

## CASE STUDY / PASSAGE BASED QUESTIONS

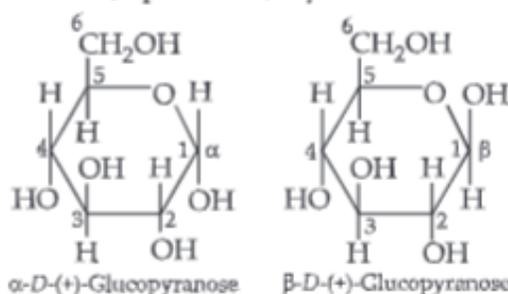
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Read the passage given below and answer the following questions :

Pentose and hexose undergo intramolecular hemiacetal or hemiketal formation due to combination of the  $-OH$  group with the carbonyl group. The actual structure is either of five or six membered ring containing an oxygen atom. In the free state all pentoses and hexoses exist in pyranose form (resembling pyran). However, in the combined state some of them exist as five membered cyclic structures, called furanose (resembling furan).



The cyclic structure of glucose is represented by Haworth structure :

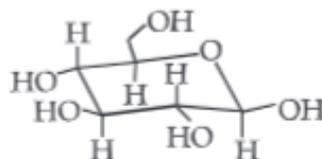


$\alpha$  and  $\beta$ -D-glucose have different configuration at anomeric (C-1) carbon atom, hence are called anomers and the C-1 carbon atom is called anomeric carbon (glycosidic carbon).

The six membered cyclic structure of glucose is called pyranose structure.

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

- (i)  $\alpha$ -D(+)-glucose and  $\beta$ -D(+)-glucose are  
 (a) enantiomers (b) conformers (c) epimers (d) anomers.
- (ii) The following carbohydrate is



- (a) a ketohexose (b) an aldohexose  
 (c) an  $\alpha$ -furanose (d) an  $\alpha$ -pyranose.

## Syllabus

## Carbohydrates :

Classification

(aldoses and ketoses),

monosaccharides

(glucose and fructose),

D-L configuration

Proteins :

Elementary idea of -

amino acids, peptide

bond, polypeptides,

proteins, structure

of proteins -

primary, secondary,

tertiary structure

and quaternary

structures

(qualitative idea

only), denaturation

of proteins.

Nucleic Acids : DNA

and RNA.



(iii) Amino acids are least soluble

(a) at pH 1

(b) at pH 7

(c) at their isoelectric points

(d) none of these.

(iv) The  $pK_{a_1}$  and  $pK_{a_2}$  of an amino acid are 2.3 and 9.7 respectively. The isoelectric point of the amino acid is

(a) 12.0

(b) 7.4

(c) 6.0

(d) 3.7

OR

A tripeptide (X) on partial hydrolysis gave two dipeptides Cys-Gly and Glu-Cys. Identify the tripeptide.

(a) Glu-Cys-Gly

(b) Gly-Glu-Cys

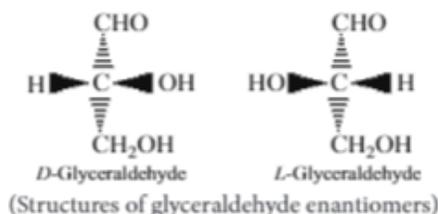
(c) Cys-Gly-Glu

(d) Cys-Glu-Gly

3

Read the passage given below and answer the following questions :

Carbohydrates can exist in either of two conformations, as determined by the orientation of the hydroxyl group about the asymmetric carbon farthest from the carbonyl.



By convention, a monosaccharide is said to have *D*-configuration if the hydroxyl group attached to the asymmetric carbon atom adjacent to the —CH<sub>2</sub>OH group is on the right hand side irrespective of the positions of the other hydroxyl groups. On the other hand, the molecule is assigned *L*-configuration if the —OH group attached to the carbon adjacent to the —CH<sub>2</sub>OH group is on the left hand side.

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

(i) *D*-Glyceraldehyde and *L*-Glyceraldehyde are

(a) epimers

(b) enantiomers

(c) anomers

(d) conformational diastereomers.

(ii) Which of the following monosaccharides, is the majority found in the human body?

