Biomolecule

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Introduction

- The living organisms are made of different types of compound
- The chemical analysis reveals that it is composed of elements like C,H,O,
- A piece of non living matter also contains same type of elements
- In fact the living things and non living things are made up of same elements
- However the relative abundance of Carbon, hydrogen is higher in the living organism than in non living matter

A Comparison of Elements Present in Non-living and Living Matter*

Element	% Weight of Earth's crust	% Weight of Human body
Hydrogen (H)	0.14	0.5
Carbon (C)	0.03	18.5
Oxygen (O)	46.6	65.0
Nitrogen (N)	very little	3.3
Sulphur (S)	0.03	0.3
Sodium (Na)	2.8	0.2
Calcium (Ca)	3.6	1.5
Magnesium (Mg)	2.1	0.1
Silicon (Si)	27.7	negligible

* Adapted from CNR Rao, *Understanding Chemistry*, Universities Press, Hyderabad.

How to analyze chemical composition ?

- Take any living tissue (a vegetable or a piece of liver, etc.) and grind it in **trichloroacetic acid (Cl_3CCOOH)** using a mortar and a pestle.
- We obtain a thick slurry. If we were to strain this through a **cheesecloth or cotton** we would obtain two fractions.

a)**the filtrate or, the acid-soluble pool (micromolecule/biomolecule),**
b) the retentate or the acid-insoluble fraction (Biomacromolecule).

a)Acid soluble pool

Scientists have found thousands of organic compounds in the acid-soluble pool. There is one feature common to all those compounds found in the acid soluble pool. They have molecular weights ranging **from 18 to around 800 daltons (Da)** approximately. Micromolecules have molecular weight less than 1000 Da.

b)Acid insoluble pool

The acid insoluble fraction, has only four types of organic **compounds i.e., proteins, nucleic acids, polysaccharides and lipids.** But the molecular weights of lipids do not exceed 800 Da, come under acid insoluble fraction. Because **Cell membrane and other membranes are broken into pieces during the experiment , and form vesicles which are not water soluble**. Therefore, these membrane fragments in the form of vesicles get separated along with the acid insoluble pool and hence in the macromolecular fraction. Therefore **lipids are not strictly macromolecule.**

- The acid insoluble fraction has molecular weight greater than 10000 Da.

Analysis of inorganic elements and compounds in the living tissue

All the carbon compounds that we get from living tissues can be called 'biomolecules'. However, living organisms have also got inorganic elements and compounds in them. A slightly different but destructive experiment has to be done. One weighs a small amount of a living tissue (say a leaf or liver and this is called wet weight) and dry it. All the water, evaporates. The remaining material gives dry weight. Now if the tissue is fully burnt, all the carbon compounds are oxidised to gaseous form (CO_2, water vapour) and are removed. What is remaining is called **'ash'**. This ash contains inorganic elements (like calcium, magnesium etc). Inorganic compounds like sulphate, phosphate, etc., are also seen in the acid-soluble fraction.

A List of Representative Inorganic Constituents of Living Tissues

Component	Formula
Sodium	Na^+
Potassium	K^+
Calcium	Ca^{++}
Magnesium	Mg^{++}
Water	H_2O
Compounds	NaCl, $CaCO_3$, PO_4^{3-} , SO_4^{2-}

The acid soluble pool represents roughly the cytoplasmic composition. The macromolecules from cytoplasm and organelles become the acid insoluble fraction. Together they represent the entire chemical composition of living tissues or organism.

Average Composition of Cells

Component	% of the total cellular mass
Water	70-90
Proteins	10-15
Carbohydrates	3
Lipids	2
Nucleic acids	5-7
Ions	1

Primary and secondary metabolites

Metabolites are organic compounds constantly utilzed in various metaolic activities in the cells. There are two types of metabolites

Primary metabolites: It is essential to the growth of the cell. They are produced continuously during the growth phase and are involved in primary metabolic processes such as respiration and photosynthesis

Eg: **proteins, nucleic acids, and polysaccharides**

Secondary metabolites : They are the compounds which are derived by pathways from primary metabolic routs, and are not essential to sustain the life of cells. These compounds do not have a continuous production Secondary metabolites are the end products of primary metabolites such as alkaloids, toxins, steroids, essential oils, lectins, drugs etc

Some Secondary Metabolites

Pigments	Carotenoids, Anthocyanins, etc.
Alkaloids	Morphine, Codeine, etc.
Terpenoides	Monoterpenes, Diterpenes etc.
Essential oils	Lemon grass oil, etc.
Toxins	Abrin, Ricin
Lectins	Concanavalin A
Drugs	Vinblastin, curcumin, etc.
Polymeric substances	Rubber, gums, cellulose

1. AMINO ACIDS

Amino acids are **building blocks of proteins**. Amino acids are organic compounds containing an amino group an acidic group as substituents on the same carbon **i.e., the α carbon**. Hence, they are called **α-amino acids**. They are substituted **methanes**. There are four substituent groups occupying the four valency positions. These are hydrogen, carboxyl group, amino group and a variable group designated as R group.

