EXERCISE-01 CHECK YOUR GRASP

SELECT THE CORRECT ALTERNATIVE (ONLY ONE CORRECT ANSWER)

1. The minimum number of carbon atoms that should be present in a monosaccharite is :

(A) 2 (B) 3 (C) 4 (D) 6

2. Carbohydrates that, on attempted hydrolysis, are not cleaved to smaller carbohydrates are called :

(A) oligosaccharides (B) polysaccharides (C) disaccharides (D) monosaccharides

3. The IUPAC name of the ketotriose is :

(A) 1, 3-dihydroxypropanone (B) 1-3-dihydroxy-2-oxopropane

(C) 2-oxo-1, 3-propanediol (C) dihydroxyacetone

4. The number of chiral centres in the open chain structure of glucose is :

(A) 3 (B) 4 (C) 5 (D) 6

5. Cane sugar on hydrolysis gives :

(A) glucose and galactose (B) glucose and fructose

(C) glucose only (D) fructose only

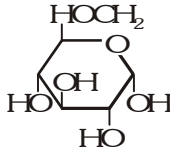
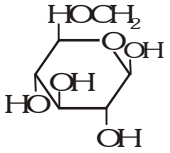
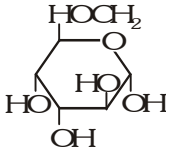
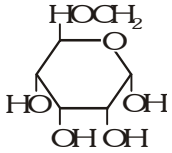
6. In D-erythrose, the configurations at C-2 and C-3 are respectively :

(A) 2R, 3R (B) 2S, 3S (C) 2R, 3S (D) 2S, 3R

7. Glucose and fructose are :

(A) diastereomers (B) anomers (C) epimers (D) functional isomers

8. Which of the following structures represents α-D-glucopyranose?

(A)  (B)  (C)  (D) 

9. Sorbitol can be obtained by the reduction of -

(A) sorbose (B) glucose (C) fructose (D) all of these

10. Freshly prepared solution of cane sugar, under the influence of acid catalyst, undergoes change in optical rotation with laps of time. This phenomenon is called -

(A) mutarotation (B) inversion

(C) racemization (D) optical rotatory dispersion

11. In the formation of osazone derivatives of aldohexoses and ketohexoses, the carbon atom (s) that participate (s) in the reactions is -

(A) C-1 (B) C-2 (C) C-1 and C-2 (D) C-2 and C-3

12. Glucose gives positive silver mirror test with ammoniacal silver nitrate because it contains -

(A) hydroxyl group (B) aldehyde group

(C) ketone group (D) vicinal diol group

13. Fructose reduces fehling's solution due to the presence of -

(A) hydroxy group (B) aldehyde group

(C) ketone group (D) α-hydroxyketone group

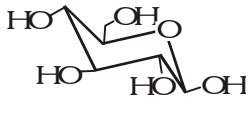
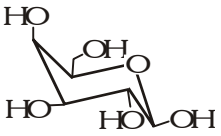
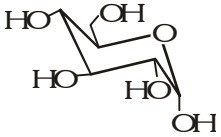
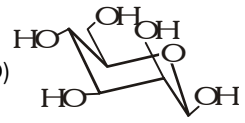
14. In the multi-step conversion of an aldose into next higher aldose by Kiliani-Fischer synthesis, the reagent employed in the first step is -

(A) $C_6H_5NHNH_2$ (B) NH_2OH (C) Br_2/H_2O (D) HCN

15. When methyl D-Glucopyranoside is oxidized with periodic acid, how many moles of the oxidizing agent are consumed per mole of the sugar ?

(A) 2 (B) 3 (C) 4 (D) 5

16. β-D-glucose is represented as -

(A)  (B)  (C)  (D) 

17. The number of carbon atoms and oxygen atoms present in the ring of the D-glucopyranose are respectively:

(A) 5 and 1 (B) 4 and 1 (C) 4 and 2 (D) 3 and 2

18. Glucose is oxidized by nitric acid to give

(A) gluconic acid (B) glucaric acid (C) glucuronic acid (D) glycolic acid

19. D-(–)- Erythrose and D-(–)- threose are separately reduced with $NaBH_4$ to give the products (A) and (B) respectively. Which of the following statements is correct about (A) and (B) ?

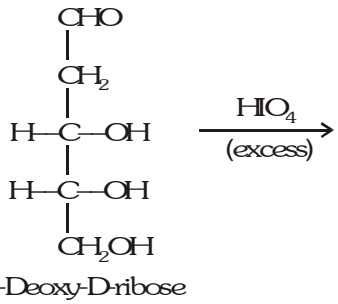
(A) Both (A) and (B) will be optically active.

(B) Both (A) and (B) will be optically inactive.

(C) (A) will be optically inactive but (B) will be optically active

(D) Neither (A) not (B) possesses any asymmetric carbon atom.

20. The products expected from the reaction are :



2-Deoxy-D-ribose

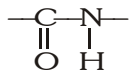
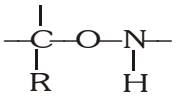
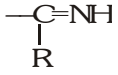
(A) $OHCCH_2CHO$, HCOOH and HCHO (B) HOOCCHOHCHOHCOOH and HCOOH

(B) $HOOCCH_2COOH$, HCOOH and HCHO (D) HOOCCOOH, HCOOH and HCHO

21. Glucose does not react with

(A) $C_6H_5NHNH_2$ (B) NH_2OH (C) HCN (D) $NaHSO_3$

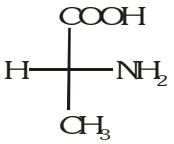
22. Which one among the following is a peptide linkage ?

(A)  (B)  (C)  (D) 

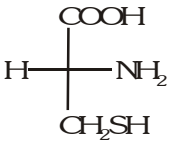
23. The pH at which an amino acids carries no net charge is called its :

(A) isoelectric point (B) Inversion point (C) Neutralization point (D) triple point

24. The configurations of the compounds I and II



I

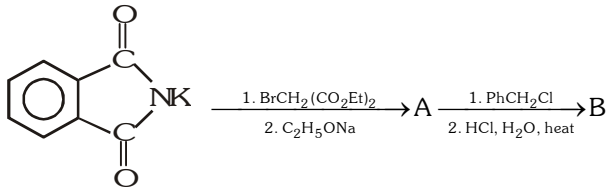


II

are respectively

(A) R and R (B) R and S (C) S and S (D) S and R

25. Consider the following sequence of reactions.



The major final product (B) is

(A) H_2NCH_2COOH (B) $PhCH(NH_2)COOH$

(C) $PhCH_2CH(NH_2)COOH$ (D) $PhCH_2C(COOEt)_2$ with NH_2

CHECK YOUR GRASP				ANSWER KEY							EXERCISE -1								
Que.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Ans.	B	D	A	B	B	A	D	A	D	B	C	B	D	D	A	A	A	B	C	A
Que.	21	22	23	24	25															
Ans.	D	A	A	B	C															