(a) *D*-type

(b) *L*-type

(c) Both of these

(d) None of these

(iii) The two functional groups present in a typical carbohydrate are

(a) —OH and —COOH

(b) —CHO and —COOH

(c)  $>C=O$  and —OH

(d) —OH and —CHO

OR

Monosaccharides contain

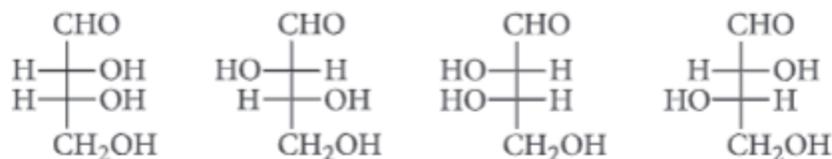
(a) always six carbon atoms

(b) always five carbon atoms

(c) always four carbon atoms

(d) may contain 3 to 7 carbon atoms.

(iv) The correct corresponding order of names of four aldoses with configuration given below



respectively, is

- (a) *L*-erythrose, *L*-threose, *L*-erythrose, *D*-threose
- (b) *D*-threose, *D*-erythrose, *L*-threose, *L*-erythrose
- (c) *L*-erythrose, *L*-threose, *D*-erythrose, *D*-threose
- (d) *D*-erythrose, *D*-threose, *L*-erythrose, *L*-threose.

#### 4

Read the passage given below and answer the following questions :

Carbohydrates are polyhydroxy aldehydes and ketones and those compounds which on hydrolysis give such compounds are also carbohydrates. The carbohydrates which are not hydrolysed are called monosaccharides. Monosaccharides with aldehydic group are called aldose and those which have free ketonic groups are called ketose. Carbohydrates are optically active. Number of optical isomers =  $2^n$

where  $n$  = number of asymmetric carbons. Carbohydrates are mainly synthesised by plants during photosynthesis. The monosaccharides give the characteristic reactions of alcohols and carbonyl group (aldehydes and ketones). It has been found that these monosaccharides exist in the form of cyclic structures. In cyclization, the  $-OH$  groups (generally  $C_5$  or  $C_4$  in aldohexoses and  $C_5$  or  $C_6$  in ketohexoses) combine with the aldehyde or keto group. As a result, cyclic structures of five or six membered rings containing one oxygen atom are formed, e.g., glucose forms a ring structure. Glucose contains one aldehyde group, one  $1^\circ$  alcoholic group and four  $2^\circ$  alcoholic groups in its open chain structure.

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

- (i) First member of ketos sugar is
  - (a) ketotriose                      (b) ketotetrose                      (c) ketopentose                      (d) ketohexose.
- (ii) In  $CH_2OHCHOHCHOHCHOHCHOHCHO$ , the number of optical isomers will be
  - (a) 16                                  (b) 8                                  (c) 32                                  (d) 4
- (iii) Some statements are given below :
  1. Glucose is aldohexose.
  2. Naturally occurring glucose is dextrorotatory.
  3. Glucose contains three chiral centres.
  4. Glucose contains one  $1^\circ$  alcoholic group and four  $2^\circ$  alcoholic groups.
 Among the above, correct statements are
  - (a) 1 and 2 only                                  (b) 3 and 4 only
  - (c) 1, 2 and 4 only                              (d) 1, 2, 3 and 4
- (iv) Two hexoses form the same osazone, find the correct statement about these hexoses.
  - (a) Both of them must be aldoses.
  - (b) They are epimers at C-3.
  - (c) The carbon atoms 1 and 2 in both have the same configuration.
  - (d) The carbon atoms 3, 4 and 5 in both have the same configuration.

**OR**

Which of the following reactions of glucose can be explained only by its cyclic structure?

- (a) Glucose forms cyanohydrin with HCN.
- (b) Glucose reacts with hydroxylamine to form an oxime.
- (c) Pentaacetate of glucose does not react with hydroxylamine.
- (d) Glucose is oxidised by nitric acid to gluconic acid.

Read the passage given below and answer the following questions :

When a protein in its native form, is subjected to physical changes like change in temperature or chemical changes 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.

