric conductivity, rendering protoplasm irritable and response to environmental changes.

(2) Some metallic and other ions such as Mg, Fe, Zn, Mo, Mn etc. act as cofactors in enzymatic activities.

(3) These regulate the osmotic pressure and chemical exchange of protoplasm from its environment.

(4) These provides linkage or chemical bonds in many chemical reactions. Such type of linkage called "Salt linkage".

(5) Some other functions of ions :

Na^+, K^+ ions – Nerve induction

Ca^{+2}, Mg^{+2} ions – Muscle contraction, Reduce more excitability of nerves and muscle.

Ca^{+2} ion – Blood clotting, Bone formation

– Most abundant mineral element in animal body

Na^+, K^+ ions – Main component of ringer solution.

Etoos Tips & Formulas

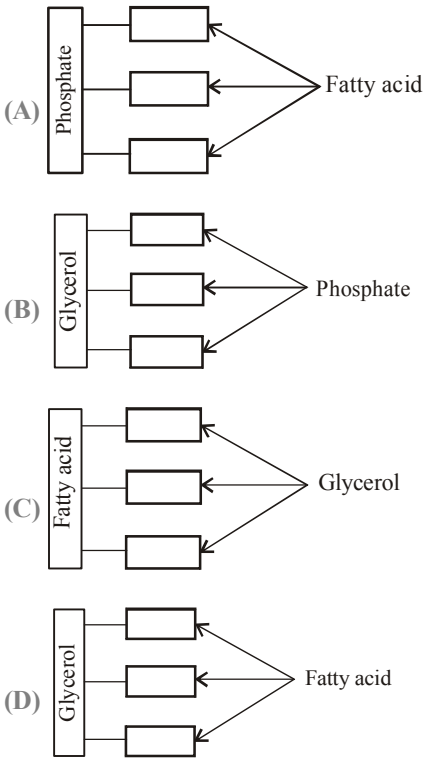
All the carbon compound that Present in living tissue.

But exceptionally lipid is micromolecule but present in acid insoluble fraction.

1. **CARBOHYDRATE**
   - → Although polysaccharide is non reducing but in a polysaccharide chain one end is reducing and another end is non reducing.
   - → Starch form helical structure so starch can hold I_2 molecules in the helical portion so starch-I_2 is blue in colour. While cellulose have linear structure so it cannot hold I_2 and don't give Iodine test.
   - → Paper made from plant pulp is cellulose.
   - → Difference between gums and fevicol → Gums are natural mucopolysaccharide while fevicol is synthetic rubber based adhesive.
2. **LIPID**
   - → Fatty acids are of two types →
     - (i) Saturated → eg palmitic acid (16 carbon compound), stearic acid
     - (ii) unsaturated → eg oleic acid, Linoleic acid, Linolenic acid, Arachidonic acid (20 carbon compound) Glycerole is trihydroxy propane."Lipids are called fats and oils on the basis of melting point. Oils have lower melting point and fats have higher melting point.
   - → Some lipids also have phosphorus like lecithin.
3. **Protein**
   - → Proteins are heteropolymer of amino acids.
   - → Amino acids contain an amino group and carboxylic group on the same carbon i.e. the a-carbon so they are called a-amino acid.
   - → Amino acid are substituted methane.
   - → Amino acids are of two types:-
     (i) Essential amino acid
     (ii) Non essential amino acid
   - → Protein show mainly four type of configuration :-
     (A) Primary configuration (B) Secondary configuration
     (C) Tertiary configuration (D) Quaternary configuration
   - → Tertiary structure is absolutely necessary for the many biological activities of protein.
4. **DNA**
   - → In a DNA molecule one purine always pairs with a pyrimidine. This generates approximately uniform distance between the two strands of DNA.
   - → In DNA plane of one base pair stacks over the other in double helix. This, in addition to H-bonds, confers stability of the helical structure of DNA.
   - → Difference between DNAs and DNase is that DNAs means many DNA and DNase means DNA digestive enzymes.
   - → Oswald Avery, Colin Macleod and Maclyn Mccarty firstly proved the genetic material is DNA.
   - → Alfred Hershey and Martha Chase Firstly proved that in bacteriophage DNA is also genetic material.
   - → A molecule that can act as a genetic material must fulfil the following criteriaÂ-
     - (i) It should be able to generate it's replica (replication)
     - (ii) It should chemically and structurally be stable
     - (iii) It should has property of mutation.
     - (iv) It should be able to express itself in the form of "Mendelian Characters".
   - → The presence of thymine at the place of uracil also provide additional stability to DNA.
   - → Both DNA and RNA are able to mutate. In fact, RNA being less stable, mutate at faster rate so virus having RNA

SOLVED EXAMPLE

Ex.1 Which one of the following diagrams shows a molecule of simple lipid



Sol. (D)

Ex.2 Which is non- reducing sugar

(A) Glucose (B) Galactose

(C) Mannose (D) Sucrose

Sol. (D) : The carbohydrates or sugar where free aldehyde or ketonic group is absent (utilized in glycosidic bond formation) can not reduce the above reagents are called non-reducing sugar i.e., Sucrose, glycogen, Starch.

