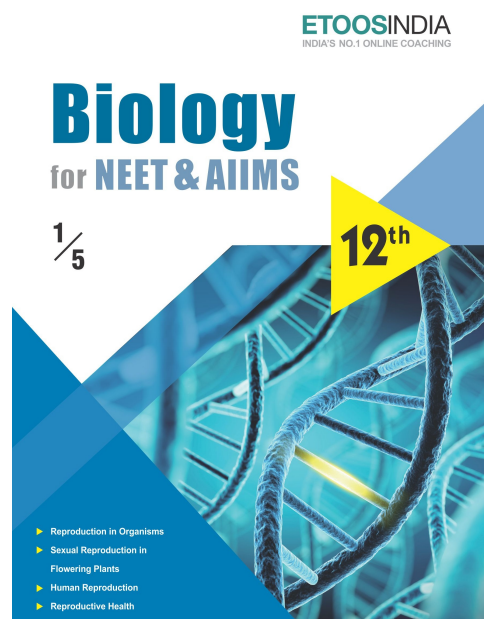
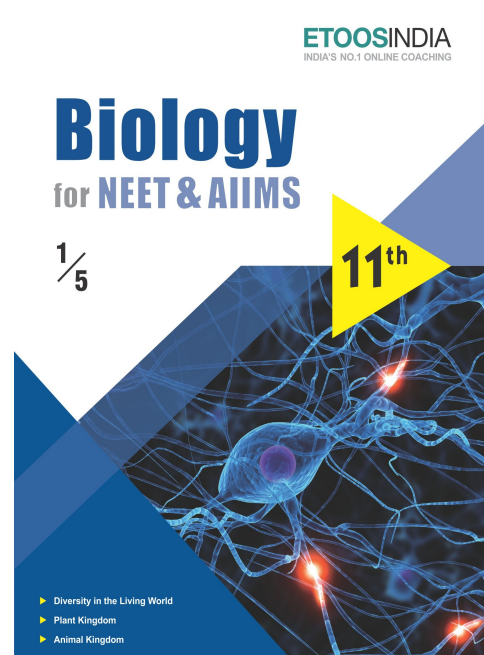
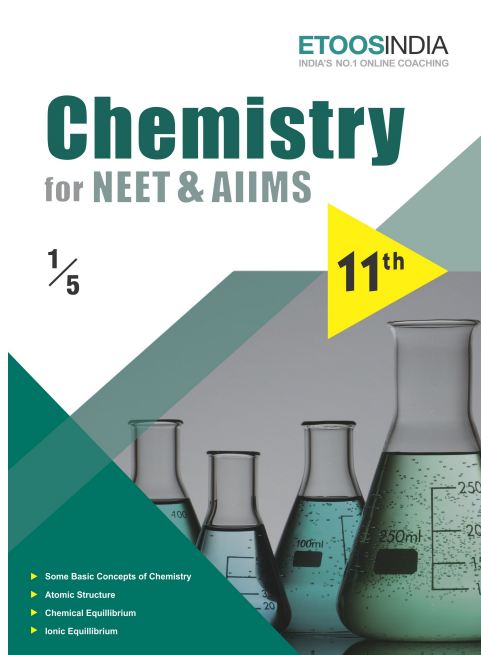
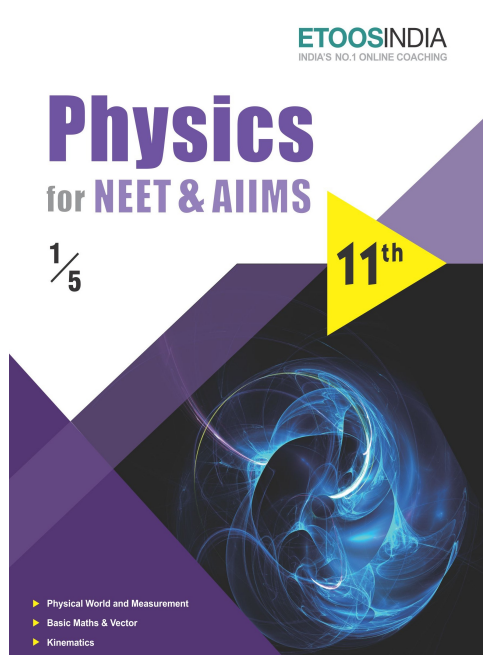


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# BIOMOLECULES & POLYMERS

*The beauty of Chemistry is that I can design my own molecular world.*

"BEN L. FERINGA"

## INTRODUCTION

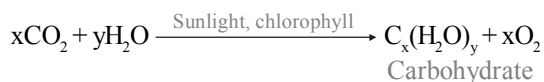
**C**omplex organic compound which governs the common activities of the living organism are called biomolecules. Living systems are made up of various complex biomolecules like carbohydrates, proteins, nucleic acids, lipids etc. In addition, some simple molecules like vitamins and mineral salts also play an important role in the functions of organism.