The denaturation causes change in secondary and tertiary structures but primary structures remains intact. Examples of denaturation of protein are coagulation of egg white on boiling, curdling of milk, formation of cheese when an acid is added to milk.

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

- (i) Mark the wrong statement about denaturation of proteins.
- The primary structure of the protein does not change.
  - Globular proteins are converted into fibrous proteins.
  - Fibrous proteins are converted into globular proteins.
  - The biological activity of the protein is destroyed.
- (ii) Which structure(s) of proteins remains(s) intact during denaturation process ?
- Both secondary and tertiary structures
  - Primary structure only
  - Secondary structure only
  - Tertiary structure only
- (iii)  $\alpha$ -helix and  $\beta$ -pleated structures of proteins are classified as
- primary structure
  - secondary structure
  - tertiary structure
  - quaternary structure.

OR

Cheese is a

- globular protein
  - conjugated protein
  - denatured protein
  - derived protein.
- (iv) Secondary structure of protein refers to
- mainly denatured proteins and structure of prosthetic groups
  - three-dimensional structure, especially the bond between amino acid residues that are distant from each other in the polypeptide chain
  - linear sequence of amino acid residues in the polypeptide chain
  - regular folding patterns of continuous portions of the polypeptide chain.

Read the passage given below and answer the following questions :

The sequence of bases along the DNA and RNA chain establishes its primary structure which controls the specific properties of the nucleic acid. An RNA molecule is usually a single chain of ribose-containing nucleotide. On the basis of X-ray analysis of DNA, J.D., Watson and F.H.C. crick (shared noble prize in 1962) proposed a three dimensional secondary structure for DNA. DNA molecule is a long and highly complex, spirally twisted, double helix, ladder like structure. The two polynucleotide chains or strands are linked up by hydrogen bonding between the nitrogenous base molecules of their nucleotide monomers. Adenine (purine) always links with thymine (pyrimidine) with the help of two hydrogen bonds and guanine (purine) with cytosine (pyrimidine) with the help of three hydrogen bonds. Hence, the two strands extend in opposite directions, *i.e.*, are antiparallel and complimentary.

In these questions (Q. No. i-iv), a statement of assertion followed by a statement of reason is given. Choose the correct answer out of the following choices.

- (a) Assertion and reason both are correct statements and reason is correct explanation for assertion.  
(b) Assertion and reason both are correct statements but reason is not correct explanation for assertion.  
(c) Assertion is correct statement but reason is wrong statement.  
(d) Assertion is wrong statement but reason is correct statement.
- (i) **Assertion :** DNA molecules and RNA molecules are found in the nucleus of a cell.  
**Reason :** There are two types of nitrogenous bases, purines and pyrimidines. Adenine (A) and guanine (G) are substituted purines; cytosine (C), thymine (T) and uracil (U) are substituted pyrimidines.
- (ii) **Assertion :** In both DNA and RNA, heterocyclic base and phosphate ester linkages are at C-1' and C-5' respectively of the sugar molecule.  
**Reason :** Nucleotides and nucleosides mainly differ from each other in presence of phosphate units.
- (iii) **Assertion :** The backbone of RNA molecule is a linear chain consisting of an alternating units of a heterocyclic base, D-ribose and a phosphate.  
**Reason :** The segment of DNA which acts as the instruction manual for the synthesis of protein is ribose.
- (iv) **Assertion :** The double helical structure of DNA was proposed by Emil Fischer.  
**Reason :** A nucleoside is an N-glycoside of heterocyclic base.

OR

**Assertion :** In DNA, the complementary bases are, adenine and guanine; thymine and cytosine.  
**Reason :** The phenomenon of mutation is chemical change in DNA molecule.

7

Read the passage given below and answer the following questions :

Proteins are high molecular mass complex biomolecules of amino acids. The important proteins required for our body are enzymes, hormones, antibodies, transport proteins, structural proteins, contractile proteins etc. Except for glycine, all  $\alpha$ -amino acids have chiral carbon atom and most of them have *L*-configuration. The amino acids exist as dipolar ion called zwitter ion, in which a proton goes from the carboxyl group to the amino group. A large number of  $\alpha$ -amino acids are joined by peptide bonds forming polypeptides. The peptides having very large molecular mass (more than 10,000) are called proteins. The structure of proteins is described as primary structure giving sequence of linking of amino acids; secondary structure giving manner in which polypeptide chains are arranged and folded; tertiary structure giving folding, coiling or bonding polypeptide chains producing three dimensional structures and quaternary structure giving arrangement of sub-units in an aggregate protein molecule.

