

7

Days

JEE Main

Crash Course for
Biomolecules, Polymers
and Chemistry in Everyday Life

Includes Chapter-wise

- **Concept Maps for Quick Revision**
- **6 yr (2019-2014) Questions with analysis**
- **Critical Points to Remember**
- **Tips to Problem Solving**
- **3 Levels of Graded Exercises**

**FULLY
SOLVED**

7

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Crash Course for

Biomolecules, Polymers

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Biomolecules

1

Topic-wise analysis of offline/online JEE Main 2014-2018

Topic Name	2014		2015		2016		2017		2018	
	Offline	Online	Offline	Online	Offline	Online	Offline	Online	Offline	Online
T1: Carbohydrates and Lipids		1		2			1	1	1	1
T2: Amino Acids, Proteins and Enzymes					1	1		2		1
T3: Vitamins and Hormones			1							
T4: Nucleic Acids	1	1								

JEE Main 5 Years at a Glance

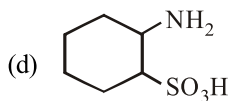
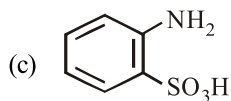
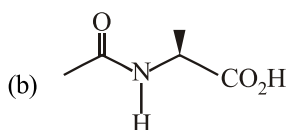
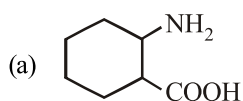
1. Among the following, the incorrect statement is:

[Online 2018]

- (a) Cellulose and amylose have 1,4-glycosidic linkage
- (b) Lactose contains β -D-galactose and β -D-glucose
- (c) Maltose and lactose have 1,4-glycosidic linkage
- (d) Sucrose and amylose have 1,2-glycosidic linkage

2. Which of the following will not exist in zwitter ionic form at pH = 7?

[Online 2018]



3. Glucose on prolonged heating with HI gives : [2018]

- (a) *n*-Hexane
- (b) 1-Hexene
- (c) Hexanoic acid
- (d) 6-iodohexanal

4. The reason for "drug induced poisoning" is :

[Online 2017]

- (a) Binding reversibly at the active site of the enzyme.
- (b) Bringing conformational change in the binding site of enzyme.
- (c) Binding irreversibly to the active site of the enzyme.
- (d) Binding at the allosteric sites of the enzyme.

5. Among the following, the essential amino acid is :

[Online 2017]

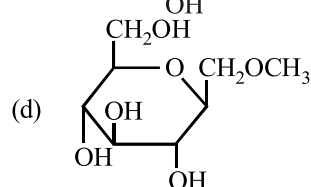
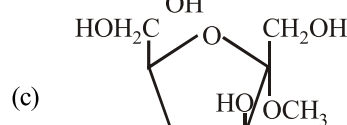
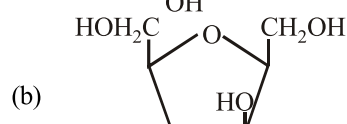
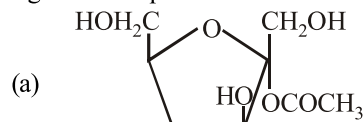
- (a) Alanine
- (b) Valine
- (c) Aspartic acid
- (d) Serine

6. The incorrect statement among the following is :

[Online 2017]

- (a) α -D-glucose and β -D-glucose are anomers.
- (b) α -D-glucose and β -D-glucose are enantiomers.
- (c) Cellulose is a straight chain polysaccharide made up of only β -D-glucose units.
- (d) The penta acetate of glucose does not react with hydroxyl amine.

7. Which of the following compounds will behave as a reducing sugar in an aqueous KOH solution? [2017]



(To be continued on page- 4)

Concept

BIOMOLECULES

Carbohydrates

Classification

- **Monosaccharides** : cannot be hydrolysed further.
- **Oligosaccharides** : yield two to ten monosaccharides.
- **Polysaccharides** : yield a large number of monosaccharide units.

Maltose:

- It is prepared by hydrolysis of starch with the enzyme diastase.
- It is **reducing sugar**.
- It hydrolyses into two α -D-glucose molecules in the presence of enzyme maltase.

Lactose:

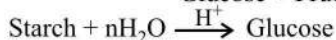
- It is found in the milk.
- It is a **reducing sugar**.
- Lactose on hydrolysis gives equimolar quantities of β -D-glucose and β -D-galactose.

Sucrose:

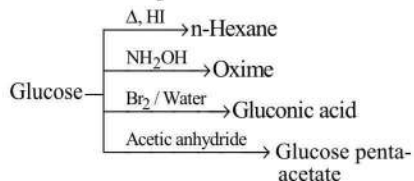
- It is obtained commercially from sugarcane or sugar beets.
- It is **non-reducing sugar**.
- Sucrose on hydrolysis gives equimolar mixture of α -D-glucose or β -D-fructose.

Glucose

- Preparation : $\text{Sucrose} \xrightarrow{\text{H}^+} \text{Glucose} + \text{Fructose}$



- Chemical Properties

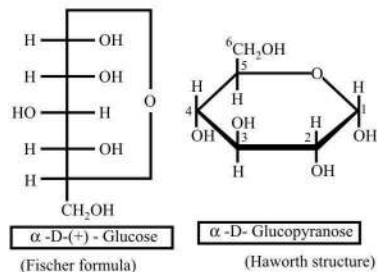


Limitations of the Open Chain Structure:

Structure:

Glucose penta-acetate does not react with hydroxyl amine thus indicating the absence of free -CHO group.

Cyclic Structure of Glucose:



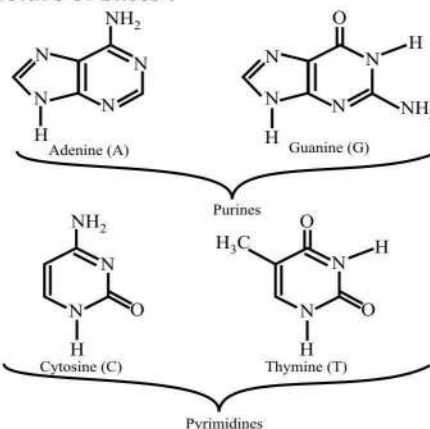
Proteins

Nucleic Acids Properties

- Play important role in replication and protein synthesis polymer of nucleotides
- Nucleotide consist of a sugar unit, nitrogenous base and a phosphate group.
- During formation of dinucleotide or polynucleotide, nucleotide units are joined by 3' - 5' phosphodiester linkages

- Nucleoside : Sugar + base

Structure of bases :



Starch:

- It is found exclusively in plants as stored as food.
- It is a polymer of α -D-glucose and consists of two components, amylose and amylopectin.
- Amylose-water soluble, constitutes about 15-20% of starch.
 - * It is a long unbranched chain with 200-1000 glucose units.
 - * 1,4- α -glycosidic linkage is present.
- Amylopectin-water insoluble, constitutes about 80-85% of starch.
 - * It is a branched chain polymer of glucose units in which main chain is formed by C1-C4 linkage where branching occurs by C1-C6 glycosidic linkage.

Cellulose:

- It is the chief constituents of the cell walls of plant.
- It contains 1-4 glycosidic linkages.
- Cellulose on hydrolysis gives β -D-glucose.

Glycogen:

- It is commonly known as animal starch.
- Its structure is similar to amylopectin.
- It is present in liver, muscles and brain.

Enzymes:

Proteins which are used as catalysts in biochemical reactions are known as biocatalysts (enzymes). Enzymes have following two specific characteristics :

(i) Specificity of Enzymes:

- (a) Generally one enzyme can catalyze only one biochemical reaction. (b) It can increase rate of reaction upto 10^{20} times.

(ii) Efficiency of Enzymes:

- (a) One molecule of enzyme can convert millions of substrate molecules into product(s) per second.

eg. Carbonic anhydrase enzyme present in red blood cells has a highest turn over number.

- (b) Enzymes are denatured at higher temperature.

- (c) Enzymes are very efficient and very specific in nature. The optimum temperature for enzyme activity lies between 40°C to 60°C .

Map

Amino acids Classification

- Essential aminoacids: cannot be synthesised in the body.
- Non Essential aminoacids : can be synthesised in the body.

(i) Essential amino acids : These are as follows

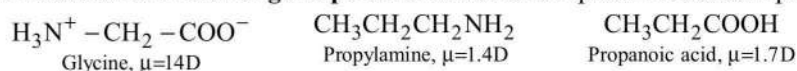
- (a) Leucine (b) Isoleucine (c) Lysine (d) Methionine
 (e) Phenylalanine (f) Threonine (g) Tryptophan (h) Valine (i) Histidine
 Arginine and histidine are **semi-essential** amino acids i.e. they are partly synthesized in tissues.

(ii) Non - essential amino acids : These are as follows

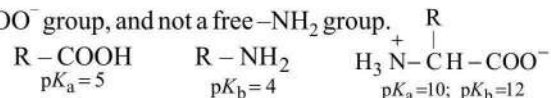
- (a) Alanine (b) Asparagine (c) Aspartic acid (d) Cysteine
 (e) Glutamic acid (f) Glutamine (g) Hydroxyproline (h) Glycine
 (i) Proline (j) Serine (k) Tyrosine (l) Arginine (m) Cystine

Properties

- They are **fairly soluble in water**, but insoluble in non-polar solvents like petroleum ether, benzene, or ether.
- Amino acids have much **larger dipole moments** than simple amines and simple acids.



- Amino acids are **less acidic than most carboxylic acids and less basic than most amines**. In fact, the acidic part of the amino acid molecule is the $-\text{NH}_3^+$ group, not a $-\text{COOH}$ group, while the basic part of the amino acid is the $-\text{COO}^-$ group, and not a free $-\text{NH}_2$ group.



The above properties point out toward the salt like character (dipolar ion structure) to amino acids. Actually, in the dry state, amino acids exist as **dipolar ions** (also known as **zwitterions** or **inner salts**), a form in which the carboxyl group is present as a carboxylate ion, $-\text{COO}^-$, and the amino group as an aminium ion, $-\text{NH}_3^+$.

Types of nucleic acid

DNA

- Carries genetic information
 - Sugar unit is 2- deoxyribose
 - Bases are : adenine, thymine, cytosin and guanine
 - It has double stranded structure
- In both chains, in between A and T, 2 hydrogen bonds are present while in C and G, 3 H-bonds are present. (A= T) (CG)

RNA

- Control protein synthesis
 - Sugar unit is ribose
 - Bases are adenine, uracil, cytosin and guanine.
 - It has single stranded structure
- On the basis of their function RNAs mainly are of three types. Messenger RNA (m-RNA), Transfer RNA (t-RNA), Ribosomal RNA (r-RNA)

Vitamins

It has been observed that certain organic compounds are required in small amounts in our diet but their deficiency causes specific diseases. These compounds are called vitamins.

Classification of Vitamins

Vitamins are classified into two groups depending upon their solubility in water or fat.

- Fat Soluble Vitamins** : Vitamins which are soluble in fat and oils but insoluble in water are kept in this group. These are vitamins A, D, E and K. They are stored in liver and adipose (fat storing) tissues.
- Water Soluble Vitamins** : B-complex and vitamin C are soluble in water so they are grouped together. Water soluble vitamins must be supplied regularly in diet because they are readily excreted in urine and can not be stored (except vitamin B₁₂) in our body.

Proteins

- Polymer of α -amino acids
- connected by peptide bond.

Classification

- Fibrous Protein** : Polypeptide chains run parallel and held together by hydrogen and disulphide bonds e.g keratin, myosin
- Globular Proteins** : Polypeptide chain is folded, looped and twisted e.g., albumin, haemoglobin.

Structure

- 1° structure** : It is the unique sequence of amino acids in each kind of protein.
- 2° structure** : Exist in two different type α -helix and β -pleated.
- 3° structure** : Overall folding of polypeptide chains
- 4° structure** : Spatial arrangement of subunits (two or more polypeptide chain) with respect to each other.

The main forces which stabilise the 2° and 3° structures of proteins are hydrogen bonds, disulphide linkages, vander waals and electrostatic force of attraction.

Denaturation of proteins :

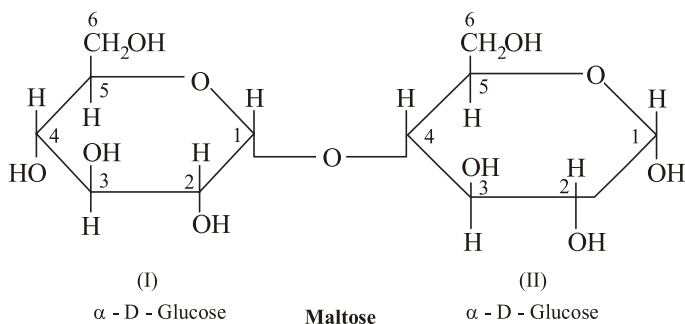
Native protein $\xrightarrow{\text{change in temp, pH}}$ Hydrogen bonds are disturbed
 (Protein loses its biological activity)
 The denaturation causes change in 2° or 3° structures but 1° structure remains intact.

8. Observation of "Ruhemann's purple" is a confirmatory test for the presence of : **[Online 2016]**
 (a) Starch (b) Reducing sugar
 (c) Protein (d) Cupric ion
9. Thiol group is present in : **[2016]**
 (a) Cysteine (b) Methionine
 (c) Cytosine (d) Cystine
10. Complete hydrolysis of starch gives : **[Online 2015]**
 (a) glucose only
 (b) galactose and fructose in equimolar amounts
 (c) glucose and galactose in equimolar amounts
 (d) glucose and fructose in equimolar amounts
11. Accumulation of which of the following molecules in the muscles occurs as a result of vigorous exercise ? **[Online 2015]**
 (a) Glycogen (b) Glucose
 (c) Pyruvic acid (d) L-lactic acid
12. Which of the vitamins given below is water soluble ? **[2015]**
 (a) Vitamin E (b) Vitamin K
 (c) Vitamin C (d) Vitamin D
13. Which of the following will not show mutarotation? **[Online 2014]**
 (a) Maltose (b) Lactose
 (c) Glucose (d) Sucrose
14. The reason for double helical structure of DNA is the operation of: **[Online 2014]**
 (a) Electrostatic attractions
 (b) van der Waals forces
 (c) Dipole - Dipole interactions
 (d) Hydrogen bonding
15. Which one of the following bases is **not** present in DNA? **[2014]**
 (a) Quinoline (b) Adenine
 (c) Cytosine (d) Thymine

Important/Critical Points to Remember

- ▶ **Sucrose $C_{12}H_{22}O_{11}$**
 It is non reducing sugar. It has glycosidic linkage between C_1 of α -glucose and C_2 of β -fructose. It is dextrorotatory but on hydrolysis give laevorotatory **inert sugar**.

- ▶ **Maltose $C_{12}H_{22}O_{11}$**
 It is reducing sugar. On hydrolysis it gives two α -D-glucose units in which C_1 of one glucose is linked to C_4 of another glucose.



- ▶ **Lactose $C_{12}H_{22}O_{11}$**
 It commonly known as milk sugar due to presence in milk. The linkage is between C_1 of β -D-galactose and C_4 of β -D-glucose. It is also reducing sugar.
- ▶ Monosaccharides which differ in configuration at C_1 in aldoses and C_2 in ketoses are called anomers. Thus α -D glucose and β -D glucose are anomers and so are α -D fructose and β -D fructose.
- ▶ **Epimers:** Monosaccharides differing in configuration at a carbon other than anomeric carbon are called epimers e.g. glucose and galactose differ in configuration at C_4 hence called C_4 epimers.
- ▶ **Osazones:** Monosaccharides and reducing disaccharides react with excess of phenyl hydrazine to form crystalline the structure known as osazones. Glucose and Fructose give same osazone.

- ▶ Twenty five amino acids have been obtained from the hydrolysis of proteins. Except two (proline and hydroxyproline) all are amino acids, the exceptional two are **imino acids**.

- ▶ **Configuration of Proteins :**

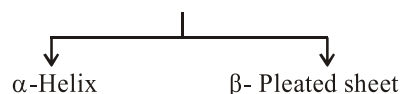


- (i) **Primary structure :**

- This type of structure was given by **Fredric Sanger** in 1953 in insulin (of one chain).
- Primary structure refers to the number, nature and sequence of the amino acids in protein molecule.
- It is important to note that the replacement of just one amino acid in the sequence of a protein destroys its biological activity.

- (ii) **Secondary structure :**

- The conformation which the polypeptide chains assume as a result of H-bonding is called secondary structure of protein.
- The H-bonds are present between hydrogen of amino group and oxygen atom of carboxylic acid group.
- This structure is of two types :



- (a) **α -Helix**

- Chain is spiral.
- Intermolecular H-bonds are present.
e.g.: Myosin, Keratin etc.

- (b) **β -Pleated sheet**

- Structure of protein is not arranged in a sequence.
- Polypeptide chains are parallel to each other.

- Intermolecular H-bonds hold together the neighbouring polypeptide chains. e.g.: Silk fibres.

(iii) Tertiary structure :

- In this structure of proteins, atoms are highly coiled and form a spherical form Ex. *Albumin*.
- Tertiary structure refers to its three dimensional structure, i.e., folding and bonding of the long peptide chains. Three types of bonds are responsible for tertiary structure, viz. hydrogen, ionic and hydrophobic.

▶ **Contractile proteins :** Found in muscles eg myosin, actin.

▶ **Tests of Protein:**

- Biuret :** Protein solution + NaOH + dil. CuSO_4 → Pink or violet colour
- Ninhydrin :** Protein solution + Ninhydrin → Blue colour
- Hopkin's cole :** Protein solution + Glyoxalic acid + conc. H_2SO_4 → Blue - violet

- Million's :** Protein solution + Millon's reagent → Pink colour.

Millon's reagent : Solution of mercuric nitrate and nitrite in nitric acid containing traces of nitrous acid.

- Iodine reaction :** Protein solution + Iodine in potassium iodide solution → Yellow colour

- Xanthoproteic test :** Protein solution + conc HNO_3 → Yellow colour $\xrightarrow{\text{NaOH}}$ Orange colour

▶ **Coenzymes :** Non proteinous components required for the activity of certain enzymes are known as coenzymes. protein part of enzymes is called **apoenzyme**.