SELECT THE CORRECT ALTERNATIVES (ONE OR MORE THEN ONE CORRECT ANSWERS)

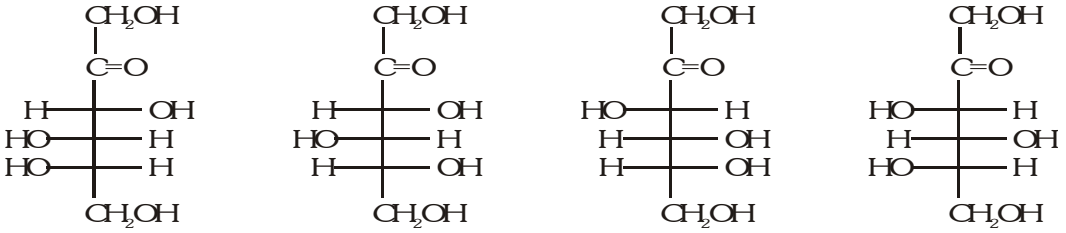
1. Which of the following carbohydrates is a disaccharide?

(A) Glucose (B) Fructose (C) Maltose (D) Lactose

2. α-D-Glucopyranose and β-D-glucopyranose are :

(A) Anomer (B) Epimer (C) Diastereomers (D) enantiomers

3. Consider the following structures.



I II III IV

Which of the following pairs represent D- and L-fructose respectively?

(A) II and I (B) I and III (C) III and IV (D) II and IV

4. (+) - sucrose is made up of -

(A) D-glucose and L-fructose (B) D-glucose and D-frucotse

(C) D-fructose and L-glucose (D) L-fructose and L-glucose

5. Glucose cannot be classified as -

(A) a carbohydrate (B) a hexose

(C) an aldose (D) an oligosaccharide

6. D-Glucose and D-mannose are -

(A) anomers (B) epimers (C) diastereomers (D) enantiomers

7. D-Glucose reacts with anhydrous methyl alcohol in the presence of dry HCl gas to form -

(A) 2,3,4,5,6-penta-O-methyl D-glucose (B) α-methyl D-glucopyranoside

(C) β-methyl D-glucopyranoside (D) Both (B) and (C)

8. When glucose is treated with an excess of HIO_4, the products formed are -

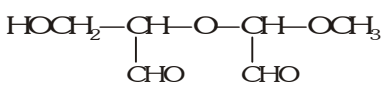
(A) one mole of glyoxal (CHOCHO), one mole of HCHO and three moles of HCOOH

(B) five moles of HCOOH and one mole of HCOH

(C) one mole of oxalic acid (COOHCOOH), three moles of HCOOH and one mole of HCHO

(D) six moles of HCOOH

9. Methyl D-glucoside on reaction with HIO_4 consume two moles of the reagent and produces the dialdehyde (A) and one mole of HCOOH :

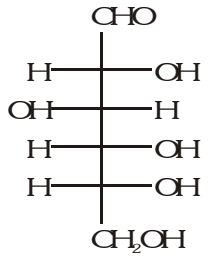


The result of this reaction proves that glucose has :

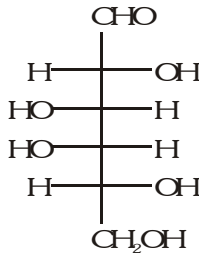
(A) a pyranose structure (B) a furanose structure

(C) an open-chain structure (D) a four-membered ring structure

10. Following are the structure of D-glucose and D-galactose-



D-Glucose



D-Galactose

which of the statement is correct about these compounds :

(A) They are diastereomers

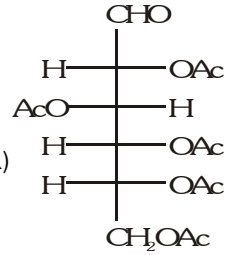
(B) both are components of lactose

(C) They are C-4 epimers

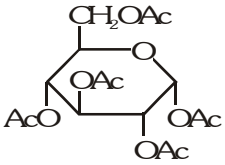
(D) they are enantiomers

11. D-Glucose is treated with an excess of acetic anhydride in the presence of pyridine. Identify the products formed.

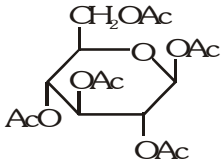
(A)



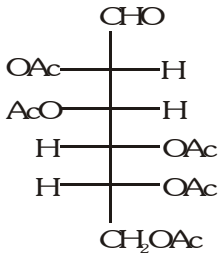
(B)



(C)

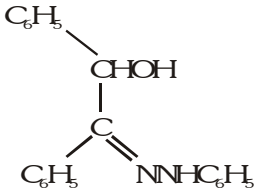


(D)

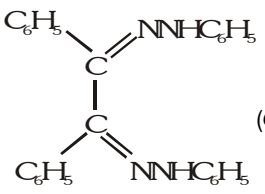


12. The product formed in the reaction is :

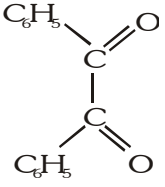
(A)



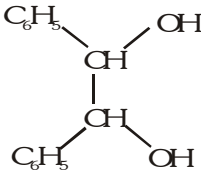
(B)



(C)



(D)



13. (+)-Sucrose has a specific rotation of +66.5 , while D-(+)-glucose and D-(–)-fructose have specific rotations of +52.5 and –92.4 respectively. After complete hydrolysis of (+)–surcose by dilute acid, what will be the specific rotation of the hydrolysis product, called invert sugar [a 1 : 1 mixture of D-(+)-glucose and D-(–)-fructose]?

(A) –39.9 (B) –72.4 (C) –19.9 (D) –34.9

14. Consider the following statements :

(A) Monosaccharides are optically active polyhydroxy carbonyl compounds.

(B) Fructose does not reduce Fehling's solution because it is a ketose.

(C) α-D(+)–Glucose and β-D(+)-glucose are anomers.

(D) D-Glucose and D-mannose are C-2 epimers.

15. Consider the following statements about sucrose.

(A) Hydrolysis of surcose with dilute acid yields an equimolar mixture of D-gluvose and D-fructose

(B) Acid hydrolysis of sucrose is accompained by a change in optical rotation.

(C) In sucrose, the glycosidic linkage is between C-1 of glucose and C-2 of fructose.

(D) Aqueous solution of sucrose exhibits mutarotation.