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(c) Assertion is correct statement but reason is wrong statement.  
(d) Assertion is wrong statement but reason is correct statement.
- (i) **Assertion :** Except glycine, all naturally occurring  $\alpha$ -amino acids are optically active.  
**Reason :** All naturally occurring  $\alpha$ -amino acids, except glycine, has at least one asymmetric carbon.

OR

**Assertion :** All amino acids are optically active.

**Reason :** Amino acids contain asymmetric carbon atoms.

(ii) **Assertion :** In  $\alpha$ -helix structure, intramolecular H-bonding takes place whereas in  $\beta$ -pleated structure, intermolecular H-bonding takes place.

**Reason :** An egg contains a soluble globular protein called albumin which is present in the white part.

(iii) **Assertion :** Secondary structure of protein refers to regular folding patterns of continuous portions of the polypeptide chain.

**Reason :** Out of 20 amino acids, only 12 amino acids can be synthesised by human body.

(iv) **Assertion :** The helical structure of protein is stabilised by intramolecular hydrogen bond between  $-NH$  and carbonyl oxygen.

**Reason :** Sanger's reagent is used for the identification of N-terminal amino acid of peptide chain.

8

Read the passage given below and answer the following questions :

Glucose is known as dextrose because it occurs in nature as the optically active dextrorotatory isomer. It is essential constituent of human blood. The blood normally contains 65 to 110 mg of glucose per 100 mL (hence named Blood sugar). The level may be much higher in diabetic persons. The urine of diabetic persons also contain considerable amount of glucose. In combined form, it occurs in cane sugar and polysaccharides such as starch and cellulose.

Glucose has an aldehyde group ( $-CHO$ ), one primary alcoholic group ( $-CH_2OH$ ) and four secondary alcoholic groups ( $-CHOH$ ) in their structure. Due to the presence five hydroxyl groups ( $-OH$ ), glucose undergoes acetylation. Glucose also undergoes oxidation with mild oxidising agents like bromine water as well as with strong oxidising agents like nitric acid. Since glucose is readily oxidised, it acts as a strong reducing agent and reduces Tollen's reagent and Fehling solution. Glucose exists in two crystalline forms :  $\alpha$ -D-glucose and  $\beta$ -D-glucose. If either of the two forms is dissolved in water and allowed to stand, the specific rotation of the solution changes gradually, until a constant value is obtained. This change is called mutarotation.

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(d) Assertion is wrong statement but reason is correct statement.

(i) **Assertion :** A diabetic person carries a packet of glucose with him always.

**Reason :** Glucose increases the blood sugar level almost instantaneously.

(ii) **Assertion :** On oxidation with nitric acid, glucose as well as gluconic acid both yield saccharic acid.

**Reason :** The pentaacetate of glucose does not react with hydroxylamine indicating the absence of free  $-CHO$  group.

(iii) **Assertion :** Glucose reacts with acetyl chloride to form pentaacetyl glucose.

**Reason :** The formation of pentaacetyl derivative confirms the presence of five  $-OH$  groups in glucose.

(iv) **Assertion :** A certain compound gives negative test with ninhydrin and positive test with Benedict's solution, the compound is an amino acid.

**Reason :** Glucose is a monosaccharide.

OR

**Assertion :** The rapid interconversion of  $\alpha$ -D-glucose and  $\beta$ -D-glucose in solution is known as racemisation.