Based on the nature of R group there are many amino acids. However, those which occur in proteins are only of **twenty types.**

Classification of amino acids

a)Based on number of amino and carboxyl groups, amino acids are classified into

a)acidic amino acids

Eg: **Glutamic acid, Aspartic acid**

b)**Basic amino acids Eg: Lysine**

c)Neutral aminoacids: Eg: Valine

- There are **aromatic amino acids**
  Eg: tyrosine, phenylalanine, tryptophan

- **Sulphur containing amino acid**
  Eg:Cyteine

b)Based on the need to the human body , Amino acids are also classified into

a)Essential amino acids

b)Non essential amino acids

a)Essential amino acids

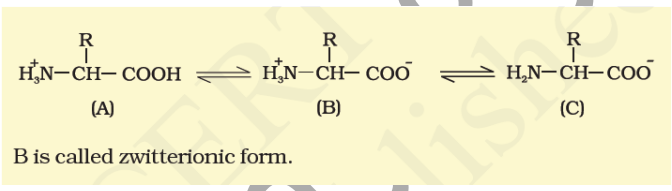
The amino acids **that cannot be synthesized in our body** and it should be provided through food is called essential amino acids

b)Non essential amino acids

The amino acids that can be synthesized in our body and **no need to be supplied through food** is called non essential amino acids

ZWITTER ION

A particular property of amino acids is the ionizable nature of –NH2 and –COOH groups. Hence in solutions of different pHs, the structure of amino acids changes. At a particular pH (Isoelctric point) of solution, amino acids occur as a dipolar ions with +ve and –ve charge in the same molecule. They are called Zwitter ions



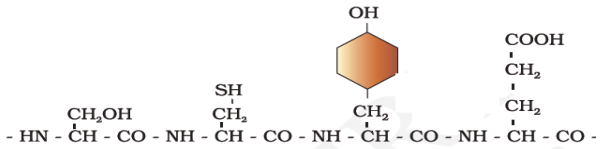
B is called zwitterionic form.

2. PROTEINS

Proteins are polypeptides formed of number of amino acids linked together by means of **Peptide bond**. **Peptide bond is formed is formed when the carboxyl (-COOH) group of one amino acid reacts with the amino (-NH2) group of the next amino acid with the elimination of a water** (the process is called **dehydration**) Proteins are formed of number of **different amino acids** and hence proteins are **heteropolymers. Based on structure proteins can be classified into**

a)Primary structure of proteins

Here the amino acids are arranged in a line .If a protein is imagined as a line, the left end represented by the first amino acid and the right end represented by the last amino acid. The first amino acid is also called as N-terminal amino acid. The last amino acid is called the C-terminal amino acid. The primary structure of protein gives the **positional information** of amino acids in a protein.



b)Secondary structure of protein

If the polypeptide is coiled to form of a helix (similar to a revolving staircase) the structure is called secondary structure of protein. In proteins, only **right handed helices** are observed.

c)Tertiary structure of protein

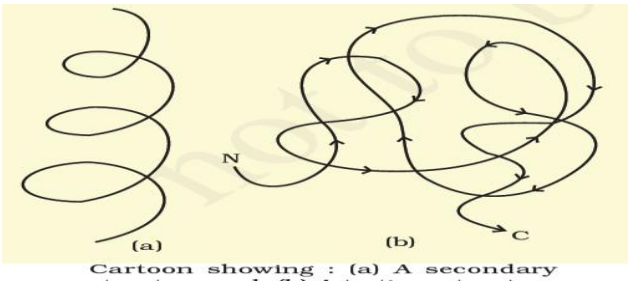
If protein chain is also folded upon itself like a hollow woolen ball, giving rise to the tertiary structure. 3-dimensional view of a protein.

- **Tertiary structure is absolutely necessary for the many biological activities of proteins.**

d)Quaternary structure

If proteins are formed of more than one polypeptide chain or subunits The manner in which these individual folded polypeptides or subunits are arranged with respect to each other (e.g. linear string of spheres, spheres arranged one upon each other in the form of a cube or plate etc.) is the architecture of a protein otherwise called the quaternary structure of a protein.

Eg: **adult Haemoglobin** consist of 4 subunits. It consist of 2α and 2β chain.



Cartoon showing : (a) A secondary structure and (b) A tertiary structure of proteins

Functions of proteins

1. some proteins acts as intercellular ground substance
eg: collagen
2. Some of the hormones are proteins

3. Some proteins helps in the transport of substance

eg: **GLUT- 4 (it helps in the transport of glucose into the cell)**

4. Some proteins fight against infectious agents

Eg: antibodies

5. Some proteins helps in blood coagulation

Eg:Fibrinogen

6. Most of the proteins are enzymes

Eg:Trypsin

7. Proteins acts as a receptor in the the sensory receptions like taste, smell, hormones etc.

- **Collagen is the most abundant protein in animal world**
- **Ribulose bisphosphate Carboxylase-Oxygenase (RuBisCO) is the most abundant protein in the whole of the biosphere**

3. LIPIDS

Lipids are water Insoluble, Contains

a)fatty acids.

A fatty acid has a carboxyl group attached to an R group.