16. Alanine, at its isoelectric point, exists in solution as :

(A) $H_2NCHCOO^{\ominus}$ with CH_3 (B) $H_3\overset{\oplus}{N}CHCOOH$ with CH_3 (C) $H_3\overset{\oplus}{N}CHCOO^{\ominus}$ with CH_3 (D) $H_2NCHCOOH$ with CH_3

17. The pK_a of acetylsalicylic acid (aspirin) is 3.5. The pH of gastric juice in human stomach is about 2-3 and pH in the small intestine is about 8, aspirin will be -

(A) Unionized in the small intestine and in the stomach

(B) Completely ionized in the stomach and almost unionized in the small intestine

(C) Ionized in the stomach and almost unionized in the small intestine

(D) Ionised in the small intestine and almost unionised in the stomach

18. Which of the following are natural polymers ?

(A) proteins (B) cellulose (C) Teflon (D) Natural rubber

19. Amino acids are produced on hydrolysis of :

(A) nucleic acids (B) carbohydrates (C) fats (D) proteins

20. Which of the following do not undergo hydrolysis :

(A) glucose (B) fructose (C) galactose (D) sucrose

BRAIN TEASERS						ANSWER KEY									EXERCISE -2
Que.	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
Ans.	C, D	A,B,C	C	B	D	B,C	D	B	A	A,B,C	B,C	B	C	A,C,D	A,B,C
Que.	**16**	**17**	**18**	**19**	**20**										
Ans.	C	D	A,B,D	D	A,B,C										

EXERCISE–03 MISCELLANEOUS TYPE QUESTIONS

TRUE OR FALSE :

1. Fructose is an aldose.
2. Glucose and fructose are both monosaccharides.
3. Carbohydrate is a polyhydroxy compound that has an aldehydic or a ketonic functional group either free or as hemiacetal or acetal.
4. Glucose undergoes oxidation with Fehling's solution or Tollen's reagent.
5. Epimers are a pair of diastereomers that differ only in the configuration about a single carbon atom.
6. The solution having equal molecules of D-glucose and D-fructose is termed invert sugar.

FILL IN THE BLANKS :

1. A disaccharide consists of two.....joined by..... bonds.
2. A polysaccharide is a polymer of.....
3. Protein is a polymer of .....
4. The glycerides which contain saturated carboxylic acids are called .....
5. Glucose and cane sugar can be distinguished by .....reagent or .....solution.

MATCH THE COLUMN

1. Match the column I with column II.

	Column-I		Column-II
(A)	α- and β- Glucose	(p)	Mutarotation
(B)	(+) and (–) Glucose	(q)	Enantiomers
(C)	D- and L- Notations	(r)	Anomers
(D)	α-Form $\rightleftharpoons$ open-chain form $\rightleftharpoons$ β-form	(s)	Configurational relationship

2. Match the column I with column II.

	Column-I		Column-II
(A)	Glucose	(p)	Inversion
(B)	Hydrolysis of cane sugar	(q)	α-amino acid
(C)	Zwitter ion	(r)	Protein
(D)	Peptide linkage	(s)	Monosaccharide

3. Match the column I with column II.

	Column-I		Column-II
(A)	Sucrose	(p)	Non-reducing sugar
(B)	Fructose	(q)	Polysaccharide
(C)	Maltose	(r)	Reducing sugar
(D)	Cellulose	(s)	Disaccharide

ASSERTION & REASON QUESTION :

These questions contains, Statement-I (assertion) and Statement-II (reason).

(A) Statement-I is True, Statement-II is True ; Statement-II is a correct explanation for Statement-I

(B) Statement-I is True, Statement-II is True ; Statement-II is NOT a correct explanation for Statement-I

(C) Statement-I is True, Statement-II is False.

(D) Statement-I is False, Statement-II is True.

1. **Statement-I :** A solution of sucrose in water is dextrorotatory but on hydrolysis in presence of $H^{\oplus}$, it becomes leavorotatory.

Because

Statement-II : Inversion of sugar follows first order kinetics.

2. **Statement-I :** The digestion of carbohydrates does not take place in stomach.

Because

Statement-II : Enzymes like salivary amylase becomes inactive in stomach where there is acidic pH.

3. **Statement-I :** Proteins are made up of any α-amino acid.

Because

Statement-II : During denaturation, primary structure of proteins is not affected.

4. **Statement-I :** Reducing sugar give red precipitate with Fehling's solution and show mutarotation.

Because

Statement-II : During mutarotation, one pure anomer is converted into mixture of two anomers.

5. **Statement-I :** Natural rubber is a polymer of cis-Isoprene.

Because

Statement-II : Polytrans isoprene is called Gutta percha.

COMPREHENSION BASED QUESTIONS :

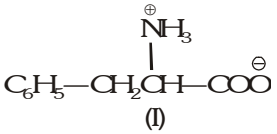
Comprehension # 1

Amino acids contains as $-NH_2$ as well as $-COOH$ group. They exist as zwitter ions.

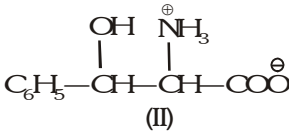
Which explain their several characteristic properties, like decomposition on heating, solubility in water, larger dipole moment. Thus in solution, amino acids may exist as dipolar ion (neutral pH), cationic (In strongly acidic solution), or anionic (in strongly basic solution).

Amino acids undergo usual reaction of the $-COOH$ group as well as $-NH_2$ group.

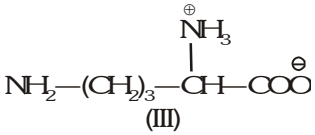
1. At intracellular pH (:6–7), amino acids can be divided into four types positively charged, negatively charged, hydrophobic and hydrophilic. Which is the correct classification of the following four amino acids ?



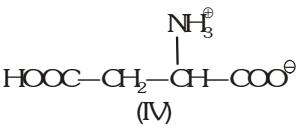
(I)



(II)



(III)



(IV)

	I	II	III	IV
(A)	hydrophobic	+ vely charged	– vely charged	hydrophilic
(B)	hydrophobic	hydrophilic	+ vely charged	– vely charged
(C)	hydrophilic	hydrophobic	+ vely charged	– vely charged
(D)	+ vely charged	– vely charged	hydrophobic	hydrophilic

2. Amino acid are -

(A) As basic as a typical amine and as acidic as a carboxylic acid

(B) Less basic than a typical amine and less acidic than a —COOH

(C) More basic than a typical amine and more acidic than a —COOH

(D) Nothing is certain

3. Base treatment of an amino acid usually result in the conversion of the acid to a derivative via the amino carboxylate salt. The above procedure -

(A) Decrease the rate of electrophilic reaction of the free amino group

(B) Decrease the rate of nucleophilic reaction of the free amino group

(C) Enhances the rate of nucleophilic reaction of the free amino group

(D) Enhances the rate of electrophilic reaction of the free amino group

4. Benzoylation of an amino acid can best be done by treating the amino acid with benzoyl chloride -

(A) In presence of dil. NaOH (B) In presence conc. NaOH

(C) In absence of NaOH (D) In presence of HCl

Comprehension # 2

Monosaccharides have —CHO (or C=O) and —OH groups, so they undergo usual oxidation and reduction. Further, monosaccharides form osazone when treated with excess of phenylhydrazine (3 equivalents). In osazone formation only the first two carbon atoms are involved. Thus monosaccharides having identical configuration on rest of C atoms except first two will form same osazone. As is the case with glucose and fructose.