**Reason :** Hydrolysis reaction will take place when a mineral acid is treated with sugar.

### ASSERTION & REASON

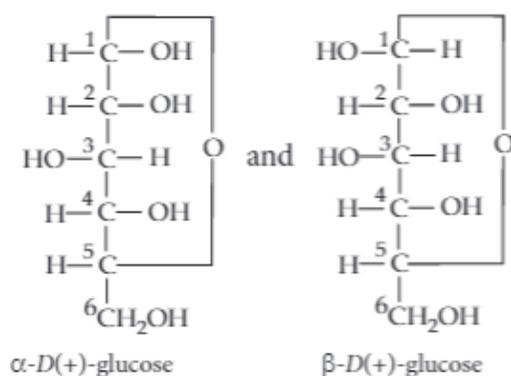
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  - (d) Assertion is wrong statement but reason is correct statement.
9. **Assertion :** Glucose and fructose are reducing sugars.  
**Reason :** Glucose and fructose contain a free aldehydic and ketonic group adjacent to a  $>$ CHOH group respectively.
10. **Assertion :** Tollens' reagent, Benedict's solution and Fehling's solution are reducing agents.  
**Reason :** Mild oxidising agents like chlorine or bromine water convert glucose into gluconic acid.
11. **Assertion :** Fructose reduces Fehling's solution and Tollens' reagent.  
**Reason :** Fructose does not contain any aldehyde group.
12. **Assertion :** The specific rotation of a freshly prepared solution of  $\alpha$ -glucose decreases from  $+112^\circ$  to  $52.7^\circ$  while that of  $\beta$ -glucose increases from  $+19^\circ$  to  $52.7^\circ$ .  
**Reason :** The change in specific rotation of an optically active compound with time to an equilibrium value is called mutarotation.
13. **Assertion :**  $\alpha$ -Amino acids exist as dipolar ions or zwitter ions.  
**Reason :**  $\alpha$ -Amino acids are the building blocks of proteins.
14. **Assertion :** Valine is an essential amino acid.  
**Reason :** The lack of essential amino acids in the diet causes Kwashiorkor.
15. **Assertion :** Glucose when treated with  $\text{CH}_3\text{OH}$  in presence of dry HCl gas gives  $\alpha$ - and  $\beta$ -methyl glucosides.  
**Reason :** Glucose reacts with phenyl hydrazine to form crystalline osazone.
16. **Assertion :** DNA has a double helix structure.  
**Reason :** The two strands in a DNA molecule are exactly similar.
17. **Assertion :** DNA undergoes replication.  
**Reason :** DNA contains cytosine and thymine as pyrimidine bases.
18. **Assertion :** Disruption of the native structure of a protein is called denaturation.  
**Reason :** The change in colour and appearance of egg during cooking is due to denaturation.
19. **Assertion :** Glycine exists as zwitter ion but *o*- and *p*-aminobenzoic acids do not.  
**Reason :** Due to the presence of  $-\text{NH}_2$  and  $-\text{COOH}$  group within the same molecule, they neutralise each other and hence,  $\alpha$ -amino acids exist as dipolar ions or zwitter ions.
20. **Assertion :** Amino acids are insoluble in benzene and ether.  
**Reason :** Amino acids exist as zwitter ions.
21. **Assertion :** Haemoglobin is a globular protein.  
**Reason :** Globular proteins are insoluble in water.

22. **Assertion** : Glucose and fructose give the same osazone.  
**Reason** : During osazone formation stereochemistry at  $C_1$  and  $C_2$  is destroyed.
23. **Assertion** :  $\beta$ -pleated sheet structure of protein shows maximum extension.  
**Reason** : Intermolecular hydrogen bonding is present in them.
24. **Assertion** : Nucleotides are phosphate esters of nucleosides.  
**Reason** : The various nucleotides in nucleic acids are linked either through purine or pyrimidine bases.
25. **Assertion** : Alpha ( $\alpha$ )-amino acids exist as internal salt in solution as they have amino and carboxylic acid groups in near vicinity.  
**Reason** :  $H^+$  ion given by carboxylic group ( $-COOH$ ) is captured by amino group ( $-NH_2$ ) having lone pair of electrons.
26. **Assertion** : Solubility of proteins is minimum at the isoelectric point.  
**Reason** : At isoelectric point, protein molecule behaves as a zwitter ion.
27. **Assertion** : Insulin is water soluble.  
**Reason** : Insulin is a globular protein.
28. **Assertion** : Glucose gives a reddish-brown precipitate with Fehling's solution.  
**Reason** : Reaction of glucose with Fehling's solution gives  $CuO$  and gluconic acid.
29. **Assertion** : Cysteine can cross link peptide chains.  
**Reason** : Amino acids are classified as essential and non-essential amino acids.
30. **Assertion** : Uracil occurs in DNA.  
**Reason** : DNA undergoes replication.