Among biomolecules, **nucleic acids**, namely DNA and RNA have the unique function of storing of proteins, which are of critical importance to life on earth. **Carbohydrate**, which are made up of primarily of molecules containing atoms of carbon, hydrogen and oxygen are essential energy source and structural components of all life and they are among the most abundant biomolecules on earth.

Polymer is defined as a high molecular weight compound formed by the combination of large number of one or more types of small molecules (Monomers)

**CARBOHYDRATES**

Carbohydrates received their name because of their general formula  $C_x(H_2O)_y$ , according to which they appear to be hydrates of carbon.



A polyhydroxy compound that has an aldehyde or a ketone functional group present, either free or as hemiacetal or acetal are called carbohydrate.

Carbohydrates are substances with the general formula  $C_x(H_2O)_y$ , and were therefore called carbohydrates (hydrates of carbon) because they contained hydrogen and oxygen in the same proportion as in water.

However, a number of compounds have been discovered which are carbohydrates by chemical behaviour, but do not conform to the formula  $C_x(H_2O)_y$ , e.g., 2-deoxyribose,  $C_5H_{10}O_4$ .

**ETOOS KEY POINTS**

It is also important to note that all compounds conforming to the formula  $C_x(H_2O)_y$  are not necessarily carbohydrates, e.g., formaldehyde,  $CH_2O$ ; acetic acid,  $C_2H_4O_2$ ; etc.

Carbohydrates are often referred to as Saccharides (Latin, Saccharum = sugar) because of the sweet taste of the simpler members of the class, the sugars.

**Classification of Carbohydrate :**

The carbohydrates are divided into three major classes depending on the number of simple sugar units present in their molecule.

- (i) **Monosaccharide** : A carbohydrate that cannot be hydrolyzed to simpler compounds is called monosaccharide. Monosaccharide which have six carbon are either aldohexoses or ketohexoses. **Ex.** glucose, fructose, ribose.
- (ii) **Oligosaccharides** : Carbohydrates that yield two to ten monosaccharide units, on hydrolysis, are called oligosaccharides. They are further classified as disaccharides, trisaccharides, tetrasaccharides, etc., depending upon the number of monosaccharides, they provide on hydrolysis. Amongst these the most common are **disaccharides**. The two monosaccharides units obtained on hydrolysis on a disaccharide may be same or different. For example, sucrose on hydrolysis gives one molecule each of glucose and fructose whereas maltose gives two molecules of glucose only.
- (iii) **Polysaccharide** : A carbohydrate that can be hydrolyzed to many monosaccharide molecules is called a polysaccharide. Example : Starch, Cellulose, etc.

The carbohydrates may also be classified as either reducing or non-reducing sugars. All those carbohydrates which reduce Fehling's solution and Tollen's reagent are referred to as reducing sugars. All monosaccharides whether aldose or ketose are reducing sugars.

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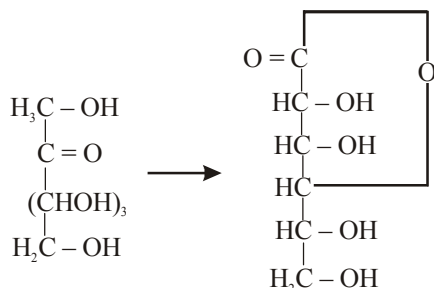
In disaccharides, if the reducing groups of monosaccharides i.e., aldehydic or ketonic groups are bonded, these are **non-reducing sugars e.g. sucrose**. On the other hand, sugars in which these functional groups are free, are called reducing sugars, for example, maltose and lactose.

**COMMON POLYMERS**

	Monomer	Repeating unit	Polymer
1.	$\text{CH}_2=\text{CH}_2$ Ethylene	$-\text{CH}_2-\text{CH}_2-$	Polyethylene
2.	$\text{CH}_3-\text{CH}=\text{CH}_2$ Propene	$-\text{CH}_2-\overset{\text{CH}_3}{\underset{ }{\text{CH}}}-$	Polypropene
3.	$\text{C}_6\text{H}_5-\text{CH}=\text{CH}_2$ Styrene	$-\text{CH}_2-\overset{\text{C}_6\text{H}_5}{\underset{ }{\text{CH}}}-$	Polystyrene
4.	$\text{CF}_2=\text{CF}_2$ Tetrafluoroethylene	$-\text{CF}_2-\text{CF}_2-$ ethylene (PTFE), Teflon	Polytetrafluoro
5.	$\text{CH}_2=\text{CH}-\text{Cl}$ Vinyl chloride	$-\text{CH}_2-\overset{\text{Cl}}{\underset{ }{\text{CH}}}-$	Polyvinyl Chloride (PVC)
6.	$\text{CH}_2=\text{CH}-\text{CN}$ Vinyl cyanide or	$-\text{CH}_2-\overset{\text{CN}}{\underset{ }{\text{CH}}}-$ poly acrylonitrile,	Polyvinyl cyanide, Acrylonitrile Orlon.
7.	$\text{CH}_2=\overset{\text{H}_3\text{C}}{\underset{ }{\text{C}}}-\overset{\text{O}}{\parallel}{\text{C}}-\text{O}-\text{CH}_3$ Methyl methacrylate	$-\text{CH}_2-\overset{\text{COOCH}_3}{\underset{\text{CH}_3}{\text{C}}}-$  Plexiglas, Lucite	Polymethyl metha acrylate,
8.	$\text{CH}_2=\text{CH}-\text{O}-\overset{\text{O}}{\parallel}{\text{C}}-\text{CH}_3$ Vinyl acetate	$-\text{CH}_2-\overset{\text{OCOCH}_3}{\underset{ }{\text{CH}}}-$	Polyvinyl Acetate
9.	$\text{CH}_2=\text{CH}-\text{CH}=\text{CH}_2$ 1,3-butadiene	$-\text{CH}_2-\text{CH}=\text{CH}-\text{CH}_2-$ Buna rubber	Polybutadiene,