A, B and C are three hexoses and form same osazone D. Compounds A to D behave as below :

(i) D $\xrightarrow{HCl}$ $\xrightarrow[CH_3COOH]{Zn}$ D-Fructose (ii) A $\xrightarrow{Ni,H_2}$ $\xrightarrow{HNO_3}$ $\xrightarrow[H_3O^+]{Na-Hg}$ B + C

(iii) B $\xrightarrow{HNO_3}$ Optically active glyceric acid (iv) C $\xrightarrow{HNO_3}$ Optically inactive glyceric acid

1. Compound D is a osazone which can be obtained from :

(A) Only one compound (B) Two compounds

(C) Three compounds (D) Four compounds

2. Compound A should be :

(A) D-glucose (B)D-fructose (C) L-glucose (D) L-fructose

3. Compound B and C, respectively, are :

(A) D-glucose and D-mannose (B) D-mannose and D-glucose

(C) D-glucose and L-glucose (D) D-glucose and L-mannose

Comprehension # 3

Carbohydrates are polyhydroxy aldehydes and ketones and those compounds which on hydrolysis give such compounds are also carbohydrates. The carabohydrates which are not hydrolysed are called monosaccharides. Other carbohydrates are oligosaccharides and polysaccharides. Monosaccharides with aldehydic group are called aldose and those with free ketonic groups are called ketose. Carbohydrates are optically active.

Number optical isomers = 2"

where n = number of asymmetric carbons. Carbohydrates are mainly synthesised by plants during photosynthesis.

1. Number of optical isomers of glucose is :

(A) 8 (B) 16 (C) 32 (D) 4

2. Fructose is :

(A) aldotriose (B) ketohexose (C) aldohexose (D) Ketotriose

3. First member of ketose sugar is :

(A) ketotriose (B) ketotetrose (C) ketopentose (D) ketohexose

---

MISCELLANEOUS TYPE QUESTION **ANSWER KEY** EXERCISE -3

- ***True / False***

1. F **2.** T **3.** T **4.** T **5.** T **6.** T

- ***Fill in the Blanks***

1. monosaccharides, glycosidic **2.** monosaccharides **3.** α-amino acids
4. fats **5.** tollen's , Fehling's

- ***Match the Column***

1. (A) → p, r ; B → q ; (C) → s ; (D) → p **2.** (A) → s ; (B) → p ; (C) → q ; (D) → r
3. (A) → p,s ; (B) → r ; (C) → p,s ; (D) → p, q

- ***Assertion - Reason Questions***

1. B **2.** A **3.** B **4.** A **5.** B

- ***Comprehension Based Questions***

Comprehension #1 : 1. (B) **2.** (B) **3.** (C) **4.** (A)
Comprehension #2 : 1. (C) **2.** (B) **3.** (A)
Comprehension #3 : 1. (B) **2.** (B) **3.** (A)

1. Deduce the molecular formula of glucose from the following data -

   The % composition is C = 40%, H=6.7% and O=53.3%. A solution of 9.0g in 100 g of H_2O freezes at 0.93 C. (K_f of H_2O = 1.86 C/mol)

2. Prove by giving one chemical reaction that glucose has hydroxyl (—OH) groups.

3. Glucose, mannose and fructose give identical osazones. Explain.

4. (+) Sucrose on hydrolysis gives a mixture of D-(+) glucose, $[\alpha]_D$=52.7 and D-(–) fructose = –92.4 , known as invert sugar. Calculate the rotation of mixture, i.e., invert sugar.

5. Explain why, although cellulose contains so many —OH groups, it is insoluble in water ?

6. The β-and α-D-glucose have different specific rotations. When either anomer is dissolved in water, their rotation change until the same fixed value results. What term is used for these changes.

7. Can amino acid be isolated at its isoelectric point ?

8. Why is the acidic hydrolysis of sucrose called inversion reaction ?

9. Illustrate the following terms :

   (a) Copolymerization (b) Vulcanization

10. Explain how does 1, 3-butadiene polymerise by different routes.

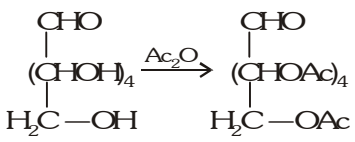
CONCEPTUAL SUBJECTIVE EXERCISE — ANSWER KEY — EXERCISE -4(A)

1. Empirical Formula is CH_2O, emp. wt. = 30, $m = \frac{\Delta T_f}{K_f}$

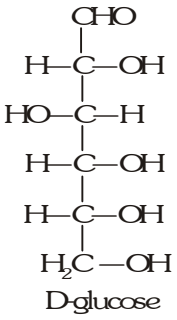
$$m = \frac{0.93}{1.86°C/mol} = 0.50\,mol$$

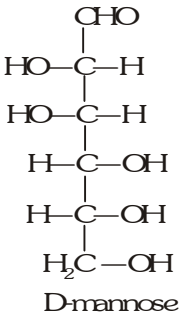
$$M.W. = \frac{90g}{0.50\ mol} = 180\,g/mol,\ n = \frac{180}{30} = 6$$

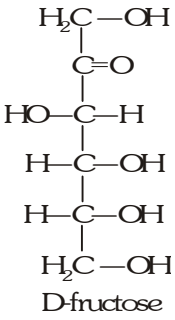
Hence, formula - 6 $CH_2O = C_6H_{12}O_6$

2. 

3. Only C_1 and C_2 are involved in osazone formation. Hence aldohexoses and ketohexoses which have the same configuration at C_3, C_4 and C_5 give the same osozone.


D-glucose


D-mannose


D-fructose

4. We know that 1 mole of sucrose yields 1 mole of glucose and 1 mole of fructose. Hence, the specific rotation of mixture will be one half of the sum of the specific rotation of the two monosaccharides.

$$[\alpha]_D \text{ of invert sugar} = \frac{1}{2}[52.7 + (-92.4)] = -19.9$$

5. Cellulose does not form hydrogen bonds with water.

6. This specific rotation change is known as mutarotation. The α-and β-D-glucoses are each in equilibrium with the open chain aldehyde form

$$\alpha\text{-D-glucose} \rightleftharpoons \text{Aldehyde form} \rightleftharpoons \beta\text{-D-glucose}$$

As each anomer begins to establish this equilibrium, its specific rotation value changes. When equilibrium is reached, the experimentaly determined rotation remains constant. A base like NaOH catalyzes the attainment of the equilibrium.