▶ **Vitamins:**

- Water soluble vitamins :** Vitamin B, complex and vitamins C.
- Fat soluble vitamins :** Vitamins A, D, E and K.

TABLE-A

Sr.No.	Name of Vitamins	Source	Deficiency Diseases
1	Vitamin A (Retinol)	Cod liver oil, carrots, egg, butter and milk	Xerophthalmia (hardening of cornea of eye) Night blindness
2	Vitamin B ₁ (Thiamine)	Seeds, whole grains, pulses, nuts	Beriberi (loss of appetite, retarded growth)
3	Vitamin B ₂ (Riboflavin)	Milk, egg white, liver, kidney	Cheilosis (fissuring at corners of mouth and lips), digestive disorders and burning sensation of the skin
4	Vitamin B ₆ (Pyridoxine)	Yeast, milk, egg yolk, rice, cereals and grams	anaemia
5	Vitamin B ₁₂ (Cyanocobalamine)	Meat, fish, egg and curd	Pernicious anaemia (RBC deficiency in haemoglobin)
6	Vitamin C (Ascorbic acid)	Citrus fruits, amla and green leafy vegetables	Scurvy (bleeding gums)
7	Vitamin D (Calciferol)	Exposure to sunlight, fish and egg yolk	Rickets (bone deformities in children) and osteomalacia (soft bones and joint pain in adults)
8	Vitamin E (Tocopherol)	Vegetable oils like wheat germ oil, cotton seed oil, sunflower oil, etc	Increased fragility of RBCs and muscular weakness, antifertility
9	Vitamin K (Phyllo-quinone)	Green leafy vegetables	Increased blood clotting time

▶ **Types of Hormones**

(i) **Steroid hormones :**

- Estrogens and Progesterones
- Testosterone
- Cortisone

(ii) **Amino acid hormones :**

- Thyroxine
- Adrenaline

(iii) **Peptide hormones :**

- Insulin
- Glucagon
- Oxytocin
- Vasopressin

▶ **Nucleic Acids**

Nitrogenous base : Derived from purines having two rings in their structure Examples are adenine (A) and Guanine (G).

Nucleotides : Nucleotides consist of 5 - carbon sugar (pentose) + nitrogenous base + 1-3 phosphate groups.

Nucleoside : Ribose + one base unit from AGCT or U

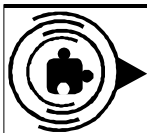
▶ **Functions of Nucleic Acids**

- To direct the synthesis of proteins.
- To transfer the genetic information (hereditary characters).

▶ **Replication :** A molecule of DNA can exactly duplicate to itself.

▶ **Template :** It means pattern. In the process of replication of DNA the parent strand serves as template.

▶ **Codons :** The nucleotide bases in RNA function in groups of three (triplet) in coding amino acids. These base triplets are called codons.



Exercise-1 : Concept Builder (Topicwise)

TOPIC 1: Carbohydrates and Lipids

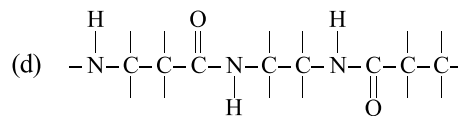
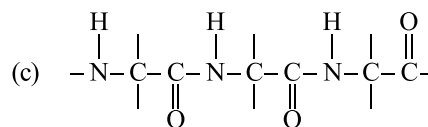
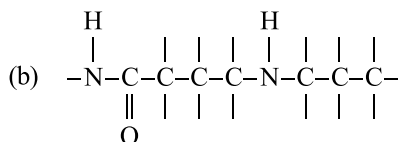
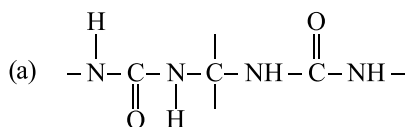
- Which of the following statement is true ?
 - Epimers are also anomers.
 - Anomers are also epimers.
 - Both of the above statements are true.
 - Neither of the two statement is true.
- The artificial sweetener that has the highest sweetness value in comparison to cane sugar is :
 - Sucralose
 - Aspartane
 - Saccharin
 - Alitame
- What is the structure of L-glyceraldehyde?
 - $$\begin{array}{c} \text{H}-\text{C}=\text{O} \\ | \\ \text{HO}-\text{CH}_2-\text{C}-\text{OH} \\ | \\ \text{H} \end{array}$$
 - $$\begin{array}{c} \text{H} \\ | \\ \text{HO}-\text{C}-\text{CH}_2\text{OH} \\ | \\ \text{CH}=\text{O} \end{array}$$
 - $$\begin{array}{c} \text{CH}_2-\text{OH} \\ | \\ \text{HO}-\text{C}-\text{H} \\ | \\ \text{H}-\text{C}=\text{O} \end{array}$$
 - Both (a) and (b)
- Which L-sugar on oxidation gives an optically active dibasic acid (2 COOH groups)?
 - $$\begin{array}{c} \text{CHO} \\ | \\ \text{H}-\text{C}-\text{OH} \\ | \\ \text{HO}-\text{C}-\text{H} \\ | \\ \text{HO}-\text{C}-\text{H} \\ | \\ \text{CH}_2\text{OH} \end{array}$$
 - $$\begin{array}{c} \text{CHO} \\ | \\ \text{H}-\text{C}-\text{OH} \\ | \\ \text{HO}-\text{C}-\text{H} \\ | \\ \text{H}-\text{C}-\text{OH} \\ | \\ \text{CH}_2\text{OH} \end{array}$$
 - $$\begin{array}{c} \text{CHO} \\ | \\ \text{H}-\text{C}-\text{OH} \\ | \\ \text{H}-\text{C}-\text{OH} \\ | \\ \text{H}-\text{C}-\text{OH} \\ | \\ \text{CH}_2\text{OH} \end{array}$$
 - $$\begin{array}{c} \text{CHO} \\ | \\ \text{HO}-\text{C}-\text{H} \\ | \\ \text{H}-\text{C}-\text{OH} \\ | \\ \text{HO}-\text{C}-\text{H} \\ | \\ \text{CH}_2\text{OH} \end{array}$$
- Rapid interconversion of α -D-glucose and β -D-glucose to solution is known as
 - racemization
 - asymmetric induction
 - fluxional isomerization
 - mutarotation
- Natural glucose is termed D-glucose because :
 - OH on the second carbon is on the right side in Fischer projection.
 - OH on the sixth carbon is on the right side in Fischer projection.
 - OH on the fifth carbon is on the right side in Fischer projection.
 - It is dextrorotatory.
- In cells the net production of ATP molecules generated from one glucose molecule is
 - 46
 - 32
 - 38
 - 40
- Which of the following gives positive Fehling solution test?
 - Protein
 - Sucrose
 - Glucose
 - Fats
- Glycolysis is
 - conversion of glucose to haem.
 - oxidation of glucose to glutamate.
 - conversion of pyruvate to citrate.
 - oxidation of glucose to pyruvate.
- α -D- Glucose and β - D-glucose differ from each other due to difference in one carbon with respect to its
 - size of hemiacetal ring
 - number of OH groups
 - configuration
 - conformation
- Which of the following does not reduce Benedict's solution?
 - Glucose
 - Fructose
 - Sucrose
 - Aldehyde
- Glucose gives silver mirror with Tollen's reagent. It shows the presence of
 - an acidic group
 - an alcoholic group
 - a ketonic group
 - an aldehydic group
- Which one of the following compounds is found abundantly in nature?
 - Fructose
 - Starch
 - Glucose
 - Cellulose
- The highest calorific value is found in
 - proteins
 - fats
 - vitamins
 - carbohydrates
- The correct statement about the following disaccharide is

 - Ring (A) is pyranose with α - glycosidic link
 - Ring (A) is furanose with α - glycosidic link
 - Ring (B) is furanose with α - glycosidic link
 - Ring (B) is pyranose with β - glycosidic link
- The most common disaccharide has the molecular formula
 - $\text{C}_{10}\text{H}_{18}\text{O}_9$
 - $\text{C}_{10}\text{H}_{20}\text{O}_{10}$
 - $\text{C}_{18}\text{H}_{22}\text{O}_{11}$
 - $\text{C}_{12}\text{H}_{22}\text{O}_{11}$
- In fructose, the possible optical isomers are
 - 12
 - 8
 - 16
 - 4
- What happens when H_2SO_4 is treated with sugar?
 - Oxidation
 - Reduction
 - Dehydration
 - Hydrolysis
- Table sugar is a
 - disaccharide of D-glucose and D-fructose.
 - a monosaccharide.
 - a disaccharide containing two glucose units.
 - D-glucose.

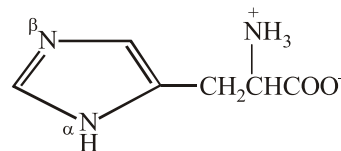
20. Complete hydrolysis of cellulose gives
 (a) D-fructose (b) D-ribose
 (c) D-glucose (d) L-glucose
21. What will happen when D-(+)-glucose is treated with methanolic —HCl followed by Tollens' reagent?
 (a) A black ppt. will be formed.
 (b) A red ppt. will be formed.
 (c) A green colour will appear.
 (d) No characteristic colour or ppt. will be formed.
22. An organic compound with the formula $\text{C}_6\text{H}_{12}\text{O}_6$ forms a yellow crystalline solid with phenylhydrazine and gives a mixture of sorbitol and mannitol when reduced with sodium. Which among the following could be the compound?
 (a) fructose (b) glucose
 (c) mannose (d) sucrose
23. For osazone formation, the effective structural unit necessary is
 (a) $\begin{array}{c} \text{CH}_2\text{OH}_3 \\ | \\ \text{CO} \\ | \end{array}$ (b) $\begin{array}{c} \text{CH}_2\text{OH} \\ | \\ \text{CO} \\ | \end{array}$
 (c) $\begin{array}{c} \text{CH}_2\text{OH} \\ | \\ \text{CHOCH}_3 \end{array}$ (d) $\begin{array}{c} \text{CH}_2\text{O} \\ | \\ \text{CHOCH}_3 \end{array}$

TOPIC 2: Amino Acids, Proteins and Enzymes

24. At iso-electric point:
 (a) Conc. of cation is equal to conc. of anion.
 (b) Net charge is zero.
 (c) Maximum conc. of di-polar ion (Zwitter ion) will be present.
 (d) All of the above.
25. Among the following organic acids, the acid present in rancid butter is:
 (a) Pyruvic acid (b) Lactic acid
 (c) Butyric acid (d) Acetic acid
26. A strongly alkaline solution of a monoaminodicarboxylic acid contains how many basic groups?
 (a) 1 (b) 2 (c) 3 (d) 4
27. Which of the following protein destroys the antigen when it enters in body cell?
 (a) Antibodies (b) Insulin
 (c) Chromoprotein (d) Phosphoprotein
28. The number of essential amino acids in man is
 (a) 8 (b) 10 (c) 18 (d) 20
29. Which one of the following structures represents the peptide chain?

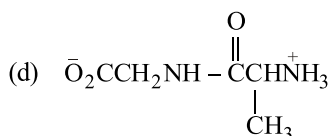
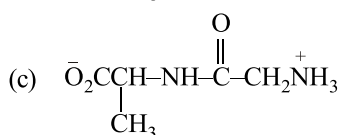
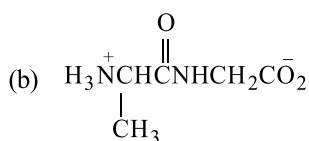
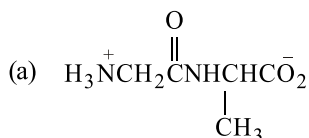


30. The helical structure of protein is stabilized by
 (a) dipeptide bonds (b) hydrogen bonds
 (c) ether bonds (d) peptide bonds
31. Which functional group participates in disulphide bond formation in proteins?
 (a) Thioester (b) Thioether
 (c) Thiol (d) Thiolactone
32. Pepsin enzyme hydrolyses
 (a) proteins to amino acids.
 (b) fats to fatty acids.
 (c) glucose to ethyl alcohol.
 (d) polysaccharides to monosaccharides.
33. Which of the following tests is not used for testing proteins?
 (a) Millon's test (b) Molisch's test
 (c) Biuret test (d) Ninhydrin test
34. The correct statement in respect of protein haemoglobin is that it
 (a) acts as an oxygen carrier in the blood.
 (b) forms antibodies and offers resistance to diseases.
 (c) enzymes are specific biological catalysts that can normally function at very high temperature ($T \sim 1000\text{K}$).
 (d) enzymes are specific biological catalysts that possess well-defined active sites.
35. The enzyme which hydrolyses triglycerides to fatty acids and glycerol is called
 (a) maltase (b) lipase (c) zymase (d) pepsin
36. Which one of the following metals is required as co-factor by all enzymes utilizing ATP in phosphate transfer?
 (a) K (b) Ca (c) Na (d) Mg
37. Which of the nitrogen of histidine is first protonated?



- (a) α (b) β (c) both (d) None
38. An electric current is passed through an aqueous solution (buffered at $\text{pH} = 6.0$) of alanine ($\text{pI} = 6.0$) and arginine ($\text{pI} = 10.2$). The two amino acids can be separated because
 (a) alanine migrates to anode, and arginine to cathode.
 (b) alanine migrates to cathode, and arginine to anode.
 (c) alanine does not migrate, while arginine migrates to cathode.
 (d) alanine does not migrate, while arginine migrates to anode.
39. A mixture of two amino acids having pI 9.60 and 5.40 can be separated
 (a) by adjusting the pH of the solution at 9.60
 (b) by adjusting the pH of the solution at 4.20
 (c) by adjusting the pH of the solution at 7.0
 (d) by adjusting the pH of the solution at 7.5

40. Imino acid among these compounds is
(a) serine (b) proline (c) tyrosine (d) lysine
41. The structural feature which distinguishes proline from natural α -amino acids?
(a) Proline is optically inactive.
(b) Proline contains aromatic group.
(c) Proline is a dicarboxylic acid.
(d) Proline is a secondary amine.
42. Which amino acid is achiral?
(a) alanine (b) valine
(c) proline (d) None of these
43. Denaturation of proteins leads to loss of its biological activity by
(a) formation of amino acids.
(b) loss of primary structure.
(c) loss of both primary and secondary structures.
(d) loss of both secondary and tertiary structures.
44. The dipeptide, Gly. Ala has structure –



TOPIC 3: Vitamins and Hormones

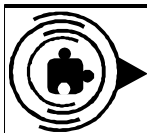
45. Vitamin K is associated with the disease:
(a) Scurvy (b) Beri-beri
(c) Blood coagulation (d) Sore throat
46. Vitamin B₁₂ contains
(a) Ca(II) (b) Fe(II) (c) Co(III) (d) Zn(II)
47. Vitamin B₆ is known as
(a) pyridoxine (b) thiamine
(c) tocopherol (d) riboflavin
48. Night blindness is caused by deficiency of:
(a) Vitamin B₁₂ (b) Vitamin A
(c) Vitamin C (d) Vitamin E
49. A vitamin that contains both N and P is:
(a) Vitamin C (b) Vitamin K
(c) Vitamin B₁₂ (d) Vitamin D
50. The enzyme which converts glucose and fructose into ethyl alcohol is
(a) diastase (b) invertase
(c) sucrose (d) zymase
51. Biotin is an organic compound present in yeast. Its deficiency in diet causes dermatitis and paralysis. It is also known as

- (a) Vitamin H (b) Vitamin B₃
(c) Vitamin B₁₂ (d) Vitamin D
52. Match List I (name of vitamin) with List II (deficiency result/disease) and select the correct answer using the codes given below the lists :

List I	List II
I. Ascorbic acid	A. Beri-beri
II. Retinol	B. Cracked lips
III. Riboflavin	C. Scurvy
IV. Thiamine	D. Night blindness
(a) I - B, II - A, III - C, IV - D	(b) I - A, II - B, III - C, IV - D
(c) I - D, II - C, III - B, IV - A	(d) I - C, II - D, III - B, IV - A

TOPIC 4 : Nucleic Acids

53. The reactions of (a) oxygen and (b) carbon monoxide with heme (the prosthetic group of haemoglobin) give
(a) only oxygen-heme complex.
(b) only carbon monoxide-heme complex.
(c) both oxygen-heme and carbon monoxide-heme complexes but oxygen-heme complex is more stable.
(d) both oxygen-heme and carbon monoxide-heme complexes but carbon monoxide-heme complex is more stable.
54. When adenine is attached to ribose sugar, it is called adenosine. To make a nucleotide from it, it would require
(a) oxygenation (b) addition of a base
(c) addition of phosphate (d) hydrogenation
55. Chargaff's rule states that in an organism :
(a) Amounts of all bases are equal.
(b) Amount of adenine (A) is equal to that of thymine (T) and the amount of guanine (G) is equal to that of cytosine (C).
(c) Amount of adenine (A) is equal to that of guanine (G) and the amount of thymine (T) is equal to that of cytosine (C).
(d) Amount of adenine (A) is equal to that of cytosine (C) and the amount of thymine (T) is equal to that of guanine (G).
56. Which of the following is not present in a nucleotide?
(a) Guanine (b) Cytosine (c) Adenine (d) Tyrosine
57. A sequence of how many nucleotides in messenger RNA makes a codon for an amino acid?
(a) Three (b) Four
(c) One (d) Two
58. The chemical change in DNA molecule that could lead to synthesis of protein with an altered amino acid sequence is called
(a) replication (b) lipid formation
(c) cellular membrane (d) mutation
59. DNA has deoxyribose, a base and the third component which is
(a) phosphoric acid (b) ribose
(c) adenine (d) thymine
60. In both DNA and RNA, heterocyclic base and phosphate ester linkages are at –
(a) C₅' and C₁' respectively of the sugar molecule
(b) C₁' and C₅' respectively of the sugar molecule
(c) C₂' and C₅' respectively of the sugar molecule
(d) C₅' and C₂' respectively of the sugar molecule



