Very Short Answer Questions

Very Short Answer Questions (PYQ)

Q.1. What is a glycosidic linkage?

[*CBSE Delhi 2013*]

Ans. The linkage between two monosaccharide units through oxygen atom is called glycosidic linkage.

Q.2. What type of bonding helps in stabilising the a**-helix structure of proteins?**

[*CBSE Delhi 2013*]

Ans. The a-helix structure of proteins is stabilised by intramolecular H-bonding between C—O of one amino acid residue and the N—H of the fourth amino acid residue in the chain.

Q.3. What are three types of RNA molecules which perform different functions?

[*CBSE Delhi 2013*]

Ans. There are three types of RNAs:

i. Ribosomal RNA (*r*RNA)
ii. Messenger RNA (*m*RNA)
iii. Transfer RNA (*t*RNA)

Q.4. What is meant by 'reducing sugars'?

[*CBSE (AI) 2010*]

Ans. Reducing Sugars: The carbohydrates which reduces Fehling's Reagent and Tollen's Reagent are referred to as reducing sugar. For example, all monosaccharide are reducing sugars.

Q.5. What are monosaccharides?

[*CBSE (AI) 2010*]

Ans. They are the simplest carbohydrates which do not undergo further hydrolysis, for example: glucose.

Q.6. What are the products of hydrolysis of sucrose?

[*CBSE (AI) 2010*]

Ans.

$$C_{12}H_{22}O_{11} + H_2O \xrightarrow{H^+} \underset{(\text{Glucose})}{C_6H_{12}O_6} + \underset{(\text{Fructose})}{C_6H_{12}O_6}$$

Q.7. What happens when glucose is treated with bromine water?

[*CBSE (F) 2010*]

Ans. When glucose is treated with bromine water it forms gluconic acid.

$$HOCH_2-(CHOH)_4-CHO \xrightarrow{Br_2/H_2O} \underset{\text{Gluconic acid}}{HOCH_2-(CHOH)_4-COOH}$$

Q.8. What happens when glucose reacts with nitric acid?

[*CBSE (F) 2010*]

Ans. Glucose gets oxidised to succinic acid

$$HOCH_2-(CHOH)_4-CHO \xrightarrow{HNO_3} \underset{\text{Succinic acid}}{HOOC-(CHOH)_4-COOH}$$

Q.9. Write a reaction which shows that all the carbon atoms in glucose are linked in a straight chain.

[*CBSE (AI) 2012*]

Ans. On prolonged heating with HI, glucose gives *n*-hexane.

$$\begin{array}{l} CHO \\ | \\ (CHOH)_4 \\ | \\ CH_2OH \end{array} \xrightarrow[\Delta]{HI} \underset{n\text{–Hexane}}{CH_3CH_2CH_2CH_2CH_2CH_3}$$

Q.10. Of the two bases named below, which one is present in RNA and which one is present in DNA?

Thymine, Uracil

[*CBSE (F) 2012*]

Ans. Thymine is present in DNA whereas uracil is present in RNA.

Q.11. Which component of starch is a branched polymer of α-glucose and insoluble in water?

[*CBSE Delhi 2014*]

Ans. Amylopectin

Q.12. Name the products of hydrolysis of sucrose.

[*CBSE Delhi 2014*]

Ans.

$$\underset{\text{Sucrose}}{C_{12}H_{22}O_{11}} + H_2O \xrightarrow{H^+} \underset{D-(+)-\text{Glucose}}{C_6H_{12}O_6} + \underset{D-(-)-\text{Fructose}}{C_6H_{12}O_6}$$

Q.13. What are the products of hydrolysis of maltose?

[*CBSE (AI) 2014*]

Ans. Maltose on hydrolysis gives two molecules of glucose.

$$\underset{\text{Maltose}}{C_{12}H_{22}O_{11}} + H_2O \xrightarrow{H^+} \underset{D-(+)-\text{Glucose}}{C_6H_{12}O_6} + \underset{D-(+)-\text{Glucose}}{C_6H_{12}O_6}$$

Q.14. Write the products of hydrolysis of lactose.

[*CBSE (AI) 2014*]

Ans.

$$\underset{\text{Maltose}}{C_{12}H_{22}O_{11}} + H_2O \xrightarrow{H^+} \underset{D-(+)-\text{Glucose}}{C_6H_{12}O_6} + \underset{D-(+)-\text{Glucose}}{C_6H_{12}O_6}$$

Q.15. What are biocatalysts? Give an example.

[*CBSE (F) 2014*]

Ans. Enzymes are termed as biocatalysts as they catalyse numerous reactions that occur in the bodies of animals and plants to maintain life process e.g., invertase, pepsin, urease.

Q.16. What type of bonding is responsible for the stability of a-helix?

[CBSE East 2016]

Ans. Intramolecular hydrogen bonding.

Q.17. Which of the two components of starch is water soluble?

[CBSE Delhi 2014]

Ans. Amylose is water soluble whereas amylopectin is water insoluble component.

Q.18. Name the two components of a-glucose which constitute starch.

[CBSE (F) 2014]

Ans. The two components of starch are amylose and amylopectin.

Very Short Answer Questions (OIQ)

Q.1. What is the structural feature characterising reducing sugars?

Ans. The main structural feature of reducing sugars is the presence of an aldehyde group (—CHO) such as in glucose, mannose, galactose, etc. or a-ketol group (—CO—CH_2OH) as present in fructose.

Q.2. Why are carbohydrates generally optically active?

Ans. Carbohydrates have chiral or asymmetric carbon atom.

Q.3. What are anomers? Give one example.

Ans. Anomers are stereoisomers which differ in orientation of —OH only around C-l, e.g., a-glucose and b-glucose.

Q.4. What is meant by inversion of sugar?

Ans. Sucrose is dextrorotatory but on hydrolysis it gives an equimolar mixture of D-(+)-glucose and D-(–)-fructose which is laevorotatory. This change of specific rotation from dextrorotation to laevorotation is known as inversion of sugar.

Q.5. What is mutarotation?

Ans. The spontaneous change of specific rotation of an optically active substance with time is called mutarotation.

Q.6. What are oligosaccharides?

Ans. Carbohydrates which on hydrolysis give 2–10 molecules of monosaccharides are called oligosaccharides. For example, sucrose, raffinose, stachyose, etc.

Q.7. Write the constituents of sucrose.

Ans. D-(+)- Glucose and D-(–)- fructose.

Q.8. Write the constituents of maltose.

Ans. Two units of α-D-glucose.

Q.9. What are polysaccharides? Give one example.

Ans. Polysaccharides are the carbohydrates which on hydrolysis give a large number of molecules of monosaccharides. For example, starch or cellulose.

Q.10. What are constituent units of cellulose?

Ans. Cellulose is a linear polymer made up of D-(+)-glucose molecules linked by b-glycosidic bonds.

Q.11. What is difference between amylose and amylopectin?

