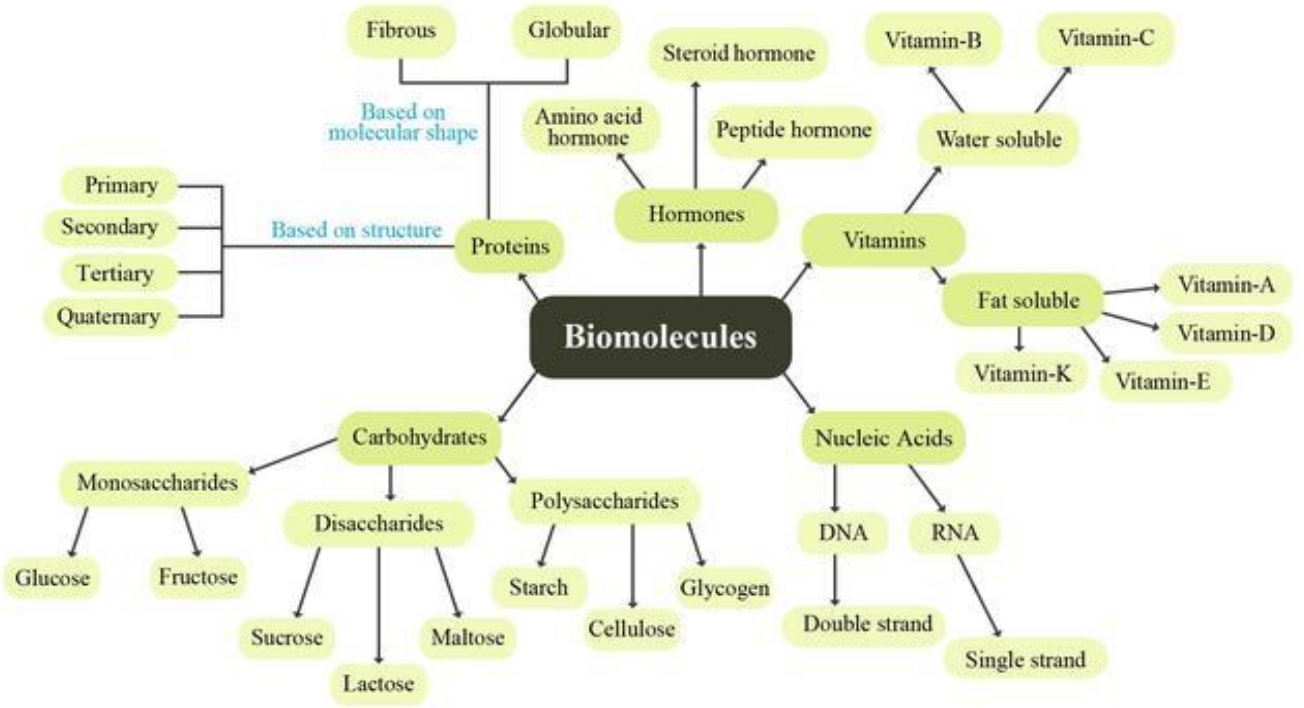
BIOMLOECULES

KEY POINTS	EXPLANATIONS
Monosaccharides	Cannot be hydrolyzed further .eg- glucose, fructose, ribose
Disaccharides	Sucrose (α-D- glucose + β-D-fructose), Maltose(α-D- glucose + α-D- glucose) Lactose(β-D-galactose + β-D-glucose)
Polysaccharides	*Starch* (two components—Amylose and Amylopectin) polymer of α-D- glucose
Amylose	Water soluble , 15-20% of starch.,unbranched chain , C1– C4 glycosidiclinkage.
Amylopectin	Water insoluble , 80-85% of starch.,branched chain polymer, C1–C4 & C1–C6 glycosidic linkage
Cellulose	Straight chain polysaccharide of β -D-glucose units/ joined by C1-C4glycosidic linkage (β-link), not digestible by human / constituent of cell wall of plant cells
Glycogen	Highly branched polymer of α-D- glucose .found in liver, muscles and brain.
reducing sugars	Aldehydic/ ketonic groups free so reduce Fehling's/ Tollens solution and. Eg- maltose and lactose
Non reducing sugars	Aldehydic/ ketonic groups are bonded so can not reduce Fehling's solution and Tollens' reagent. Eg- Sucrose
Anomers.	The two cyclic hemiacetal forms of glucose differ only in the configuration of the hydroxyl group at C1, called anomeric carbon Such isomers, i.e., α –form and β -form, are called anomers.
Invert sugar	Sucrose is dextrorotatory but after hydrolysis gives dextrorotatory glucose and laevorotatory fructose. Since the laevorotation of fructose (–92.4°) is more than dextrorotation of glucose (+ 52.5°), the mixture is laevorotatory. Thus, hydrolysis of sucrose brings about a change in the sign of rotation, from dextro (+) to laevo (–) and the product is named as invert sugar.
Glycosidic linkage	Linkage between two monosaccharide through oxygen atom.
Importance of Carbohydrates	Major portion of our food. used as storage molecules as starch in plants and glycogen in animals. Cell wall of bacteria and plants is made up of cellulose. Wood and cloth are cellulose.Provide raw materials for many important industries like textiles, paper, lacquers and breweries.
Essential amino acids	which cannot be synthesised in the body and must be obtained through diet, eg- Valine, Leucine
Nonessential amino acids	which can be synthesised in the body, eg - Glycine, Alanine
zwitter ion.	In aqueous solution, amino acids exist as a dipolar ion known as zwitter ion.
peptide linkage	peptide linkage is an amide linkage formed between –COOH group and –NH2 group of two successive amino acids in peptide chain.
1^0- str. of proteins:	sequence of amino acids in protein.
2^0- str. of proteins:	secondary structure of protein refers to the shape in which a long polypeptide chain can exist. They are found to exist in two types of structures viz. α -helix and β -pleated sheet structure.
Tertiary structure of proteins:	Further folding of the secondary structure. It gives rise to two major molecular shapes viz. fibrous and globular.