The R group could be **a methyl (–CH3), or ethyl (–C2H5) or higher number of –CH2 groups (1 carbon to 19 carbons).**

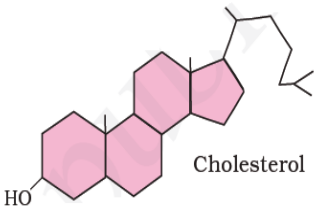
For example

(1)palmitic acid : It has **16 carbons** including carboxyl carbon.

(**2)Arachidonic acid** : It has **20 carbon** atoms including the carboxyl carbon.

- Fatty acids could be
  - i) **saturated**-it is without double bond
  - ii) **unsaturated**-It is with one or more C=C double bonds).

Another simple lipid is **glycerol** which is **trihydroxy propane**



Many lipids have both glycerol and fatty acids. Here the fatty acids are found **esterified** with glycerol. They can be

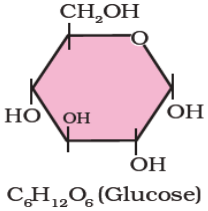
i)monoglycerides= 1 Fatty acids+ 1 Glycerol
ii)diglycerides= 2 fatty acids+ 1glycerol
iii) triglecerides=3 fatty acids+1 glcyerol

- These are also called fats and oils based on melting point. Oils have lower melting point (e.g., gingely oil) and hence remain as oil in winters.Fats have high melting point and occur in solid form in room temperature.
- Some lipids have **phosphorous and a phosphorylated organic compound in them.** These are **phospholipids**. They are found in cell membrane.

Eg: **Lecithin**

4. Polysaccharide

Polysaccharides are long chains of **sugars**. They are threads containing different **monosaccharides** as building blocks.



$C_6H_{12}O_6$ (Glucose)

For example,

1)**cellulose** is a polymeric polysaccharide consisting of only one type of monosaccharide i.e., glucose. Cellulose is a **homopolyme**r. Plant cell walls are made of cellulose

2)**Starch** is a variant of this but present as a **store house of energy in plant tissues**. It is also a homopolymer of glucose.

3.**Glycogen** : Animals have another variant called glycogen. It is also a homopolymer of glucose.

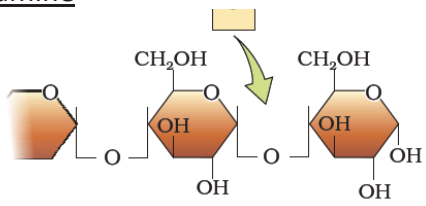
4.**Inulin** is a polymer of **fructose.**

- In a polysaccharide chain (say glycogen), the right end is called the reducing end and the left end is called the non-reducing end.

Starch forms helical secondary structures. starch can hold I_2 molecules in the helical portion. The **starch-I_2 is blue in colour**. Cellulose does not contain complex helices and hence cannot hold I_2.

6)**Exoskeletons** of arthropods have a complex polysaccharide called **chitin**. It is a homopolymer

Amino sugars : Glucosamine, N-acetyl galactosamine

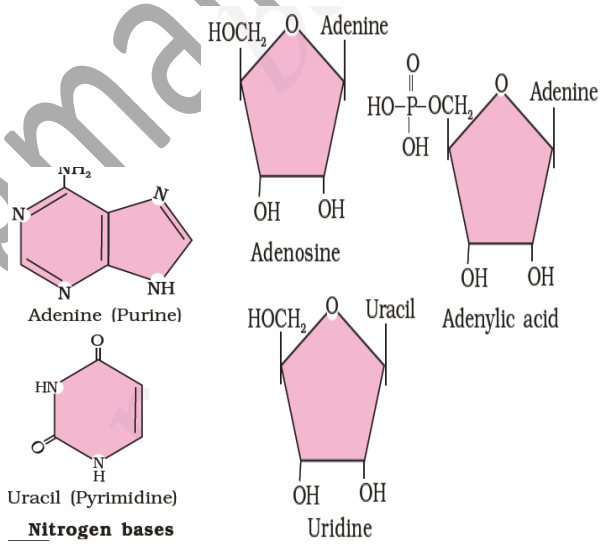


5. Nucleic acids

- Nucleic acids are macro molecule and found in the acid insoluble part .Nucleic acids act as the genetic material in all organisms. Nucleic acids are of two types DNA and RNA

DNA (Deoxy ribonucleic acid)

- DNA is formed of **two polynucleotides**. Each poly nucleotides are formed of number of **nucleotides.**
- A Single nucleotide is formed of nucleoside and phosphate . **Adenylic acid, thymidylic acid, guanylic acid, uridylic acid and cytidylic acid are nucleotides**
- A nucleoside formed of sugar and nitrogen base, **Adenosine, guanosine, thymidine, uridine and cytidine are nucleosides**.
- Sugar in DNA is deoxyribose and sugar in RNA is ribose
- Nitrogen bases are heterocyclic compounds.It is of two types, purines (Double rings) and Pyramidine (Single ring).
- Purines include **adenine, guanine,**
- Pyramidine include **uracil, cytosine and thymine**
- Nitrogen bases in DNA are **Adenine, guanine, thymine, Cytosine**
- Nitrogen bases in RNA is **Adenine, guanine, uracil ,Cytosine**
- There are two hydrogen bonds between A and T and three hydrogen bonds between G and C.
- At each step of ascent, the strand turns **36°.** One full turn of the helical strand would involve ten steps or ten base pairs.The pitch would be 34Å. The rise per base pair would be 3.4Å. This form of DNA with the above mentioned salient features is called **B-DNA.**



Turnover

One of the greatest discoveries ever made was the observation that all these biomolecules have a **turn over**. Biomoleculues are constantly being changed into some other biomolecules and also made from some other biomolecules. This is called turn over. This breaking and making is through chemical reactions constantly occurring in living organisms. Together all these chemical reactions are called **metabolism**.