**SOLVED EXAMPLE**

- Ex. 1** Sucrose on hydrolysis yields a mixture which is  
 (A) Optically inactive (B) Dextrorotatory (C) Laevorotatory (D) Racemic
- Sol.** (C) Sucrose on hydrolysis yields equimolar mixture of D-(—)-fructose and D-(+)-glucose. Since specific rotation of (—)-fructose is greater than (+)-glucose D the mixture is laevorotatory.
- Ex. 2** A high molecular weight molecule which does not contain repeating structural units is called a  
 (A) Polymer (B) Macromolecule (C) Both (A) and (B) (D) None of these
- Sol.** (B) A polymer has always repeating structural units derived from monomer. For example proteins and nucleic acid are regarded as macromolecules, but not polymers because their molecules do not contain repeating structural units. All polymers are macromolecules, but all macromolecules are not polymers.
- Ex. 3** The force of attraction between the neighbouring peptide chains is  
 (A) van der Waal's force (B) Covalent bond (C) Hydrogen bond (D) Peptide linkage
- Sol.** (C) Neighbouring peptide chains are held by hydrogen bonds between —CO— and —NH—.
- Ex. 4** Peptides on hydrolysis give  
 (A) Ammonia (B) Amines (C) Amino acids (D) Hydroxy acids
- Sol.** (C) Peptides are formed by condensation of  $\alpha$ -amino acids. Therefore, on hydrolysis they yield  $\alpha$ -amino acids.
- Ex. 5** An example of a condensation polymer is  
 (A) PVC (B) terylene (C) polypropylene (D) polystyrene
- Sol.** (B) In condensation polymerization, a series of condensation reactions between the (generally two) monomers containing atleast two functional groups each occur with the loss of a small molecule such as  $H_2O$ ,  $CH_3OH$  or  $HX$  ( $X = \text{halogen}$ ). Terylene is a condensation polymer of ethylene glycol and terephthalic acid.
- Ex. 6** Although both polymers are prepared by free radical processes, poly (vinyl chloride) is amorphous and poly (vinylidene chloride) (saran) is highly crystalline. How do you account for the different? (vinylidene chloride is 1,1-dichloroethene).
- Sol.** As poly (vinyl chloride) is able to show stereoisomerism and further it is formed by a free radical process, it is atactic (chlorine atoms (distributed randomly), the molecules fit together poorly. Poly (vinylidene chloride) has two identical substituents on each carbon and the chains fit together well.
- Ex. 7** Compound A  $C_5H_{10}O_4$ , is oxidized by  $Br_2 - H_2O$  to the acid,  $C_5H_{10}O_5$ . (A) Forms a triacetate ( $Ac_2O$ ) and is reduced by HI to n-pentane. Oxidation of (A) with  $HIO_4$  gives, among other product, 1 molecule of  $CH_2O$  and 1 molecule of  $HCO_2H$ . What are the possible structures of (A) and how could you distinguish between them?
- Sol.** (A) is an aldehyde, contains three hydroxyl groups and the carbon skeleton consists of five carbon atoms in a straight chain. Also, the formula  $C_5H_{10}O_4$  therefore suggests that (A) is a deoxy-sugar. If we now try to work out the possibilities based directly on the periodic oxidation of (A), we shall find it.
- Ex. 8** Convert