Ex.3 Which one of the following biomolecules is correctly characterised

(A) Lecithin - a phosphorylated glyceride found in cell membrane

(B) Palmitic acid - an unsaturated fatty acid with 18 carbon atoms

(C) Adenylic acid - adenosine with a glucose phosphate molecule

(D) Alanine amino acid - Contains an amino group and an acidic group anywhere in the molecule

Sol. (A)

Ex.4 Which of the following is a homopolysaccharide is

(A) Heparin (B) Inulin

(C) Pectin (D) Hyaluronic acid

Sol. (B)

Ex.5 Given below is the chemical formula of

$$CH_3(CH_2)_{14}-\overset{\overset{O}{\|}}{C}-OH$$

(A) Palmitic acid (B) Stearic acid

(C) Glycerol (D) Galactose

Sol. (A)

Ex.6 Select the wrong statement

(A) The building blocks of lipids are amino acids

(B) Majority of enzymes contain a non-protein part called the prosthetic group

(C) The thylakoids are arranged one above the other like a stack of coins forming a granum

(D) Crossing-over occurs at pachytene stage of meiosis I

(E) Steroids are complex compounds commonly found in cell membranes and animal hormones

Sol. (A)

Ex.7 Chitin is a

(A) Polysaccharide

(B) Nitrogenous polysaccharide

(C) Lipoprotein

(D) Protein

Sol. (B) : Polymer of N-acetyglucosamine $(C_8H_{13}O_5N)_n$ that forms exoskeleton of arthropods and cell wall of fungi.

Ex.8 Which one of the following pairs is not correctly matched

(A) Recombinant DNA	- DNA formed by the joining of segments of DNA from different sources
(B) Purine	- Nitrogenous bases Cytosine, thymine and uracil
(C) ATP	- The principal energy carrying compound in the cell
(D) r-RNA	- RNA molecules found in ribosomes

Exercise # 1 SINGLE OBJECTIVE NEET LEVEL

1. Which of the following biomolecule is insoluble in water :
(A) α-Keratin (B) Haemoglobin
(C) Ribonuclease (D) Adenine

2. Which one of the following statement is true for protein synthesis (translation) :
(A) Amino acids are directly recognized by m-RNA
(B) The third base of the codon is less specific
(C) Only one codon codes for an amino acid
(D) Every t-RNA molecule has more than one amino acid attachment site

3. Amino acid sequence, in protein synthesis is decided by the sequence of
(A) tRNA (B) mRNA
(C) cDNA (D) rRNA

4. One turn of the helix in a B-form DNA is approximately
(A) 20 nm (B) 0.34 nm
(C) 3.4 nm (D) 2 nm

5. Antiparallel strands of a DNA molecule means that
(A) one strand turns anti-clockwise
(2 the phosphate groups of two DNA strands, at their ends, share the same position
(C) the phosphate groups at the start of two DNA strands are in opposite position (pole)
(D) one strand turns clockwise

6. The causative agent of mad-cow disease is
(A) Bacterium (B) Prion
(C) Worm (D) Virus

7. Thymine is –
(A) 5–Methyl uracil (B) 4–Methyl uracil
(C) 3–Methyl uracil (D) 1–Methyl uracil

8. Molecular basis of organ differentiation depends on the modulation in transcription by :
(A) RNA polymerase (B) Ribosome
(C) Transcription factor (D) Anticodon

9. The two polynucleotide chains in DNA are :
(A) Parallel (B) Discontinuous
(C) Antiparallel (D) Semiconservative

10. Which monosaccharide does not show optical isomerism :
(A) Dihydroxy acetone (B) Glyceraldehyde
(C) Erythrose (D) Ribose

11. Polysome is formed by :-
(A) A ribosome with several subunits
(B) Ribosomes attached to each other in a linear arrangement
(C) Several ribosomes attached to a single mRNA
(D) Many ribosomes attached to a strand of endoplasmic reticulum