7. Yes, the solubility of an amino acid in water is minimum at its isoelectric point and thus its isolation is attempted at this pH.

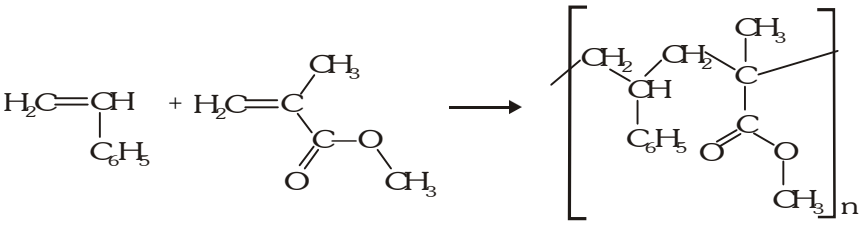
8. The hydrolysis proceed as follows :

$$\underset{\substack{\text{Sucrose}\\ [\alpha]_D=+66.5^\circ}}{C_{12}H_{22}O_{11}} + H_2O \xrightarrow{HCl} \underset{\substack{\text{D(+)-glucose}\\ [\alpha]_D=+52.7^\circ}}{C_6H_{12}O_6} + \underset{\substack{\text{D(-)-fructose}\\ [\alpha]_D=92.4^\circ}}{C_6H_{12}O_6}$$

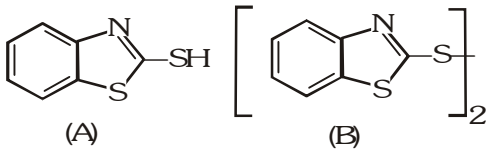
Since there is a change in the sign of rotation from Dextro to Laevo as a result of hydrolysis, it is called inversion reaction. Sucrose is often called invert sugar.

9. (a) **Copolymerization :** Poymerization of a single monomeric compound to form a homopolymer is known as homopolymerization. Evidently such a polymer is made up of identical units. In contrast, a copolymer results when two different kinds of monomers are polymerized together to give a product containing both the monomers. Such a processes, known as copolymerization.

Example :



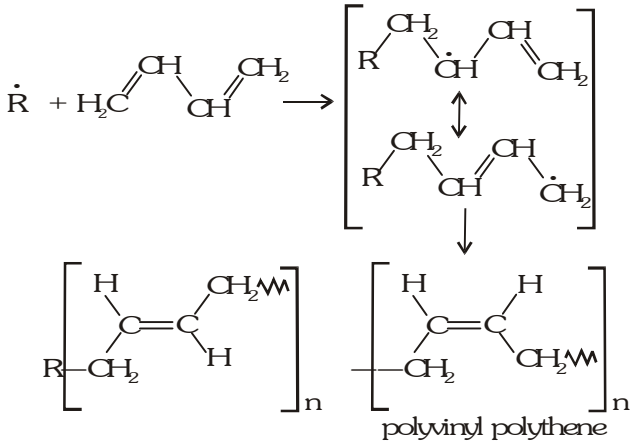
(b) **Vulcanization :** In its original form natural rubber is not a very useful substance as it softens at moderate temperatures and hardens quickly to a brittle substance. It was subsequently discovered by Goodyear in 1839 that heating the gum rubber with sulphur produced a material of improved elasticity with much greater toughness and resistance to heat. The process is called vulcanization and is brought about with the help of vulcanization accelerators such as 2-mercaptobenzothiazole (A) and 2,2'-dithiobisbenzothioazole (B).



(A) (B)

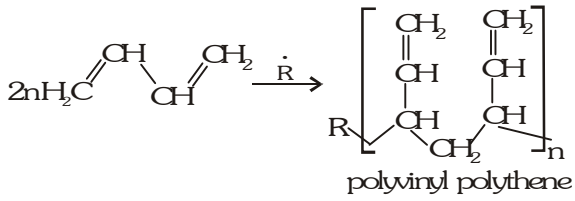
10. Butadiene is a conjugated diene and its free radical polymersiation can occur in two ways.

(i) When the polymerization take place at C_1 and C_4 of butadiene, an unbranched polymer results. It can exist either as trans-polybutadiene or as cis isomer or as the mixture of both.



polyvinyl polythene

(ii) 1,3-butadiene can also undergo polymerization at C_1 and C_2 to give polyvinyl polyethene as the product.



polyvinyl polythene

1. Glucose and fructose are both reducing sugars. Why is sucorse regarded as a non-reducing sugar ?

2. (i) Name the type of linkages responsible for the formation of primary and secondary structures of proteins.

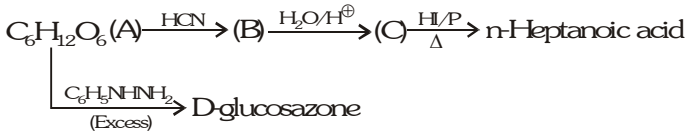
   (ii) On electrolysis in acidic solution, α-amino acids migrate towards cathode while in alkaline medium, they migrate towards anode. Explain.

   (iii) What are essential and non-essential amino acids. Give two example of each.

3. When the ketohexose, D(–) fructose is treated with phenyl hydrazine it produces an osazone that is identical with the one prepared from either D-(+) glucose or D-(+) mannose. How is the configuration of D(–) fructose related to those of D-(+) glucose and D-(+) mannose ?

4. Glycine exists as a dipolar ion, while anthranilic acid does not. Expalin

5. Compound (A), $C_6H_{12}O_6$, is oxidized by bromine water into a monobasic acid and also reduces Tollen's reagent and Fehling's solution. It also responds to the following reactions. Identify the compound (A).



6. What is a peptide linkage ? What is the geometry and bond lengths in a peptide molecule ?

7. Cellulose, a polysaccharide having β-D-glucoside units, has a stronger and more compact physical structure than starch which has α-D-glucsoe unit. Explain ?

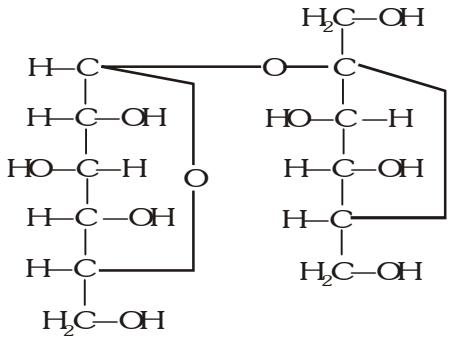
8. Order the following monomers with respect to their expected reactivity toward cationic polymerization and explain your answer.