Exercise-2 : Concept Applicator

- Vitamin D is also known as
 - sunshine vitamin
 - ascorbic acid
 - growth vitamin
 - reproductive vitamin
- Which of the following pairs can be distinguished by Fehling's solution?
 - Glucose and fructose
 - Glucose and sucrose
 - Methanal and ethanal
 - Hydroxypropanone and benzaldehyde.
- Which of the following carbohydrates is not related to (+)-glucose?
 - Amylopectin
 - Amylose
 - Inulin
 - Glycogen.
- The possible number of diastereomers for D-glucose is
 - 14
 - 15
 - 16
 - 7
- For the complex conversion of D-glucose into the corresponding osazone, the minimum number of equivalents of phenyl hydrazine required is:
 - two
 - three
 - four
 - five
- Which reagent/s can be used to distinguish glucose and fructose?
 - Bromine water
 - Tollen's reagent
 - Schiff's reagent
 - (I), (II) and (III)
 - (II) and (III)
 - Only (I)
 - Only (III)
- Among the three compounds shown below, two yield the same product on reaction with warm HNO_3 . The exception is:

(a)

$$\begin{array}{c} \text{CHO} \\ | \\ \text{HO} - \text{C} - \text{H} \\ | \\ \text{H} - \text{C} - \text{OH} \\ | \\ \text{H} - \text{C} - \text{OH} \\ | \\ \text{CH}_2\text{OH} \end{array}$$

(b)

$$\begin{array}{c} \text{CHO} \\ | \\ \text{HO} - \text{C} - \text{H} \\ | \\ \text{HO} - \text{C} - \text{H} \\ | \\ \text{H} - \text{C} - \text{OH} \\ | \\ \text{CH}_3 \end{array}$$

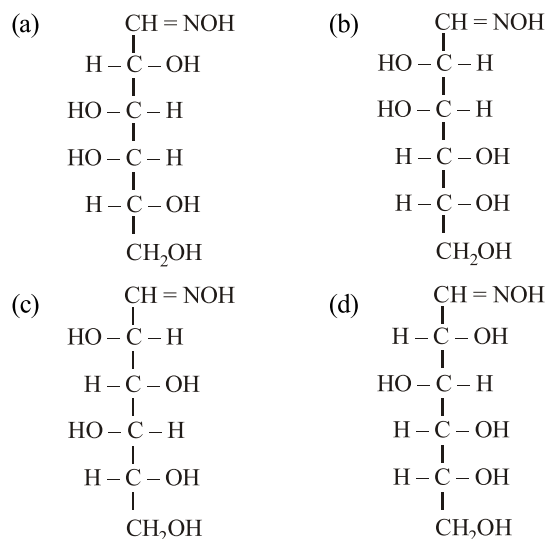
(c)

$$\begin{array}{c} \text{CHO} \\ | \\ \text{HO} - \text{C} - \text{H} \\ | \\ \text{HO} - \text{C} - \text{H} \\ | \\ \text{H} - \text{C} - \text{OH} \\ | \\ \text{CH}_2\text{OH} \end{array}$$

(d) None of these
- A distinctive and characteristic functional group of fats is
 - an ester group
 - a peptide group
 - a ketonic group
 - an alcoholic group
- Iso-electric point of alanine is (pH = 6). At which pH, maximum concentration of zwitter ion of alanine will be present?
 - pH > 6
 - pH < 6
 - pH = 6
 - pH = 7
- Find iso-electric point of given amino acid

$$\begin{array}{c} \text{CH}_3 - \text{CH} - \text{CO}_2\text{H} \\ | \\ \text{NH}_3^+ \end{array} \quad \begin{array}{l} pK_a = 2.2 \\ pK_b = 4.4 \end{array}$$
 - 3.3
 - 5.9
 - 9.6
 - 11.8
- A biological catalyst is essentially
 - a carbohydrates
 - an amino acid
 - a nitrogen molecule
 - fats
- In an amino acid, the carboxyl group ionises at $pK_{a_1} = 2.34$ and ammonium ion at $pK_{a_2} = 9.60$. The isoelectric point of the amino acid is at pH
 - 5.97
 - 2.34
 - 9.60
 - 6.97
- Which of the following statements is incorrect?
 - Enzymes are organic catalysts.
 - Enzymes have a very large turnover number.
 - Enzymes action is specific.
 - Enzymes always require a coenzyme in their catalytic action.
- Among the following vitamins the one whose deficiency causes rickets (bone deficiency) is
 - Vitamin A
 - Vitamin B
 - Vitamin D
 - Vitamin C
- Which of the following statements is correct?
 - RNA controls the synthesis of proteins.
 - The sugar present in DNA is D-(–)-ribose.
 - RNA has double stranded α -helix structure.
 - DNA mainly occurs in the cytoplasm of the cell.
- Which of the following is known as the universal energy currency of the cell?
 - ATP
 - AMP
 - DNA
 - RNA
- The base present in DNA, but not in RNA is
 - guanine
 - adenine
 - uracil
 - thymine
- Double stranded DNA virus with 20,000 base pairs has nucleotides
 - 20,000
 - 10,000
 - 666
 - 40,000
- Fructose reduces Tollen's reagent due to
 - enolisation of fructose followed by conversion to glucose (having aldehydic group) by the base present in Tollen's reagent.
 - asymmetric carbons.
 - primary alcoholic group.
 - secondary alcoholic group.
- Which one of the following statements is not true regarding (+) Lactose?
 - On hydrolysis (+) Lactose gives equal amount of D(+) glucose and D(+) galactose.
 - (+) Lactose is a β -glycoside formed by the union of a molecule of D(+) glucose and a molecule of D(+) galactose.
 - (+) Lactose is a reducing sugar and does not exhibit mutarotation.
 - (+) Lactose, $\text{C}_{12}\text{H}_{22}\text{O}_{11}$ contains 8-OH groups.

21. Which of the statements about "denaturation" given below are correct ?
 (A) Denaturation of proteins causes loss of secondary and tertiary structures of the protein.
 (B) Denaturation leads to the conversion of double strand of DNA into single strand.
 (C) Denaturation affects primary structure which gets distorted.
 Options :
 (a) (B) and (C) (b) (A) and (C)
 (c) (A) and (B) (d) (A), (B) and (C)
22. Which one of the following statements is incorrect about enzyme catalysis?
 (a) Enzymes are mostly proteinous in nature.
 (b) Enzyme action is specific.
 (c) Enzymes are denaturated by ultraviolet rays and at high temperature.
 (d) Enzymes are least reactive at optimum temperature.
23. Deficiency of vitamin B₁ causes the disease:
 (a) Convulsions (b) Beri-beri
 (c) Cheilosis (d) Sterility
24. Which of the following acids does not exhibit optical isomerism ?
 (a) Maleic acid (b) α -Amino acids
 (c) Lactic acid (d) Tartaric acid
25. Which one of the following sets of monosaccharides forms sucrose?
 (a) α -D-Galactopyranose and α -D-Glucopyranose
 (b) α -D-Glucopyranose and β -D-Fructofuranose
 (c) β -D-Glucopyranose and α -D-Fructofuranose
 (d) α -D-Glucopyranose and β -D-Fructopyranose
26. In DNA the linkages between different nitrogenous bases are
 (a) peptide linkage (b) phosphate linkage
 (c) H-bonding (d) glycosidic linkage
27. D(+) glucose reacts with hydroxylamine and yields an oxime. The structure of the oxime would be



28. Which of the following hormones is produced under the condition of stress which stimulates glycogenolysis in the liver of human beings?
 (a) Thyroxin (b) Insulin
 (c) Adrenaline (d) Estradiol
29. The correct statement regarding RNA and DNA, respectively is
 (a) The sugar component in RNA is arabinose and the sugar component in DNA is 2'-deoxyribose.
 (b) The sugar component in RNA is ribose and the sugar component in DNA is 2'-deoxyribose.
 (c) The sugar component in RNA is arabinose.
 (d) The sugar component in RNA is 2'-deoxyribose and the sugar component in DNA is arabinose.
30. Which of the following statements is not correct :
 (a) Ovalbumin is a simple food reserve in egg-white.
 (b) Blood proteins thrombin and fibrinogen are involved in blood clotting.
 (c) Denaturation makes the proteins more active.
 (d) Insulin maintains sugar level in the blood of a human body.

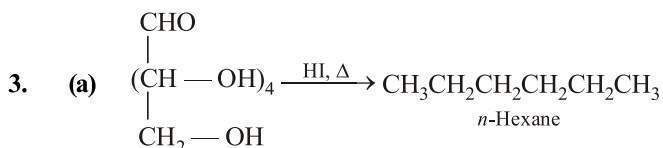


JEE Main 5 Years at a Glance																			
1	(d)	2	(b)	3	(a)	4	(c)	5	(b)	6	(b)	7	(a)	8	(c)	9	(a)	10	(a)
11	(d)	12	(c)	13	(d)	14	(d)	15	(a)										
EXERCISE-1 : Concept Builder (Topicwise)																			
1	(b)	7	(c)	13	(d)	19	(a)	25	(c)	31	(c)	37	(b)	43	(d)	49	(c)	55	(b)
2	(d)	8	(c)	14	(b)	20	(c)	26	(c)	32	(a)	38	(c)	44	(a)	50	(d)	56	(d)
3	(d)	9	(d)	15	(a)	21	(d)	27	(a)	33	(b)	39	(a)	45	(c)	51	(a)	57	(a)
4	(a)	10	(c)	16	(d)	22	(a)	28	(b)	34	(a)	40	(b)	46	(c)	52	(d)	58	(d)
5	(d)	11	(c)	17	(b)	23	(b)	29	(c)	35	(b)	41	(d)	47	(a)	53	(d)	59	(a)
6	(c)	12	(d)	18	(c)	24	(d)	30	(b)	36	(d)	42	(d)	48	(b)	54	(c)	60	(b)
EXERCISE-2 : Concept Applicator																			
1	(a)	4	(a)	7	(b)	10	(b)	13	(d)	16	(a)	19	(a)	22	(d)	25	(b)	28	(c)
2	(b)	5	(b)	8	(a)	11	(b)	14	(c)	17	(d)	20	(c)	23	(b)	26	(c)	29	(b)
3	(c)	6	(c)	9	(c)	12	(a)	15	(b)	18	(d)	21	(c)	24	(a)	27	(d)	30	(c)

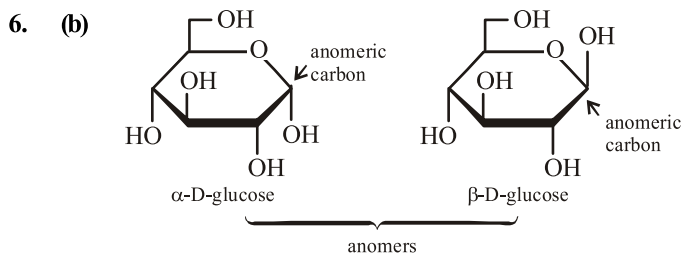
Hints and Solutions

JEE MAIN 5 YEARS AT A GLANCE

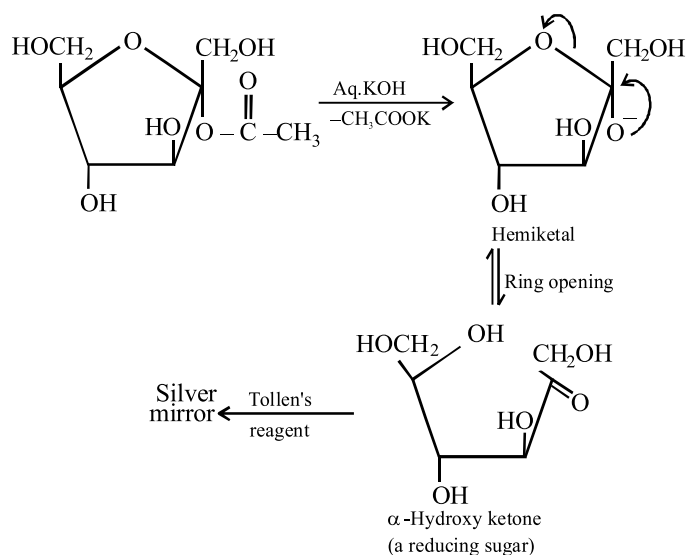
- (d) In amylose 1, 4- α -glycosidic linkage is present.
- (b) The N atom of amide is not basic.



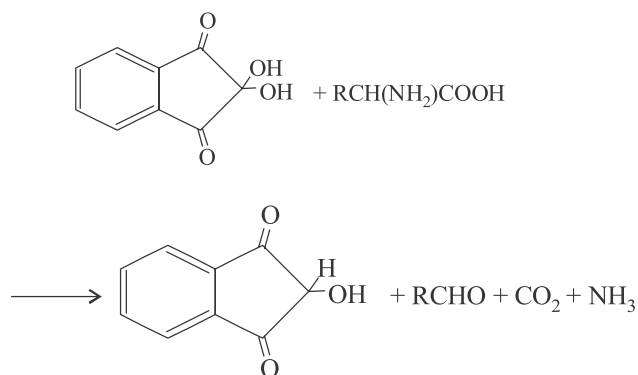
- (c) Enzyme inhibition can be either reversible or irreversible. In case of irreversible inhibition the inhibitor dissociates very slowly from its target enzyme because it has become tightly bound to the enzyme either covalently or non-covalently. Some irreversible inhibitors are important drugs like Penicilline and Aspirin. Thus "drug induced poisoning" may bound irreversibly to the active site of the enzyme.
- (b) Those amino acids that cannot be synthesized in our body and must be supplied in diet is called essential amino acid for ex. valine, histidine, isoleucine etc.



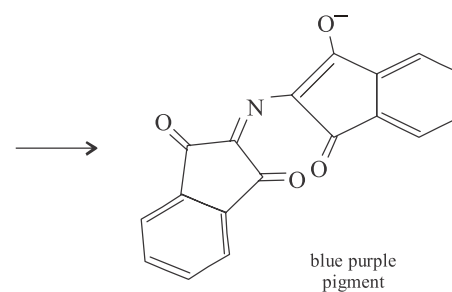
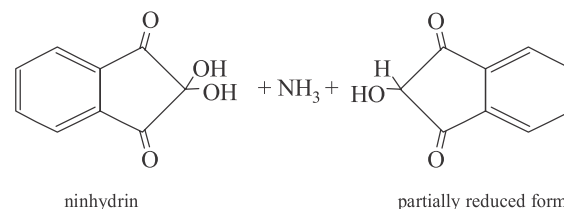
- (a)



- (c) Ninhydrin is often used to detect α -amino acids and also free amino and carboxylic acid groups on proteins and peptides. When about 0.5 mL of a 0.1% solution of ninhydrin is boiled for one or two minutes with a few mL of dilute amino acid or protein solution, a blue color develops. Ninhydrin degrades amino acids into aldehydes, ammonia, and CO_2 through a series of reactions; the net result is ninhydrin in a partially reduced form hydrindantin;



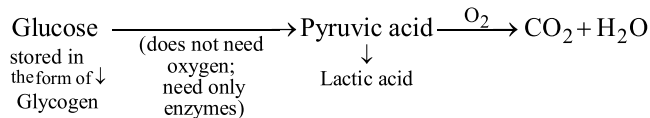
Ninhydrin then condenses with ammonia and hydrindantin to produce an intensely blue or purple pigment, sometimes called Ruhemann's purple:



- (a) Among 20 naturally occurring amino acids "Cysteine" has '-SH' or thiol functional group.
 \Rightarrow General formula of amino acid $\rightarrow \text{R}-\underset{\text{NH}_2}{\text{CH}}-\text{COOH}$
 \Rightarrow Value of R = $-\text{CH}_2-\text{SH}$ in Cysteine.

10. (a) Starch is a mixture of amylose & amylopectin polysaccharides and monomer is glucose. Thus on complete hydrolysis it gives only glucose.

11. (d)



During vigorous exercise sufficient oxygen is not available to meet the energy demand so, energy is derived through conversion of pyruvic acid to lactic acid.

12. (c) Water-soluble vitamins dissolve in water and are not stored by the body. The water soluble vitamins include the vitamin B-complex group and vitamin C.

13. (d) Sucrose does not contain a free aldehydic or ketonic group hence it does not show mutarotation.

14. (d) The two polynucleotide chains of DNA molecules are twisted around a common axis but run in opposite directions to form a right handed helix. The two chains are joined together by specific hydrogen bonds.

15. (a) DNA contains ATGC bases
So quinoline is not present in DNA.

EXERCISE 1 : CONCEPT BUILDER (TOPICWISE)

1. (b) Epimers are those diastereomers which differ in the configuration of only one chiral carbon which may be C_1 , C_2 , C_3 , etc.; while anomers are diastereomers that differ in the configuration of a specific chiral carbon which is C_1 in aldoses and C_2 in ketoses.

2. (d) Alitame is an artificial sweetener that is 2,000 times as sweet as sugar.

3. (d)

4. (a) (a) and (d) are L^- sugar but (a) gives an optically active dibasic acid.

5. (d)

6. (c) Fischer gave the prefix "D" to compounds whose bottom chiral has its OH to the right. So natural glucose is called D-glucose or dextrose.

7. (c) $C_6H_{12}O_6 + 6O_2 + 2ATP \longrightarrow 6CO_2 + 6H_2O + 38ATP$
 \therefore Net ATP molecules evolved = 38

8. (c) Glucose contains aldehyde group.

9. (d) It is a common pathway for both the aerobic & anaerobic respiration in which 1 glucose molecule is converted to 2 molecules of pyruvate.

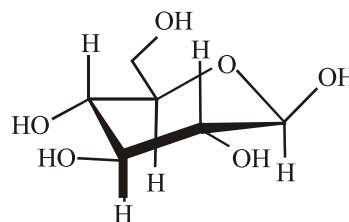
10. (c) α and β -D-glucoses differ in the arrangement of groups around one carbon atom (C_1) i.e., they differ in configuration at C_1 , hence these are also known as anomers.

11. (c) Sucrose does not have free $-CHO$ or $-CO$ group, hence it does not reduce Benedict's solution. Remember that fructose has an α -hydroxy ketonic group, which is also reducing group (difference from ordinary ketonic group)

12. (d) Glucose + Tollen's reagent \rightarrow Gluconic acid + Ag-mirror

13. (d)

14. (b) 1 g fat provides 37 kJ of energy on oxidation, while 1 g carbohydrate on oxidation gives 17 kJ of energy. Hence, fat has highest calorific value.