**Exercise # 1**

**SINGLE OBJECTIVE**

**NEET LEVEL**

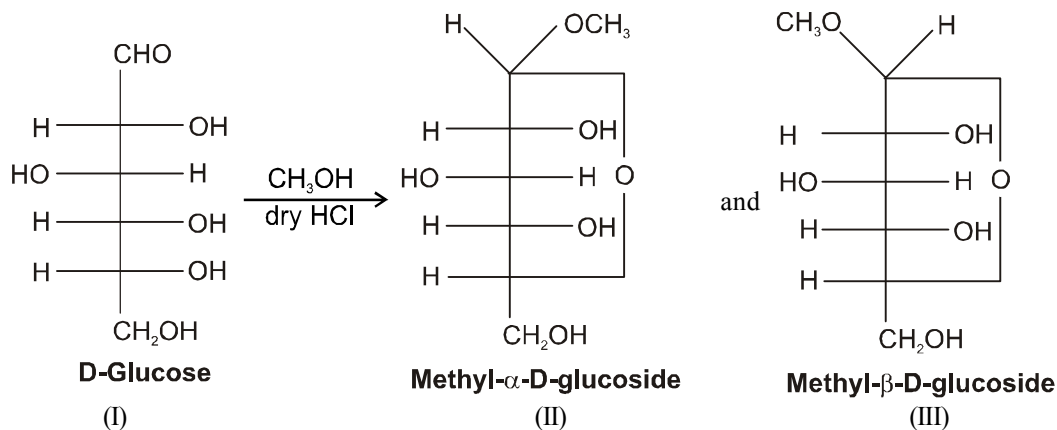
1. Which one among the following is a thermosetting plastic  
(A) PVC (B) PVA  
(C) Bakelite (D) Perspex
2. The basis on the mode of their formation, the polymers can be classified  
(A) As addition polymers only  
(B) As condensation polymers only  
(C) As copolymers  
(D) Both as addition and condensation polymers
3. Thermoplastics are  
(A) Linear polymers (B) Highly cross-linked  
(C) Both (A) and (B) (D) Crystalline
4. 'Cis-1, 4-polyisoprene' is  
(A) Thermoplastic  
(B) Thermosetting plastic  
(C) Elastic (rubber)  
(D) Resin
5. 'Shellac' secreted by lac insects is  
(A) Natural plastic (B) Natural resin  
(C) Natural elastic (D) Any of these
6. Which of the following is a syndiotactic polymer in  $[-CH_2-C(YZ)-]_z-$   
(A) All Y group lie on one side of the chain and all Z groups on the other side  
(B) The Y and Z groups lie alternately on each side of the chain  
(C) The Y and Z groups are arranged in a random fashion  
(D) Y and Z groups are same
7. Polymers of the type  $Z - Mn - Y$ , i.e. those which contain a foreign molecule in addition to the recurring unit are known as  
(A) Semisynthetic polymers  
(B) Atactic polymers  
(C) Telomers  
(D) Plasticiser
8. In the natural rubber 'Caoutchuc', the isoprene units are joined by  
(A) Head-to-head (B) Tail-to-tail  
(C) Heat-to-tail (D) All of these
9. The degree of crystallinity of which of the following is highest  
(A) Atactic polyvinylchloride  
(B) Isotactic polyvinylchloride  
(C) Syndiotactic polyvinylchloride  
(D) all of these
10. Monomers are converted to polymer by  
(A) Hydrolysis of monomers  
(B) Condensation reaction between monomers  
(C) Protonation of monomers  
(D) None of these
11. Polymer formation from monomers starts by  
(A) Condensatin reaction between monomers  
(B) Coordinate reaction between monomers  
(C) Conversion of monomer to monomer ions by protons  
(D) Hydrolysis of monomers
12. When condensation product of hexamethylenediamine and adipic acid is heated to 553 K (80°C) in an atmosphere of nitrogen for about 4-5 hours, the product obtained is  
(A) Solid polymer of nylon 66  
(B) Liquid polymer of nylon 66  
(C) Gaseous polymer of nylon 66  
(D) Liquid polymer of nylon 66
13. Polymerization of glycol with dicarboxylic acids is  
(A) Addition polymerisation  
(B) Condensation polymerisation  
(C) Telomerisation  
(D) Any of these
14. The 'mercerised cellulose' is chemically prepared by  
(A) Acetylation (B) Mercuriation  
(C) Halogenation (D) Hydrolysis
15. The plastics if are hard, become soft and readily workable by addition of certain compounds called  
(A) Catalysts (B) Telomers  
(C) Plasticisers (D) Vulcaniser
16. Discovery of 'nylon' is associated with  
(A) Newyork and London  
(B) Newyork and Longuet  
(C) Nyholm and London  
(D) None of these