   $H_2C{=}CHCH_3$, $H_2C{=}CHCl$, $H_2C{=}CH{-}C_6H_5$, $H_2C{=}CHCO_2CH_3$.

9. What product would you expect to obtain from catalytic hydrogenation of natural rubber ? Would the product be syndiotactic, atactic, or isotactic ?

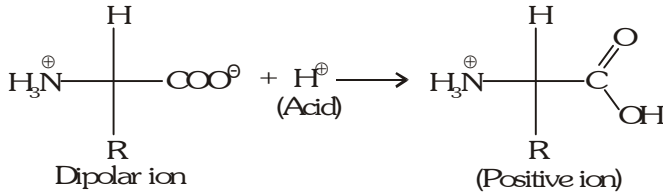
10. Irradiation of poly (1, 3-butadiene), followed by addition of styrene, yields a graft copolymer that is used to make rubber soles for shoes. Draw the structure of a representative segment of this styrene- butadiene graft copolymer.

1. In the formation of sucrose (disaccharide), both glucose and fructose molecules are linked to each other at their aldehydic and ketonic groups respectively. Since these are not free in sucrose, it is a non-reducing sugar. This is further confirmed by the structure of sucrose.



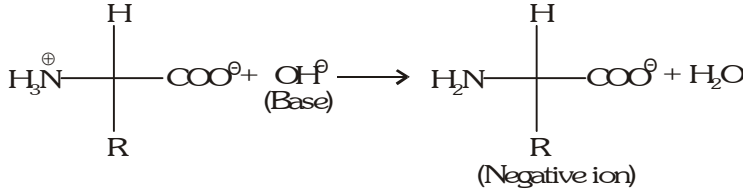
2. (a) Peptide linkages (—CO—NH—) are present in the primary structures of proteins while the secondary structures of proteins involve hydrogen bonding.

(b) An α-amino acid has a dipolar structure, In acidic medium, it exists as a positive ion



In electric field, the positive ion moves towards cathode.

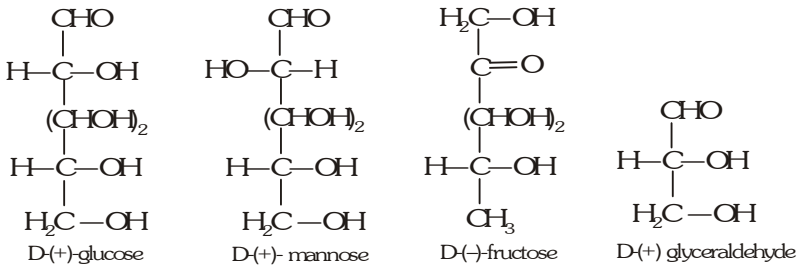
In alkaline medium, the dipolar ion changes to anion and moves towards anode under the influence of applied electric field.



(c) Amino acids which are not synthesized by the body are called essential amino acids. For ex., Leucine and Lysine.

Amino acids which are synthesized by the body are known as non-essential amino acids. for ex. Glycine and Alanine.

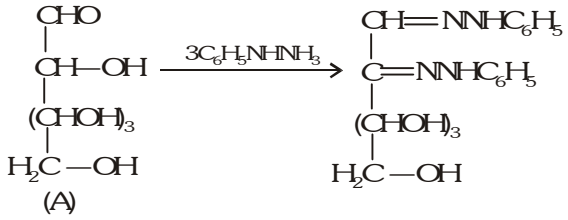
3. Sugars forming same osazone have different configuration of C_1 and C_2 that are involved in osazone formation, the rest four carbon atoms (C_3, C_4, C_5 and C_6 are same) are identical. Since all belongs to D-Family hence the configuration of last but one asymmetric carbon atom would be the same.



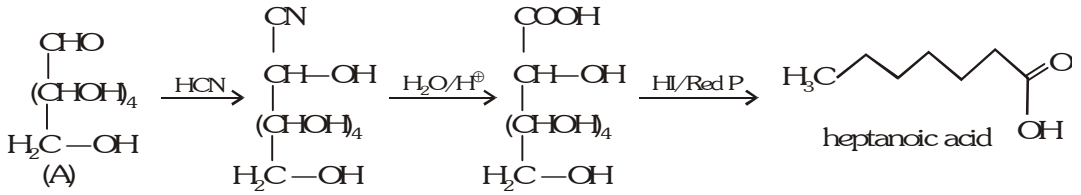
4. In anthranilic acid, the —COOH group is too weakly acidic to transfer a proton (H^+) to the weakly basic $—NH_2$ group attached to the electron-withdrawing benzene ring. When attached to an aliphatic carbon, the $—NH_2$ group is sufficiently basic to accept H^+ from —COOH group.

5. (i) (A) is glucose because it is readily oxidised by Br_2 water to gluconic acid. It reduces Fehling's and Tollen's reagent because it is a reducing sugar.

(ii) With excess phenyl hydrazine it gives glucosazone.



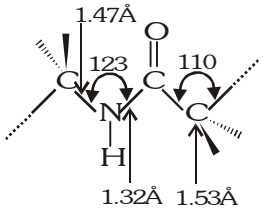
(iii)



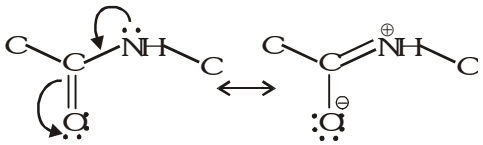
(A) is glucose.

6. Peptides are the polyamides formed by the condensation of amino group of one amino acid with the carboxylic group of the other. They are in fact secondary amides having —CO—NH— linkage commonly referred to as peptide linkage.

Studies on the structure determination of peptides have revealed that the amide group is flat and carbonyl and amino groups lie in one plane having H (of NH) and O (of CO) trans with respect to each other. Further the pioneering work by Linus Pauling on the X-ray studies of peptides has revealed that the C—N bond length of —CO—NH—is 1.32 A which is shorter than the usual 1.47 Å showing slight double bond character.



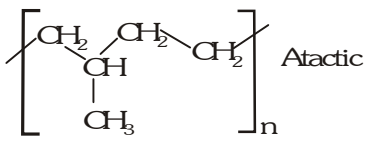
the double bond character of the C—N bond may be rationalized on the basis of resonance and because of this there is restricted rotation about amide bond, thus giving rise to cis, trans isomerism in which the trans isomer predominates.



7. In cellulose the C—O bonds in β-D-glucoside units are all equatorial which would give a more stable polymeric chain (less steric interacion), whereas in starch the C—O bonds in a-D-glucoside units have to be axial if other C—O bonds are equatorial. The latter arrangement is less stable than the former because of increased steric interaction.