15. (a)

16. (d)

17. (b) Fructose has 3 chiral centres and hence number of optical isomers are $2^3 = 8$

18. (c)

19. (a)

20. (c)

21. (d) Reaction of D-(+)-glucose with methanolic $-HCl$ leads to formation of methyl glucoside (C_1-OH group is methylated) which, being acetal, is not hydrolysable by base, so it will not respond Tollen's reagent.

22. (a) Since the compound forms a yellow crystalline solid, i.e. osazone with phenylhydrazine, it may be an aldohexose or a ketohexose. Further, since on reduction, compound forms a mixture of sorbitol and mannitol, it must be a ketohexose, i.e. fructose. Recall that glucose on reduction gives only one alcohol glucitol (Sorbitol)

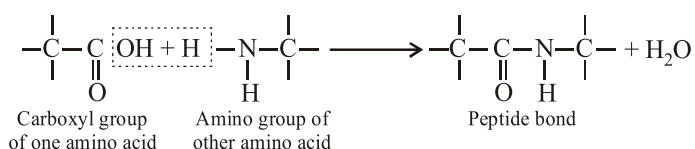
23. (b)

24. (d)

25. (c) Butyric acid also known as butanoic acid is found in milk, and butter and is a product of anaerobic fermentation. It has an unpleasant smell and acid taste.

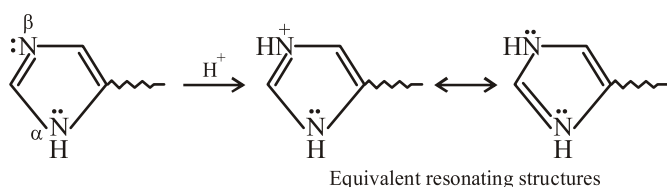
26. (c) In strongly alkaline solution of an amino acid, all of its $-COOH$ groups are converted into $-COO^-$. Thus a strongly alkaline solution of a monoaminodicarboxylic acid will have one $-NH_2$ and two $-COO^-$ groups, all of which are basic in nature. Further remember that $-NH_2$ group is more basic than $-COO^-$ group.

27. (a) When antigens enter into the body cells and destroy them, then antibodies being proteins are synthesised in the body and combine with antigens and destroy these by forming inactive complexes. Therefore antibodies destroy antigens.
28. (b) There are 20 amino acids in man, out of which 10 are essential.
29. (c) The bond formed between two amino acids by the elimination of a water molecule is called a peptide linkage or bond. The peptide bond is simply another name for amide bond.



The product formed by linking amino acid molecules through peptide linkages. —CO—NH—, is called a peptide.

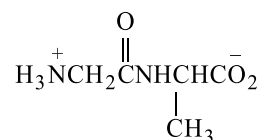
30. (b) The α -helix structure is formed when the chain of α -amino acids coils as a right handed screw (called α -helix) because of the formation of hydrogen bonds between amide groups of the same peptide chain, i.e., NH group in one unit is linked to carbonyl oxygen of the third unit by hydrogen bonding. This hydrogen bonding between different units is responsible for holding helix in a position.
31. (c) $2\text{R}-\text{S}-\text{H} \xrightleftharpoons[\text{Disulphide}]{\text{Thiol}} \text{R}-\text{S}-\text{S}-\text{R}$
32. (a)
33. (b) Molisch test is used for testing carbohydrates.
34. (a) Haemoglobin acts as an oxygen carrier in the blood since it reacts with oxygen to form unstable oxyhaemoglobin which easily breaks to give back haemoglobin and oxygen.
35. (b) Triglycerides are lipids, hence these are hydrolysed by lipases to glycerol and fatty acids.
36. (d) Mg acts as a cofactor to the enzyme as it forms complex with phosphate group of ATP that is utilized in the transfer of ATP phosphate.
37. (b) Protonation at β -N leads to imidazolium ion, which is stabilized by two equivalent resonating structures.



38. (c) At the given pH (6) of the solution, alanine (pI = 6.0), exists as a dipolar ion while arginine (pI = 10.2) exists as a cation. Hence on passing an electric current, alanine

will not migrate to any electrode, while arginine will migrate to cathode.

39. (a) Every amino acid exists exclusively as dipolar ion when the pH of the solution is equal to its isoelectric point (pI), hence at this pH it does not migrate to either electrode, while at other pH, an amino acid migrates either to cathode or to anode depending upon its pI. Thus at pH 9.60, amino acid with pI 5.40 will exist as an anion and migrate to anode; while that with pI 9.60 will not migrate to any electrode.
40. (b) Proline contains imino (secondary amino), $>\text{NH}$ group
41. (d)
42. (d) All are chiral
43. (d)
44. (a) By convention, the amino acid with the free amino group (N-terminal) is written at the left end and the one with the unreacted carboxyl group (C-terminal) at the right end. Thus, the structure of Gly. Ala is



45. (c)
46. (c) Vitamin B₁₂, also called cyanocobalamin, is anti-pernicious anaemia vitamin.
47. (a) Vitamin B₆ is called pyridoxine. It is found in fruits, green-vegetables, milk, etc.
48. (b) Vitamin A.
49. (c) Vitamin B₁₂ contains both N and P.
50. (d)
51. (a)
52. (d) Ascorbic acid - Scurvy
Retinol - Night blindness
Riboflavin - Cracked lips
Thiamine - Beri-Beri
Thus option (d) is correct.
53. (d) $\text{Hb} + \text{CO} \longrightarrow \text{HbCO}$
Carboxyhaemoglobin (stable)
 $\text{Hb} + \text{O}_2 \rightleftharpoons \text{HbO}_2$
Oxyhaemoglobin (unstable).
54. (c)
55. (b) $\frac{A}{T} = \frac{G}{C} = 1$
Amount of A = T and that of G = C.
56. (d) Tyrosine is an α -amino acid, and not a purine or pyrimidine.
57. (a) The sequence of bases in mRNA are read in a serial order in groups of three at a time. Each triplet of

nucleotides (having a specific sequence of bases) is known as codon. Each codon specifies one amino acid. Further since, there are four bases, therefore, $4^3 = 64$ triplets or codons are possible.

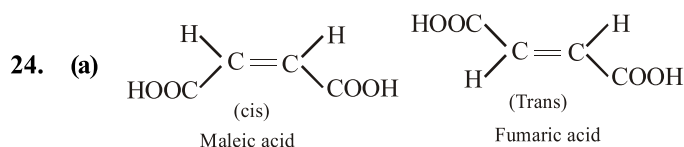
58. (d)
59. (a)
60. (b) In DNA and RNA heterocyclic base and phosphate ester are at C_1' and C_5' respectively of the sugar molecule.
Each corner is shared by 8 cubes and each face is shared by 2 faces

EXERCISE 2 : CONCEPT APPLICATOR

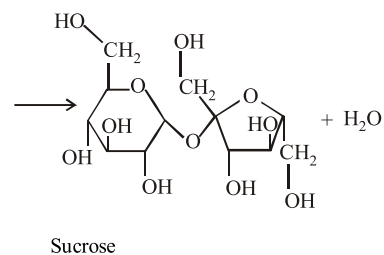
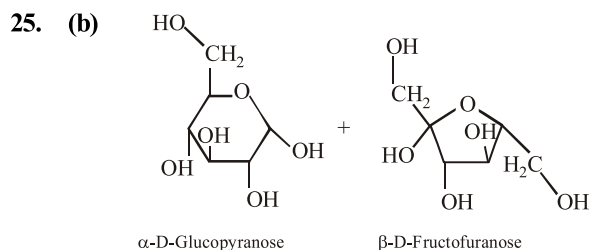
1. (a)
2. (b) Glucose is a hemiacetal, so in presence of a base (alkaline medium is provided by Fehling's solution) it can develop —CHO group in the form of open chain structure which responds Fehling's solution. Sucrose is a glycoside, *i.e.* its hemiacetal OH groups (one due to glucose and another due to fructose) are not free, so it can't attain —CHO group. Hence it will not respond Fehling's solution.
3. (c) Inulin is a polysaccharide of fructose, while all others are polysaccharides of glucose; although all the four has same molecular formula, $(C_6H_{10}O_5)_n$.
4. (a) Total number of stereoisomers for D-glucose, having four chiral atoms, is $2^4 = 16$; of which two (D-glucose and L-glucose) are enantiomers so number of diastereomers for D-glucose will be 14.
5. (b) $D\text{-glucose} + 3\text{PhNH}_2 \longrightarrow \text{osazone}$
6. (c)
7. (b) a and c give the same product.
8. (a)
9. (c) At isoelectric point, conc. of Zwitter ion will be maximum.
10. (b) $I.P. = \frac{pK_{a_1} + pK_{a_2}}{2}$ so $\frac{(14.0 - 4.4) + 2.2}{2} = \frac{11.8}{2} = 5.9$
11. (b) Biological catalysts are enzymes and all enzymes are proteins.
12. (a) Isoelectric point (pH)
$$= \frac{pK_{a_1} + pK_{a_2}}{2} = \frac{2.34 + 9.60}{2} = 5.97$$

13. (d) Enzymes may or may not require a coenzyme for their catalytic action.
14. (c) Deficiency of vitamin D causes rickets.
15. (b)
16. (a) ATP is known as universal energy currency of the cell.
17. (d) Thymine is present in DNA, while in RNA there is uracil.

18. (d) 19. (a) 20. (c)
21. (c) When the proteins are subjected to the action of heat, mineral acids or alkali, the water soluble form of globular protein changes to water insoluble fibrous protein. This is called denaturation of proteins. During denaturation secondary and tertiary structures of protein destroyed but primary structure remains intact.
22. (d) Enzymes are most reactive at optimum temperature. The optimum temperature for enzyme activity lies between 40°C to 60°C .
23. (b) Beri-beri.



Maleic acid shows geometrical isomerism but does not show optical isomerism.



Sucrose is a disaccharide of $\alpha\text{-D-Glucopyranose}$ and $\beta\text{-D-Fructofuranose}$.

26. (c) The base pairs of the two strands of DNA are linked together through H-bonds.
27. (d)
28. (c) Adrenaline is a hormone produced by adrenal glands during high stress or exciting situations. This powerful hormone is part of the human body's acute stress response system, also called the fight or flight response.
29. (b) Sugar in DNA is 2-deoxyribose whereas sugar in RNA is ribose.
30. (c) Due to denaturation of proteins, helix get uncoiled and protein loses its biological activity.

Polymers

2

Topic-wise analysis of offline/online JEE Main 2014-2018

Topic Name	2014		2015		2016		2017		2018	
	Offline	Online	Offline	Online	Offline	Online	Offline	Online	Offline	Online
T1: Classification of Polymers		1								1
T2: Preparation and Properties of Polymers		1		1	1	2	1	1		
T3: Uses of Polymers			1	1						

JEE Main 5 Years at a Glance

- Which of the following statements is not true? **[Online 2018]**
 - Chain growth polymerisation involves homopolymerisation only
 - Chain growth polymerisation includes both homopolymerisation and copolymerisation
 - Nylon 6 is an example of step-growth polymerisation
 - Step growth polymerisation requires a bifunctional monomer
- Which of the following is a biodegradable polymer? **[Online 2017]**
 - $\left[\text{HN} - (\text{CH}_2)_5 \text{CONH} - \text{CH}_2 - \overset{\text{O}}{\parallel}{\text{C}} \right]_n$
 - $\left[\text{HN} - (\text{CH}_2)_5 - \overset{\text{O}}{\parallel}{\text{C}} \right]_n$
 - $\left[\text{HN} - (\text{CH}_2)_6 \text{NHCO} - (\text{CH}_2)_4 - \overset{\text{O}}{\parallel}{\text{C}} \right]_n$
 - $\left[\overset{\text{O}}{\parallel}{\text{C}} - \text{C}_6\text{H}_4 - \text{COO} - (\text{CH}_2)_2 - \text{O} \right]_n$
- The formation of which of the following polymers involves hydrolysis reaction? **[2017]**
 - Nylon 6
 - Bakelite
 - Nylon 6, 6
 - Terylene
- Which of the following polymers is synthesized using a free radical polymerization technique? **[Online 2016]**
 - Terylene
 - Melamine polymer
 - Nylon 6, 6
 - Teflon
- Assertion** : Rayon is a semisynthetic polymer whose properties are better than natural cotton.
Reason : Mechanical and aesthetic properties of cellulose can be improved by acetylation. **[Online 2016]**
 - Both assertion and reason are correct, but the reason is not the correct explanation for the assertion
 - Both assertion and reason are correct, and the reason is the correct explanation for the assertion
 - Assertion is incorrect statement, but the reason is correct.
 - Both assertion and reason are incorrect.
- Which of the following statements about low density polythene is **FALSE**? **[2016]**
 - Its synthesis requires dioxygen or a peroxide initiator as a catalyst.
 - It is used in the manufacture of buckets, dust-bins etc.
 - Its synthesis requires high pressure.
 - It is a poor conductor of electricity.
- Match the polymers in column - A with their main uses in column - B and choose the correct answer: **[Online 2015]**

Column - A	Column - B
(A) Polystyrene	(i) Paints and lacquers
(B) Glyptal	(ii) Rain coats
(C) Polyvinyl chloride	(iii) Manufacture of toys
(D) Bakelite	(iv) Computer discs

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

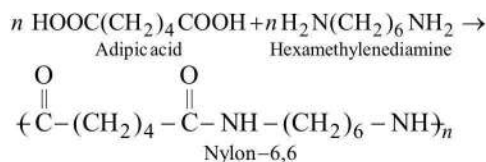
(To be continued on page-18)

Concept

Important Condensation Polymers

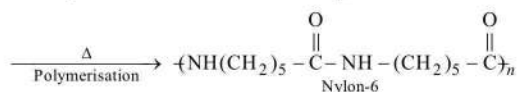
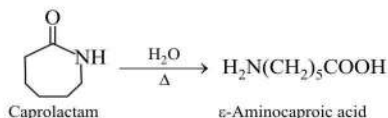
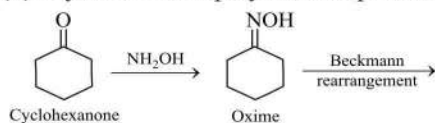
(i) **Nylons** : Synthetic polyamides are known as nylons

(a) **Nylon-6,6** : Copolymer of adipic acid (6C) and hexamethylenediamine (6C).



It has high tenacity and elasticity. It is resistant to abrasion and not affected by sea water. It is used for reinforcement of rubber tyres, manufacture of parachute, safety belts, carpets and fabrics.

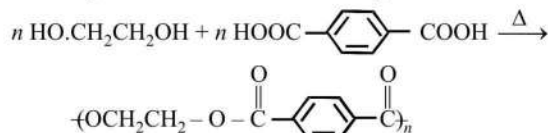
(b) **Nylon 6** : Homopolymer of caprolactam (6C)



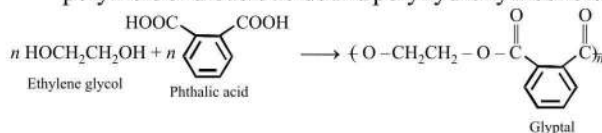
(ii) **Polyesters** : Condensation polymers of a dibasic acid and a diol

(a) **Terylene** (dacron) / Polyethylene terephthalate (PET)

It is resistant to mineral and organic acids. It is used for blending with wool to provide better crease, in safety helmets and aircraft battery boxes.



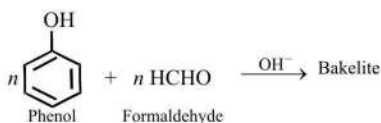
(b) **Glyptal or Alkyd resin** (general name) : Condensation polymers of dibasic acids and polyhydroxy alcohols



Cross linked copolymer; used for making good insulators, sheets, rods, switches, lacquers and adherant paints.

(iii) **Thermosetting Resins**

(a) **Bakelite** : Phenol formaldehyde resin

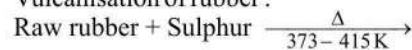


POLYMERS

Rubber

Natural rubber (manufactured from rubber latex: It is linear polymer of isoprene (2-methyl-1,3-butadiene)

Vulcanisation of rubber :

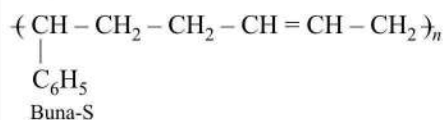
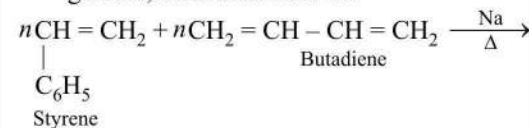


stiffened rubber (cross linked)

Synthetic rubber :

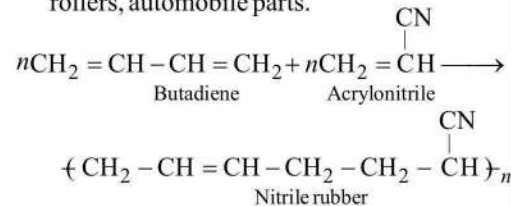
(i) **Buna-S or SBR:**

It is used for manufacture of tyres, floor tiles, gaskets, cable insulators etc.

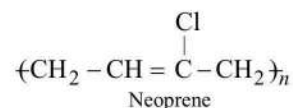
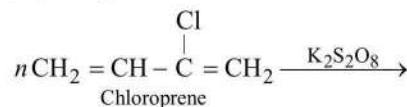


(ii) **Nitrile Rubber (Buna-N):**

Excellent resistant to heat and chemicals. It is used for making conveyer belts, printing rollers, automobile parts.



(iii) **Neoprene:**



Map

Biodegradable polymers

Non-resistant to environmental degradation

- (i) PHBV
- (ii) Nylon-2-nylon-6

Polymerisation reaction:

• Addition Polymerisation:

Governed by free radical mechanism.

Steps involved:

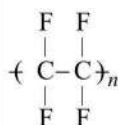
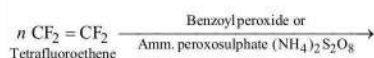
- (a) Chain initiation
- (b) Chain Propagating
- (c) Chain terminating

• Condensation Polymerisation:

involves stepwise intermolecular condensation.

Teflon or

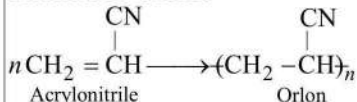
• Polytetrafluoroethylene (PTFE):



It is extremely tough, resistant to heat and chemicals. It is used for making gaskets, pump parts, coating utensils, high frequency insulators.