12. In the DNA molecule:-
(A) the proportion of Adenine in relation to thymine varies with the organism
(B) there are two strands which run antiparallel one in 5' →3' direction and other in 3' → 5'
(C) the total amount of purine nucleotides and pyrimidine nucleotides is not always equal
(D) there are two strands which run parallel in the 5' →3' direction

13. Which of the following bond is not related to nucleic acid :
(A) H-bond (B) Ester bond
(C) Glycosidic bond (D) Peptide bond

14. Removal of introns and joining the exons in a defined order in a transcription unit is called :-
(A) Capping (B) Splicing
(C) Tailing (D) Transformation

15. Whose experiments cracked the DNA and discovered unequivocally that a genetic code is a "triplet" :-
(A) Beadle and tatum
(B) Nirenberg and Mathaei
(C) Hershey and Chase
(D) Morgan and Sturtevant

16. A higher nucleotide is a nucleotide having
(A) higher molecular weight
(B) More than one phosphate redicle
(C) More than one nitrogen base
(D) More than one sugar residue

17. Which is odd -
(A) Chitin Carbohydrates (B) Pectin - Protein
(C) Steroid - Lipid (D) Wax - Lipid

18. Cholesterol is synthesized in -
(A) pancreas (B) Brunners gland
(C) Spleen (D) Liver

Exercise # 2 SINGLE OBJECTIVE AIIMS LEVEL

1. Which is a disaccharide -
(A) Galactose (B) Fructose
(C) Maltose (D) Dextrin

2. To get quick energy one should use -
(A) Carbohydrate (B) Fats
(C) Vitamins (D) Proteins

3. Which is not polysaccharide -
(A) Sucrose (B) starch
(C) Glycogen (D) cellulose

4. Characteristic feature of haemoglobin-
(A) Reversible union with oxygen
(B) Red Colour
(C) Presence of Cu
(D) Presence of Globulin protein

5. External Coat composed of cellulose like material occurs in-
(A) Hemichordata (B) Urochordata
(C) Cephalochordata (D) Cyclostomata

6. Common in feather and Silk is-
(A) Carbohydrate (B) Fats
(C) Protein (D) Nucleic acid

7. Monosaccharide is -
(A) Pentose Sugar (B) Hexose Sugar
(C) Only Glucose (D) all the above

8. Which substance is most abundant in cell-
(A) Carbohydrates (B) Protein
(C) Water (D) Fats

9. Dipeptide is-
(A) Structure of two peptide bonds
(B) Two amino acids linked by one peptide bond
(C) bond between one amino acid and one peptide
(D) None

10. Nails, horns and hoofs contain -
(A) Chitin (B) Keratin
(C) Both (D) None

11. In which form the extra Sugars stored in the body -
(A) Glucose monosaccharide
(B) Sucrose Disaccharide
(C) Glycogen polysaccharide
(D) Fatty acid and glycerol

12. Products of proteins catabolism
(A) NH_3,CO_2 and Urea
(B) Urea, CO_2 and NH
(C) Urea, NH_3 and uric acid
(D) Urea, NH_3, alanine and creatine

13. Glycogen is -
(A) Polymer of amino acids
(B) Polymer of fatty acids
(C) Unsaturated fats
(D) Polymer of glucose

14. Carbohydrate is -
(A) Polymers of fatty acid
(B) Polymer of amino acids
(C) Poly hydroxy aldehyde or ketone
(D) None

15. Which compound produces more than twice the amount of energy as compared to carbohydrates
(A) Protein (B) Fats
(C) Vitamins (D) Glucose

16. What is the normal ratio of sugar in human blood.
(A) .01 % (B) 0.1%
(C) 1 % (D) 0.18%

17. Corbohydrate metabolism is controlled by :
(A) Parathormone (B) Insulin
(C) Glucose (D) Vitamin B_{12}

18. Fattyness is due to the excess of :-
(A) Connective tissue (B) Blood
(C) Muscular tissue (D) Adipose tissue

19. Starving person will first use :-
(A) Fats (B) Glycogen
(C) Blood protein (D) Muscle protein

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	Column - II
A. Galactose	**i.** Protein
B. Anticoagulant	**ii.** Phospholipid
C. Fructose	**iii.** Brain sugar
D. Lecithin	**iv.** Heparin
E. Insulin	**v.** Fruit sugar

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

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

Column - I	Column - II
A. Cotton fibre	**i.** Starch
B. Exoskeleton of cockroach	**ii.** Glycogen
C. Liver	**iii.** Chitin
D. Peeled potato	**iv.** Inulin
E. Roots of *Dahlia*	**v.** Cellulose