Majority of these metabolic reactions are always linked to some other reactions. This series of linked reactions is called metabolic pathways. **This metabolic pathways are similar to automobile traffic in a city.** Another feature of these metabolic reactions

is that every chemical reaction is a catalysed reactions and it is catalysed by enzymes. So a multistep chemical reactions, when each of the step is catalysed by the same enzyme complex or different enzyme is called a metabolic pathway.

Eg: 1. In Glycolysis, glucose becomes Pyruvic acid through **ten different enzymes** catalysed metabolic reactions. But under normal aerobic condtions pyruvic acid is formed.

Eg :2 .In yeast, during fermentation, the same pathway leads to the production of ethanol.

Eg: 3. In our skeletal muscle, under anaerobic condtions, **lactic acid is formed**

Metabolism

The chemical reactions taking place in a living organism is called metabolism. Metabolic pathways include 2 processes.

a)Catabolism : It is the breakdown process. This process lead to the **release of energy**

Eg: When glucose is degraded to lactic acid in our skeletal muscle , energy is liberated which stored in the form of chemical bonds. When needed this bond energy is utilized

b)Anabolism : It is a synthetic phase. It **requires energy**

- The energy currency in living systems is the bond energy in a chemical called ATP **(Adenosine triphosphate)**

The living state

The system at equilibrium cannot perform a work. As living organisms work continuously, they cannot afford to reach equilibrium. Hence the living state is a non equilibrium steady state to be able to perform a work.

Metabolism provides a mechanism for the production of energy. Hence the living state and metabolism are synonymous. Without metabolism there cannot be a living state.

- The blood concentration of glucose in a normal healthy individual is 4.5-5.0mM.

6. Enzymes

Enzymes are **biological catalyst** capable of promoting a biochemical reactions within a living system. Almost all enzymes are proteins. But some nucleic acids behave like enzymes are called **ribozymes.**

Substrate : Substance upon which the enzyme act.

Active site : it is the substrate binding site of an enzyme

End product : the substance obtained at the end of enzymatic reactions

- Enzymes are damaged at high temperature (Above 40 c)
- Some enzymes isolated from organism who normally live under extreme high temperature (like hot vents) are stable and retain their catalytic power even at high temperature (80-90 c).
- Thermal stability is thus an important quality of such enzymes isolated from thermophilic organisms .

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Nature of Enzyme action

Each enzyme (E) has a substrate (S) binding site in its molecule so that a highly reactive enzyme-substrate complex (ES) is produced. This complex is short-lived and dissociates into its product(s) P.

The catalytic cycle of an enzyme action can be described in the following steps:

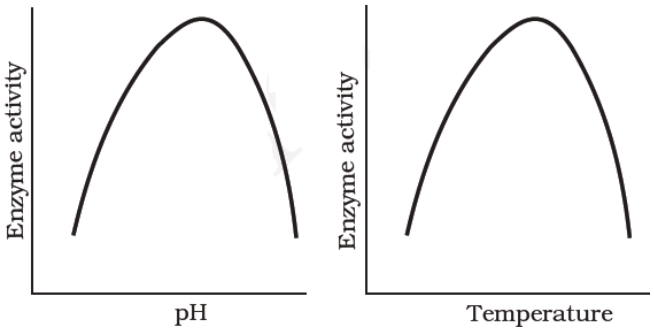
1. First, the substrate binds to the active site of the enzyme, fitting into the active site.
2. The binding of the substrate induces the enzyme to alter its shape, fitting more tightly around the substrate.
3. The active site of the enzyme, now in close proximity of the substrate breaks the chemical bonds of the substrate and the new enzyme- product complex is formed.
4. The enzyme releases the products of the reaction and the free enzyme is ready to bind to another molecule of the substrate and run through the catalytic cycle once again

$$E + S \rightleftharpoons ES \longrightarrow EP \longrightarrow E + P$$

Factors affecting enzyme activity

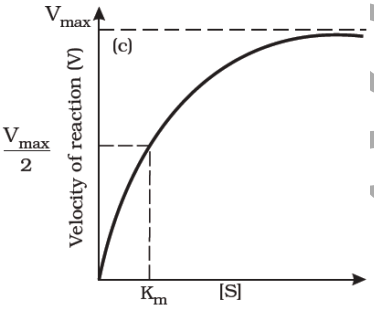
The activity of an enzyme can be affected by a change in the conditions which can **alter the tertiary structure of the protein**. These include temperature, pH, change in substrate concentration or binding of specific chemicals that regulate its activity