• Polyacrylonitrile (PAN),

Acrlon or Orlon:



It is hard used in preparing clothes and carpets.

Classification

• Based on Source :

(a) **Natural polymers:** protein, cellulose

(b) **Semi-synthetic:** cellulose nitrate

(c) **Synthetic:** PVC, nylon-6, 6

• Based on structure :

(a) **Linear:** Polymers containing the monomeric units linked together to form long straight chains stacked over one another to give packed structure. Such polymers have high tensile strength, high densities, high m.p. and b.p. Examples - fibres and plastics.

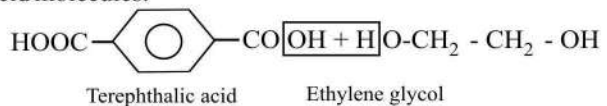
(b) **Branched :** Long chain of monomer units containing side chains of different lengths form branched polymers. The chains are loosely packed, hence polymers have low density, low m.p. and low tensile strength. Examples - amylopectin and glycogen.

(c) **Cross linked:** Such polymers have three dimensional network and are hard, brittle and rigid. Examples - bakelite, melamine.

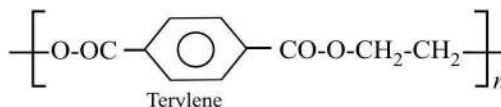
• Based on Polymerisation :

(a) **Addition Polymers:** In addition polymerisation, the unsaturated monomeric molecules undergo repeated addition reactions in the presence of catalysts like O_2 , organic peroxides. Some examples of addition polymers are polythene from ethylene, polypropylene from propylene, polyisoprene from isoprene, etc.

(b) **Condensation Polymers:** Condensation polymerisation normally takes place by repeated condensation of monomeric molecules usually with the elimination of small molecules like water, alcohol, CO_2 , HCl, etc. For example, terylene is formed by removal of water molecule from ethylene glycol and terephthalic acid molecules.



This condensation step goes on repeating to form terylene.



Condensation is also known as *step growth polymerisation*.

• Based on Molecular force :

(a) **Elastomers:** Here, the intermolecular forces of attraction between the polymer chains are the weakest. They have high degree of elasticity and consist of randomly called molecular chains of irregular shape having a few cross-links. For ex : natural rubber, vulcanized rubber, etc.

(b) **Fibres:** These polymers have very least stretchability, because the polymeric chains in them are joined together by very strong intermolecular forces like innumerable hydrogen bonds and have sharp melting points. Nylon-6,6 is an important example of this class.

(c) **Thermoplastics:** Thermoplastic polymers readily become soft on heating and thus can be moulded into required shapes. Some important examples of this class of polymers are polyvinyl chloride, polythene, polypropylene, polystyrene etc.

(d) **Thermosetting:** They are semi-fluid substances with low molecular masses which when heated become hard and infusible, because of sufficiently large number of cross links. They acquire a shape of three-dimensional network. Important examples of this class of polymers are bakelite, urea formaldehyde resin, etc.

8. Which one of the following structures represents the neoprene polymer ? [Online 2015]
- (a) $\left(\text{CH} - \text{CH}_2 \right)_n$
 $\quad \quad \quad |$
 $\quad \quad \quad \text{C}_6\text{H}_5$
- (b) $\left(\text{CH}_2 - \text{CH} \right)_n$
 $\quad \quad \quad |$
 $\quad \quad \quad \text{CN}$
- (c) $\left(\text{CH}_2 - \text{C} = \text{CH} - \text{CH}_2 \right)_n$
 $\quad \quad \quad |$
 $\quad \quad \quad \text{Cl}$
- (d) $\left(\text{CH}_2 - \text{CH} \right)_n$
 $\quad \quad \quad |$
 $\quad \quad \quad \text{Cl}$
9. Which polymer is used in the manufacture of paints and lacquers ? [2015]
- (a) Polypropene (b) Polyvinyl chloride
 (c) Bakelite (d) Glyptal
10. Structure of some important polymers are given. Which one represents Buna-S? [Online 2014]
- (a) $\left(\text{CH}_2 - \overset{\text{CH}_3}{\text{C}} = \text{CH} - \text{CH}_2 \right)_n$
- (b) $\left(\text{CH}_2 - \text{CH} = \text{CH} - \text{CH}_2 - \overset{\text{C}_6\text{H}_5}{\text{CH}} - \text{CH}_2 \right)_n$
- (c) $\left(\text{CH}_2 - \text{CH} = \text{CH} - \text{CH}_2 - \overset{\text{CN}}{\text{CH}} - \text{CH}_2 \right)_n$
- (d) $\left(\text{CH}_2 - \overset{\text{Cl}}{\text{C}} = \text{CH} - \text{CH}_2 \right)_n$
11. Which one of the following is an example of thermosetting polymers? [Online 2014]
- (a) Neoprene (b) Buna-N
 (c) Nylon 6, 6 (d) Bakelite

Important/Critical Points to Remember

- ▶ Diphenylamine is added as an antioxidant to rubber to protect it from degradation on exposure to air.
- ▶ Super glue is a polymer of methyl α -cyanoacrylate.
- ▶ Ebonite is high sulphur (20–30% S) rubber and is obtained by vulcanization of natural rubber.
- ▶ Rubber obtained from waste rubber articles is called reclaimed rubber.
- ▶ **Polymethyl methacrylate, lucite or plexiglass :** used for making lenses, artificial eyes, dentures, aircraft windows.
- ▶ **Polyesters**
 - (i) **Terylene (dacron) / Polyethylene Terephthalate (PET)**
Ethylene glycol and Terephthalic acid
It is used for blending with wool to provide better crease, in safety helmets and aircraft battery boxes.
 - (ii) **Glyptal or Alkyd resin :** For making good insulators, sheets, rods, switches, lacquers and adherant paints.
Ethylene glycol and Phthalic acid
- ▶ **Rubbers**
 - (i) **Buna - S or SBR or GSR (Government styrene rubber):** Styrene + Butadiene
 - (ii) **Nitrile rubber (GR-A or Buna - N) :** Butadiene + Acrylonitrile
 - (iii) **Neoprene:** Chloroprene
 - (iv) **Heavy rubber :** cis polyisoprene
 - (v) **Gutta percha :** trans polyisoprene
- ▶ **Nylon 6,6 :** Copolymer of adipic acid (6C) and hexamethylene diamine (6C).

$$n \text{ HOOC}(\text{CH}_2)_4\text{COOH} + n\text{H}_2\text{N}(\text{CH}_2)_6\text{NH}_2 \rightarrow$$

Adipic acid Hexamethylene diamine

$$\left(\text{C} - (\text{CH}_2)_4 - \overset{\text{O}}{\parallel} \text{C} - \text{NH} - (\text{CH}_2)_6 - \text{NH} \right)_n$$

Nylon 6, 6

It is used for reinforcement rubber tyres, manufacture of parachute, safety belts, carpets and fabrics.
- ▶ **Nylon 6 :** Homopolymer of caprolactam (6C)
- ▶ **Nylon 6, 10 :** Copolymer of hexamethylene diamine (6C) and sebacoyl chloride (10C)
- ▶ **Kevlar:** It is aromatic polyamide resembling nylons aircraft industries, bullet proof vests, ropes cables.
- ▶ **Polyurethanes :** Polymers of diisocyanate and eg. Perlon-U, Substitute of leather.
- ▶ **Nylon-2-nylon-6**
copolymer of glycine and amino caproic acid ($\text{H}_2\text{N}(\text{CH}_2)_5\text{COOH}$). It is biodegradable.
- ▶ **Plasticizers**
The substances added to resins to increase their plasticity and flexibility are known as plasticizers. Examples are, vegetable oils phosphates.

Tips to Problem Solving

- ▶ **Number average molecular weight (\bar{M}_n)** is given by

$$\bar{M}_n = \frac{N_1M_1 + N_2M_2 + N_3M_3 + \dots}{N_1 + N_2 + N_3 + \dots} = \frac{\sum N_i M_i}{\sum N_i}$$

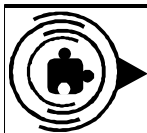
Where N_1 is number of molecules having molecular weight M_1

- ▶ **Mass - average molecular weight (\bar{M}_w)** is given by

$$\bar{M}_w = \frac{N_1M_1^2 + N_2M_2^2 + N_3M_3^2 + \dots}{N_1M_1 + N_2M_2 + N_3M_3 + \dots} = \frac{\sum N_i M_i^2}{\sum N_i M_i}$$

- ▶ **Polydispersity index**

It is the ratio of mass average molecular weight \bar{M}_w to the number average molecular weight \bar{M}_n



Exercise-1 : Concept Builder (Topicwise)

TOPIC 1: Classification of Polymers

- Among cellulose, polyvinyl chloride, nylon and natural rubber, the polymer in which the intermolecular force of attraction is weakest is
 - Nylon
 - Polyvinyl chloride
 - Cellulose
 - Natural Rubber
- The process of heat-softening, moulding and cooling to 'rigidness' can be repeated for
 - thermoplastics
 - thermosetting plastics
 - Both (a) and (b)
 - Neither (a) nor (b)
- Which of the following polymer is a polyamide?
 - Terylene
 - Nylon
 - Rubber
 - Vulcanised rubber
- Natural rubber is a polymer of
 - butadiene
 - isoprene
 - 2-methylbutadiene
 - hexa-1, 3-diene
- $[\text{NH}(\text{CH}_2)_6\text{NHCO}(\text{CH}_2)_4\text{CO}]_n$ is a
 - addition polymer
 - thermosetting polymer
 - homopolymer
 - copolymer
- Ebonite is a
 - natural rubber
 - synthetic rubber
 - highly vulcanized rubber
 - polypropene
- Which of the following is not an example of addition polymer?
 - Polystyrene
 - Nylon
 - PVC
 - Polypropylene
- A condensation polymer among the following is
 - dacron
 - PVC
 - polystyrene
 - teflon
- PVC is:
 - thermoplastic polymer
 - compound polymer
 - thermosetting polymer
 - simple polymer
- The synthetic polymer which resembles natural rubber is
 - neoprene
 - chloroprene
 - glyptal
 - nylon
- Which of the following polymer is an example of fibre?
 - silk
 - dacron
 - nylon-6, 6
 - All of these
- Which of the following is not a biopolymer?
 - Proteins
 - Rubber
 - Cellulose
 - RNA
- Which is not an example of copolymer?
 - SAN
 - ABS
 - Saran
 - PVC
- In addition polymer monomer used is
 - unsaturated compounds
 - saturated compounds
 - bifunctional saturated compounds
 - trifunctional saturated compounds
- Thermosets are:
 - cross-linked polymers
 - don't melt or soften on heating
 - cross-linking is usually developed at the time of moulding where they harden reversibly
 - all of the above
- Three dimensional molecular structure with cross links are formed in the case of a
 - thermoplastic
 - thermosetting plastic
 - Both (a) and (b)
 - none of the above
- Which of the following statements is not correct for fibres?
 - Fibres possess high tensile strength and high modulus.
 - Fibres impart crystalline nature.
 - Characteristic features of fibres are due to strong intermolecular forces like hydrogen bonding.
 - All are correct.
- Perlon is
 - Rubber
 - Nylon-6
 - Terylene
 - Orlon
- Which one of the following is a chain growth polymer?
 - Nucleic acid
 - Polystyrene
 - Protein
 - Starch

TOPIC 2: Preparation and Properties of Polymers

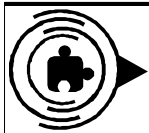
- Ziegler-Natta catalyst is
 - $\text{K}[\text{PtCl}_3(\text{C}_2\text{H}_4)]$
 - $(\text{Ph}_3\text{P})_3\text{RhCl}$
 - $\text{Al}_2(\text{C}_2\text{H}_5)_6 + \text{TiCl}_4$
 - $\text{Fe}(\text{C}_5\text{H}_5)_2$
- Which pair of polymers have similar properties?
 - Nylon, PVC
 - PAN, PTFE
 - PCTFE, PTFE
 - Bakelite, alkyl resin
- Which of the following catalyst is used in preparation of high density polythene?
 - Peroxide catalyst
 - Ziegler - Natta catalyst
 - Wilkinson's catalyst
 - Pd - catalyst
- Melamine plastic crockery is a condensation polymer of
 - HCHO and melamine
 - HCHO and ethylene
 - melamine and ethylene
 - None of these

24. Which of the following polymers is synthesized using a free radical polymerization technique?
 (a) Terylene (b) Melamine polymer
 (c) Nylon 6, 6 (d) Teflon
25. Synthetic polymer bakelite can be prepared from following compounds
 (a) Styrene and vinyl chloride
 (b) Acrylonitrile and vinyl chloride
 (c) Adipic acid and ethylene glycol
 (d) Phenol and formaldehyde
26. For natural polymers PDI is generally
 (a) 0 (b) 1 (c) 100 (d) 1000
27. Nylon 6,6 is a polyamide obtained by the reaction of
 (a) $\text{COOH}(\text{CH}_2)_4\text{COOH} + \text{NH}_2\text{C}_6\text{H}_4\text{NH}_2$ (p)
 (b) $\text{COOH}(\text{CH}_2)_4\text{COOH} + \text{NH}_2(\text{CH}_2)_6\text{NH}_2$
 (c) $\text{COOH}(\text{CH}_2)_6\text{COOH} + \text{NH}_2(\text{CH}_2)_4\text{NH}_2$
 (d) $\text{COOH}(\text{CH}_2)_4\text{COOH} + \text{NH}_2(\text{CH}_2)_6\text{NH}_2$
28. $\text{CF}_2 = \text{CF}_2$ is a unit of
 (a) teflon (b) buna - S
 (c) bakelite (d) polythene
29. Monomer of $\left[\begin{array}{c} \text{CH}_3 \\ | \\ \text{---C---CH}_2\text{---} \\ | \\ \text{CH}_3 \end{array} \right]_n$ is
 (a) 2-methylpropene (b) styrene
 (c) propylene (d) ethene
30. Orlon is a polymer of
 (a) styrene (b) tetrafluoroethylene
 (c) vinyl chloride (d) acrylonitrile
31. PVC is formed by polymerisation of
 (a) ethene (b) 1-chloropropene
 (c) propene (d) 1-chloroethene
32. Caprolactam polymerises to give
 (a) terylene (b) teflon (c) glyptal (d) nylon-6
33. Interparticle forces present in nylon-6,6 are
 (a) van der waal's
 (b) hydrogen bonding
 (c) dipole-dipole interactions
 (d) none of these
34. The process involving heating of rubber with sulphur is called
 (a) galvanisation (b) vulcanization
 (c) bessemerisaion (d) sulphonation
35. Which of the following polymers do not involve cross linkages?
 (a) Melmac (b) Bakelite
 (c) Polythene (d) Vulcanised rubber
36. Number average molecular mass, \overline{M}_n and weight average molecular mass (\overline{M}_w) of synthetic polymers are related as
 (a) $\overline{M}_n = (\overline{M}_w)^{1/2}$ (b) $\overline{M}_n = \overline{M}_w$
 (c) $\overline{M}_w > \overline{M}_n$ (d) $\overline{M}_w < \overline{M}_n$
37. Select the correct statement.
 (a) Vinyon is a copolymer of vinyl chloride and vinyl acetate
 (b) Saran is a copolymer of vinyl chloride and vinylidene chloride
 (c) Butyl rubber is a copolymer of isobutylene and isoprene
 (d) All of the above are correct
38. Low density polythene is prepared by
 (a) Free radical polymerisation
 (b) cationic polymerisation
 (c) anionic polymerisation
 (d) Ziegler-Natta polymerisation
39. Head-to-tail addition takes place in chain-growth polymerisation, when monomer is
 (a) $\text{CH}_2 = \text{CH}-\text{C}_6\text{H}_5$ (b) $\text{CH}_2 = \text{CH}-\text{CH} = \text{CH}_2$
 (c) $\text{CH}_2 = \text{C}(\text{CH}_3) - \text{COCH}_3$ (d) $\text{CH}_2 = \text{CH}-\text{C} \equiv \text{N}$
40. Characteristic property of teflon is
 (a) it has 2000 poise viscosity
 (b) it has high surface tension
 (c) it is non-inflammable and resistant to heat
 (d) it is highly reactive

TOPIC 3: Uses of Polymers

41. The polymer used for optical lenses is
 (a) polypropylene (b) polyvinyl chloride
 (c) polythene (d) polymethyl methacrylate
42. Polymer used in bullet proof glass is
 (a) lexan (b) PMMA (c) nomex (d) kevlar
43. Glyptals are chiefly employed in
 (a) toy making (b) surface coating
 (c) photofilm making (d) electrical insulators
44. Which polymer is used for making magnetic recording tapes?
 (a) Dacron (b) Acrilan (c) Glyptal (d) Bakelite
45. Isoprene is a valuable substance for making
 (a) propene (b) liquid fuel
 (c) synthetic rubber (d) petrol
46. The polymer used in making synthetic hair wigs is made up of
 (a) $\text{CH}_2 = \text{CHCl}$ (b) $\text{CH}_2 = \text{CHCOOCH}_3$
 (c) $\text{C}_6\text{H}_5\text{CH} = \text{CH}_2$ (d) $\text{CH}_2 = \text{CH}-\text{CH} = \text{CH}_2$
47. Which of the following has been used in the manufacture of non-inflammable photographic films?
 (a) Cellulose nitrate (b) Cellulose xanthate
 (c) Cellulose perchlorate (d) Cellulose acetate
48. Which of the following is currently used as a tyre cord?
 (a) Terylene (b) Polyethylene
 (c) Polypropylene (d) Nylon - 6

49. PVC is used for
- manufacture of cosmetics
 - manufacture of tyres
 - manufacture of nonstick pans
 - manufacture of plastic pipes
50. The plastic household crockery is prepared by using
- melamine and tetrafluoroethane
 - malonic acid and hexamethylenamine
 - melamine and vinyl acetate
 - melamine and formaldehyde



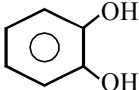
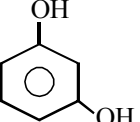
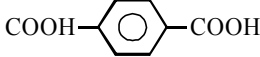
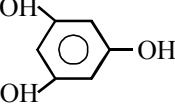
Exercise-2 : Concept Applicator