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

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

Column - I	Column - II
A. Tetrose sugar	**i.** Galactose
B. Pentose sugar	**ii.** Maltose
C. Hexose sugar	**iii.** Erythrose
D. Disaccharide	**iv.** Ribose
	v. Sedoheptulose

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

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

Column - I (Category)	Column - II (Secondary metabolities)
A. Pigments	**i.** Concanacalin A
B. Terpenoids	**ii.** Monoterpenes, diterpenes
C. Alkaloids	**iii.** Morphine, codeine
D. Lectins	iv Carotenoids, anthocyanins

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

5. Match the following and choose the correct combination from the options given

Column - I (Organic Compound)	Column - II (Example)
A. Fatty acid	**i.** Glutamic acid
B. Phospholipid	**ii.** Tryptophan
C. Aromatic amino acid	**iii.** Lecithin
D. Acidic amino acid	**iv.** Palmitic acid

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

Exercise # 4

PART - 1 PREVIOUS YEAR (NEET/AIPMT)

1. Which is an essential amino acid ? [CBSE AIPMT-2000]
(A) Serine (B) Aspartic acid
(C) Glycine (D) Phenylalanina

2. ATP is a [CBSE AIPMT-2000]
(A) nucleotide (B) nucleosome
(C) nucleosie (D) purine

3. One of the similarities between DNAand RNA is that both [CBSE AIPMT-2000]
(A) are polymers of nucleotides
(B) are capaoble of replicating
(C) have similar sugars
(D) have similar pyrimidine bases

4. Feedback inhibition of an enzymatic reaction is caused by [CBSE AIPMT-2000]
(A) are polymers of nucleotids
(B) are capable of replicating
(C) have similar sugars
(D) have similar pyrimidine bases

5. Enzymes enhance the rate of reaction [CBSE AIPMT-2000]
(A) forming a reactant - product complex
(B) changing the equilibrium point of the reaction
(C) combining with the product as soon as it is formed
(D) lowering the axtivation energy of the reaction

6. The transfer RNA molecule in 3D appears [CBSE AIPMT-2000]
(A) L-shaped (B) E-shaped(C) Lipo-proteins (D) S-shaped

7. Conjugated proteins containin crabohydrates as prosthetic group are known as [CBSE AIPMT-2000]
(A) chromoproteins (B) glycoproteins
(C) lipoproteins (D) nucleoproteins

8. In plants, inulin and pectin are [CBSE AIPMT-2000]
(A) reserve materials
(B) wastes
(C) excretory material
(D) insect-attracting material

9. Element necessary for the middle lamella [CBSE AIPMT-2001]
(A) Ca (B) Zn
(C) K (D) Cu

10. Cytochrome is [CBSE AIPMT-2001]
(A) metallo flavoprotein
(B) Fe containing porphyrin pigment
(C) glycoprotin
(D) lipid

11. Spoilage of oil can be detected by which on earth is [CBSE AIPMT-2000]
(A) protein (B) cellulose
(C) lipids (D) steroids

12. Most abundant organic compound on earth is [CBSE AIPMT-2001, 04]
(A) protein (B) cellulose
(C) lipids (D) steroids

13. Hydrolytic enzymes which act at low pH [CBSE AIPMT-2002]
(A) proteases (B) α - amylases
(C) hydrolases (D) peroxidases

14. Which steroid is used for transformation? [CBSE AIPMT-2002]
(A) Cortisol (B) Cholesterol
(C) Testosterone (D) Progesterone

15. Which of the following is a reduycing gugar? [CBSE AIPMT-2002]
(A) Galactose (B) Gluconic acid
(C) β-methyl galactoside (D) Sucrose

16. Lipids are insoluble in water because lipid moleules are [CBSE AIPMT-2002]
(A) hydrohilic (B) hydrophobic
(C) neutral (D) Zwitter ions

17. Collagen is [CBSE AIPMT-2002]
(A) fibrous protein (B) globular protein
(C) liped (D) carbohydrate

18. The major portion of the dry weight of plants comprises of [CBSE AIPMT-2003]
(A) carbon, nitrogen and hydrogen
(B) carbon, hydrogen and oxygen
(C) nitrogen, phosphorus and potassium
(D) calcium, magnesium and sulphur

MOCK TEST

1. In a polysaccharide, number of monosaccharides are linked by
(A) glycosidic bond (B) peptide bond (D) hydrogen bond (D) phosphoester bond

2. Which of the following is/are cellulosic?
(i) Paper (ii) Cotton fibre (iii) Chitin (iv) Glycogen
(A) (i) and (ii) only (B) (i) and (iii) only (C) (i), (iii) and (iv) only (D) (iii) and (iv) only
(E) (iii) only