Ans. Amylose is water soluble linear polymer of a-glucose. Amylopectin is water insoluble branched chain polymer of a-glucose.

Q.12. What is the major structural polysaccharide in higher plants?

Ans. Cellulose.

Q.13. Why is cellulose not digested in human body?

Ans. It is due to the fact that human beings do not have enzyme to digest cellulose.

Q.14. State two main functions of carbohydrates.

Ans. (i). Carbohydrates act as biofuel to provide energy for functioning of living organisms.

(ii). They act as constituents of cell walls.

Q.15. Which polysaccharide is stored in the liver of animals?

Ans. Glycogen.

Q.16. Name two carbohydrates which act as biofuels.

Ans. Starch and glycogen.

Q.17. What are amino acids?

Ans. Amino acids are biomolecules which contain an amino (—NH_2) group and a carboxylic acid group (—COOH) at a-carbon.

Q.18. What is the importance of amino acids to us?

Ans. Amino acids are the building blocks of proteins which are essential for the growth and maintenance of life.

Q.19. Among the amino acids phenylalanine, glutamine and alanine which one is an essential amino acid?

Ans. Phenylalanine is an essential amino acid.

Q.20. Out of lysine and leucine which one is a basic amino acid?

Ans. Lysine.

Q.21. Give an example each of essential and non-essential amino acids.

Ans. Valine is an essential amino acid whereas glycine is a non-essential amino acid.

Q.22. What are zwitter ions?

Ans. A zwitter ion is a dipolar ion formed by neutralisation of acidic and basic centres present within the molecule.

Q.23. What is isoelectric point?

Ans. The pH at which there is no net migration of the amino acid under the influence of an applied electric field is called isoelectric point. For example, the isoelectric point of glycine is 6.1.

Q.24. Define native state in reference to protein.

Ans. The sequence in which amino acids are linked together with the help of peptide bonds form native state of protein.

Q.25. What type of bonding occurs in globular proteins?

Ans. van der Waals interactions, disulphide bridges, dipolar interactions (ionic) and hydrogen bonding.

Q.26. What are the ultimate products of digestion of proteins?

Ans. Amino acids.

Q.27. What is the secondary structure of proteins?

Ans. The secondary structure of proteins arises due to the regular folding of the backbone of the polypeptide chain due to hydrogen bonding between $>C=O$ and —NH group of the peptide bond.

Q.28. What is meant by tertiary structure of proteins?

Ans. Tertiary structure of protein includes folding and twisting of secondary structure of proteins. It has compact and folded structure. It involves H-bonding, disulphide linkage, ionic or salt bridges and hydrophobic interactions.

Q.29. Give one example of a denaturated protein.

Ans. Curdling of milk.

Q.30. What are enzymes?

Ans. Enzymes are globular proteins which are biological catalysts. They are highly specific in their action.

Q.31. Name the enzymes present in the saliva of human beings.

Ans. Amylase.

Q.32. Which biomolecules act as catalysts?

Ans. Globular proteins (Enzymes).

Q.33. Name the enzyme that is used to dissolve blood clots.

Ans. Streptokinase.

Q.34. Name the enzyme that breaks large protein into small peptides.

Ans. Pepsin, trypsin.

Q.35. Name two diseases caused due to deficiency of enzymes.

Ans. Albinism and phenylketonuria.

Q.36. The deficiency of which vitamin causes the disease 'pernicious anaemia'?

Ans. Vitamin B_{12}.

Q.37. Give two examples of water-soluble vitamins.

Ans. Vitamin B, Vitamin C.

Q.38. Give the chemical name of Vitamin B_{12}.

Ans. Cyanocobalamin.

Q.39. Name the vitamin whose deficiency is responsible for poor coagulation of blood.

Ans. Vitamin K.

Q.40. Deficiency of which vitamin causes beri-beri and pain in joints?

Ans. Vitamin B_1.

Q.41. Deficiency of which vitamin causes scurvy?

Ans. Vitamin C.

Q.42. What is nucleoside?

Ans. Nucleoside consists of a base joined to sugar molecule, *e.g*., adenosine contains adenine and ribose, guanosine contains guanine and ribose, cytidine contains cytosine and ribose.

Q.43. Out of aspartic acid and ascorbic acid which one is a vitamin?

Ans. Ascorbic acid.

Q.44. Among B group vitamins B_1, B_2, B_6 and B_{12} which vitamin can be stored in our body?

Ans. Vitamin B_{12}.

Q.45. What is function of 'fibrinogen' in the blood?

Ans. It helps in protective blood clotting.

Q.46. Name the purines present in DNA.

Ans. Adenine and guanine.

Q.47. What purine and pyrimidine bases are present in DNA and RNA?

Ans. Purines: adenine and guanine; **Pyrimidines:** cytosine and thymine in DNA and cytosine and uracil in RNA.

Q.48. Name the base that is found in nucleotide of RNA only.

Ans. Uracil.

Q.49. Name two of the different types of RNA molecules found in the cells of organisms.

Ans. Messenger RNA (*m*RNA) and transfer RNA (*t*RNA).

Q.50. Name the molecule which provides energy for all the activities of a cell.

Ans. Adenosine triphosphate (ATP).

Q.51. Write biological importance of nucleic acid.

Ans.

i. To transmit genetic material to their offsprings.
ii. Protein synthesis.

Q.52. Name two a**-amino acids which form a dipeptide which is 100 times more sweet than cane sugar.**

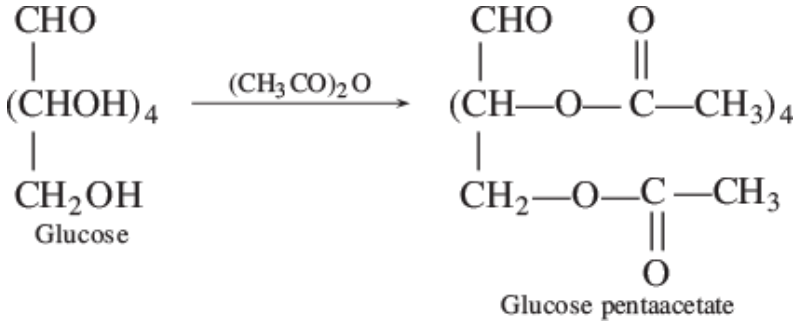
[NCERT Exemplar]

Ans. Aspartic acid and phenylalanine.

Q.53. How do you explain the presence of five —OH groups in glucose molecule?

[*NCERT Exemplar*] [*HOTS*]

Ans. Glucose gives pentaacetate derivative on acetylation with acetic anhydride. This confirms the presence of five —OH groups.



Glucose

Glucose pentaacetate

Q.54. The K_a and K_b values of a**-amino acids are very low. Why?**

[*HOTS*]

Ans. In a-amino acids the acidic group is $—^{+}NH_3$, instead of —COOH group as in carboxylic acids and basic group is $—COO^{-}$ instead of $—NH_2$ group as in amines. That is why they have low values of K_a and K_b.