- Nylon threads are made of
 - polyester polymer
 - polyamide polymer
 - polyethylene polymer
 - polyvinyl polymer
- A polymer made from a polymerization reaction that produces small molecules (such as water) as well as the polymer is classified as a/an polymer.
 - addition
 - natural
 - condensation
 - elimination
- Ethylene-propylene rubber (EPR) is
 - unsaturated and stereoregular
 - saturated and stereoregular
 - atactic and unsaturated
 - syndiotactic and unsaturated
- Synthetic polymer bakelite can be prepared from following compounds
 - Styrene and vinyl chloride
 - Acrylonitrile and vinyl chloride
 - Adipic acid and ethylene glycol
 - Phenol and formaldehyde
- If a polythene sample contains two monodisperse fractions in the ratio 2 : 3 with degree of polymerization 100 and 200, respectively, then its weight average molecular weight will be :
 - 4900
 - 4600
 - 4300
 - 5200
- Mark out the most unlike form of polymerization of $\text{CH}_2 = \text{CH} - \text{CH} = \text{CH}_2$
 - $$\left(\begin{array}{c} \text{H} \\ \diagdown \quad \diagup \\ \text{C} = \text{C} \\ \diagup \quad \diagdown \\ \text{CH}_2 \quad \text{CH}_2 \\ \text{H} \end{array} \right)_n$$
 - $$\left(\begin{array}{c} \text{H} \\ \diagdown \quad \diagup \\ \text{C} = \text{C} \\ \diagup \quad \diagdown \\ \text{CH}_2 \quad \text{CH}_2 \\ \text{H} \end{array} \right)_n$$
 - $$\left(\text{CH}_2 - \overset{\text{CH} = \text{CH}_2}{\underset{|}{\text{CH}}} - \text{CH}_2 - \overset{\text{CH} = \text{CH}_2}{\underset{|}{\text{CH}}} \right)_n$$
 - $$\left(\begin{array}{c} \text{CH}_2 \quad \text{CH}_2 \\ || \quad || \\ \text{C} - \text{C} \end{array} \right)_n$$
- The condensation of hexamethylenediamine with sebacoyl chloride at 525 K gives
 - nylon-6,20
 - nylon-6,01
 - nylon-6,10
 - None of these
- Formation of polyethylene from calcium carbide takes place as follows

$$\text{CaC}_2 + 2\text{H}_2\text{O} \longrightarrow \text{Ca(OH)}_2 + \text{C}_2\text{H}_2$$

$$\text{C}_2\text{H}_2 + \text{H}_2 \longrightarrow \text{C}_2\text{H}_4$$

$$n\text{C}_2\text{H}_4 \longrightarrow \left(-\text{CH}_2 - \text{CH}_2 - \right)_n$$
 The amount of polyethylene obtained from 64.1 kg of CaC_2 is
 - 7 kg
 - 14 kg
 - 21 kg
 - 28 kg
- Polymer formation from monomers starts by
 - condensation or addition reaction between monomers
 - coordinate reaction between monomers
 - conversion of monomer to monomer ions
 - hydrolysis of monomers.
- Which of the following is fully fluorinated polymer?
 - PVC
 - Thiokol
 - Teflon
 - Neoprene
- Among the following, the wrong statement is
 - PMMA is plexiglass
 - SBR is natural rubber
 - PTFE is teflon
 - LDPE is low density polythene
- In which of the following polymers, empirical formula resembles with monomer?
 - Bakelite
 - Teflon
 - Nylon-6,6
 - Dacron
- Which is a polymer of three different monomers?
 - ABS
 - SBR
 - NBR
 - Nylon-2,6
- The polymer which has conducting power is
 - polyethylene
 - polybutadiene
 - polystyrene
 - polyacetylene
- Orlon is a -
 - homopolymer and addition polymer
 - copolymer and addition polymer
 - homopolymer and condensation polymer
 - copolymer and condensation polymer
- Which of the following is not correct regarding terylene?
 - Step-growth polymer
 - Synthetic fibre
 - Condensation polymer
 - Thermosetting plastic

17. 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 AlCl_3
18. The mass average molecular mass & number average molecular mass of a polymer are 40,000 and 30,000 respectively. The polydispersity index of polymer will be
 (a) < 1 (b) > 1 (c) 1 (d) 0
19. The monomeric units of terylene are glycol and which of the following
- (a)  (b) 
- (c)  (d) 
20. Given the polymers (i) Nylon-66; (ii) Buna-S; (iii) Polythene. Arrange these in increasing order of their inter-molecular forces (lower to higher)
 (a) (i) $>$ (ii) $>$ (iii) (b) (ii) $>$ (iii) $>$ (i)
 (c) (ii) $<$ (iii) $<$ (i) (d) (iii) $<$ (i) $<$ (ii)
21. Which one of the following statement is *not true*?
 (a) In vulcanization the formation of sulphur bridges between different chains make rubber harder and stronger.
 (b) Natural rubber has the *trans*-configuration at every double bond
 (c) Buna-S is a copolymer of butadiene and styrene
 (d) Natural rubber is a 1, 4 - polymer of isoprene
22. The compound which cannot be used as a plasticizer, is
 (a) di-n-butylphthalate (b) tricresyl phosphate
 (c) di-n-octylphthalate (d) diethyl phthalate
23. When condensation product of hexamethylenediamine and adipic acid is heated to 525 K in an atmosphere of nitrogen for about 4-5 hours, the product obtained is
 (a) solid polymer of nylon 6, 6
 (b) liquid polymer of nylon 6, 6
 (c) gaseous polymer of nylon 6, 6
 (d) liquid polymer of nylon 6
24. Of the following which one is classified as polyester polymer?
 (a) Terylene (b) Bakelite (c) Melamine (d) Nylon-66
25. Which one of the following is not a condensation polymer?
 (a) Melamine (b) Glyptal (c) Dacron (d) Neoprene
26. Which of the following statements is false?
 (a) Artificial silk is derived from cellulose.
 (b) Nylon-6,6 is an example of elastomer.
 (c) The repeat unit in natural rubber is isoprene.
 (d) Both starch and cellulose are polymers of glucose.
27. Which of the following organic compounds polymerizes to form the polyester Dacron?
 (a) Propylene and para $\text{HO}-(\text{C}_6\text{H}_4)-\text{OH}$
 (b) Benzoic acid and ethanol
 (c) Terephthalic acid and ethylene glycol
 (d) Benzoic acid and para $\text{HO}-(\text{C}_6\text{H}_4)-\text{OH}$
28. Biodegradable polymer which can be produced from glycine and aminocaproic acid is :
 (a) PHBV (b) Buna - N
 (c) Nylon 6, 6 (d) Nylon - 2- nylon 6
29. Caprolactum is used for the manufacture of :
 (a) Nylon - 6 (b) Teflon (c) Terylene (d) Nylon - 6,6
30. Natural rubber has
 (a) all cis-configuration
 (b) all trans-configuration
 (c) alternate cis-and trans-configuration
 (d) random cis-and trans-configuration



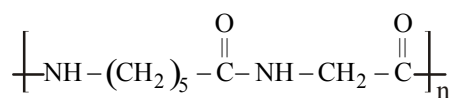
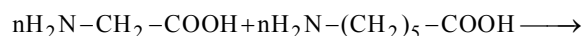
JEE Main 5 Years at a Glance																			
1	(b)	2	(a)	3	(a)	4	(d)	5	(a)	6	(b)	7	(d)	8	(c)	9	(d)	10	(b)
11	(d)																		
EXERCISE-1 : Concept Builder (Topicwise)																			
1	(d)	6	(c)	11	(d)	16	(b)	21	(c)	26	(b)	31	(d)	36	(c)	41	(d)	46	(a)
2	(a)	7	(b)	12	(b)	17	(d)	22	(b)	27	(b)	32	(d)	37	(d)	42	(b)	47	(d)
3	(b)	8	(a)	13	(d)	18	(b)	23	(a)	28	(a)	33	(b)	38	(a)	43	(b)	48	(d)
4	(b)	9	(a)	14	(a)	19	(b)	24	(d)	29	(a)	34	(b)	39	(a)	44	(d)	49	(d)
5	(d)	10	(a)	15	(d)	20	(c)	25	(d)	30	(d)	35	(c)	40	(c)	45	(c)	50	(d)
EXERCISE-2 : Concept Applicator																			
1	(b)	4	(d)	7	(c)	10	(c)	13	(a)	16	(d)	19	(c)	22	(d)	25	(d)	28	(d)
2	(c)	5	(a)	8	(d)	11	(b)	14	(d)	17	(a)	20	(c)	23	(b)	26	(b)	29	(a)
3	(b)	6	(d)	9	(a)	12	(b)	15	(a)	18	(b)	21	(b)	24	(a)	27	(c)	30	(a)

Hints and Solutions

JEE MAIN 5 YEARS AT A GLANCE

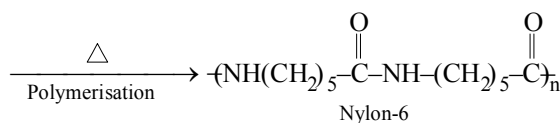
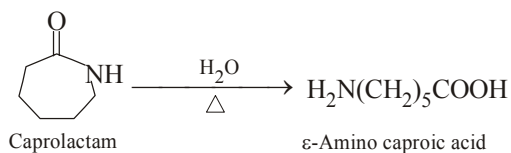
1. (b) The statement (b) is not true. Chain growth polymerisation (or addition polymerisation) involves homopolymerisation only. Examples of such polymers include polythene, orlon and teflon.

2. (a)



Nylon-2-Nylon-6
biodegradable step-growth copolymer

3. (a) Formation of nylon-6 involves hydrolysis of caprolactam, (its monomer) in initial state.



4. (d) Teflon or polytetrafluoroethene is an addition polymer and its monomer is alkene derivative ($\text{CF}_2=\text{CF}_2$) whereas terylene, melamine and nylon-6, 6 are condensation polymers.

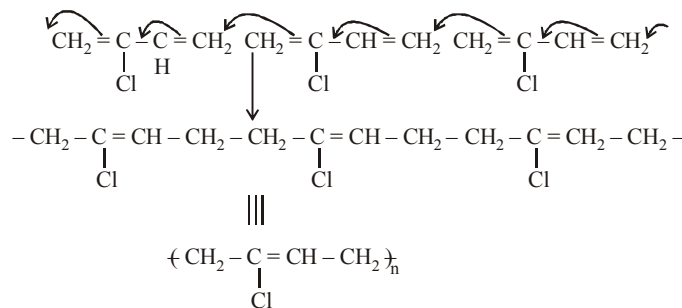
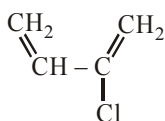
5. (a)

6. (b) High density polythene is used in the manufacture of housewares like buckets, dustbins, bottles, pipes etc. Low density polythene is used for insulating electric wires and in the manufacture of flexible pipes, toys, coats, bottles etc.

7. (d) **Polymer Use**

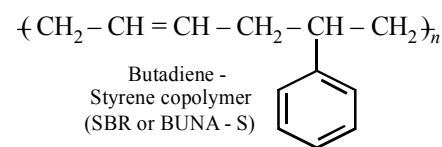
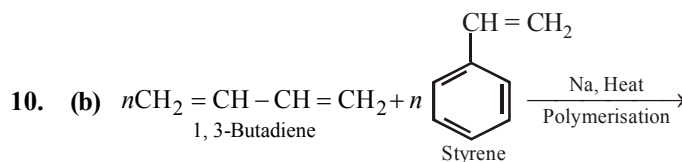
Polystyrene	Manufacture of toys
Glyptal	Paints and lacquers.
P.V.C.	Rain Coats
Bakelite	Computer discs

8. (c) Chloroprene



Neoprene is a polymer of chloroprene

9. (d) Glyptal is used in the manufacture of paints and lacquers.



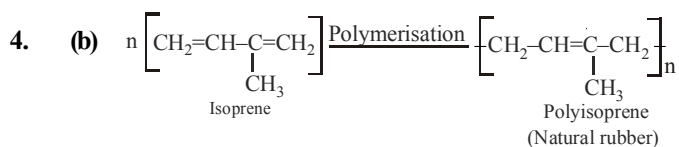
11. (d) Polymers which change irreversibly into hard and rigid material on heating are known as thermosetting polymers e.g bakelite.

EXERCISE 1 : CONCEPT BUILDER (TOPICWISE)

1. (d) Nylon and cellulose, both have intermolecular hydrogen bonding, polyvinyl chloride has dipole-dipole interaction, while natural rubber has van der Waal forces which are weakest.

2. (a)

3. (b) Nylon is a polyamide fibre. It is prepared by the condensation polymerisation of adipic acid ($\text{HOOC}(\text{CH}_2)_4\text{COOH}$) and hexamethylene diamine ($\text{H}_2\text{N}(\text{CH}_2)_6\text{NH}_2$).



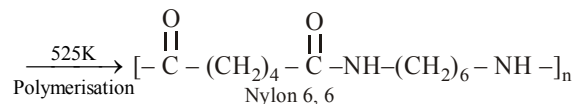
5. (d) The given compound is a copolymer of hexamethylene diamine and adipic acid. It is actually nylon-6, 6.
 6. (c) Ebonite is a hard highly vulcanized rubber, containing 20-25%, sulphur.
 7. (b) Nylon is a condensation polymer
 8. (a) Dacron is a condensation polymer formed by condensation of terephthalic acid and ethylene glycol.
 9. (a) PVC is an example of thermoplastic polymer.
 10. (a) The synthetic polymer neoprene (polychloroprene) is prepared by polymerisation of chloroprene. This is inferior to natural rubber but is more resistant to aerial oxidation and to other solvents.
 11. (d) Silk is protein fibre. Dacron is polyester fibre and nylon-66 is polyamide fibre.
 12. (b) Since proteins, cellulose and RNA control various activities of plants and animals, they are called biopolymers. They are found in living organisms.
 13. (d) 14. (a)
 15. (d) These are characteristics of thermosets.
 16. (b) Thermosetting plastics have three dimensional cross linked structure.
 17. (d) All the given statements about fibres are correct.
 18. (b) Perlon is nylon-6. It is prepared from a single monomer (caprolactam) having a potential amino group at one end and a potential carbonyl group at other end.
 19. (b) Polystyrene is a chain growth polymer.
 20. (c)
 21. (c) PCTFE and PTFE both have same carbon backbone.



22. (b) High density polythene is formed when addition polymerisation of ethene takes place in a hydrocarbon solvent in presence of catalyst such as ziegler-natta catalyst.
 23. (a) Melamine plastic crockery is a copolymer of HCHO and Melamine.
 24. (d) Teflon or polytetrafluoroethene is an addition polymer and its monomer is alkene derivative ($\text{CF}_2=\text{CF}_2$) whereas

terylene, melamine and nylon-6, 6 are condensation polymers.

25. (d) 26. (b)
 27. (b) $n \text{HOOC}(\text{CH}_2)_4 \text{COOH} + n \text{H}_2\text{N}(\text{CH}_2)_6 \text{NH}_2$
Adipic acid Hexamethylene diamine



28. (a) $n \text{CF}_2=\text{CF}_2 \xrightarrow{\text{Polymerisation}} \left[-\text{CF}_2-\text{CF}_2- \right]_n$
Teflon

29. (a) Monomer of $\left[\begin{array}{c} \text{CH}_3 \\ | \\ \text{C}-\text{CH}_2 \\ | \\ \text{CH}_3 \end{array} \right]_n$ polymer is

2-methylpropene.

30. (d) Orlon is a trade name of polyacrylonitrile
 31. (d) P.V.C. (Polyvinyl chloride) is formed by polymerisation of vinyl chloride, $\text{CH}_2=\text{CHCl}$, whose IUPAC name is 1-chloroethene
 32. (d) 33. (b) 34. (b)
 35. (c) Polythene is a linear polymer

36. (c) $\text{PDI} = \frac{\overline{M}_w}{\overline{M}_n}$

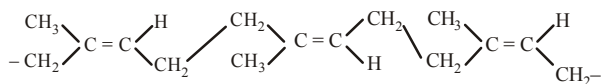
For synthetic polymer, $\text{PDI} > 1$

$$\therefore \overline{M}_w > \overline{M}_n$$

37. (d)
 38. (a) Ethene on free radical polymerisation gives low density polythene.
 39. (a)
 40. (c) Teflon is non-inflammable and resistant to heat so it is used in coating, particularly in non-sticking frying pans.
 41. (d) Polymethyl methacrylate is hard, fairly rigid. It is used for optical lenses.
 42. (b) PMMA and polycarbonate are used in bullet proof glass
 43. (b) Glyptal is an alkyd resin obtained from polyhydric alcohols and polybasic organic acids or their anhydrides. They are used for surface coatings.
 44. (d)
 45. (c) Rubber is a polymer of isoprene.

20. (c) Nylon – 6, 6 is a fibre with hydrogen bonds thus have strongest intermolecular forces. Buna-S is an elastomer whereas polythene is thermoplastic. The intermolecular forces of attraction in thermoplastics is intermediate between elastomer and fibres. Therefore forces in elastomers are weakest.

21. (b)



Natural rubber

(All cis configuration)

All statements except (b) are correct

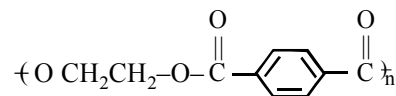
22. (d) Generally high boiling esters or haloalkanes act as plasticizer.
23. (b) The condensation polymerisation of hexamethylene diamine and adipic acid is done in solution form by interface technique. In this, liquid nylon polymer is obtained.