Fibrous proteins	Polypeptide chains run parallel, held together by hydrogen and disulphide bonds, fibre– like structure. Water insoluble .Eg- are keratin(in hair, wool, silk) and myosin (present in muscles).
Globular proteins	Chains of polypeptides coil around to give a spherical shape. Water soluble. Eg- Insulin and albumins

Stab.forces2°& 3°	hydrogen bonds, disulphide linkages, van der Waals and electrostatic forces of attraction.
Denaturation of Proteins	When a protein is subjected to physical change like change in temperature or chemical change like change in pH, the hydrogen bonds are disturbed. Due to this, globules unfold and helix get uncoiled and protein loses its biological activity. This is called denaturation of protein. (During denaturation 2° and 3° structures are destroyed but 1º structure remains intact.) eg- The coagulation of egg white on boiling, curdling of milk
DNA	pentose sugar (D-2-deoxyribose) + phosphoric acid + nitrogenious bases (A , G , C, T)
RNA	pentose sugar (ribose) + phosphoric acid + nitrogenious bases (A , G , C, U)
Nucleoside / tides	Nucleoside □ sugar + base Nucleotides □ sugar + base + phosphate
Phosphodiester link	Linkage between two nucleotides in polynucleotides
Functions of Nucleic Acids	DNA reserve genetic information, maintain the identity of different speciese is capable of self duplication during cell division, synthesizes protein in the cell.

MIND-MAP



QUESTION BANK

I- (MCQ)

1. Which of the following polymer is found in the liver of animals?

   (a) Amylose (b) Cellulose (c) Amylopectin (d) Glycogen

2. The secondary structure of Protein is stabilized by :

   (a) Peptide bonds (b) vander Waals forces (c) Hydrogen bonds(d) Dipole-dipole interactions

3. Nucleic acids are the polymers of:

   a)Nucleosides (b)Nucleotides (c)Bases (d) Sugars

4. DNA and RNA contains four bases each. Which of the following bases is not present in RNA?

   (a) Adenine (b) Uracil(c) Thymine (d) Cytosine

5. The presence or absence of hydroxyl group on which carbon atom of sugar differentiate RNA and DNA

   (a) 2^{nd} (b) 4^{th} (c) 3^{rd} (d) 1^{st}

6. Proteins can be classified in to two types on the basis of their molecular shape i.e. fibrous protein and globular proteins. Examples of fibrous proteins is :

   (a) Insulin (b) Keratin (c) Myoglobin (d) Haemoglobin

7. The reagent used for obtaining osazone derivatives of fructose is

   (a) NH_2OH (b)NH_2-NH_2 (c)NH_2-NHC_6H_5 (d)2,4- DNP

8. The disease resulting from the intake of amino acid deficient diet is:

   (a)kwashiorkar (b)pernicious anaemia (c)PEM (d) haemophilia

9. Keratin present in hair is an example of:

   (a)fibrous protein b) globular protein c) conjugated protein (d)derived protein

10. DNA and RNA differ in:-

    (a)Sugar (b)purines (c)pyrimidines (d)both a) and b)

II-ASSERTION-REASON TYPE

Directions: In the following questions, A statement of Assertion (A) is followed by a statement of Reason (R). Mark the correct choice as.