Exercise # 2

SINGLE OBJECTIVE

AIIMS LEVEL

- Which of the following pairs form the same osazone ?  
 (A) Glucose and fructose (B) Glucose and galactose  
 (C) Glucose and arabinose (D) Lactose and maltose
- The term inverted sugar refers to an equimolar mixture :  
 (A) D-Glucose and D-galactose (B) D-Glucose and D-fructose  
 (C) D-Glucose and D-mannose (D) D-Glucose and D-ribose
- Cellulose on hydrolysis yields  
 (A)  $\beta$ -D-Fructose (B)  $\alpha$ -D-Glucose (C)  $\beta$ -D-Glucose (D)  $\alpha$ -D-Fructose
- Glucose when treated with  $\text{CH}_3\text{OH}$  in presence of dry HCl gas gives  $\alpha$ - and  $\beta$ - methylglucosides because it contains  
 (A) an aldehydic group (B) a  $-\text{CH}_2\text{OH}$  group (C) a ring structure (D) five  $-\text{OH}$  group
- $\alpha$ -D glucose and  $\beta$ -D-glucose differ from each other due to the difference in one of the carbon atoms, with respect to its  
 (A) Number of OH groups (B) Configuration (C) Conformation (D) Size of hemiacetal ring
- In Ketohexose the possible optical isomers are  
 (A) 12 (B) 4 (C) 16 (D) 8
- Which of the following indicates the presence of 5  $-\text{OH}$  groups in glucose  
 (A) Penta-acetyl derivative of glucose (B) Cyanohydrin formation of glucose  
 (C) Reaction with fehling's solution (D) Reaction with Tollen's reagent
- Find true and False from the following statements regarding carbohydrates  
 $S_1$  : All monosaccharides whether aldoses or ketoses are reducing sugars.  
 $S_2$  : Bromine water can be used to differentiate between aldoses and ketoses  
 $S_3$  : A pair of diastereomeric aldoses which differ only in configuration at C-2 are anomers.  
 $S_4$  : Osazone formation destroys the configuration at C-2 of an aldose, but does not affect the configuration of the rest of the molecule.  
 (A) TTTT (B) TFTF (C) TTFT (D) FTTF
- D-glucose, on treating with methanol in presence of dry HCl gives methyl glucosides according to the following reaction



Mention true (T) and False (F) from the following statements

- $S_1$  : The glucosides do not reduce fehling's solution  
 $S_2$  : The glucosides do not react with hydrogen cyanide or hydroxylamine  
 $S_3$  : Behaviour of glucosides as stated in  $S_1$  and  $S_2$  indicates the absence of free  $-\text{CHO}$  group.  
 $S_4$  : The two forms of glucosides are enantiomers.

- (A) TTFF (B) FTTF (C) TTTF (D) TFTF

**Exercise # 3**

**PART - 1**

**MATRIX MATCH COLUMN**

1. Match Column-I with Column-II.

**Column-I**

(polymer)

- (A) Bakelite
- (B) Polypropylene
- (C) Glyptal
- (D) Nylon-6

**Column-II**

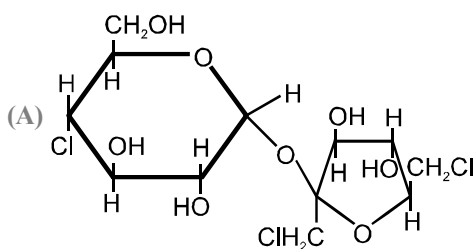
(monomer)

- (p)  $\omega$ -caprolactam
- (q) Ethylene glycol + phthalic anhydride
- (r) propene
- (s) Phenol + formaldehyde

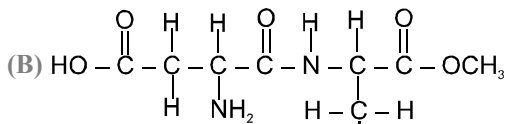
2. Match the Following :

**Column I**

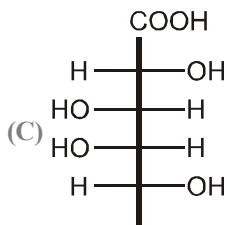
(Artificial sweeteners)



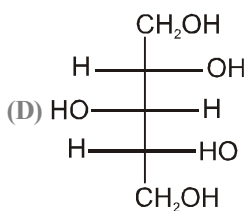
(Sucralose)



(Aspartame)



(Galactaric)  
(Aldaric acid)



(Xylitol)

**Column II**

(Characteristics)

(p) A derivative of dipeptide

(q) A derivative of disaccharide

(r) Reduction product of an aldopentose

(s) Oxidation product of aldohexose



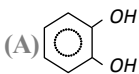
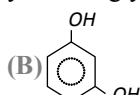
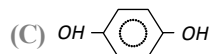
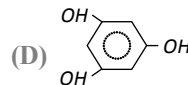
Exercise # 4

PART - 1

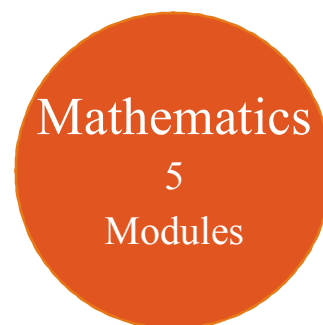
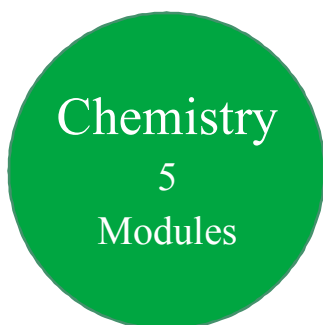
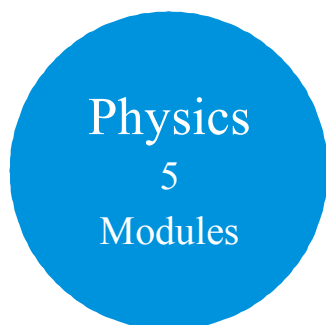
PREVIOUS YEAR (NEET/AIPMT)