## HINTS & EXPLANATIONS

1. (i) (d):  $\alpha$ -D-(+)-glucose and  $\beta$ -D-(+)-glucose differ in configuration at  $C_1$  (i.e., anomeric or glycosidic carbon) and hence are called anomers.



- (ii) (b): This structure is an example of pyranose and aldohexose. Here, the carbohydrate's structure is of the  $\beta$ -pyranose form.

- (iii) (a):  $C-1$  is the anomeric carbon.

- (iv) (d): Anomers are cyclic monosaccharides or glycosides that are epimers, differing from each other

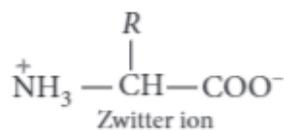
in the configuration at  $C-1$ , if they are aldoses or in the configuration at  $C-2$  if they are ketoses.

OR

(d): Ordinary glucose is  $\alpha$ -glucose, with a fresh aqueous solution having specific rotation,  $[\alpha]_D = +111^\circ$ . On keeping the solution for sometime,  $\alpha$ -glucose slowly changes into an equilibrium mixture of  $\alpha$ -glucose (36%) and  $\beta$ -glucose (64%) and the mixture has specific rotation  $+52.5^\circ$ .

2. (i) (a): Carboxylic acids are stronger acids than  $-\overset{+}{N}H_3$ , therefore  $X$  is the strongest acid. Since  $-COOH$  has  $-I$  effect which decreases with distance therefore, effect is more pronounced on  $Z$  than on  $Y$ . As a result  $Z$  is more acidic than  $Y$ , therefore, overall order of increasing acid strength is  $X > Z > Y$ .

- (ii) (d): In aqueous solutions, amino acids mostly exist as zwitter ion or dipolar ion.

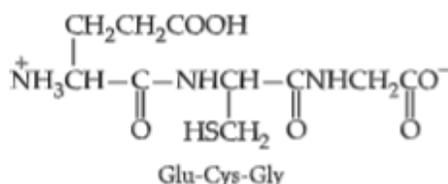


(iii) (c): Amino acids are least soluble at their isoelectric points. At a specific pH, called isoelectric point, the positive and negative charges balance each other and the net charge becomes zero. If there is a charge, the amino acid prefers to interact with water, rather than other amino acid molecules, this charge makes it more soluble.

(iv) (c): Isoelectric point =  $\frac{2.3+9.7}{2} = 6$

OR

(a): Since the tripeptide on hydrolysis gave two dipeptides Glu-Cys and Cys-Gly, hence, cysteine must be in between glutamic acid and glycine as given below:



3. (i) (b)

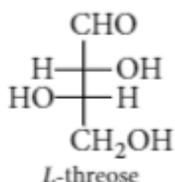
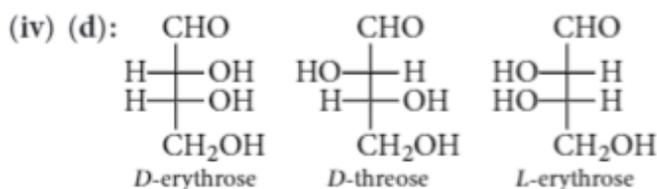
(ii) (a)

(iii) (c): Carbohydrates are essentially polyhydroxy aldehydes and polyhydroxy ketones. Thus, the two

functional groups present are  $>\text{C}=\text{O}$  (aldehyde or ketone) and  $-\text{OH}$ .

OR

(d)



4. (i) (a)

(ii) (a)

(iii) (c): Glucose contains four chiral centres.

(iv) (d): In the formation of osazone, C-1 and C-2 react with phenylhydrazine to form phenylhydrazone. If C-3, C-4, C-5 have same configuration they will form same osazone even if they differ in configuration at C-1 or C-2.