(A) Both A and R are true and R is the correct explanation of A

(B) Both A and R are true but R is NOT the correct explanation of A

(C) A is true but R is false

(D) A is false and R is True

1. Assertion (A): D(+)–Glucose is dextrorotatory in nature.
Reason (R): 'D' represents its dextrorotatory nature.

2. Assertion (A): Deoxyribose, $C_5H_{10}O_4$ is not a carbohydrate.
Reason (R): Carbohydrates are optically active polyhydroxy aldehyde or polyhydroxy ketone or substances which give aldehyde or ketone on hydrolysis.

3. Assertion (A): Glucose reacts with hydroxylamine to form an oxime and also adds a molecule of hydrogen cyanide to give cyanohydrin.
Reason (R): The carbonyl group is present in the open chain structure of glucose.

4. Assertion (A): The two strands of DNA are complementary to each other.
Reason (R): The hydrogen bonds are formed between specific pairs of bases.

5. Assertion (A): All naturally occurring α amino acids except glycine are optically active.
Reason (R): Most naturally occurring α amino acids have L-configuration.

III-SHORT ANSWER TYPE-I (2-MARKS)

Q1. Describe what do you understand by primary structure and secondary structure of proteins.
Q2.i)Which of the following is a polysaccharide:Starch, maltose, fructose, glucose.
ii)Write the name of the vitamin responsible for the coagulation of blood.
Q3.i) Glucose on reaction with HI gives n-Hexane. What does it suggest about the structure of glucose.
ii) Give one example each for water-soluble vitamins and fat soluble vitamins.
Q4.i)Write one reaction of D-glucose which cannot be explained by its open chain structure.
ii)What type of linkage is present in nucleic acids?
Q5. i) Explain what is meant by pyranose structure of glucose?
ii) Deficiency of which vitamin causes Scurvy?

IV-SHORT ANSWER TYPE-II (3-MARKS)

Q1. Differentiate between the following:
i) Amylose and Amylopectin ii) Globular protein and Fibrous protein iii) Nucleotide and Nucleoside
Q2. Define the following terms: i)Polysaccharides ii) Denatured protein iii) Vitamins
Q3.i) What are the hydrolysis products of DNA ?
ii) What happens when D-glucose is treated with Bromine water?
iii) What is the effect of denaturation on the structure of protein?
Q4. Write the reactions involved when D-glucose is treated with the following reagents:
i) Br_2 water ii) H_2N-OH iii) $(CH_3CO)_2O$
Q5. i) Write the product when D-glucose is treated conc.HNO_3.
ii) Amino acids show amphoteric behaviour. Why?
iii) Write one difference between α -helix and β -pleated sheet structure of proteins.
Q6.Define: i) Anomers ii) Essential Amino acids iii) Oligosaccharides
Q7.Write the main Structural difference between RNA and DNA. Of the four bases, name those which are common to both DNA and RNA.

V-PASSAGE/CASE STUDY/SOURCE BASED QUESTIONS:-

CASE-1- Read the given passage and answer the questions that follow.
Living system are made up of complex molecules called Biomolecules. Carbohydrate, proteins, enzymes, nucleic acids, lipids, hormones ATP, DNA and RNA play an important role in our daily life. Carbohydrates provide us energy. Protein help in growth and maintenance of body. Nucleic acids, RNA helps in protein synthesis, DNA helps in transfer of genetic characteristics. Fat are source of energy and protect our vital organs.
(a) Why are carbohydrates optically active?

(b) Name two acidic amino acids.
(c) Name a protein which has quarternary structure.
(d) What are products of hydrolysis of fats?
(e) What is role of glycerol in shaving creams?

CASE-2 Read the given passage and answer the questions that follow.