- Which one of the following has magnesium ?  
[CBSE AIPMT 2000]  
(A) Vitamin-B<sub>12</sub> (B) Chlorophyll  
(C) Haemocyanin (D) Carbonic anhydrase
- $\alpha$ -D-(+)-glucose and  $\beta$ -D-(+)-glucose are  
[CBSE AIPMT 2000]  
(A) anomers (B) epimers  
(C) enantiomers (D) geometrical isomers
- The hormone which controls the processes like burning of fats, proteins and carbohydrates to liberate energy in the body is  
[CBSE AIPMT 2000]  
(A) cortisone (B) thyroxine  
(C) adrenaline (D) insulin
- CF<sub>2</sub> = CF<sub>2</sub> is a monomer of [CBSE AIPMT 2000]  
(A) Buna-S (B) teflon  
(C) glyptal (D) nylon-6
- Which one of the following is not correctly matched ?  
[CBSE AIPMT 2001]  
(A) Neoprene  $\left[ \text{CH}_2 - \underset{\text{Cl}}{\text{C}} = \text{CH} - \text{CH}_2 \right]_n$   
(B) Nylon - 66  $\left[ \text{NH} - (\text{CH}_2)_6 - \text{NH} - \text{CO} - (\text{CH}_2)_4 - \text{C} - \text{O} \right]_n$   
(C) Terylene  $\left[ \text{O} - \text{CH}_2 - \text{CH}_2 - \overset{\text{O}}{\parallel} \text{C} - \text{C}_6\text{H}_4 - \overset{\text{O}}{\parallel} \text{C} \right]_n$   
(D) PMMA  $\left[ \text{CH}_2 - \underset{\text{CHCH}_3}{\overset{\text{CH}_3}{\text{C}}} \right]_n$
- Which one of the following gives positive Fehling's solution test ?  
[CBSE AIPMT 2001]  
(A) Sucrose (B) Glucose  
(C) Fats (D) Protein
- Which of the following is correct about H-bonding in nucleotide ?  
[CBSE AIPMT 2001]  
(A) A-T, G-C (B) A-G, T-C  
(C) G-T, A-C (D) A-A, T-T
- Which of the following is correct statement ?  
[CBSE AIPMT 2001]  
(A) Starch is a polymer of  $\alpha$ -glucose  
(B) Amylose ia a component of cellulose  
(C) Proteins are composed of only one type of amino acid  
(D) In cyclic structure of fructose, ther are four carbons and one oxygen atom
- Which statement is incorrect about peptide bond  
 $\begin{array}{c} \text{O} \\ \parallel \\ -\text{C}-\dot{\text{N}}\text{H}-? \end{array}$   
[CBSE AIPMT 2001]  
(A) C-N bond length in proteins is longer than usual bond length of C-N bond  
(B) Spectroscopic analysis show planar structure of  $\begin{array}{c} \text{O} \\ \parallel \\ -\text{C}-\text{NH}- \end{array}$  group  
(C) C-n bond length in proteins is smaller than usual bond length of C-N bond  
(D) None of the above
- Enzymes are made up of  
[CBSE AIPMT 2002]  
(A) edible proteins  
(B) proteins with specific structure  
(C) nitrogen conatining carbohydrates  
(D) carbohydrates
- Which is not true statemen ?  
[CBSE AIPMT 2002]  
(A)  $\alpha$ -carbon of  $\alpha$ -amino acid is asymmetric  
(B) All proteins are found in L-form  
(C) Human bond can synthesise all proteins they need  
(D) At pH = 7 both amino and carboxylic groups exist in ionised form
- Monomer of  $\left[ \begin{array}{c} \text{CH}_3 \\ | \\ -\text{C}-\text{CH}_2 \\ | \\ \text{CH}_3 \end{array} \right]_n$  is  
[CBSE AIPMT 2002]  
(A) 2-methylpropene (B) styrene  
(C) propylene (D) ethene
- Cellulose is a polymer of [CBSE AIPMT 2002]  
(A) glucose (B) fructose  
(C) ribose (D) sucrose
- Acrilan is a hard, horny and a high melting material. Which of the following represents its structure ?  
[CBSE AIPMT 2003]  
(A)  $\left( -\text{CH}_2 - \underset{\text{COOC}_2\text{H}_5}{\text{CH}} - \right)_n$  (B)  $\left( -\text{CH}_2 - \underset{\text{Cl}}{\text{CH}} - \right)_n$   
(C)  $\left( \text{CH}_2 - \underset{\text{CN}}{\text{CH}} - \right)_n$  (D)  $\left( -\text{CH}_2 - \underset{\text{COOCH}_3}{\overset{\text{CH}_3}{\text{C}}} - \right)_n$