a)Temperature and pH



Enzymes generally function in a narrow range of temperature and pH. Each enzyme shows its highest activity at a particular temperature and pH called the **optimum temperature** and **optimum pH.** Activity declines both below and above the optimum value. Low temperature preserves the enzyme in a temporarily inactive state whereas high temperature destroys enzymatic activity because proteins are **denatured by heat.**

b) Concentration of Substrate



With the increase in substrate concentration, the velocity of the enzymatic reaction rises at first. The reaction ultimately reaches a maximum velocity (Vmax) which is not exceeded by any further rise in concentration of the substrate. This is because the enzyme molecules are fewer than the substrate molecules and after saturation of these molecules, there are no free enzyme molecules to bind with the additional substrate molecules

c) Enzyme Inhibition

The substance that shutoff the enzyme activities are called **inhibitors** and the process is called **enzyme inhibition**. When the inhibitor closely resembles the substrate in its molecular structure and inhibits the activity of the enzyme, it is known as competitive inhibitor. Due to its close structural similarity with the substrate, the inhibitor competes with the substrate for the substrate binding site of the enzyme (Active site). Consequently, the substrate cannot bind and as a result, the enzyme action declines,

e.g., **inhibition of succinic dehydrogenase by malonate which closely resembles the substrate succinate in structure**.

- Such competitive inhibitors are often used in the control **of bacterial pathogens.**

Classification and Nomenclature of Enzymes

Thousands of enzymes have been discovered, isolated and studied. Most of these enzymes have been classified into different groups based on the type of reactions they catalyse. Enzymes are divided into **6 classes** each with **4-13 subclasses** and named accordingly by a four-digit number.

1.Oxidoreductases/dehydrogenases: Enzymes which catalyse oxidoreduction between two substrates S and S' e.g.,

S reduced + S' oxidised → S oxidised + S' reduced.

2.Transferases: Enzymes catalysing a transfer of a group, G (other than hydrogen) between a pair of substrate S and S' e.g.,

S - G + S' → S + S' - G

3.Hydrolases: Enzymes catalysing hydrolysis of ester, ether, peptide, glycosidic, C-C, C-halide or P-N bonds.

4.Lyases: Enzymes that catalyse removal of groups from substrates by mechanisms other than hydrolysis leaving double bonds.

5.Isomerases: Includes all enzymes catalysing inter-conversion of optical, geometric or positional isomers.

6.Ligases: Enzymes catalysing the linking together of 2 compounds, e.g., enzymes which catalyse joining of C-O, C-S, C-N, P-O etc. bonds.

Co-factors

The protein art of an enzyme is called apoenzyme. The non protein part of en enzyme is called cofactor.Three kinds of cofactors may be identified: **prosthetic groups, co-enzymes and metal ions.**

a)Prosthetic groups: they are organic compounds and are distinguished from other cofactors in that they are tightly bound to the apoenzyme.

Example: in **peroxidase and catalase**, which catalyze the breakdown of hydrogen peroxide to water and oxygen**, haem** is the prosthetic group and it is a part of the active site of the enzyme.

b)Co-enzymes : they are also organic compounds but their association with the apoenzyme is only transient, usually occurring during the course of catalysis.

The essential chemical components of many coenzymes are vitamins, e.g., coenzyme nicotinamide adenine dinucleotide (NAD) and NADP contain the vitamin niacin.

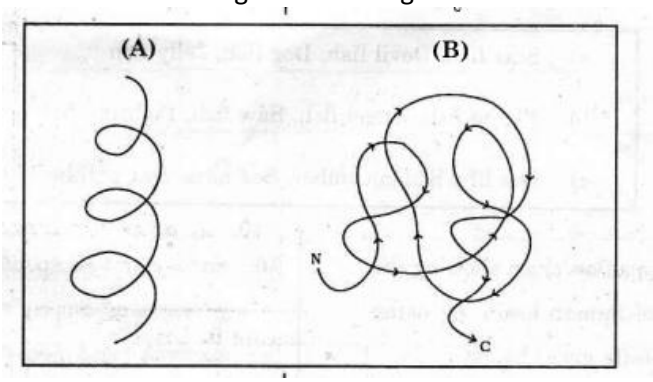
c)Metal ions :A number of enzymes require metal ions for their activity which form coordination bonds with side chains at the active site and at the same time form one or more cordination bonds with the substrate,

e.g., **zinc** is a cofactor for the proteolytic enzyme **carboxypeptidase.**

- Catalytic activity is **lost** when the co-factor is removed from the enzyme

Previous years question

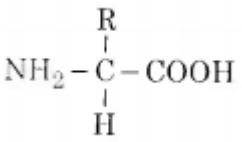
1. ..... is the most abundant protein in the animal world. (HSE March 2019)(1)
2. Observe the diagram A and B given below



a)What is A and B'

b)Mention the other two levels of protein structure ? (HSE March 2019)(2)

3. General formula of amino acid is given below (HSE-Model-2019)(3)



(a) Prepare the amino acide serine using this formula

(b) Proteins carry out many functionsin living organisms, list any four.