24. (a) Polyesters are condensation polymers of a dibasic acid and a diol, e.g., terylene



Ethylene glycol

Terephthalic acid



Terylene

25. (d) Neoprene is an addition polymer of chloroprene.
26. (b) Nylons (polyamides) are fibres.
27. (c)
28. (d) $\text{H}_2\text{N}-\text{CH}_2-\text{COOH} + \text{H}_2\text{N}-(\text{CH}_2)_5-\text{COOH} \rightarrow$
 $\left(\text{HN}-\text{CH}_2-\text{CO}-\text{NH}-(\text{CH}_2)_5-\text{CO} \right)_n$
 Glycineaminocaproic acid
29. (a)
30. (a)

Chemistry in Everyday Life

3

Topic-wise analysis of offline/online JEE Main 2014-2018

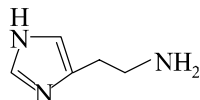
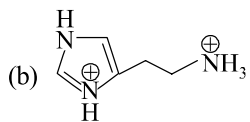
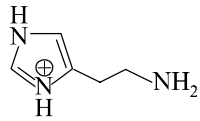
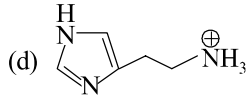
Topic Name	2014		2015		2016		2017		2018	
	Offline	Online	Offline	Online	Offline	Online	Offline	Online	Offline	Online
T1: Drug and Medicines		2	1		1	1			1	1
T2: Food Preservatives and Cleansing Agents				1						

JEE Main 5 Years at a Glance

- The correct match between items of List-I and List-II is: **[Online 2018]**

List-I	List-II
(A) Phenelzine	(p) Pyrimidine
(B) Chloroxylenol	(q) Furan
(C) Uracil	(r) Hydrazine
(D) Ranitidine	(s) Phenol

 - (A)-(s); (B)-(r); (C)-(q); (D)-(p)
 - (A)-(r); (B)-(s); (C)-(p); (D)-(q)
 - (A)-(r); (B)-(s); (C)-(q); (D)-(p)
 - (A)-(s); (B)-(r); (C)-(p); (D)-(q)
- The predominant form of histamine present in human blood is (pK_a , Histidine – 6.0) **[2018]**

(a) 	(b) 
(c) 	(d) 
- Which of the following is a bactericidal antibiotic? **[Online 2016]**
 - Ofloxacin
 - Tetracycline
 - Chloramphenicol
 - Erythromycin
- Which of the following is an anionic detergent? **[2016]**
 - Cetyltrimethyl ammonium bromide.
 - Glyceryl oleate.
 - Sodium stearate.
 - Sodium lauryl sulphate.
- Which artificial sweetener contains chlorine? **[Online 2015]**
 - Sucralose
 - Alitame
 - Aspartame
 - Saccharin
- Which of the following compounds is not an antacid? **[2015]**
 - Phenelzine
 - Ranitidine
 - Aluminium hydroxide
 - Cimetidine
- Which one of the following is used as Antihistamine? **[Online 2014]**
 - Omeprazole
 - Chloranphenicol
 - Diphenhydramine
 - Norethindrone
- Aminoglycosides are usually used as: **[Online 2014]**
 - Antibiotic
 - Analgesic
 - Hypnotic
 - Antifertility

Concept

CHEMISTRY IN EVERYDAY LIFE

Drug - Target Interaction:

• **Enzyme as drug targets** : Drugs inhibit the attachment of substrate for their attachment on the active sites of enzymes. Some drugs have the capability to bind allosteric site of the enzyme and changing the shape of active site so that substrate cannot recognise it.

• **Receptors as drug targets** : Drugs that bind to the receptor site and inhibit its natural function (antagonists). These are useful when blocking of message is required. Some drugs mimic the natural messenger by switching on the receptor (agonists). These are useful when there is lack of natural chemical messenger.

Classification of Drugs:

- **Based on pharmacological effect** : This classification is based on pharmacological effect of the drugs. It is useful for doctors.
- **Based on drug action** : Drugs which act on a particular biochemical process are kept under one class.
- **Based on Chemical Structure** : Drugs having common structural features are grouped together in one class
- **Based on molecular target** : It is based on the interaction with biomolecules such as lipids, proteins, carbohydrates and nucleic acid.

Therapeutic Action of Drugs

- **Antacids** : Antacids are the drugs which neutralize excess acid in the gastric juices and give relief from acid indigestion. They remove the excess acid and raise the pH to appropriate level in stomach. There are mainly weak bases. Examples– $Mg(OH)_2$, $KHCO_3$ Omeprazole, Lansoprazole, Histamine, Cimetidine and Ranitidine.
- **Antihistamines** : Antihistamines are the drugs which diminish the main action of histamine (Chemical substance which cause allergic reactions in body) released in the body and thus prevent the allergic reactions. These are also anti-allergic drugs. Examples diphenhydramine hydrochloride (Banadryl) , Pheniramine maleate (Avil) etc.
- **Tranquilizers** : The chemical substances used to cure mental diseases are called **tranquilizers**. These are used to release mental tension and reduce anxiety. These are the constituents of sleeping pills. They act on higher centres of nervous system. e.g. equanil, serotonin, valium etc.
- **Analgesics** : For relieving pain.
- **Non-narcotic analgesics (non-addictive)** : Aspirin and paracetamol
- **Narcotic analgesics (addictive)** : Morphine, heroin, codeine etc.
- **Antibiotics** : (a) Bactericidal destroy microbes e.g. penicilin, ofloxacin etc.
(b) Bacteriostatic : Inhibit growth of microbes e.g. Chloramphenicol, erythromycin etc.
- **Spectrum** : The complete range of microorganism that can be killed by a particular antibiotic is known as spectrum. These are of following types:
 - Narrow spectrum antibiotics** : Streptomycin, Chloromycetin.
 - Broad spectrum antibiotics** : Chloramphenicol, Tetracycline.
- **Antiseptics** : May kill or stop growth of microbes e.g. dettol.
- **Antifertility** : Control menstrual cycle and ovulation of females e.g., norethindrone, novestrol etc.

Map

Soaps and Detergents

Detergents:

- Sodium salts of alkylbenzene sulphonic acids.
- Types of detergents :**
Detergents are of three types :
 - Anionic detergents
 - Cationic detergents
 - Non-ionic detergents.
- (i) Anionic detergents.** These are so called because a large part of their molecules are anions. These are of two types.

(a) Sodium alkyl sulphates :

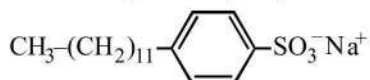
Example of this type of detergents is : sodium lauryl sulphate,



(b) Alkyl benzene sulphonates :

Example :

Sodium-4-(1-dodecyl) benzenesulphonate (SDS).



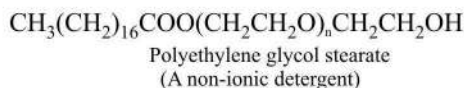
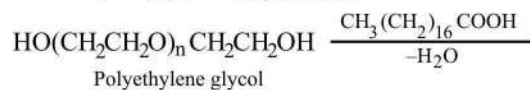
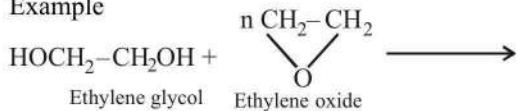
Sod. 4-(dodecyl)benzenesulphonate

(ii) Cationic detergents :

e.g., cetyltrimethylammonium bromide.

(iii) Non-ionic detergents :

Example



- Cleansing action of detergents:** The cleansing action of detergents are same as that of soaps. For example. A detergents, Sodium lauryl sulphate, $\text{CH}_3(\text{CH}_2)_{11}\text{CH}_2\text{O}-\text{SO}_2\text{Na}$, contains the polar group $-\text{OSO}_3^-$ alongwith the long hydrocarbon chains. It is an anionic detergent in which anions associate together to form an ionic micelle. Similarly, Cationic detergent also forms micelle.

Soaps:

- Sodium salts of long chain fatty acids like stearic acid, oleic acid, palmitic acid etc, are called hard soaps and the potassium salts of these fatty acids are called soft soaps
- Types of Soaps:**
 - Toilet soaps
 - Floating soaps
 - Medicated soaps
 - Transparent soaps
 - Shaving soaps
 - Laundry soaps

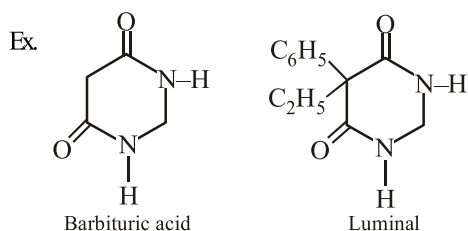
Chemicals in Food:

- Food Additives:** The chemicals, synthetic or natural substances added to food preparations for different purposes as given below are known as food additives.
 - Nutrients :** To increase the nutritive value of the food e.g., carbohydrates, proteins etc.
 - Preservatives :** To retard spoilage from bacterial action. e.g., NaNO_2 and NaNO_3 (in meat), $\text{C}_6\text{H}_5\text{COONa}$ (in tomato ketchup, fruit juices), Sodium metabisulphite (in pickles), Citric acid (fruit drinks), Sodium propionate (in bread and cheese) and SO_2 (in wine and juices).
 - Flavouring agents :** To enhance the flavour or to develop flavour e.g., alkyl alkanoates (esters), mono-sodium glutamate (MSG), vanillin, cinnamaldehyde.
 - Antioxidants :** To exclude oxygen to retard or prevent spoilage eg. BHT (Butylated hydroxy toluene) and BHA (Butylated hydroxy anisole).
 - Sweetners :** To add sweet taste e.g., saccharin, aspartame, sucralose.
- | Artificial sweetener | Sweetness Value |
|----------------------|-----------------|
| Aspartame | 100 |
| Saccharin | 550 |
| Sucralose | 600 |
| Alitame | 2000 |
- Colourants :** To give colour eg. Amaranth, Kesar etc.

Important/Critical Points to Remember

- ▶ 0.2% solution of phenol acts as antiseptic and its 1% solution acts as disinfectant.
- ▶ Dettol is an antiseptic. It is a mixture of chloroxylenol and terpineol in a suitable solvent.
- ▶ Bithional is an antiseptic which is generally added to medicated soaps to reduce the odour produced by bacterial decomposition of organic matter on the skin.
- ▶ The chemical substances used to cure mental diseases are called **tranquilizers**.

- (i) **Hypnotics** : These are also known as tranquilizers and are used to reduce mental tension and anxiety. These induce sleep. These are components of sleeping pills (sedatives)



- (ii) **Non Hypnotics** : They reduce tension and anxiety. These do not induce sleep. Equanil is also an important tranquilizer used in depression and hypertension.

Ex. Chlordiazepoxide, Meprobamate.

- ▶ Chemical substances which are used to control pregnancy in women are called *anti-fertility* drugs. For example, norethindrone, mestranol
- ▶ The drugs which have been used to fight allergy are called **antihistamines**. These are so called because they check the production of histamines. Cetirizine, Chlorpheniramine, Promethazine hydrochloride etc.

Antacids are substances that decrease gastric acidity by neutralising hydrochloric acid.

(i) **Systemic antacids** : Systemic antacids like sodium bicarbonate decrease acidity but cause systemic alkalosis due to absorption of bicarbonate. Hence acid-base balance is disturbed.

(ii) **Non-systemic antacids** : These may contain one or more of the following compounds : $\text{Al}(\text{OH})_3$, $\text{Mg}(\text{OH})_2$, MgCO_3 , CaCO_3 , magnesium trisilicate, magaldrate etc. These antacids are not absorbed after administration and hence acid-base imbalance is minimal.

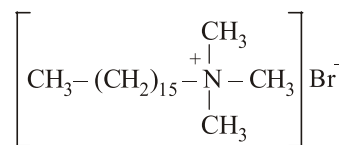
▶ The most common preservative used is sodium benzoate, $\text{C}_6\text{H}_5\text{COONa}$. It is metabolized by conversion to hippuric acid, $\text{C}_6\text{H}_5\text{CONHCH}_2\text{COOH}$ which ultimately is excreted in the urine. Salts of propionic acid and sorbic acid are also used as preservatives.

▶ The first popular artificial sweetener was saccharin. Saccharin is approximately 600 times sweeter than cane sugar.

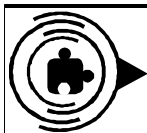
Aspartame is unstable at cooking temperatures, limiting its use as a sugar substitute to cold foods and soft drinks. Alitame is more stable than aspartame during cooking. One potential problem with alitame and similar type of high-potency sweeteners is the difficulty in controlling sweetness of food. Sucralose is predicted to become a great commercial success.

▶ **Cationic detergents** :

e.g., cetyltrimethylammonium bromide, i.e.,



Cetyl trimethyl ammonium bromide
(cationic detergent used in hair conditioners)



Exercise-1 : Concept Builder (Topicwise)

TOPIC 1: Drugs and Medicines

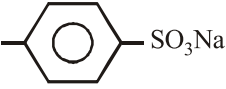
- An antipyretic is
 - quinine
 - paracetamol
 - luminal
 - piperazine
- Salol can be used as
 - antiseptic
 - antipyretic
 - analgesic
 - none of these
- Which one of the following is employed as a tranquilizer?
 - Naproxen
 - Tetracycline
 - Chlorpheninamine
 - Equanil
- Terfenadine is commonly used as a/an
 - tranquilizer
 - antihistamine
 - antimicrobial
 - antibiotic
- Tranquillizers are substances used for the treatment of
 - cancer
 - AIDS
 - mental diseases
 - physical disorders
- Which of the following is used for inducing sleep?
 - Paracetamol
 - Chloroquine
 - Bithional
 - Barbituric acid derivatives
- Chloramine-T is a/an
 - disinfectant
 - antiseptic
 - analgesic
 - antipyretic
- Penicillin was first discovered by
 - A. Fleming
 - Tence and Salke
 - S.A. Waksna
 - Lewis Pasteur
- Which of the following term means pain killer?
 - Antibiotic
 - Analgesic
 - Antipyretic
 - Penicillin
- Which of the following hormones is produced under the condition of stress which stimulates glycogenolysis in the liver of human beings ?
 - Thyroxine
 - Insulin
 - Adrenaline
 - Estradiol
- Arsenic containing medicine used for the treatment of syphilis is :
 - Tetracycline
 - Ofloxacin
 - Erythromycin
 - Salvarsan
- Which of the following is an insecticide
 - Bakelite
 - TNT
 - BHC
 - Aspirin
- Which of the following statements about aspirin is **not** true?
 - It is effective in relieving pain.
 - It is a neurologically active drug.
 - It has antiblood clotting action.
 - It belongs to narcotic analgesics.
- Chemically heroin is
 - morphine monoacetate
 - morphine dibenzoate
 - morphine diacetate
 - morphine monobenzoate
- Sulphonamides act as
 - Antiseptic
 - Analgesic
 - Antimicrobials
 - Antipyretic
- Substances used for bringing down temperature in high fever are called
 - pyretics
 - antipyretics
 - antibiotics
 - antiseptics
- Various phenol derivatives, tincture of iodine (2 – 3%) I₂ in (water / alcohol) and some dyes like methylene blue are
 - antiseptics
 - disinfectants
 - analgesics
 - antipyretics
- The insecticide containing 99% γ – isomer of benzene hexachloride is known as
 - lindane
 - TNT
 - malathion
 - methoxychlor
- The following compound is used as

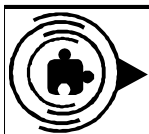
 - an anti-inflammatory compound
 - analgesic
 - hypnotic
 - antiseptic
- Amoxicillin is semi-synthetic modification of
 - penicillin
 - streptomycin
 - tetracyclin
 - chloroampheniol
- Which of these is a hypnotic ?
 - metaldehyde
 - acetaldehyde
 - paraldehyde
 - none of these

22. Which of the following is used as an antibiotic?
 (a) ciprofloxacin (b) paracetamol
 (c) ibuprofen (d) tocopherol
23. Barbituric acid and its derivatives are well known
 (a) antipyretics (b) analgesics
 (c) antiseptics (d) tranquillizers
24. The drug used for prevention of heart attacks is
 (a) aspirin (b) valium
 (c) chloramphenicol (d) cephalosporin
25. Omeprazole and lansoprazole are used as –
 (a) antifertility (b) antiallergic
 (c) antibiotic (d) antacid
26. Sulpha drugs are used for
 (a) precipitating bacteria
 (b) removing bacteria
 (c) decreasing the size of bacteria
 (d) stopping the growth of bacteria
27. Streptomycin is effective in the treatment of
 (a) tuberculosis (b) malaria
 (c) typhoid (d) cholera
28. An antibiotic with a broad spectrum
 (a) kills the antibodies
 (b) acts on a specific antigen
 (c) acts on different antigens
 (d) acts on both the antigens and antibodies
29. Which of the following is not an antiseptic drug?
 (a) Iodoform (b) Dettol
 (c) Gammexane (d) Genation violet
30. A medicine which promotes the secretion of urine is called
 (a) uretic (b) monouretric
 (c) diuretic (d) triuretic
31. Veronal, a barbiturate drug is used as
 (a) anaesthetic (b) sedative
 (c) antiseptic (d) None of these
32. A drug effective in the treatment of pneumonia, bronchitis, etc, is
 (a) streptomycin (b) chloramphenicol
 (c) penicillin (d) sulphaguanidine
33. An ester used as medicine is
 (a) ethyl acetate (b) methyl acetate
 (c) methyl salicylate (d) ethyl benzoate
34. Select the incorrect statement.
 (a) Equanil is used to control depression and hypertension.
 (b) Mifepristone is a synthetic steroid used as “morning after pill”.
 (c) 0.2 per cent solution of phenol is an antiseptic while its 1.0 per cent solution is a disinfectant.
 (d) A drug which kills the organism in the body is called bacteriostatic.
35. Which of the following acts as an antioxidant in edible oils ?
 (a) Vitamin B (b) Vitamin C
 (c) Vitamin D (d) Vitamin E
36. Which of the following is used as an antioxidant in food?
 (a) BTX (b) BHT
 (c) BHC (d) All the three
37. Which one of the following compounds is an anti-fertility drug?
 (a) Aspirin (b) Chloromycetin
 (c) Saheli (d) Penicillin
38. Which is used for sterilization of water in water supply system of cities?
 (a) Chlorine (b) Sulphurdioxide
 (c) Potassium permanganate (d) DDT
39. The drug which is effective in curing malaria is
 (a) quinine (b) aspirin
 (c) analgin (d) equanil
40. Heroin is a derivative of
 (a) cocaine (b) morphine
 (c) caffeine (d) nicotine
41. The formulation of dettol contains
 (a) chloroxylenol (b) terpineol
 (c) alcohol (d) All of these
42. Which of the following is an alkaloid?
 (a) Nicotine (b) Piperine
 (c) Cocaine (d) All of these
43. Morphine is
 (a) an alkaloid (b) an enzyme
 (c) a carbohydrate (d) a protein
44. Which of the following is an antidiabetic drug?
 (a) Insulin (b) Penicillin
 (c) Chloroquine (d) Aspirin
45. Further growth of cancerous cells in the body is arrested by
 (a) physiotherapy (b) chemotherapy
 (c) electrotherapy (d) psychotherapy