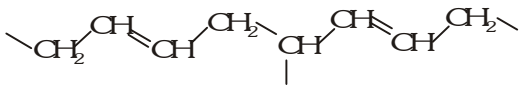
8. $H_2C{=}CHCO_2CH_3 < H_2C{=}CHCl < H_2C{=}CHCH_3 < H_2C{=}CH-C_6H_5$

9.

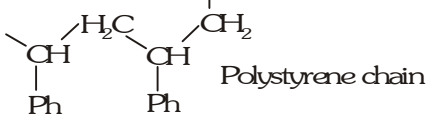


Atactic

10.



Polybutadiene chain



Polystyrene chain

EXERCISE–05 PREVIOUS YEARS QUESTIONS

1. The pair of compounds in which both the compounds give positive test with Tollen's reagent is :

(A) Glucose and Sucrose (B) Fructose and Sucrose **[IIT-04]**

(C) Acetophenone and Hexanal (D) Glucose and Fructose

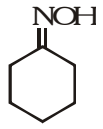
2. The two forms of D-glucopyranose obtained from the solution of D-glucose are called **[IIT-05]**

(A) Isomers (B) Anomers

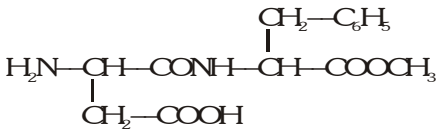
(C) Epimers (D) Enantiomers

3. Give the structure of the product in each of the following reactions. **[IIT-2000]**

(i) Suctose $\xrightarrow{H^+}$ A + B

(ii)  $\xrightarrow{H^+}$ C $\xrightarrow{\text{Polymerisation}}$ $[-D-]_n$

4. Aspartame, an artificial sweetener, is a peptide and has the following structure : **[IIT-2001]**



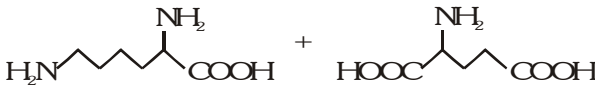
(i) Identify the four functional groups.

(ii) Write the zwitterionic structure.

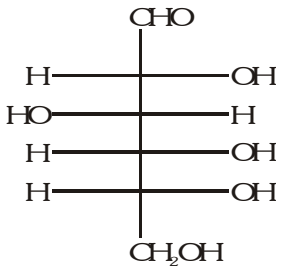
(iii) Write the structure of the amino acids obtained from the hydrolysis of aspartame.

(iv) Which of the two amino acids is more hydrophobic ?

5. Following two amino acids lysine and glutamine form dipeptide linkage. What are two possible dipeptides ?

 **[IIT-2003]**

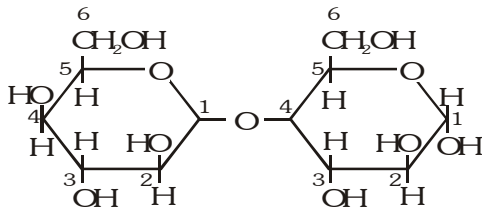
6. The Fisher projection of D-glucose is drawn below. **[IIT-2004]**



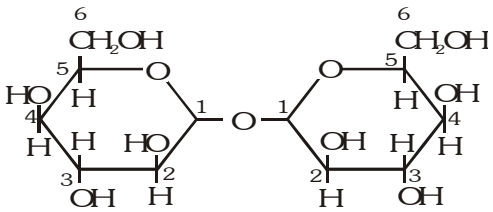
(i) Draw the Fisher projection of L-glucose.

(ii) Give the reaction of L-glucose with Tollen's reagent.

7. Which of the following will reduce Tollen's reagent? Explain. **[IIT-2005]**



A

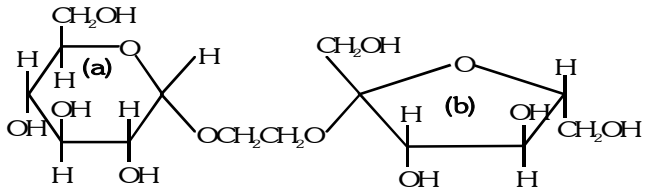


B

8. Match column I with column II **[IIT-2007]**

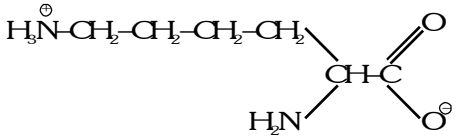
Column X	Column Y
(a) cellulose	(p) natural polymer
(b) nylon-6, 6	(q) synthetic polymer
(c) protein	(r) amide linkage
(d) sucrose	(s) glycoside linkage

9. The correct statement about the following disaccharide is – **[IIT-2010]**

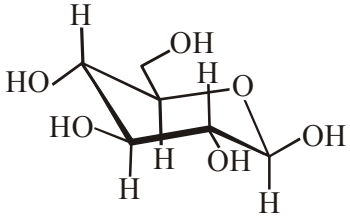


(A) Ring **(a)** is pyranose with α–glycosidic link
(B) Ring **(a)** is furanose with α–glycosidic link
(C) Ring **(b)** is furanose with α–glycosidic link
(D) Ring **(b)** is pyranose with β–glycosidic link

10. The total number of basic groups in the following form of lysine is : **[IIT-2010]**

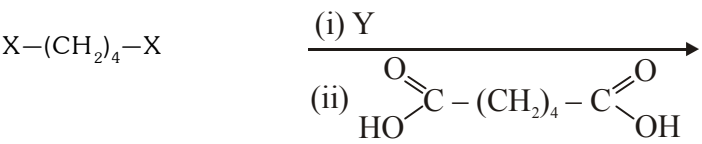


11. The following carbohydrate is **[IIT-2011]**



(A) a ketohexose
(B) an aldohexose
(C) an α-furanose
(D) an α-pyranose

12. The correct functional group X and the reagent/reaction conditions Y in the following scheme are



[IIT-2011]

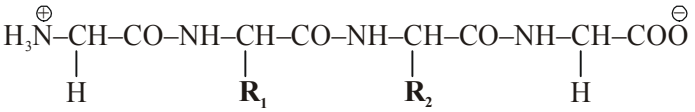
(A) X = $COOCH_3$, Y = H_2/Ni/heat

(B) X = $CONH_2$, Y = H_2/Ni/heat

(C) X = $CONH_2$, Y = Br_2/NaOH

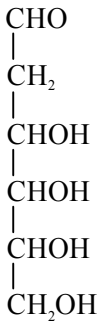
(D) X = CN, Y = H_2/Ni/heat

13. The substitutes $\mathbf{R_1}$ and $\mathbf{R_2}$ for nine peptides are listed in the table given below. How many of these peptides are positively changed at pH = 7.0 ? **[IIT-2012]**