OR

(c): Pentacetate of glucose does not react with hydroxylamine showing absence of free  $-\text{CHO}$  group. This cannot be explained by open structure of glucose.

5. (i) (c)

(ii) (b)

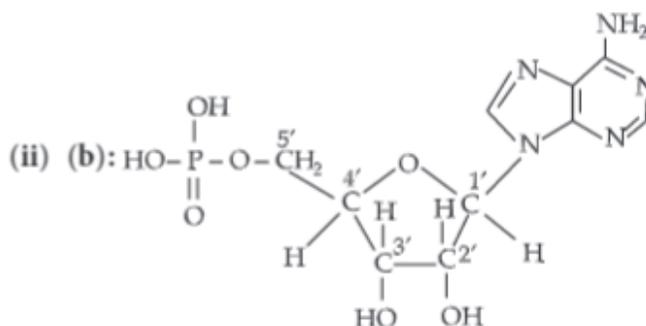
(iii) (b)

OR

(c): Cheese is a denatured protein.

(iv) (d)

6. (i) (d): DNA occurs in nucleus of the cell while RNA is found mainly in cytoplasm of the cell.



Nucleosides contain only sugar and a base whereas nucleotides contain sugar, base and a phosphate group as well.

(iii) (c): The segment of DNA which acts as the instruction manual for the synthesis of protein is gene.

(iv) (d): The double helical structure of DNA was proposed by Watson and Crick.

OR

(d): In DNA, the complementary bases are, adenine and thymine; guanine and cytosine.

7. (i) (a)

OR

(d): All amino acids except glycine are optically active because they contain, asymmetric carbon atom. They exist in both *D* and *L*-forms. Most naturally occurring amino acids have *L*-configuration.

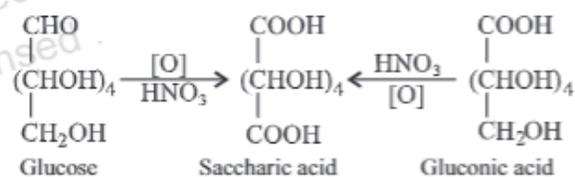
(ii) (b): In  $\alpha$ -helix structure, the formation of hydrogen bonds takes place between  $-\text{CO}-$  and  $-\text{NH}$  groups, whereas in  $\beta$ -pleated structure, hydrogen bonds are formed between amide groups of two different chains.

(iii) (c): Out of 20 amino acids, only 10 amino acids can be synthesised by human body.

(iv) (b)

8. (i) (a)

(ii) (b):



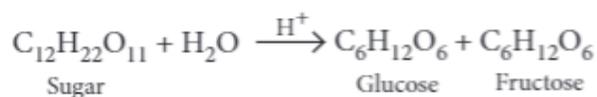
Strong oxidising agents like nitric acid oxidises both the terminal  $-\text{CHO}$  and  $-\text{CH}_2\text{OH}$  groups of glucose to give the dibasic acid, saccharic acid.

(iii) (b)

(iv) (d): If a certain compound gives negative test with ninhydrin and positive test with Benedict's solution then the compound should be a monosaccharide.

OR

(d) : The rapid interconversion of  $\alpha$ -D-glucose and  $\beta$ -D-glucose in solution is known as mutarotation. Sugar gets hydrolysed with mineral acids.



9. (a): Reducing sugars contain a free aldehydic or ketonic group adjacent to a  $>\text{CHOH}$  group and reduce Tollen's reagent, Schiff's reagent or Benedict's solution.

10. (d): Benedict's solution, Tollens' reagent, Fehling's solution etc. are mild oxidising agents. They oxidise the aldoses and ketoses to the corresponding acids and get themselves reduced.

11. (b): Fructose on warming with dilute alkali, gives rise to an equilibrium mixture of glucose, fructose and mannose. The ability of fructose to reduce Fehling solution and Tollens' reagent is probably due to the isomerisation of fructose to glucose and mannose (this is called Lobry de Bruyn and Elkenstein rearrangement).