Biomolecules are complex molecules which build up living organisms and required for their growth, maintenance and ability to reproduce. Carbohydrates are polyhydroxy aldehydes and ketones which are major sources of energy. Monosachharides are simple sugars which cannot be hydrolysed. Oligosachharide, on hydrolysis give 2 to 10 molecules of monosachharides. Polysachharides like starch and cellulose on hydrolysis give large number of molecules of glucose a-glucose and b-glucose (Anomers). Proteins are complex nitrogeneous polymers of amino acids connected through peptide bonds. The sequence in which amino acids are linked is called Primary structure. Secondary structures are of 2 types a-helix in globular proteins and b-pleated structure in fibrous proteins involving H-bonds. Tertiary structure has H-bonds, disulphide linkage, ionic bonding and van der Waals' forces. Insulin is hormone for metabolism of glucose, has quarternary structure. Denaturation of protein destroys secondary and tertiary structure, loss of biological activity but primary structure remaining the same.Enzymes are highly specific, work at specific pH, moderate temperature and catalyse biochemical reactions. Hormones perform specific functions and secreated by endocrine glands. Vitamins are essential for healthy body. A, D, E, K are fat soluble vitamins. Vitamin C and B1, B2, B6 are water soluble. B12 is neither water, nor fat soluble. Nucleic acids are polymer of nucleotides. RNA consist of m-RNA, t-RNA, r-RNA. RNA has Adenine, Cytosine, Uracil and Guanine. It helps in protein synthesis. It cannot replicate. DNA contains deoxyribose, A, C, G and Thymine. It transfers genetic characteristics. DNA has double helix structure and undergoes replication.

(a) Name a disachharide which on hydrolysis give glucose and galactose.
(b) What tyhpe of protein is albumin?
(c) Name one non-reducing sugar.
(d) Which one is complementary base of cytosine in one strand of DNA to that in other strand of DNA?
(e) Which linkage by which nucleotide are joined together between 5′ and 3′ atoms of pentose sugar?
(f) Which enzyme can dissolve blood clots to prevent heart attack?

CASE-3. Read the given passage and answer the questions that follow

Carbohydrates are optically active polyhydroxy aldehydes or polyhydroxy ketones or substances which give these on hydrolysis. These work as body fuels and act as a source of energy. These are broadly classified as monosaccharides, disaccharides and polysaccharides.The disaccharides and polysaccharides give molecules of mono-saccharides on hydrolysis.These may be reducing or non-reducing. Reducing sugars reduce Fehling solution and Tollen's reagent. Non-reducing sugars such as sucrose donot reduce Fehling solution and Tollen's reagent. Monosaccharides may be aldoses or ketoses. Among these glucose and fructose are very common. Glucose has one aldehydic group, four 2° alcoholic groups and one 1° alcoholic group while fructose has one keto group, three 2° alcoholic groups and two 1° alcoholic groups.Glucose has pyranose structure and fructose has furanose structure. The monosaccharides in polysaccharides and disaccharides are held together by glycosidic linkages.

The following are multiple choice questions. Choose the most appropriate answer:

i) In which of the following pair, both are reducing sugars?
(a) Glycogen, glucose (b) Galactose, maltose (c) Sucrose, lactose (d) Lactose, maltose
ii) D-Galactose and D-glucose have different configuration of H and OH groups at:
(a) C-2 (b) C-3 (c) C-4 (d) C-5
(iii) Maltose on hydrolysis gives;
(a) Glucose and fructose (b) Glucose and galactose
(c) Glucose and amylose (d) Glucose only
(iv) The number of asymmetric C-atoms in cyclic form of D-glucose is:
(a) 5 (b) 3 (c) 4 (d) 1
(v) The carbohydrate stored in liver of human beings is;
(a) Glucose (b) Glycogen (c) Galactose (d) Amylopectin

VI-LONG ANSWER TYPE-III (5-MARKS)

Q1. a) Write the name of component of starch which is water soluble?
b) Why vitamin C cannot be stored in our body?

c)What products would be formed when a nucleotide from DNA containing thymine is hydrolysed?
d) What type of linkage hold together monomers of DNA ?
e) How nucleosides are differ from nucleotides?
Q2.a) What forces are responsible for the stability of α -helix? Why is it named as **3.6_{13} α -helix** ?
b)What is isoelectric point of amino acids?
c) What do you mean by Native state of protein?