3. The chitinous exoskeleton of arthropods is formed by the polymerisation of
(A) N - acetyl glucosamine (B) lipoglycans
(C) deratin sulphate and chondroitin sulphate (D) D - glucosamine

4. Macromolecule chitin is
(A) sulphur containing polysaccharide (B) simple polysaccharide
(C) nitrogen containing polysaccharide (D) phosphorous containing polysaccharide

5. Which of the following statements is not correct?
(A) Starch is a polymer of α-glucose.
(B) Starch is made up of amylose and amylospectin.
(C) Amylose is linear structure consisting of several glucose residues joined by 1,4-glycosidic linkages.
(D) Amylopectin is a straight chain with several glucose residues joined only by 1,4-glycosidic linkages.

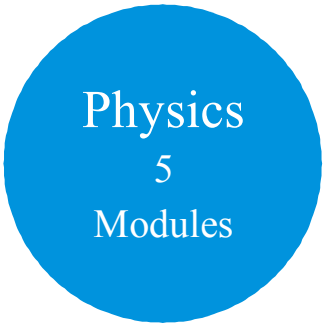
6. Carbohydrates are commonly found as starch in plants storage organs. Which of the following five properties of starch (1-5) make it useful as a storage material?
(1) Easily translocated (2) Chemically non-reactive
(3) Easily digested by animals (4) Osmotically inactive
(5) Synthesised during photosynthesis
The useful properties are
(A) (1), (3) and (5) (B) (1) and (5) (C) (2) and (3) (D) (2) and (4)

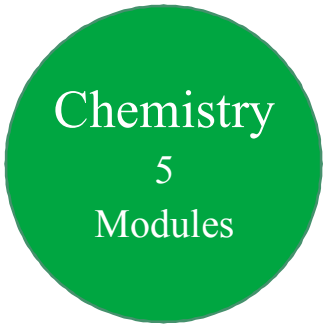
7. Which of the following is the least likely to be involved in stabilising the three-dimensional folding of most proteins?
(A) Hydrogen bonds (B) Electrostatic interaction
(C) Hydrophobic interaction (D) Ester bonds

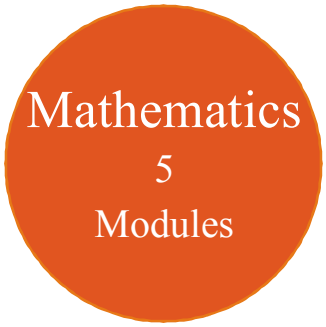
8. Which one of the following statements is wrong?
(A) Uracil is a pyrimidine (B) Glycine is a sulphur containing amino acid
(C) Sucrose is a disaccharide (D) Cellulose is a polysaccharide

9. Which of the following statements about amino acids is false?
(A) Based on the nature of the carboxyl group there are many amino acids.
(B) Amino acids are substituted methanes.
(C) Amino acids have an amino group and acidic group as substituents on the α-carbon.
(D) There are four substituent groups occupying the four valency positions.
(E) Tryptophan is an aromatic amino acid.

11th Class Modules Chapter Details







PHYSICS

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

CHEMISTRY

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

BIOLOGY

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

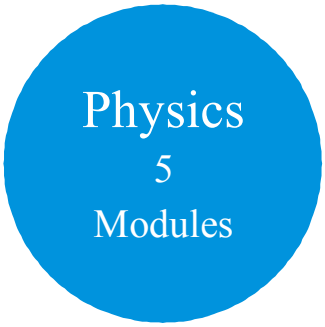
Module-4

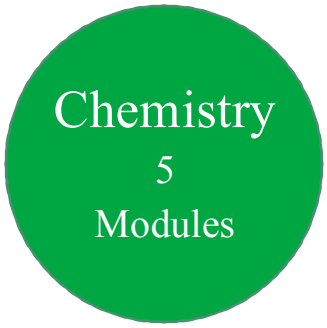
1. Photosynthesis in Higher Plants
2. Respiration in Plants
3. Plant Growth and Development
4. Digestion & Absorption
5. Breathing & Exchange of Gases

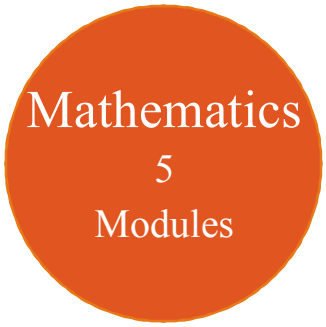
Module-5

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