Short Answer Questions-I

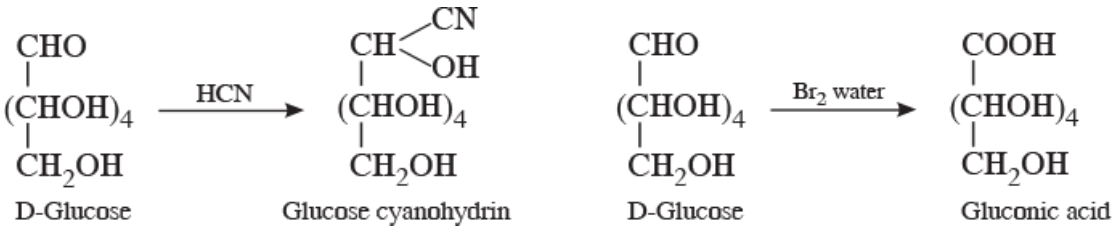
Short Answer Questions-I (PYQ)

Q.1. Write the reactions involved when D-glucose is treated with the following reagents:

(*i*) HCN (*ii*) Br_2 water

[*CBSE (F) 2013*]

Ans. (*i*) HCN **(*ii*)** Br_2 water



D-Glucose — Glucose cyanohydrin — D-Glucose — Gluconic acid

Q.2. Explain what is meant by the following:

[*CBSE (AI) 2011; (F) 2011*]

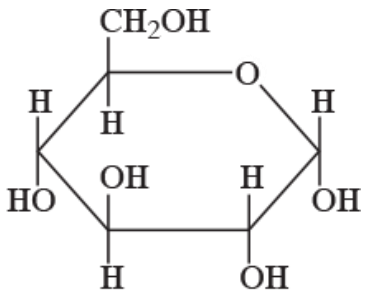
Q. peptide linkage

Ans.

The amide $(-\overset{O}{\overset{\|}{C}}-NH-)$ linkage between two a-amino acids formed with the loss of a water molecule is called a peptide linkage.

Q. pyranose structure of glucose.

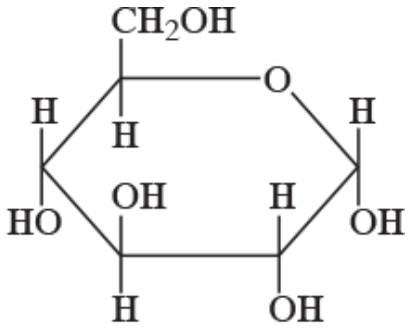
Ans. The six-membered cyclic structure of glucose is called pyranose structure (a- or b-), in analogy with heterocylic compound pyran.



α-D-(+)-Glucopyranose

Q. pyranose structure of glucose.

Ans. The six-membered cyclic structure of glucose is called pyranose structure (a- or b-), in analogy with heterocylic compound pyran.



α-D-(+)-Glucopyranose

Q.3. Name the four bases present in DNA. Which one of these is not present in RNA? [*CBSE (AI) 2009*]

Ans. The four bases present in DNA are adenine (A), guanine (G), cytosine (C) and thymine (T).

Thymine (T) is not present in RNA.

Q.4. Name the bases present in RNA. Which one of these is not present in DNA?

[*CBSE Delhi 2011*]

Ans. The bases present in RNA are adenine (A), guanine (G), cytosine (C) and uracil (U). Uracil is not present in DNA.

Q.5. Describe what you understand by primary structure and secondary structure of proteins.

[*CBSE Delhi 2011; (F) 2011*]

Ans. 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 types of secondary structures are a-helix and b-pleated sheet structures.

In a-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 b-pleated structure, all peptide chains are stretched out to nearly maximum extension and then laid side by side and are held together by hydrogen bonds.

Q.6. Answer the following the questions.

[*CBSE Allahabad 2015*]

Q. Write one difference between a**-helix and** b**-pleated sheet structures of protein.**

Ans. In a-helix structure of proteins, the polypeptide chains are stabilized by intramolecular hydrogen bonding whereas b-pleated sheet structure of proteins is stabilized by intermolecular hydrogen bonding.

Q. Write the name of the disease caused by the deficiency of vitamin B_{12}.

Ans. Pernicious anaemia is caused due to deficiency of vitamin B_{12}.

Q.7. Answer the following questions.

[*CBSE Central 2016*]

Q. What type of linkage is present in nucleic acids?

Ans. Phosphodiester linkage.

Q. Give one example each for fibrous protein and globular protein.

Ans. Fibrous protein: Myosin, keratin, collagen, etc.

Globular protein: Insulin, haemoglobin, etc.

Q.8. What are the following substances?

[*CBSE (F) 2009*]

Q. Invert sugar

Ans. Invert Sugar: Sucrose is dextrorotatory, on hydrolysis in the presence of HCl or enzyme invertase, it produces a mixture of D–C(+)–glucose and D–(–)–fructose which is laevorotatory called invert sugar.

Q. Polypeptides

Ans. Polypeptide: If more than ten a-amino acids are joined together by peptide bond (–CONH–) the polyamide thus formed is called polypeptide.

Q.9. Write such reactions and facts about glucose which cannot be explained by open chain structure.

[*CBSE (AI) 2011*]

Ans. The following facts and reactions cannot be explained by open chain structure of glucose.

- **i.** Despite having the aldehyde group, glucose does not give 2, 4-DNP test, Schiff's test and it does not form the hydrogen sulphite addition product with $NaHSO_3$.
- **ii.** The penta-acetate of glucose does not react with hydroxylamine indicating the absence of free aldehydic group.

Q.10. Name two water soluble vitamins, state their sources and the diseases caused due to their deficiency in diet.

[*CBSE (F) 2009*]

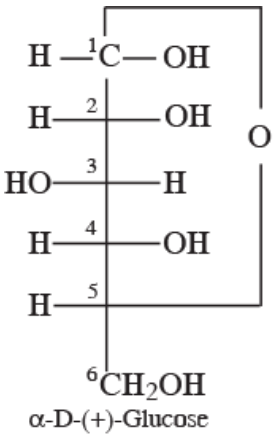
Ans. B group vitamin and vitamin C are soluble in water.

	Name of Vitamins	**Sources**	**Deficiency diseases**
(*i*)	Vitamin B_{12}	Meat, fish, egg and curd	Pernicious anaemia
(*ii*)	Vitamin C	Citrus fruits and *amla*	Scurvy

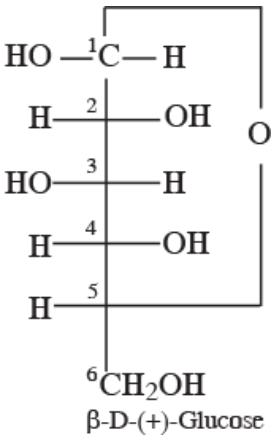
Q.11. What is essentially the difference between α-form of glucose and β-form of glucose? Explain.

[*CBSE Delhi 2011*]

Ans.