(c) Give one word

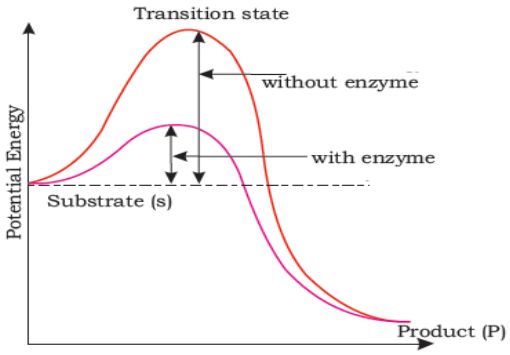
(i) The nucleic acid that behave like enzymes

(ii) The organic compound tightly bound to the apoenzyme.

(iii) The non-protein organic compound that are not tightly bound to the apoenzyme

(iv) The protein part of the enzyme

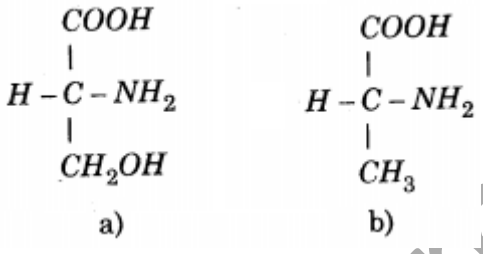
4. Observe the graph given below (HSE-Aug-2018)(3)



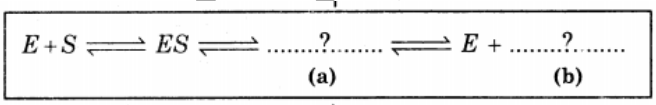
a) Identify the graph.

b) Mention the role of Enzyme in this process.

5. The molecular structure of 2 amino acids are given below Name them.(HSE-March-2018)(2)



6. a)Complete the diagrammatic representation showing the nature of enzyme action : (HSE-March-2018)(3)



b) List out any two factors affecting enzyme activity.

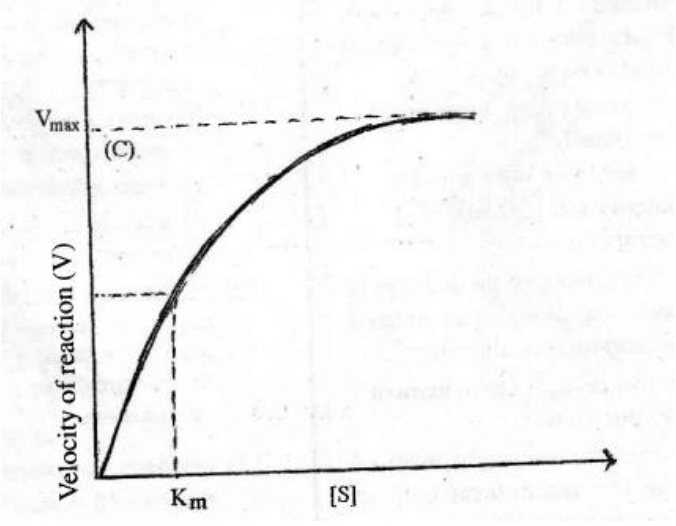
c)Based on the reaction formulae given below, identify the classes of the enzymes.

i) S reduced + S' oxidized ⟶ S oxidized + S' reduced

ii) $X\!-\!Y$; $C\!-\!C$ ⟶ $X-Y+C=C$

7. a) Effect of change in concentration of substrate on enzyme activity is graphically represented' After reaching a maximum velocity (Vmax)" the reaction is not exceeded by any further rise in concentration of substrate' Explain"

b) Mention any 2 other factors that affect enzyme activity ? (HSE-Model-2018)(3)

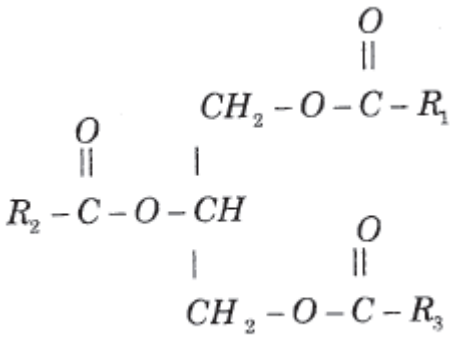


8. Fill in the blanks suitably (HSE-Model-2018)(2)
   In a proteins aminoacids are linked by ….(a)…In a polysacharides individual monosacharides are linked by…….(b)…..
9. Identify the wrong statement from the following and correct it (HSE-July-2017)(1)
   a)Lipds are not strictly macromolecule
   b)Cellulose is not a polysaccharide
10. Examples of 2 enzymatic reactions A and B are given. Identify the class of enzyme in A and B (HSE-July-2017)(2)
    A) S reduced + S' oxidised → S oxidised + S' reduced.
    (S,S'- Substrate)
    B) S - G + S' → S + S' – G
    (S,S'- substrate,G-Group)

OR

11. " Proteins is a heteropolymer not a homopolymer " . Substantiate the statement ? (HSE-July-2017)(2)