12. (b): Glucose exists in two forms, *i.e.*  $\alpha$ -D-glucose with a specific rotation of  $+112^\circ$  and  $\beta$ -D-glucose with a specific rotation of  $+19^\circ$ . However, when either of these two forms is dissolved in water and allowed to stand, it gets converted into the same equilibrium mixture of both the  $\alpha$ - and  $\beta$ -forms with a small amount of open chain form. As a result of this equilibrium, the specific rotation of a freshly prepared solution of  $\alpha$ -glucose decreases from  $+112^\circ$  to  $52.7^\circ$  while that of  $\beta$ -glucose increases from  $+19^\circ$  to  $52.7^\circ$ .

13. (b)

14. (b): Valine is an essential amino acid. The amino acids which the body cannot synthesize are called essential amino acid.

15. (b): Because of the ring structure  $\text{C}_1$  in glucose becomes chiral and hence glucose exists in two stereoisomeric forms, *i.e.*,  $\alpha$ - and  $\beta$ -, corresponding to each stereoisomeric form glucose forms two methyl glucosides, *i.e.*,  $\alpha$ - and  $\beta$ -methyl glucosides.

16. (c): The two strands in a DNA molecule are not exactly similar but are complimentary.

17. (b): The genetic information of the cell is contained in the sequence of base A, T, G and C in DNA molecule when a cell divides, DNA molecules replicate and make exact copies of themselves so that each daughter cell will have DNA identical to that of the parent cell.

18. (b): Due to denaturation, a protein loses its biological activity. During denaturation the protein molecule uncoils from a more random conformation and precipitates from the solution.

19. (b): In *o*- or *p*-aminobenzoic acids, the lone pair of electrons on the  $-\text{NH}_2$  group is donated towards the benzene ring. As a result, the basic character of  $-\text{NH}_2$  group and acidic character of  $-\text{COOH}$  group decreases. Therefore, the weakly acidic  $-\text{COOH}$  group cannot transfer  $\text{H}^+$  ion to the weakly basic  $-\text{NH}_2$  group therefore, *o* and *p*-aminobenzoic acids do not exist as zwitter ion.

20. (b): Amino acids are soluble in polar solvents like  $\text{H}_2\text{O}$ ,  $\text{NaOH}$  and  $\text{HCl}$  and insoluble in non-polar solvents like benzene, ether, etc.

21. (c): Globular proteins have weak intermolecular forces of attraction and hence they are soluble in water.

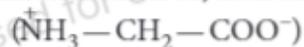
22. (a): Glucose and fructose differ from each other only at C<sub>1</sub> and C<sub>2</sub> positions.

23. (b): In β-pleated sheet structure, the polypeptide chains are held together by intermolecular H-bonds. Extension and contraction of β-pleated sheet structure of protein depends on the size of R.

24. (c): The various nucleotides in nucleic acids are linked through phosphate ester groups

25. (a): NH<sub>2</sub>—CH<sub>2</sub>—COOH is a typical α-amino acid.

In solution it exists as, internal salt or zwitter ion,

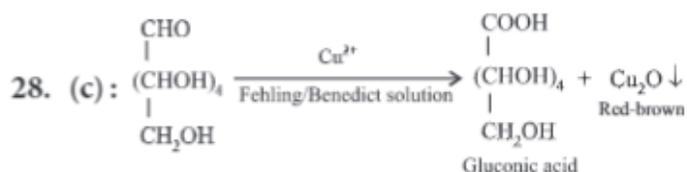


because the proton (H<sup>+</sup>) of —COOH group is captured by —NH<sub>2</sub> group as NH<sub>2</sub> has a lone pair of electrons on N atom.

26. (a): At isoelectric point, protein molecules behave as zwitter ions and hence, do not move toward

any electrode or act as neutral molecules. This reduces their solubility to minimum and thus, helps in their separation and purification.

27. (b): Insulin is a globular protein. This protein has three-dimensional folded structure. These are stabilised by internal hydrogen bonding, hence, they are water soluble.



29. (b): Cysteine can cross link peptide chains through disulphide bridge. Cross linking by disulphide bridge can occur either between the distant, properly oriented parts of the same polypeptide chain (as in oxytocin or vasopressin) or between different polypeptide chains.

30. (d): Uracil occurs in RNA.