α-D-(+)-Glucose



β-D-(+)-Glucose

Q.12. Write the main structural difference between DNA and RNA. Of the four bases, name those which are common to both DNA and RNA.

[*CBSE (AI) 2011*]

Ans. Structural difference between DNA and RNA

	DNA	**RNA**
(*i*)	The sugar present in DNA is 2-deoxy-D-(–)-ribose.	The sugar present in RNA is D-(–)-ribose.
(*ii*)	DNA has double stranded a-helix structure.	RNA has single a-helix structure.

The common bases present in both DNA and RNA are adenine (A), guanine (G) and cytosine (C).

Q.13. Answer the following questions.

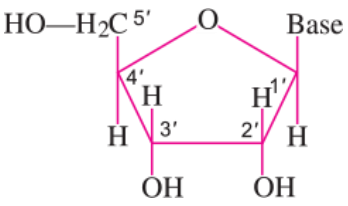
[*CBSE (F) 2013*]

Q. What type of bonding helps in stabilising the a**-helix structure of proteins?**

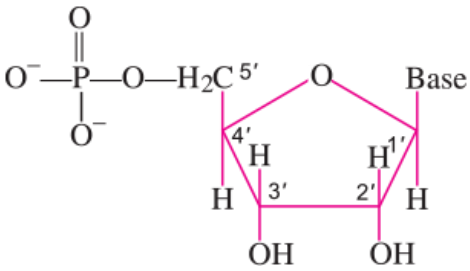
Ans. Hydrogen bonds (intermolecular) between the C==O of one amino acid residue and N—H of the fourth amino acid residue in the chain give stability to the structure.

Q. What is the structural difference between a nucleoside and a nucleotide?

Ans. A nucleoside is formed of pyrimidine or purine base connected to C-1 of sugar (ribose or deoxyribose) by a b-linkage.



A nucleotide contains all the three basic components of nucleic acids, *i.e.*, a phosphoric acid group, a pentose sugar and a nitrogenous base.

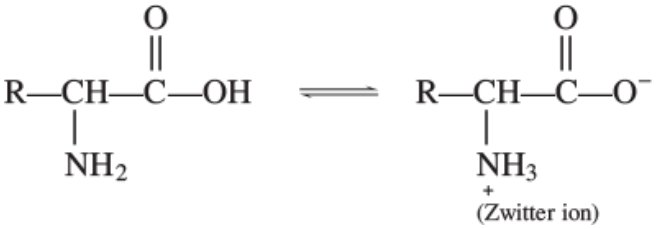


Short Answer Questions-I (OIQ)

Q.1. Amino acids behave like salts rather than simple amines or carboxylic acids. Explain.

[*NCERT Exemplar*]

Ans. In aqueous solution, the carboxyl group loses a proton and amino group accepts a proton to form a zwitter ion.



Q.2. Which forces are responsible for the stability of α-helix? Why is it named as 3.6_{13} helix?

Ans. Hydrogen bonds between $-\mathrm{N}-\mathrm{H}$ and $-\overset{O}{\overset{\|}{C}}-$ groups of peptide bonds give stability to the structure. Thus, a structure having maximum hydrogen bonds shall be favoured. a-Helix is one of the most common ways in which a polypeptide chain forms all 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 of an adjacent turn of the helix.

The a-helix is also known as 3.6_{13} helix, since each turn of the helix has approximately 3.6 amino acid residue and a 13-member ring is formed by hydrogen bonding.

Q.3. How do you explain the presence of an aldehydic group in a glucose molecule?

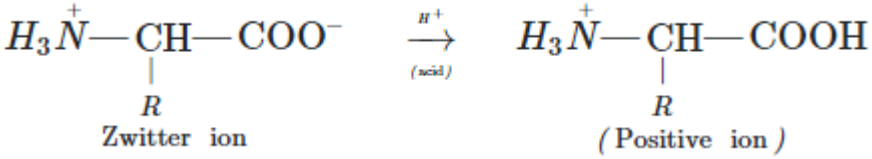
[*NCERT Exemplar*]

Ans. Glucose reacts with hydroxylamine to form a monoxime and adds one molecule of hydrogen cyanide to give cyanohydrin so it contains a carbonyl group which can be an aldehyde or a ketone. On mild oxidation with bromine water, glucose gives gluconic acid which is a six carbon carboxylic acid. This indicates that carbonyl group present in glucose is an aldehydic group.

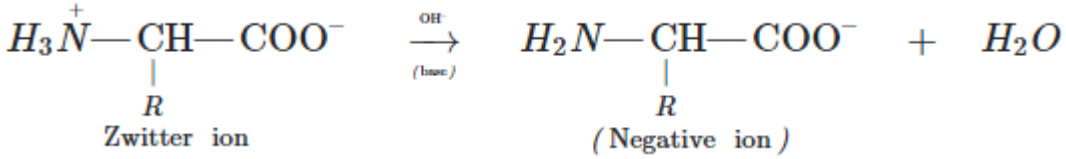
Q.4. Give reasons for the following:

Q. On electrolysis in acidic solution amino acids migrate towards cathode, while in alkaline solution these migrate towards anode.

Ans. In acidic solution, the carboxylate anion accepts a proton and gets converted into carboxylic group resulting in the formation of a positive ion.



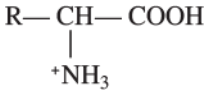
In presence of a base, the NH_3^+ ion changes to —NH_2 group by losing a proton and this gives a negative ion.

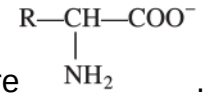


This means that in acidic medium, the amino acid migrates towards the cathode while in alkaline solution, it migrates towards anode on electrolysis.

Q. The monoamino monocarboxylic acids have two pK_a values.

Ans. In aqueous solution, monoamino monocarboxylic acid behave like salt at isoelectric point. At a pH lower than isoelectric point (*i.e.*, in acidic medium) it shows

one pK_a value which corresponds to structure  and at a pH higher than isoelectric point (*i.e*., basic medium), it shows

another pK_a value which corresponds to structure  .

Q.5. Define enzymes. How do enzymes differ from ordinary chemical catalysts?

Ans. Enzymes are naturally occurring simple or conjugate proteins acting as specific catalysts in cell processes. The enzyme facilitates a biochemical reaction by providing alternative lower activation energy pathways thereby increasing the rate of reaction.

Enzymes are different from ordinary chemical catalysts in following ways:

- **i.** They are highly specific in their action, *i.e*., each enzyme can catalyse only a specific type of reaction.
- **ii.** Enzymes can speed up reactions to the extent of about ten million times.
- **iii.** Enzymes function at a moderate temperature (about 310 K) and moderate pH (6–8).
- **iv.** Even a small quantity of an enzyme can catalyse the reaction of a large quantity of the substrate. This is because in chemical reactions the catalyst (enzyme) is regenerated after the reaction.

Q.6. If one strand of a DNA has the sequence —ATGCTTCA—, what is the sequence of the bases in the complementary strand?