**STRAIGHT OBJECTIVE TYPE**

- Perlon is  
(A) Rubber (B) Nylon-6 (C) Terelene (D) Oxlon
- Styrene at room temperature is  
(A) Solid (B) Liquid (C) Gas (D) Colloidal solution
- Which one of the following can be used as monomer in a polymerisation reaction  
(A)  $\text{CH}_3\text{CH}_2\text{Cl}$  (B)  $\text{CH}_3\text{CH}_2\text{OH}$  (C)  $\text{C}_6\text{H}_6$  (D)  $\text{C}_3\text{H}_6$
- The Ziegler-Natta catalysts are  
(A) Stereospecific (B) Non-metallic complexes  
(C) Gaseous catalysts (D) Universal in all polymerisation reactions
- Melamine is  
(A) Gas (B) Yellow liquid (C) White crystalline solid (D) Colloidal solution
- Insulin is a protein which plays the role of  
(A) An antibody (B) A hormone (C) An enzyme (D) A transport agent
- Proteins fulfil several functions in living systems. An example of a protein which acts as a hormone is  
(A) Casein (B) Oxytocin (C) Trypsin (D) Keratin
- Pick out the unsaturated fatty acid from the following  
(A) Stearic acid (B) Lauric acid (C) Oleic acid (D) Palmitic acid
- Vitamin  $\text{B}_{12}$  contains metal  
(A) Ca (II) (B) Zn (II) (C) Fe (II) (D) Co (III)
- The number of molecules of ATP produced in the lipid metabolism of a molecule of palmitic acid is  
(A) 130 (B) 36 (C) 56 (D) 86
- Protein can be most easily removed from  
(A) Alkanes (B) Alkenes (C) Alkynes (D) Benzene
- A raw material used in making nylon is  
(A) Adipic acid (B) Butadiene (C) Ethylene (D) Methyl methacrylate
- Nylon is formed when a dicarboxylic acid is treated with a  
(A) Dihydric alcohol (B) Polyhydric alcohol (C) Diamine (D) Diester
- Vinyl chloride can be converted into PVC. In this reaction, the catalyst used is  
(A) Peroxides (B) Cuprous chloride  
(C) Anhydrous zinc chloride (D) Anhydrous  $\text{AlCl}_3$
- The monomeric units of terylene are glycol and which of the following  
(A)  (B)  (C)  (D) 
- Neoprene, a synthetic rubber contains which of the following element besides C and H  
(A) N (B) O (C) Cl (D) F
- Hydrolysis of sucrose is called  
(A) Esterification (B) Saponification (C) Inversion (D) Hydration

# 11<sup>th</sup> Class Modules Chapter Details



PHYSICS	CHEMISTRY	BIOLOGY
<p><b>Module-1</b></p> <ol style="list-style-type: none"> <li>1. Physical World &amp; Measurements</li> <li>2. Basic Maths &amp; Vector</li> <li>3. Kinematics</li> </ol> <p><b>Module-2</b></p> <ol style="list-style-type: none"> <li>1. Law of Motion &amp; Friction</li> <li>2. Work, Energy &amp; Power</li> </ol> <p><b>Module-3</b></p> <ol style="list-style-type: none"> <li>1. Motion of system of particles &amp; Rigid Body</li> <li>2. Gravitation</li> </ol> <p><b>Module-4</b></p> <ol style="list-style-type: none"> <li>1. Mechanical Properties of Matter</li> <li>2. Thermal Properties of Matter</li> </ol> <p><b>Module-5</b></p> <ol style="list-style-type: none"> <li>1. Oscillations</li> <li>2. Waves</li> </ol>	<p><b>Module-1(PC)</b></p> <ol style="list-style-type: none"> <li>1. Some Basic Concepts of Chemistry</li> <li>2. Atomic Structure</li> <li>3. Chemical Equilibrium</li> <li>4. Ionic Equilibrium</li> </ol> <p><b>Module-2(PC)</b></p> <ol style="list-style-type: none"> <li>1. Thermodynamics &amp; Thermochemistry</li> <li>2. Redox Reaction</li> <li>3. States Of Matter (Gaseous &amp; Liquid)</li> </ol> <p><b>Module-3(IC)</b></p> <ol style="list-style-type: none"> <li>1. Periodic Table</li> <li>2. Chemical Bonding</li> <li>3. Hydrogen &amp; Its Compounds</li> <li>4. S-Block</li> </ol> <p><b>Module-4(OC)</b></p> <ol style="list-style-type: none"> <li>1. Nomenclature of Organic Compounds</li> <li>2. Isomerism</li> <li>3. General Organic Chemistry</li> </ol> <p><b>Module-5(OC)</b></p> <ol style="list-style-type: none"> <li>1. Reaction Mechanism</li> <li>2. Hydrocarbon</li> <li>3. Aromatic Hydrocarbon</li> <li>4. Environmental Chemistry &amp; Analysis Of Organic Compounds</li> </ol>	<p><b>Module-1</b></p> <ol style="list-style-type: none"> <li>1. Diversity in the Living World</li> <li>2. Plant Kingdom</li> <li>3. Animal Kingdom</li> </ol> <p><b>Module-2</b></p> <ol style="list-style-type: none"> <li>1. Morphology in Flowering Plants</li> <li>2. Anatomy of Flowering Plants</li> <li>3. Structural Organization in Animals</li> </ol> <p><b>Module-3</b></p> <ol style="list-style-type: none"> <li>1. Cell: The Unit of Life</li> <li>2. Biomolecules</li> <li>3. Cell Cycle &amp; Cell Division</li> <li>4. Transport in Plants</li> <li>5. Mineral Nutrition</li> </ol> <p><b>Module-4</b></p> <ol style="list-style-type: none"> <li>1. Photosynthesis in Higher Plants</li> <li>2. Respiration in Plants</li> <li>3. Plant Growth and Development</li> <li>4. Digestion &amp; Absorption</li> <li>5. Breathing &amp; Exchange of Gases</li> </ol> <p><b>Module-5</b></p> <ol style="list-style-type: none"> <li>1. Body Fluids &amp; Its Circulation</li> <li>2. Excretory Products &amp; Their Elimination</li> <li>3. Locomotion &amp; Its Movement</li> <li>4. Neural Control &amp; Coordination</li> <li>5. Chemical Coordination and Integration</li> </ol>