ANSWERS BIOMOLECULES

I ANSWERS OF MCQ;

1-d 2-c 3-b 4-c *5-a 6-b* 7- c 8 –a 9- a 10-d

II-ANSWERS OF ASSERTION-REASON;

1. C 2.D 3.A 4.A 5.B

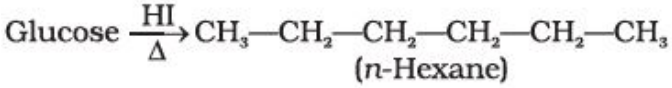
III-ANSWERS OF SHORT ANSWER (TYPE-I)

A1. **Primary structure** : The specific sequence in which the various a-amino acids present in a protein are linked to one another is called its primary structure. Any change in the primary structure creates a different protein .

Secondary Structure : The conformation which the polypeptide chain assumes as a result of hydrogen bonding is known as secondary structure. The two of secondary structures are α-helix and β-pleated sheet structures.
In α-helix structure, the polypeptide chain forms all the possible hydrogen bonds by twisting into a right-handed screw (helix) with the −NH group of each amino acid residue hydrogen bonded to the >C=O groups of an adjacent turn of the helix. In β-pealed structure. , all peptide chains are stretched out to nearly maximum extension and then laid side by and are held together by hydrogen bonds.

A2. I) Starch ii) Vitamin K

A3. i) Glucose on prolonged heating with HI and red phosphorus gives n-hexane HI (excess)

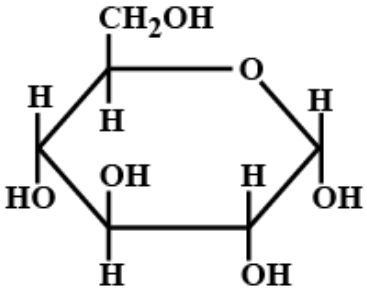


ii) Water soluble vitamin: Vitamin B; Fat soluble vitamin:Vitamin A

A4.i) Despite having aldehydic (-CHO) group. Glucose does not react with NaHSO3 to form addition product

ii) Phosphodiester linkage.

A5.i) The six-membered cyclic structured of glucose is called pyranose structure (a− or b−) in analogy with hetercylic compound pyran.



α-D-(+)-Glucopyranose

ii) Vitamin -C

IVANSWERS OF SHORT ANSWER (TYPE-II)

1.i)

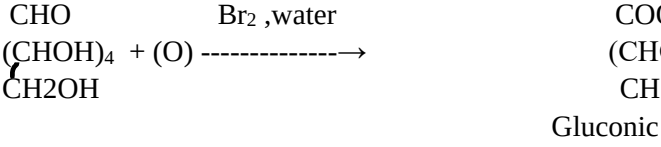
Amylose	Amylopectin
It is a straight-chain polymer of D-glucose units	It is a branched-chain polymer of D-glucose units

Constitutes 20% of starch	Constitutes 80% of starch
It is soluble in water	It is insoluble in water
It contains α-1,4-glycosidic bonds between two glucose units	It contains α-1,4-glycosidic bonds between two glucose unit in the straight chain and α-1,6-glycosidic bonds at the branching

1ii).a: Glycosidic linkage is joint monosaccharide units while peptide linkage is joint amino acid units.
b: Glycosidic linkage is formed by the reaction between aldehyde or ketone group and alcoholic groups while peptide linkage is formed by the reaction between amino acids and carboxyl groups.

1 iii). a: Fibrous proteins are generally composed of long and narrow strands and have a structural role whereas globular proteins generally have a more compact and rounded shape and have functional roles

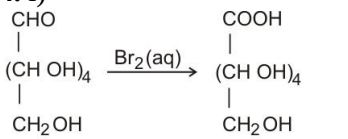
b: Fibrous proteins are generally insoluble in water such as keratin, while globular proteins are usually soluble in water such as insulin.
2.i) Carbohydrates which yield a large number of monosaccharide units on hydrolysis are called **polysaccharides.** Some common examples are starch, cellulose, glycogen, gums.
ii) When a protein in its native form, is subjected to physical change like change in temperature or chemical change like change in pH, the hydrogen bonds are disturbed. Due to this, globules unfold and helix get uncoiled and protein loses its biological activity. This is called **denaturation of protein**.
iii) organic compounds required in the diet in small amounts to perform specific biological functions for normal maintenance of optimum growth and health of the organism are called Vitamins.
3.i)DNA on hydrolysis gives pentose sugar + phosphoric acid + Base(ATGC).
ii) Glucose gets oxidised to six carbon carboxylic acid (gluconic acid) on reaction with a mild oxidising agent like bromine water. This indicates that the carbonyl group is present as an aldehydic group.