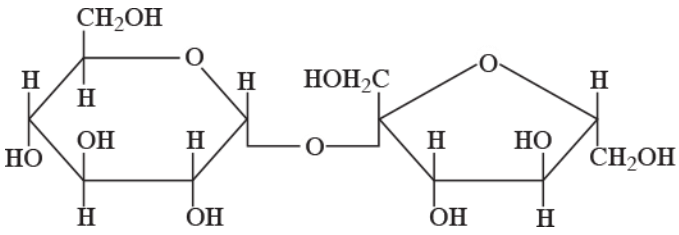
Ans. As we know that in DNA molecule, adenine (A) always pairs with thymine (T) and cytosine (C) always pairs with guanine (G). Thus,

Sequence of bases in one strand: A T G C T T C A

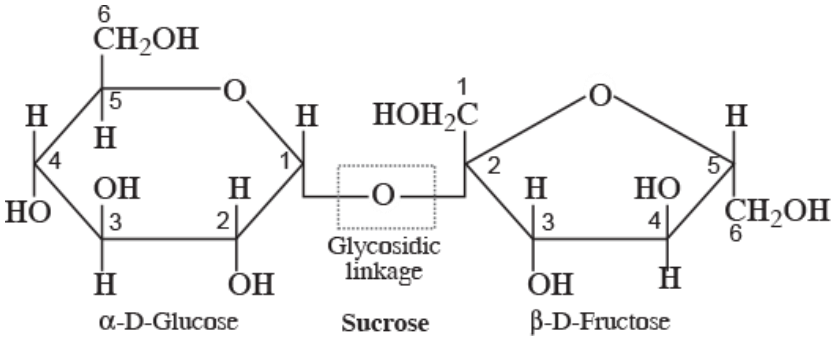
Sequence of bases in the complementary strand:T A C G A A G T

Q.7. Label the glucose and fructose units in the following disaccharide and identify anomeric carbon atoms in these units. Is the sugar reducing in nature? Explain.

[*NCERT Exemplar*] [*HOTS*]

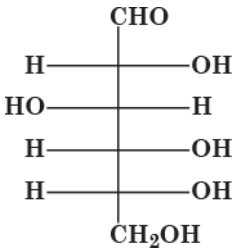


Ans. C-l of glucose unit and C-2 of fructose unit are anomeric carbon atoms in the given disaccharide. The disaccharide is non-reducing sugar because —OH groups attached to anomeric carbon atoms are involved in the formation of glycosidic bond.

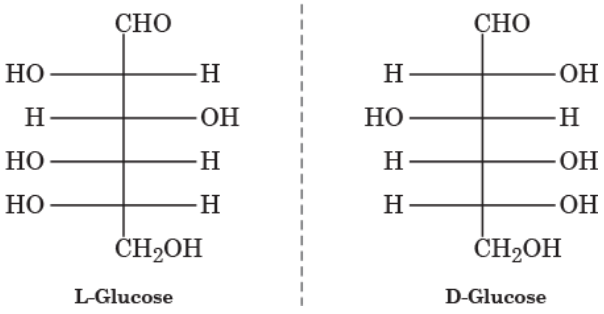


Q.8. The Fischer projection of D-Glucose is given alongside.

Q. Give the Fischer projection of L-Glucose.

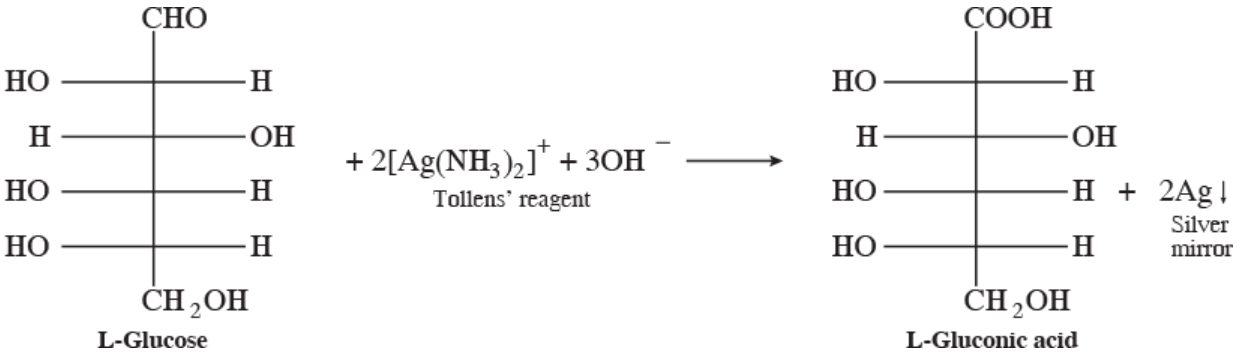


Ans. The Fischer projection of L-Glucose is the mirror image of D-Glucose.



Q. What happens when L-Glucose is treated with Tollens' reagent?

Ans. L–Glucose reduces Tollens' reagent to metallic silver.



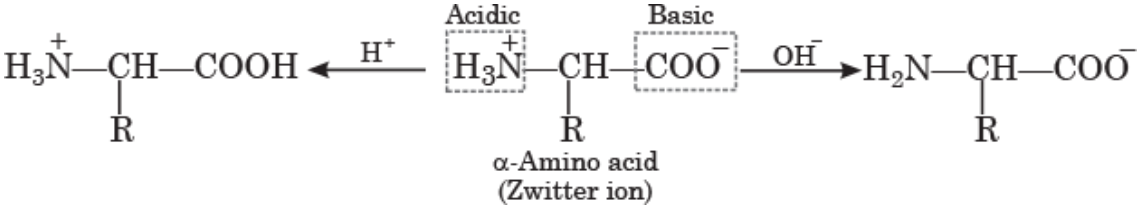
Q.9. Give reasons for the following:

Q. Glucose and fructose give the same osazone.

Ans. During osazone formation, the reaction occurs only at C-1 and C-2. As glucose and fructose differ from each other only in the arrangement of atoms at C-1 and C-2, therefore they give the same osazone.

Q. Amino acids are amphoteric in nature.

Ans. Since amino acids have both acidic (—$^{+}NH_3$) as well as basic (—COO^{-}) groups, therefore, they are amphoteric in nature.



Short Answer Questions-II

Short Answer Questions-II (PYQ)

Q.1. Define the following terms:

Q. Glycosidic linkage

Ans. The linkage between two monosaccharides through oxygen atom in an oligosaccharide or a polysaccharide is known as glycosidic linkage.

Q. Invert sugar

Ans. Sucrose is dextrorotatory (+ 66.5°) but after hydrolysis it gives an equimolar mixture of D-(+)-glucose and D-(–)-fructose, which is laevorotatory. This change of specific rotation from dextrorotation to laevorotation is called inversion of sugar and the mixture obtained is called invert sugar.

Q. Oligosaccharides

Ans. Carbohydrates which on hydrolysis give two to ten molecules of monosaccharides are called oligosaccharides *e.g.*, sucrose.