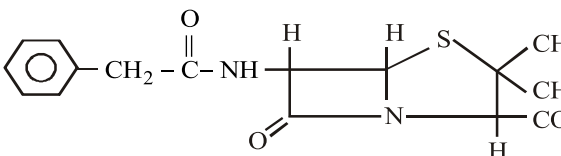
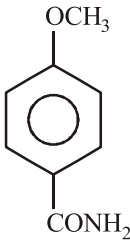
TOPIC 2: Food Preservatives and Cleansing Agents

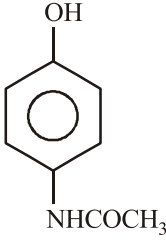
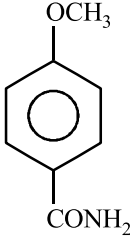
46. Structurally biodegradable detergents, should contain
 (a) normal alkyl chain (b) branched alkyl chain
 (c) phenyl side chain (d) cyclohexyl side chain
47. Detergents are prepared by the action of H_2SO_4 on which of the following?
 (a) Cholesterol (b) Lauryl alcohol
 (c) Cyclohexanol (d) *p*-Nitrophenol

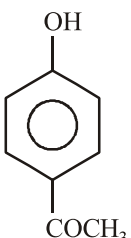
48. Substance used for the preservation of coloured fruit juices is
- (a) benzene (b) benzoic acid
(c) phenol (d) sodium meta bisulphite
49. Which of the following represents a synthetic detergent?
- (a) $C_{15}H_{31}COOK$
(b) $CH_3[CH_2]_{16}COONa$
(c) $C_{12}H_{25}$  SO_3Na
(d) None of these
50. Match the chemicals in Column I with their uses in Column II.
- | | Column I | | Column II |
|-----|--------------------|-------|----------------------|
| (A) | Sodium perborate | (I) | Disinfectant |
| (B) | Chlorine | (II) | Antiseptic |
| (C) | Bithional | (III) | Milk bleaching agent |
| (D) | Potassium stearate | (IV) | Soap |
- (a) A - I, B - II, C - III, D - IV
(b) A - II, B - III, C - IV, D - I
(c) A - III, B - I, C - II, D - IV
(d) A - IV, B - I, C - II, D - III



Exercise-2 : Concept Applicator

1. An antibiotic contains nitro group attached to aromatic nucleus. It is
- (a) penicillin (b) streptomycin
(c) tetracycline (d) chloramphenicol
2. Sulphaguanidine is used for
- (a) dysentery (b) urinary infections
(c) antiseptic (d) antipyretic
3. Interferon is connected with
- (a) tonic (b) virus
(c) carbohydrate (d) ore of iron
4. Phenacetin is used as
- (a) antipyretic (b) antiseptic
(c) antimalarial (d) antibiotic
5. A large number of antibiotics have been isolated from
- (a) Bacteria actinomycetes (b) Acids
(c) Alkanals (d) Bacteria rhizobium
6. Aspirin can be prepared by the reaction of
- (a) Salicylaldehyde with acetic anhydride in presence of H_2SO_4
(b) Salicylic acid with methanol in presence of H_2SO_4
(c) Salicylic acid with acetic anhydride in presence of H_2SO_4
(d) Cinnamic acid with acetic anhydride in presence of H_2SO_4
7. Which of the following is a hallucinogenic drug?
- (a) Methedrine (b) Calmose
(c) LSD (d) Seconal
8. Placebo is often given to patients. It is
- (a) an antidepressant
(b) a broad spectrum antibiotic
(c) a sugar pill
(d) a tonic
9. An antibiotic with a broad spectrum
- (a) kills the antibodies
(b) acts on a specific antigen
(c) acts on different antigens
(d) acts on both the antigens and antibodies
10. H_1 - Receptor antagonists is a term associated with :
- (a) Antiseptics (b) Antihistamins
(c) Antacids (d) Analgesics
11. The structure given below is known as
- 
- (a) Penicillin F (b) Penicillin G
(c) Penicillin K (d) Ampicillin
12. The correct structure of the drug paracetamol is
- (a) 

(b) 
- (c) 

(d) 

13. Which one of the following can possibly be used as analgesic without causing addiction and mood modification?
- (a) Diazepam
(b) Morphine
(c) N-acetyl-para-aminophenol
(d) Tetrahydrocannabinol

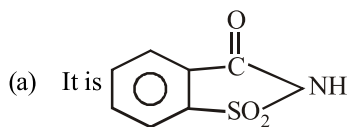
14. Antiseptics and disinfectants either kill or prevent growth of microorganisms. Identify which of the following statements is **not true**:

- (a) Chlorine and iodine are used as strong disinfectants.
(b) Dilute solutions of boric acid and hydrogen Peroxide are strong antiseptics.
(c) Disinfectants harm the living tissues.
(d) A 0.2% solution of phenol is an antiseptic while 1% solution acts as a disinfectant.

15. Which is correct about vanillin?

- (a) A flavouring agent having vanilla flavour
(b) *p*-hydroxy-*m*-methoxy benzaldehyde
(c) A food additive
(d) All of these

16. Which is correct about saccharin?



- (b) It is 600 times sweeter than sugar
(c) It is used as sweetening agent
(d) All of these

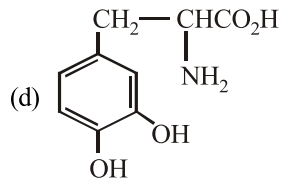
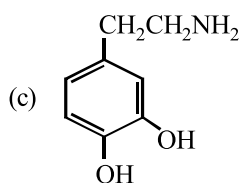
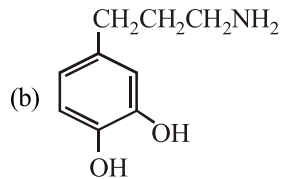
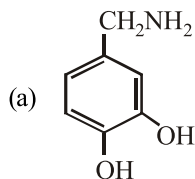
17. Benzalkonium chloride is a

- (a) cationic surfactant and antiseptic
(b) anionic surfactant and soluble in most of organic solvents
(c) cationic surfactant and insoluble in most of organic solvents
(d) cationic surfactant and antimalarial

18. Antiseptic chloroxylenol is

- (a) 4-chloro-3, 5-dimethylphenol
(b) 3-chloro-4, 5-dimethylphenol
(c) 4-chloro-2, 5-dimethylphenol
(d) 5-chloro-3, 4-dimethylphenol

19. Parkinson's disease is linked to abnormalities in the levels of dopamine in the body. The structure of dopamine is



20. Arsenic drugs are mainly used in the treatment of

- (a) Jaundice
(b) Typhoid
(c) Syphilis
(d) Cholera

21. The drug  is used as

- (a) Antacid
(b) Analgesic
(c) Antimicrobial
(d) Antiseptic

22. Which one of the following is employed as a tranquilizer drug?

- (a) Promethazine
(b) Valium
(c) Naproxen
(d) Mifepristone

23. Which of the following hormones contain iodine?

- (a) Insulin
(b) Testosterone
(c) Adrenaline
(d) Thyroxine

24. Chloroamphenicol is an :

- (a) antifertility drug
(b) antihistaminic
(c) antiseptic and disinfectant
(d) antibiotic-broad spectrum

25. Streptomycin, well known antibiotic, is a derivative of

- (a) peptides
(b) carbohydrates
(c) purines
(d) terpenes

26. Artificial sweetner which is stable under cold conditions only is :

- (a) Saccharine
(b) Sucralose
(c) Aspartame
(d) Alitame

27. Bithional is generally added to the soaps as an additive to function as a/an :

- (a) Dryer
(b) Buffering agent
(c) Antiseptic
(d) Softner

28. Which of the following is an analgesic?

- (a) Novalgin
(b) Penicillin
(c) Streptomycin
(d) Chloromycetin

29. Mixture of chloroxylenol and terpineol acts as:

- (a) antiseptic
(b) antipyretic
(c) antibiotic
(d) analgesic

30. Which of the following represents soap?

- (a) $C_{17}H_{35}COOK$
(b) $C_{17}H_{35}COOH$
(c) $C_{15}H_{31}COOH$
(d) $(C_{17}H_{35}COO)_2Ca$



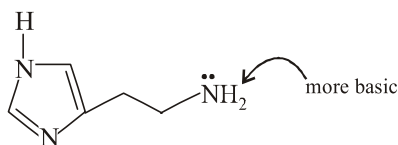
JEE Main 5 Years at a Glance																			
1	(b)	2	(d)	3	(a)	4	(d)	5	(a)	6	(a)	7	(c)	8	(a)				
EXERCISE-1 : Concept Builder (Topicwise)																			
1	(b)	6	(d)	11	(d)	16	(b)	21	(c)	26	(d)	31	(b)	36	(b)	41	(d)	46	(b)
2	(a)	7	(b)	12	(c)	17	(a)	22	(a)	27	(a)	32	(c)	37	(c)	42	(d)	47	(b)
3	(d)	8	(a)	13	(d)	18	(a)	23	(d)	28	(c)	33	(c)	38	(a)	43	(a)	48	(b)
4	(b)	9	(b)	14	(c)	19	(b)	24	(a)	29	(c)	34	(d)	39	(a)	44	(a)	49	(c)
5	(c)	10	(c)	15	(c)	20	(a)	25	(d)	30	(c)	35	(d)	40	(b)	45	(b)	50	(c)
EXERCISE-2 : Concept Applicator																			
1	(d)	4	(a)	7	(c)	10	(b)	13	(c)	16	(d)	19	(c)	22	(b)	25	(b)	28	(a)
2	(a)	5	(a)	8	(c)	11	(b)	14	(b)	17	(a)	20	(c)	23	(d)	26	(c)	29	(a)
3	(b)	6	(c)	9	(c)	12	(b)	15	(d)	18	(a)	21	(a)	24	(d)	27	(c)	30	(a)

Hints and Solutions

JEE MAIN 5 YEARS AT A GLANCE

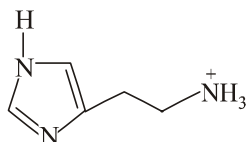
1. (b) Phenelzine contains hydrazine
Chloroxylenol contains phenol
Uracil is the pyrimidine base
Ranitidine contains furan ring

2. (d) Structure of histamine

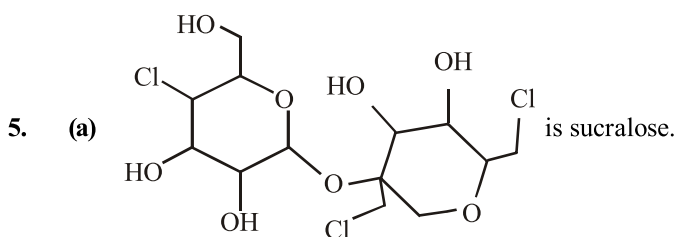
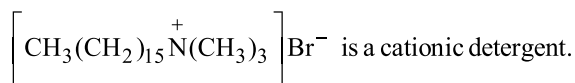


Blood is slightly basic in nature (7.35 pH). At this pH, terminal NH_2 will get protonated due to more basic nature.

\therefore Predominant structure of histamine is



3. (a) Bactericidal are the drugs that kills bacteria. Ofloxacin works by stopping the growth of bacteria. This antibiotic treats only bacterial infections.
4. (d) Sodium lauryl sulphate ($\text{C}_{11}\text{H}_{23}\text{CH}_2\text{OSO}_3^- \text{Na}^+$) is an anionic detergent. Glyceryl oleate is a glyceryl ester of oleic acid. Sodium stearate ($\text{C}_{17}\text{H}_{35}\text{COO}^- \text{Na}^+$) is a soap. Cetyltrimethyl ammonium bromide



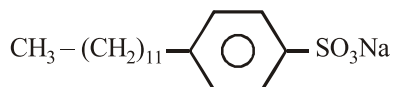
6. (a) Phenelzine is an antidepressant, while others are antacids.
7. (c) Diphenhydramine is used as antihistamine.
8. (a) The aminoglycosides are among the oldest antibiotics.

EXERCISE 1 : CONCEPT BUILDER (TOPICWISE)

1. (b) Paracetamol is an antipyretic
2. (a) Salol is phenyl salicylate used as antiseptic.
3. (d) Equanil is an important medicine used in depression and hypertension.

4. (b) Terfenadine is commonly used as antihistamine.
5. (c) 6. (d) 7. (b) 8. (a)
9. (b) Analgesic means pain killer.
10. (c) 11. (d) 12. (c)
13. (d) Aspirin is a non-narcotic analgesic.
14. (c)
15. (c) Sulphonamides act as antimicrobials.
16. (b)
17. (a) Antiseptic drugs cause destruction of micro-organism that produce septic diseases e.g. Dettol, savlon, boric acid, phenol, iodoform, KMnO_4 and some dyes such as methylene blue, gentian violet.
18. (a) Lindane or gammexane is γ isomer of BHC.
19. (b) It is acetyl salicylic acid i.e., aspirin which is used as analgesic and antipyretic.
20. (a) Amoxicillin is semisynthetic modification of penicillin
21. (c) Paraldehyde is a hypnotic.
22. (a) Ciprofloxacin is used as an antibiotic, while paracetamol, ibuprofen and tocopherol are respectively antipyretic, pain killer and vitamin E.
23. (d)
24. (a) Due to anti-blood clotting action of aspirin, it is used to prevent heart attack.
25. (d) Antacids decrease acidity in stomach.
26. (d) Sulpha drugs (antibacterials and antibiotics) are group of drugs which are derivatives of sulphanilamide.
27. (a)
28. (c) Broad spectrum antibiotics act on different antigens.
29. (c) Gammexane is an insecticide.
30. (c) 31. (b) 32. (c)
33. (c) Oil of winter green or methyl salicylate is used as medicine.
34. (d) Bacteriostatic drugs inhibit the growth of organisms while bactericidal drugs kill the microorganisms.
35. (d) Vitamin E is an antioxidant present in edible oils.
36. (b) 37. (c) 38. (a)
39. (a) Substances used for the treatment of malaria are antimalarials, e.g. quinine, chloroquine.
40. (b) Heroin is acyl derivative of morphine.
41. (d) Dettol (antiseptic) is a mixture of 4.8% chloroxylenol + 9.9% terpineol and absolute alcohol.
42. (d)
43. (a) It is an alkaloid, a class of organic compounds which is basic in nature and of plant origin containing at least one nitrogen atom in a ring structure of molecule.
44. (a)
45. (b) Paul Ehrlich, the father of chemotherapy defined it to injure or destroy infection caused by microorganism by the use of drugs without causing any injury to the host.

46. (b) Structurally, biodegradable detergents should contain branched alkyl chain.
 47. (b)
 48. (b) Benzoic acid is used as preservative as sodium benzoate.
 49. (c) The most widely used domestic detergent is the sodium dodecyl benzene sulphonate (SDS).

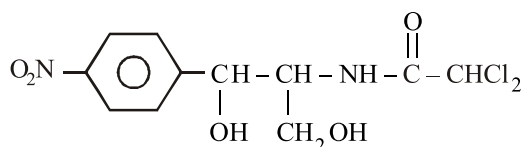


50. (c) The correct matching is as follows :

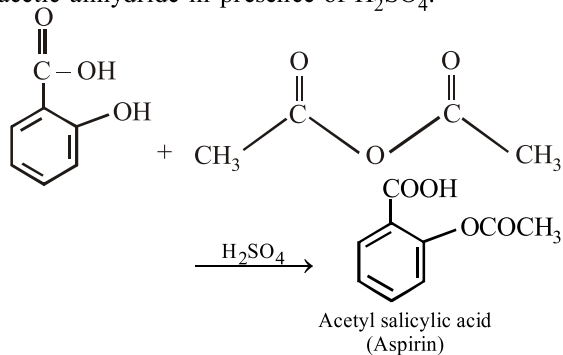
	Column I	Column II
(A)	Sodium perborate	Milk bleaching agent
(B)	Chlorine	Disinfectant
(C)	Bithional	Antiseptic
(D)	Potassium stearate	Soap

EXERCISE 2 : CONCEPT APPLICATOR

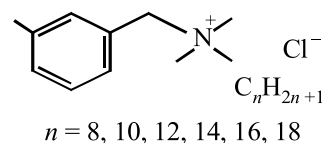
1. (d) Chloramphenicol is



2. (a) 3. (b) 4. (a) 5. (a)
 6. (c) Aspirin is prepared by reaction of salicylic acid with acetic anhydride in presence of H_2SO_4 .



7. (c) 8. (c)
 9. (c) Broad spectrum antibiotics act on different antigens.
 10. (b) The term "antihistamine" refers only to H_1 antagonists, which is also known as H_1 -receptor antagonists and H_1 -antihistamine.
 11. (b)
 12. (b)
 13. (c) We know that N-acetyl-para-aminophenol (or paracetamol) is an antipyretic which can also be used as an analgesic to relieve pains.
 14. (b) Dilute solutions of boric acid and hydrogen peroxide are weak antiseptics.
 15. (d) All are characteristics of vanillin.
 16. (d) All are characteristics of saccharin.
 17. (a) Benzalkonium chloride, also known as alkyl dimethyl benzyl ammonium chloride is nitrogenous cationic surface active agent belonging to the quaternary ammonium group. It is used as antiseptic.



18. (a) 19. (c) 20. (c) 21. (a) 22. (b)
 23. (d)
 24. (d) Chloroamphenicol is a broad spectrum antibiotic.
 25. (b)
 26. (c) Aspartame is stable under cold conditions.
 27. (c) Bithional is added to soaps to impart antiseptic properties.
 28. (a) Novalgin is most widely used as analgesic. Analgesics are pain relieving.
 29. (a) Dettol is a mixture of chloroxylenol and terpineol which is a very commonly known antiseptic.
 30. (a) Soaps are the sodium or potassium salts of higher fatty acids e.g., $\text{C}_{17}\text{H}_{37}\text{COOK}$ (potassium stearate). These are obtained by alkaline hydrolysis of oils and fats. The reaction is called saponification.