Gluconic acid

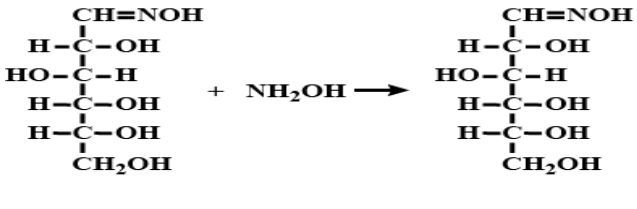
iii) During denaturation 2° and 3° structures are destroyed but 1º structure remains intact.) eg- The coagulation of egg white on boiling, curdling of milk.

4. i)



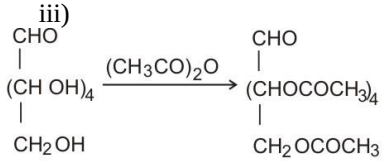
Gluconic Acid

ii)

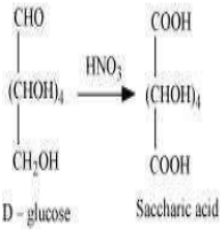


D(+) glucose **Oxime**

iii)



Glucose penta acetate

5.i) 

ii) Amino acids have amino (−NH2) group, basic in nature and accepts a proton and COOH group loses a proton forming a dipolar ion, called the Zwitter ion. In this form, amino acids behave both as acids and bases so they are amphoteric in nature.

iii) In α-helix structure of proteins, the polypeptide chains are stabilized by intramolecular hydrogen bonding whereas β-pealed sheet structure of proteins is stabilized by intermolecular hydrogen bonding.

6.i) The two cyclic hemiacetal forms of glucose differ only in the configuration of the hydroxyl group at C1, called anomeric carbon Such isomers, i.e., α –form and β -form, are called anomers.

ii) which cannot be synthesised in the body and must be obtained through diet, eg- Valine, Leucine

iii) Oligosaccharides are formed when two or more monosaccharides join together by O-glycosidic bonds. Examples include sucrose, lactose and maltose.

Q7.

DNA	RNA
i)The sugar present in DNA in 2−deoxyribos	i) The sugar present in RNA is D−ribose
ii) DNA has double stranded a-helix structure.	ii) RNA has single a-helix structure
iii)Nitrogenous base **Urasil** is not present.	iii) Nitrogenous base **Thymines** not present.

Common bases present in both DNA and RNA are adenine (A) , guanine (G) and Cytosine (C).

V-ANSWERS OF PASSAGE/CASE STUDY/SOURCE BASED QUESTIONS;

CASE-1. (a) Ans. It is because they contain 'Chiral' carbon atoms.

(b) Ans. Aspartic acid and Glutamic acid.

(c) Ans. Haemoglobin.

(d) Ans. Glycerol and fatty acids.

(e) Ans. Glycerol is hygroscopic in nature, therefore, keep the skin moist.

CASE-2. (a)Ans. Lactose.

(b) Ans. Globular protein.

(c) Ans. Sucrose

(d) Ans. Guanine.

(e) Ans. Phosphodiester linkage.

(f) Ans. Streptokinase

CASE-3: i)d ii) c iii) d iv) b v)c

VI-LONG ANSWER TYPE-III (5-MARKS)

1.a) Amylose b)Vitamin C is water soluble and hence cannot be stored in our body.

c)2-deoxy-D-ribose, thymine and phosphoric acid.

d) Hydrogen bonds

e) The molecule in which one of the nitrogen bases (purines or pyrimidine) is bonded with a sugar molecule is called nucleoside. When the phosphate group is attached to the nucleoside, the compound formed is nucleotide.

2.a)The stability of α -helix structure is due to the hydrogen bonding between -NH- and -CO- Groups of the same polypeptide chains. The α -helix structures is termed as 3.6_{13} because each turn of helix has approximately 3.6 amino acids and a 13 membered ring is formed by hydrogen bonding.

b)The pH at which a particular amino acid does not migrate under the influence of an electric field is called isoelectric point of that amino acid.

c) Native state of protein is the most energetically stable state of a protein. In this state the protein possesses maximum hydrogen bonds and it corresponds to the proteins found in a biological system with a definite configuration and biological activity.

----------x----------x----------x----------x----------