Q.2. Define the following terms:

[*CBSE (F) 2014*]

Q. Polysaccharides

Ans. Carbohydrates that yield a large number of monosaccharide units on hydrolysis are called polysaccharides *e.g.*, starch, cellulose, gums etc.

Q. Amino acids

Ans. Amino acids are the compounds, whose molecule contains both the carboxylic acid (–COOH) group and the amino ($–NH_2$) group. Of the various amino acids, the a-amino acids are most important because they are the building blocks of proteins.

Q. Enzymes

Ans. Enzymes are complex nitrogenous organic compounds produced in living cells of plants and animals. Chemically, enzymes are globular proteins with high molar mass ranging from 15,000 to 1,000,000 g mol^{-1}.

Q.3. Write three such behaviours of glucose which cannot be explained by an open chain structure of glucose molecule. What alternative structure has been proposed for the glucose molecule? [*CBSE (F) 2012*]

Ans. The following reactions cannot be explained by the open chain structure of glucose.

i. Despite having the aldehyde group, glucose does not give 2, 4–DNP test, Schiff's test and it does not form the hydrogensulphite addition product with $NaHSO_3$.
ii. The pentaacetate of glucose does not react with hydroxyl amine indicating the absence of free —CHO group.
iii. D–Glucose on treatment of methyl alcohol in the presence of dry HCl gas gives two isomers, methyl a-D-glucoside and methyl b–D–glucoside. These glucosides do not reduce fehling solution and also do not react with hydrogen cyanide indicating the absence of free —CHO group.

A ring structure called pyranose structure (a- or b-) is proposed for the glucose molecule.

Q.4. What is glycogen? How is it different from starch? How is starch structurally different from cellulose?

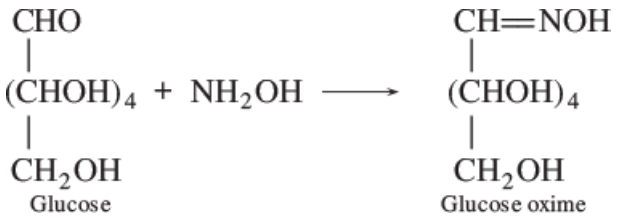
[*CBSE (F) 2012*]

Ans. Glycogen is a polymer of a–D–glucose. The carbohydrates are stored in animal body as glycogen. Starch is also a polymer of a–D–glucose and consist of two components amylose and amylopectin. Amylose is linear chain polymer of a–D–glucose. Both glycogen and amylopectin are branched chain polymers of a–D–glucose but glycogen is more highly branched than amylopectin. Starch is the main storage polysaccharide of plants.

Q.5. Answer the following questions.

Q. Write the product obtained when D-glucose reacts with H_2N—OH.

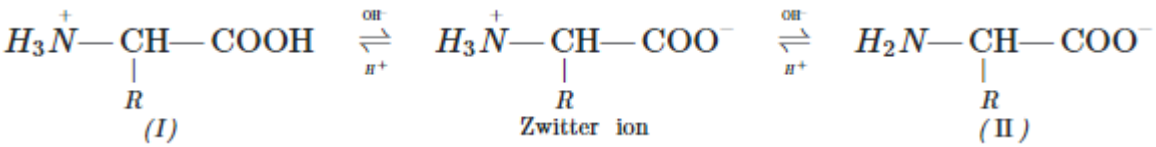
Ans.



Glucose — Glucose oxime

Q. Amino acids show amphoteric behaviour. Why?

Ans. In aqueous solution, amino acids exist as a zwitter ion. In zwitter ionic form, amino acids show amphoteric behaviour as they react both with acids and bases.



In acidic medium COO^- ion of the zwitter ion accepts a proton to form the cation (I) while in basic medium $^+NH_3$ loses a proton to form the cation (II).

Q. Why cannot vitamin C be stored in our body?

Ans. As vitamin C is water soluble, therefore, it is readily excreted in urine and hence cannot be stored in the body.

Q.6. Answer the following questions.

[*CBSE Panchkula 2015*]

Q. Which one of the following is a polysaccharide?

Starch, Maltose, Fructose, Glucose

Ans. Starch

Q. What is the difference between native protein and denatured protein?

Ans. Protein found in a biological system with unique three-dimensional structure and biological activity is called native protein.

When a protein in its native form is subjected to change such as change in temperature, change in pH, its 2° and 3° structures are destroyed and it loses its biological activity. The protein thus formed is called denatured protein.

Q. Write the name of the vitamin responsible for the coagulation of blood.

Ans. Vitamin K.

Q.7. Answer the following questions.

[*CBSE Delhi 2014*]

Q. Deficiency of which vitamin causes scurvy?

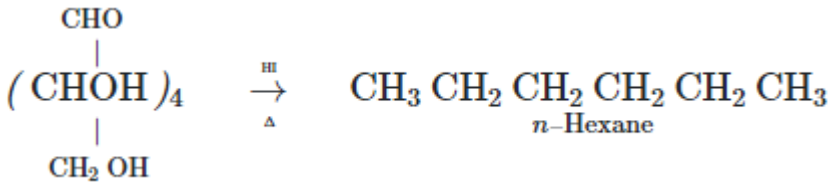
Ans. Vitamin C

Q. What type of linkage is responsible for the formation of proteins?

Ans. Peptide linkage

Q. Write the product formed when glucose is treated with HI.

Ans. On prolonged heating with HI, glucose gives *n*-hexane.



Q.8. Answer the following questions.

[*CBSE Delhi 2014*]

Q. Deficiency of which vitamin causes night-blindness?

Ans. Vitamin A

Q. Name the base that is found in nucleotide of RNA only.'

Ans. Uracil

Q. Glucose on reaction with HI gives *n*-hexane. What does it suggest about the structure of glucose?

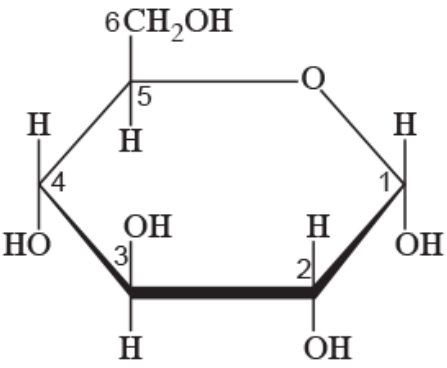
Ans. Uracil

Q.9. Answer the following questions.

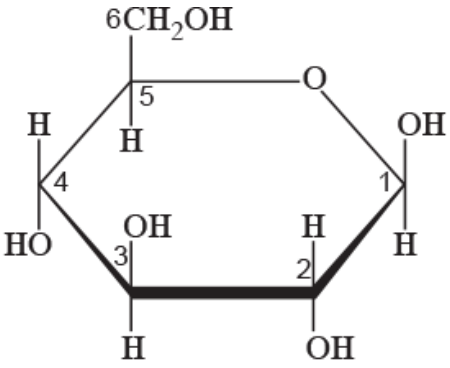
[*CBSE (F) 2016*]

Q. Draw the pyranose structure of glucose.

Ans.