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# 12<sup>th</sup> Class Modules Chapter Details

Physics  
5  
Modules

Chemistry  
5  
Modules

Mathematics  
5  
Modules

PHYSICS	CHEMISTRY	BIOLOGY
<p><b>Module-1</b></p> <ol style="list-style-type: none"> <li>1. Electrostatics</li> <li>2. Capacitance</li> </ol> <p><b>Module-2</b></p> <ol style="list-style-type: none"> <li>1. Current Electricity</li> <li>2. Magnetic Effect of Current and Magnetism</li> </ol> <p><b>Module-3</b></p> <ol style="list-style-type: none"> <li>1. Electromagnetic Induction</li> <li>2. Alternating Current</li> </ol> <p><b>Module-4</b></p> <ol style="list-style-type: none"> <li>1. Geometrical Optics</li> <li>2. Wave Optics</li> </ol> <p><b>Module-5</b></p> <ol style="list-style-type: none"> <li>1. Modern Physics</li> <li>2. Nuclear Physics</li> <li>3. Solids &amp; Semiconductor Devices</li> <li>4. Electromagnetic Waves</li> </ol>	<p><b>Module-1(PC)</b></p> <ol style="list-style-type: none"> <li>1. Solid State</li> <li>2. Chemical Kinetics</li> <li>3. Solutions and Colligative Properties</li> </ol> <p><b>Module-2(PC)</b></p> <ol style="list-style-type: none"> <li>1. Electrochemistry</li> <li>2. Surface Chemistry</li> </ol> <p><b>Module-3(IC)</b></p> <ol style="list-style-type: none"> <li>1. P-Block Elements</li> <li>2. Transition Elements (d &amp; f block)</li> <li>3. Co-ordination Compound</li> <li>4. Metallurgy</li> </ol> <p><b>Module-4(OC)</b></p> <ol style="list-style-type: none"> <li>1. HaloAlkanes &amp; HaloArenes</li> <li>2. Alcohol, Phenol &amp; Ether</li> <li>3. Aldehyde, Ketone &amp; Carboxylic Acid</li> </ol> <p><b>Module-5(OC)</b></p> <ol style="list-style-type: none"> <li>1. Nitrogen &amp; Its Derivatives</li> <li>2. Biomolecules &amp; Polymers</li> <li>3. Chemistry in Everyday Life</li> </ol>	<p><b>Module-1</b></p> <ol style="list-style-type: none"> <li>1. Reproduction in Organisms</li> <li>2. Sexual Reproduction in Flowering Plants</li> <li>3. Human Reproduction</li> <li>4. Reproductive Health</li> </ol> <p><b>Module-2</b></p> <ol style="list-style-type: none"> <li>1. Principles of Inheritance and Variation</li> <li>2. Molecular Basis of Inheritance</li> <li>3. Evolution</li> </ol> <p><b>Module-3</b></p> <ol style="list-style-type: none"> <li>1. Human Health and Disease</li> <li>2. Strategies for Enhancement in Food Production</li> <li>3. Microbes in Human Welfare</li> </ol> <p><b>Module-4</b></p> <ol style="list-style-type: none"> <li>1. Biotechnology: Principles and Processes</li> <li>2. Biotechnology and Its Applications</li> <li>3. Organisms and Populations</li> </ol> <p><b>Module-5</b></p> <ol style="list-style-type: none"> <li>1. Ecosystem</li> <li>2. Biodiversity and Conservation</li> <li>3. Environmental Issues</li> </ol>

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