12. Identify the given biomolecule that comes under fat (HSE-sept-2016)(1)

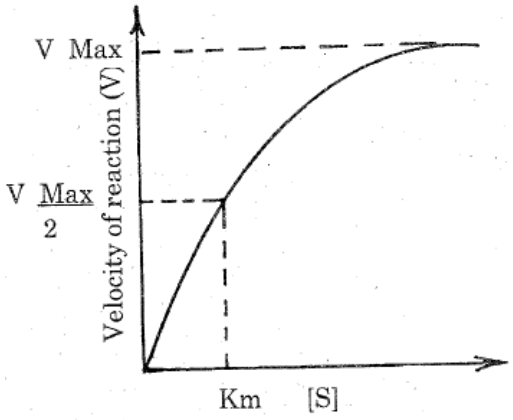


13. a)Name the biomacromolecule (Polymer) in which peptide bond is present ?
    b)Name the bond present between phosphate and hydroxy group of sugar in nucleic acid ? (HSE-sept-2016)(2)

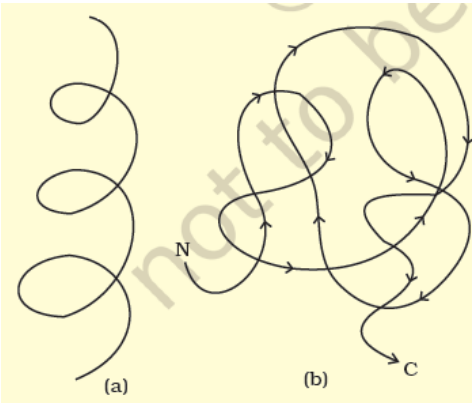
14. Metabolites are organic compunds constantly utilzed in various metaolic activities in the cells (HSE-March-2016)(2)
    a)What are the two types of metabolites in the cells?
    b)Give an example for each type of metabolites?
15. Enzymes are biocatalyst which regulate various biochemical reaction
    Illustrate the following reaction
    (HSE-March-2016)(2)

$$E + S \longrightarrow ES \longrightarrow E + P$$

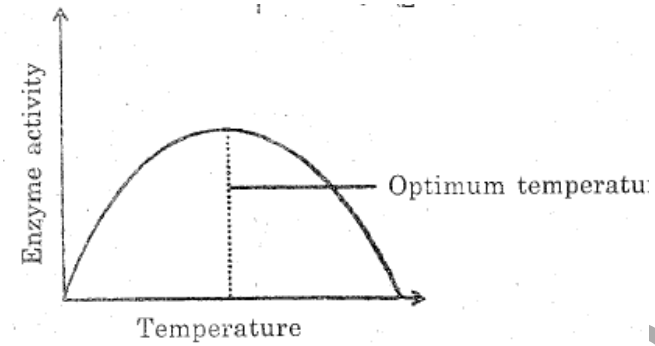
16. Compelete the following sequence with approprite words
    (HSE September-2015)(1)
    Amino acids:……(a)…….bond:protein ……(b)……: glycosidic bond : polysacharide
17. Based on the graph given below, explain the effect of concentration of substrate on enzyme activity.
    (HSE September-2015)(2)



18. Identify the protein structures, (a) and (B) from the following figure
    (HSE March-2015)(1)



19. Analyze the graph showing the activity of an enzyme, influenced by temperature (HSE march-2015)(2)



a)What is meant by optimum temperature?

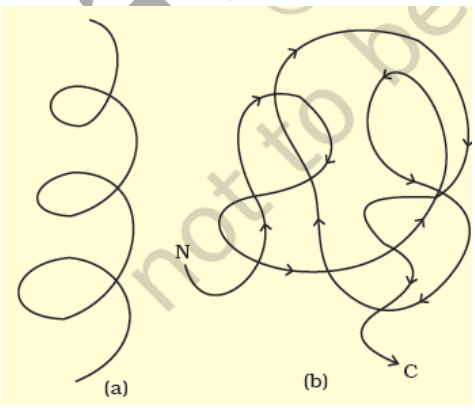
b)why does enzyme activity declines at too low and at too high temperature?

5. a. Why are proteins heteropolymers?

b.Identify the proteins from the given list of iomacromolecule and write its functions

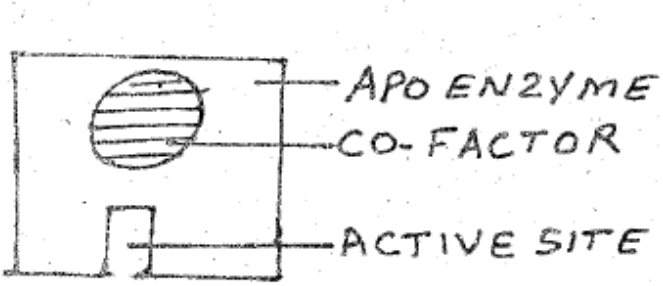
(Cellulose,starch,antibody, inulin)

c.Identify the type of protein structure of a and b (HSE August-2014)(3)



6. Symbolic presntation of a functional enzyme is given below

(HSE August-2014)(3)



a.Write one difference between cofactor and apoenzyme?

b.name the different types of cofactor

c.what is the cofactor for the enzyme , carboxypeptidase

7. Name the chemical bond formed between the following

(HSE March-2014)(1)