α-D-(+) Glucopyranose



β-D-(+) Glucopyranose

Q. What type of linkage is present in proteins?

Ans.

Peptide linkage $(-\overset{O}{\overset{\|}{C}}-NH-)$

Q. Give one example each for water-soluble vitamins and fat-soluble vitamins

Ans. Vitamin C and B group vitamins are water soluble vitamins.

Vitamins A, D, E and K are fat soluble vitamins.

Q.10. Differentiate between fibrous proteins and globular proteins. What is meant by the denaturation of a protein?

[*CBSE (AI) 2010*]

Ans.

	Fibrous Proteins	**Globular Proteins**
(*i*)	Consist of linear thread-like molecules which tend to lie side by side to form fibre like structure.	Polypeptide chain is folded, around itself forming almost spheroidal shape.
(*ii*)	Insoluble in water.	Soluble in water.
(*iii*)	Keratin in hair, fibroin in silk, etc.	Albumin in eggs, insulin, etc.

Denaturation of Proteins

When a protein in its native form, is subjected to a change in temperature or change in pH, the hydrogen bond 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 1° structures remain intact, *e.g.*, coagulation of egg white on boiling, curdling of milk, etc.

Q.11. Answer the following questions.

[*CBSE Delhi 2016*]

Q. Write the name of two monosaccharides obtained on hydrolysis of lactose sugar.

Ans.

$$\underset{\text{Lactose}}{C_{12}H_{22}O_{11}} + H_2O \xrightarrow{H_2O/H^+} \underset{D\text{–}(+)\text{–Glucose}}{C_6H_{12}O_6} + \underset{D\text{–}(+)\text{–Galactose}}{C_6H_{12}O_6}$$

Q. Why vitamin C cannot be stored in our body?

Ans. Glycogen is a polymer of a–D–glucose. The carbohydrates are stored in animal body as glycogen. Starch is also a polymer of a–D–glucose and consist of two components amylose and amylopectin. Amylose is linear chain polymer of a–D–glucose. Both glycogen and amylopectin are branched chain polymers of a–D–glucose but glycogen is more highly branched than amylopectin. Starch is the main storage polysaccharide of plants.

Q. What is the difference between a nucleoside and nucleotide?

Ans. A nucleoside is formed when 1-position of pyrimidine (cytosine, thymine or uracil) or 9-position of purine (guanine or adenine) base is connected to C-1 of sugar (ribose or deoxyribose) by a b-linkage. Hence, in general, nucleosides may be represented as: Sugar–Base.

A nucleotide contains all the three basic compounds of nucleic acids, *i.e.*, a phosphoric acid group, a pentose sugar and a nitrogenous base. These are obtained by esterification of $C'_5 - \text{OH}$ group of the pentose sugar by phosphoric acid. Thus, in general, a nucleotide is represented as:

$$\text{Base—Sugar—}O\text{—}\overset{\overset{O}{\|}}{P}\text{—OH}\underset{O}{\|}$$

Short Answer Questions-II (OIQ)

Q.1. Answer the following questions.

[*CBSE Sample Paper 2014*]

Q. Give one structural difference between amylose and amylopectin

Ans. Amylose is a long unbranched chain polymer of α-D(+) glucose.

Amylopectin is a branched chain polymer of α-D glucose.

Q. Name the protein and its shape present in oxygen carrier in human body.

Ans. Globular protein and its shape is spherical.

Q. Name two fat storing tissues in human body.

Ans. Liver and adipose tissue.

Q.2. Answer the following questions.

[*CBSE Sample Paper 2015*]

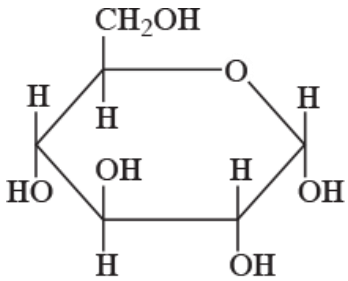
Q. Which of the following biomolecules is insoluble in water? Justify.

Insulin, Haemoglobin, Keratin.

Ans. Keratin being a fibrous protein insoluble in water.

Q. Draw the Haworth structure for α-D-Glucopyranose.

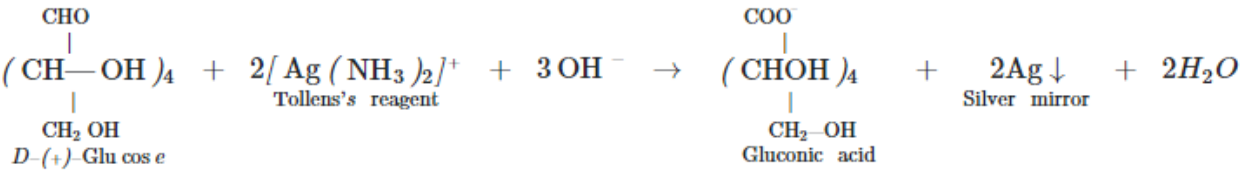
Ans.



α-D-(+)-Glucopyranose

Q. Write chemical reaction to show that glucose contains aldehyde as carbonyl group.

Ans.



Q.3. Answer the following questions.

[*CBSE Sample Paper 2016*] [*HOTS*]

Q. A non-reducing disaccharide 'A' on hydrolysis with dilute acid gives an equimolar mixture of D-(+)-glucose and D-(–)-fructose.

$$A + H_2O \xrightarrow{HCl} C_6H_{12}O_6 + C_6H_{12}O_6$$

$[\alpha]_D = +66.5$ ÔøΩ $+52.5$ ÔøΩ -92.4 ÔøΩ

Identify A. What is the mixture of D-(+)-glucose and D-(–)-fructose known as? Name the linkage that holds the two units in the disaccharide.

Ans.

i. A = $C_{12}H_{22}O_{11}$ (sucrose).
ii. Invert sugar.
iii. Glycosidic linkage.

Q. a-amino acids have relatively higher melting points than the corresponding halo acids. Explain.

Ans. α-Amino acids act as zwitter ions, (H_3N^+—CHR—COO^-) or dipolar ions. Due to this dipolar salt-like structure, they have strong dipole-dipole interactions. Therefore, their melting points are higher than the corresponding halo acids which do not exist as zwitter ions.

Q.4. Explain the following items:

Q. Avitaminosis

Ans. Avitaminosis: Lack of more than one vitamin causes multiple deficiency diseases called avitaminosis.

Q. Biocatalysts

Ans. Biocatalysts: A number of reactions that occur in the bodies of animals and plants to maintain the life process are catalysed by enzymes. The enzymes are thus termed as biocatalysts. Almost all the enzymes are globular proteins. An enzyme catalyses a biochemical reaction by providing alternate lower activation path thereby increasing the rate of the biochemical reaction. For example, activation energy for acid hydrolysis of sucrose is 6.22 kJ mol^{-1} while the activation energy is only 2.15 kJ mol^{-1} when hydrolysed in the presence of enzyme sucrase.