Peptide	R_1	R_2
I	H	H
II	H	CH_3
III	CH_2COOH	H
IV	CH_2CONH_2	$(CH_2)_4NH_2$
V	CH_2CONH_2	CH_2CONH_2
VI	$(CH_2)_4NH_2$	$(CH_2)_4NH_2$
VII	CH_2COOH	CH_2CONH_2
VIII	CH_2OH	$(CH_2)_4NH_2$
IX	$(CH_2)_4NH_2$	CH_3

14. When the following aldohexose exists in its d-configuration , the total number of stereoisomers in its pyranose form is - **[IIT-2012]**

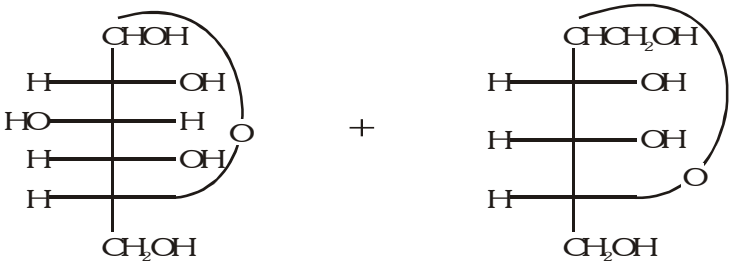


15. A tetrapeptide has –COOH group on alanine. This produces glycine (Gly), valine (Val), phenyl alanine (Phe) and alanine (Ala), on complete hydrolysis. For this tetrapeptide, the number of possible sequences (Primary structures) with $-NH_2$ group attached to a chiral center is. **[IIT-2013]**

1.(D) Glucose being an aldehyde responds to Tollen's test while fructose, although a ketose, undergoes rearrangement in presence of basic medium (provided by Tollen's reagent) to form glucose, which then responds to Tollen's test).

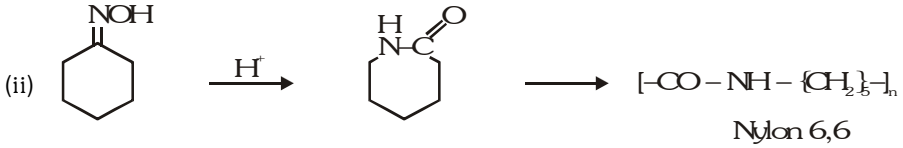
2. (B) The two isomeric forms (α - and β -) of D-glucopyronose differ in configuration only at C-1; hence these are called anomers.

3. (i) surcrose ⟶



D-Glucose (A) + D-Fructose (B)

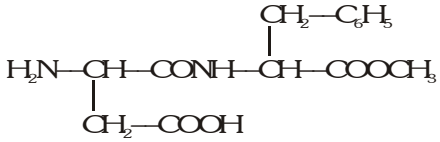
(ii)



C(caprolactam) ⟶ [–CO – NH – {CH_2}$_5$–]$_n$

Nylon 6,6

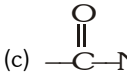
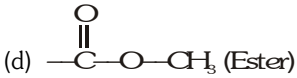
4.



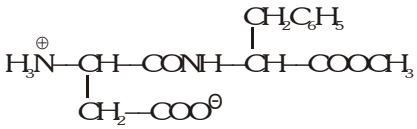
Aspartame (Aspartamine)

(i) Four functional groups present in aspartamine are

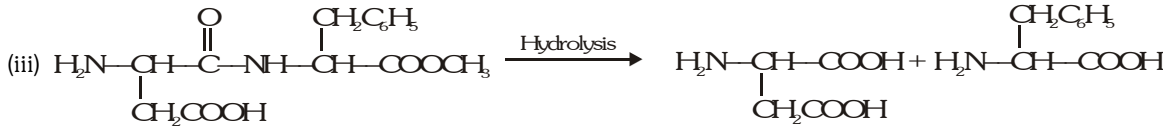
(a) $-NH_2$ (Amine) (b) –COOH (Carboxylic acid)

(c)  (Amide) (d)  (Ester)

(ii) Zwitterion structure is given as follows :

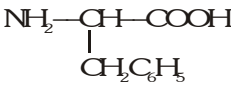


(iii)



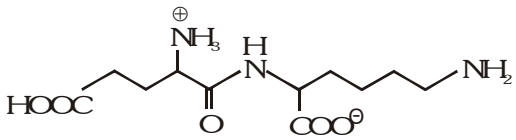
(a) (b)

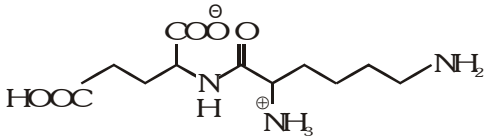
Hence on hydrolysis two amino acids (a) and (b) are obtained.

(iv) Of the above two amino acids, 

is more hydrophobic due to presence of non-polar and bulky benzyl group.

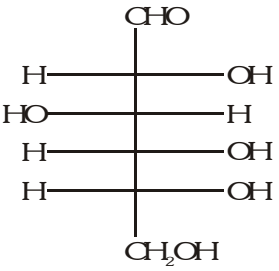
5. The structure of two possible dipeptides are



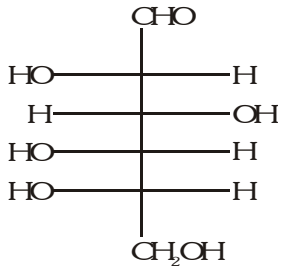


6. L-Glucose is an enantiomer of D-glucose, hence

(i)

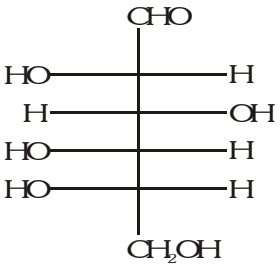


D-Glucose

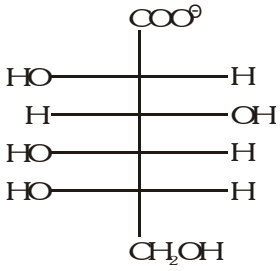


L-Glucose

(ii)



$Ag(NH_3)_2^{\oplus}$ (Tollen's reagent)



L-Glucose

7. In the two disaccharides structure A will be reducing sugar since both monosaccharides units are not linked through their reducing centres, while in structure B both the monosaccharide units are linked through their reducing centres, hence it will be non-reducing.

8.

(A) : (p) and (s)	Cellulose is a natural polymer and has a C_1–C_4 β-glycosidic linkage.
(B) : (q) and (r)	Nylon-6, 6 is a synthetic polymer of hexamethylenediamine and adipic acid and has amide linkage.
(C) : (p) and (r)	Proteins are natural polymers of α amino acids joined by amide linkages (peptide bonds).
(D) : (s)	Sucrose is a disaccharide of α-D glucose and β-D-fructose and has an α, β-glycosidic linkage.

9. (A) **12.** (A,B,C,D) **13.** 4 **14.** 8 **15.** 4