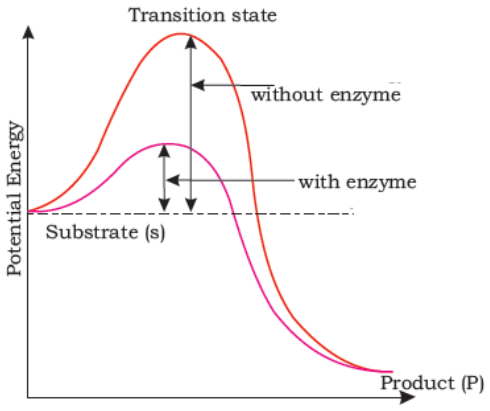
a. Amino acids in a protein moleucle

b. Sugar and phosphate in a nucleic acid

8. Distinguish between cofactor and coenzyme with an example for each?

(HSE March-2014)(2)

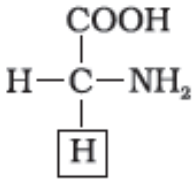
9. Oserve the graph and answer the following (HSE-SEPTEMBER-2013)(3)



a.Find out the role of enzyme?

b.Mention any two factors that influence the activity of an enzyme and state their influences?

10.

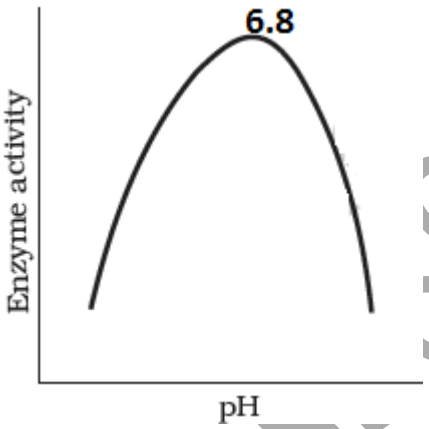


(HSE MARCH-2013)(1.5)

a. Identify this compound?
b. Name the bond produced when another compound of the same category combine with this?
c. If a number of such molecule bonded together , what will e the resultant molecule ?

11. Oserve the graph shoing the activity of an enzyme influenced y pH

(HSE march-2013)(2)



a. Name the possible enzyme involved in this reaction?
b. Where is its site of action
c. Mention any other factor which affects this enzyme
d. Name another similar enzyme acting on the same sustrate

12. Fill in the blanks

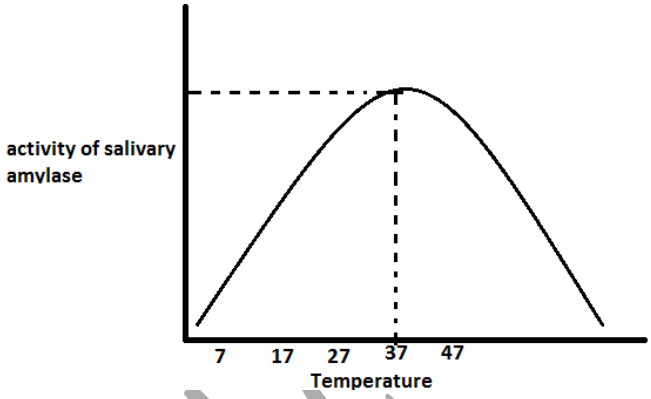
(HSE September-2012)(1)

Carbohydrate : sugar

Proteins:…….

13. Analyse the graph showing the activity of salivary amylase

(HSE September-2012)(1)



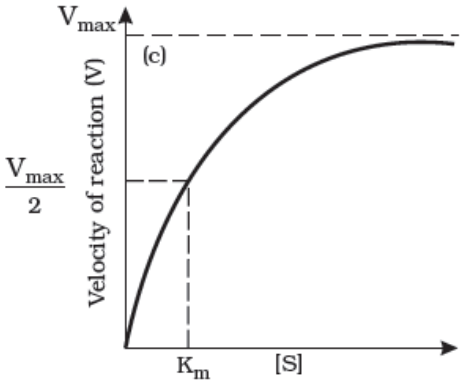
a. Which is the optimum temperature for salivary amylase from the graph?
b. Why the activity declines below the optimum value ?

14. Non protein constituent called cofactor are bound to the enzyme to make the enzyme catalytically activity

(HSE March-2011)(3)

a. Name the protein portion of the enzyme
b. What happens to the catalytic activity when the cofactor is removed from the enzyme?
c. Mention any two kinds of cofactor with examples?

15. Observe the graph



(HSE-March 2010)

a. What is meant by 'V_{max}' value?

b.Why is 'V_{max}' not exceeded by any further rise in the substrate concentration

c.If a chemical substance closely resembling to that of a substrate is introduced into a reaction system, what will be the consequences? Sustantiate

16. Fill in the blanks coloumns with the correct terms/sentence (HSE march-2009) (2)

A	B
……(1)…….	Catalyse oxiod reduction between 2 sustrate
Transferase	……(2)…….
Lyases	Catalyse hydrolysis of ester, glycosidic bond
……(3)…….	Catalyse inter conversion of opical isomers
Ligase	……(4)…….