Q. Polypeptides

Ans. Polypeptide: If more than ten a-amino acids are joined together by peptide bond (—CONH—) the polyamide thus formed is called polypeptide.

Q.5. Answer the following the questions.

Q. Name the three major classes of carbohydrates and give an example of each of these classes.

Ans.

i. **Monosaccharides:** The simple carbohydrates that cannot be broken further into smaller units on hydrolysis, *e.g.*, glucose and fructose, ribose, etc.
ii. **Oligosaccharides:** These are the carbohydrates which on hydrolysis give two to ten units of monosaccharides, *e.g*., sucrose, maltose, raffinose, stachyose, etc.
iii. **Polysaccharides:** These are the carbohydrates which produce a large number of monosaccharide units on hydrolysis, *e.g*., starch, cellulose, etc.

Q. Answer the following:

i. **What type of linkage is responsible for the primary structure of proteins?**
ii. **Name the location where protein synthesis occurs in our body.**

Ans.

i. Peptide linkage
ii. Protein synthesis occurs at the ribosome in the cytoplasm.

Q.6. Answer the following questions.

Q. Write about the following on protein synthesis:

i. **Name the location where protein synthesis occurs.**
ii. **How do 64 codons code for only 20 amino acids?**
iii. **Which of the two bases of the codon are more important for coding?**

Ans.

a. Protein synthesis occurs at the ribosome in the cytoplasm.
b. More than one codon (a combination of three nucleotide, *i.e.*, triplet) can code for the same amino acids, *e.g.*, proline is encoded by CCU, CCA, CCG and CCC.
c. First two bases of a codon are more important for coding, the third being less specific.

Q. What deficiency diseases are caused due to lack of vitamins A, B_1, B_6 and K in human diet?

Ans.

S. No.	Name of Vitamins	Sources	Deficiency Diseases
1.	Vitamin A	Fish liver oil, carrots, butter and milk	Xerophthalmia (hardening of cornea of eye), night blindness
2.	Vitamin B_1 (Thiamine)	Yeast, milk, green vegetables and cereals	Beri-beri (loss of appetite, retarded growth)
3.	Vitamin B_6 (Pyridoxine)	Yeast, milk, egg yolk, cereals and grams	Convulsions

Q. Comment on the specificity of enzyme action. What is the most important reason for their specificity?

Ans. In case of enzymatic reaction, the enzyme is so built that it binds to the substrate in a specific manner. Enzymatic reaction involves the following steps:

Step I: Binding of substrate (S) to enzyme (E) to form a complex.

$$E + S \rightarrow [\mathrm{ES}]\ (\mathrm{Enzyme-substrate\ complex})$$

Step II: Product formation in the complex.

$$[\mathrm{ES}] \rightarrow \mathrm{EP}\ (\mathrm{Enzyme-product\ complex})$$

Step III: The dissociation of the enzyme product complex, leaving the enzyme unchanged.

$$\mathrm{EP} \rightarrow E + P$$

The specificity of the enzymes is due to the presence of some specific regions, called the active site, on their surface. The shape of active site is such that only a specific

substrate can fit into it in the same way as one key can open a particular lock. This specific binding leads to the formation of an enzyme–substrate complex which accounts for the high specificity of enzyme catalysed reactions. This most accepted model is popularly known as Lock and Key model. For example, urease catalyses only the hydrolysis of urea and none of the several thousand other enzymes present in the cell catalyses that reaction.

Q.8. Describe the mechanism of replication of DNA.

Ans. The process by which a DNA molecule produces two identical copies of itself is called replication of DNA. In the DNA double helix, the sequence of bases in one chain is complementary to the sequence in the other chain, therefore, one controls the other.

During cell division (mitosis), the two strands of the DNA double helix partly unwind and each serves as the template for the synthesis of a new DNA molecule. DNA replication follows the base pairing rules by which A pairs with T and G pairs with C. Therefore, each daughter molecule is an exact replication of the parent molecule. DNA replication is semiconservative, *i.e.*, only half of the parental DNA is conserved and only one strand is synthesised. DNA replication takes place only in the 5′ → 3′ direction.

Q.9. An optically active compound having molecular formula $C_6H_{12}O_6$ is found in two isomeric forms (A) and (B) in nature. When (A) and (B) are dissolved in water, they show the following equilibrium

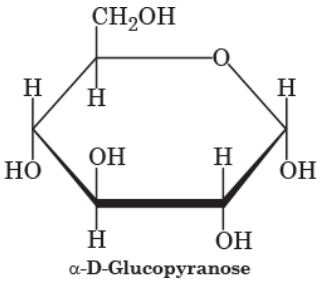
$$\underset{[\alpha]_D = 111^\circ}{\text{(A)}} \rightleftharpoons \underset{52.2^\circ}{\text{Equilibrium mixture}} \rightleftharpoons \underset{19.2^\circ}{\text{(B)}}$$

i. **What are such isomers called?**
ii. **Can they be called enantiomers? Justify your answer.**
iii. **Draw the cyclic structure of isomer (A).** **[*HOTS*]**

Ans. (i). Anomers

(ii). Since these anomers are not mirror images of each other so they cannot be called as enantiomers.

(iii)



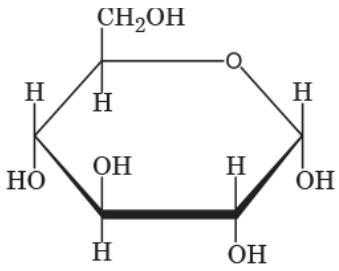
α-D-Glucopyranose

Q.10.

i. **Despite having an aldehyde group, glucose does not give 2,4-DNP test. What does this indicate?**
ii. **Draw the Haworth structure of** a**-D-(+)-Glucopyranose.**
iii. **What is the significance of D and (+) here? [*HOTS*]**

Ans. i. This indicates that the aldehyde group in glucose is not free.

ii.



α-D(+)-Glucopyranose

(iii) '*D*' gives the configuration, *i.e*., the —OH group at C-5 is on the right hand side. (+) sign indicates that the isomer is dextrorotatory.

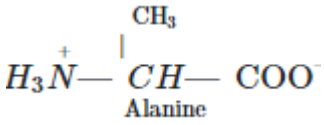
Q.11. An optically active amino acid (A) can exist in three forms depending on the pH of the medium. The molecular formula of (A) is $C_3H_7NO_2$.

[*HOTS*]

i. **Write the structure of compound (A) in aqueous medium. What are such ions called?**
ii. **In which medium will the cationic form of compound (A) exist?**
iii. **In alkaline medium, towards which electrode will the compound (A) migrate in electric field?**

Ans. i. A = Alanine

In aqueous medium alanine exists as Zwitter ion.



Alanine

ii. In acidic medium.

iii. In alkaline medium, it will exist in the anionic form and will migrate towards anode in electric field.