HINTS & SOLUTIONS

EXERCISE - 1
Single Choice

1. D is relative configuration, assigned to D – glyceraldehyde.

2. Glycosidic linkage is an acetal linkage as it connects two (hemiacetal) monosaccharide units.

3. Sucrose $\longrightarrow$ Gulose + Fructose
$+65^{\circ}$ $+52.5^{\circ}$ -90°
the product mixture is overall laevorotatory

4. Hydrolysis of sucrose (dextrorotatory) into (+) glucose and (–) fructose gives overall levorotatory mixture of products, hence the process is known as "inversion of sugar".

5. Aqueous solution of starch give blue colour with iodine solution.

6. Glucose fructose have same configurations on C – 3, C – 4, C – 5 so they form same osazone.

7. Inverted sugar is 1 : 1 mixture of glucose and fructose.

8. Cellulose on hydrolysis yields β – D – glucose, because β – D – glucose units are polymerised in cellulose.

9. α and β methyl glucosides are formed because glucose contains a ring structure and the reaction with CH_3OH passes through a carbanion.

10. α – D glucose and β – D – glucose differ in configuration at C – 1.

11. In Ketohexose total no. of chiral centres = 3. Hence total no. of stereo isomers = $2^3 = 8$

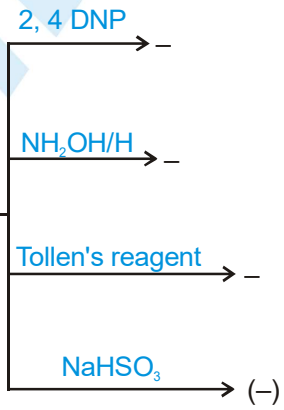
12. Glucose when reacts with acetic anhydride forms pentaacetate derivative which indicates the presence of 5-OH groups in glucose.

13. S_1 S_2 and S_4 are correct. S_3 is incorrect because anomers are those which have difference in configuration at C–1.

14. S_1, S_2 and S_3 are true but S_4 is False because the glycosides are non-super impossible non-mirror images hence they are diastereomers.

15. Given carbohydrate contains six carbons and a aldehydic group, thus is an aldohexose.

17. glucose pentacetate



18. Glycine $H_2N - CH_2 - COOH$ is optically inactive hence ans

19. The dipeptide is made of two amino acids they are alanine and glycine hence the name of dipeptide is alanylglycine.

20. The force of attraction between the neighbouring peptide chains is hydrogen bonding.

21. Since in (A) the number of amino groups is more than that of carboxylic groups. Therefore it is basic.

22. α – amino acid is that in which $-NH_2$ group is present at α – carbon.

23. Nylon - 66 has amide linkage.

24. Ziegler Natta Catalyst is $Al_2(C_2H_5)_6 + TiCl_4$.

25. **(A)** Starch is polymer of α - D - glucose.

26. The monomer of Nylon - 66 are adipic acid and hexamethylene diamine.

29. The monomer is 2-methylpropene.

33. Oils and fats are esters of higher fatty acids with Glycerol.

34. The chief constituents of cell membranes are phospholipids.

35. Deoxyribose is present in DNA and Ribose is present in RNA.

36. The pentose sugar in DNA and RNA has the furanose structure.

37. Guanine is not a pyrimidine base.

38. The relationship between the nucleotide triplets and the amino acids is called a genetic code.

40. The most concentrated source of energy in the human body is fats.

41. Riboflavin is a vitamin.

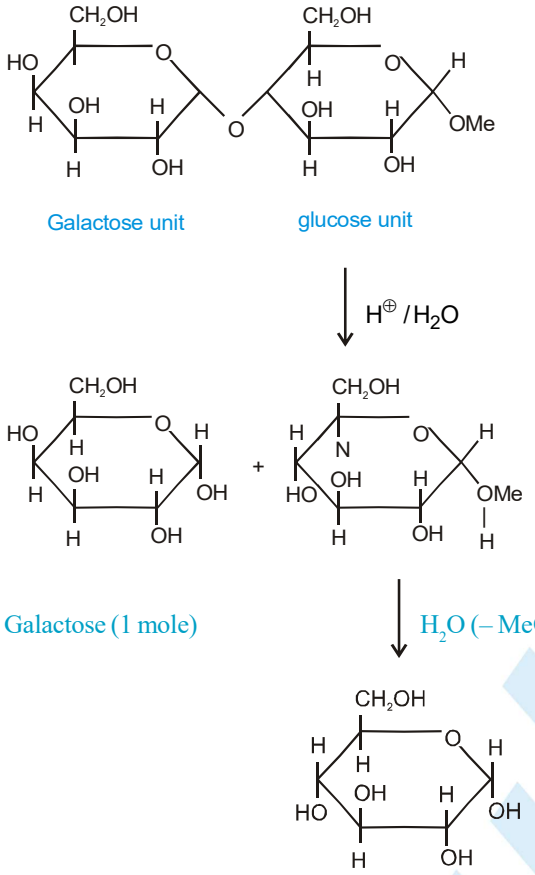
45. Vitamin E is also called Tocopherol.

47. The best source of vitamin C is Citrus fruits.

48. Deficiency of vitamin E causes loss of sexual power and reproduction.

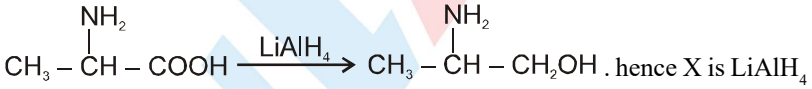
53. Milk contains vitamins A, D and E.

55.



56. (A) is the Hawarth projection of α–D–glucose it is also known as glucopyranose.

57. Fructose on enolisation remains in the equilibrium with mannose and glucose hence reduces tollens reagent.

60. 

. hence X is $LiAlH_4$

61. Aspartame is an artificial sweetener, III is incorrect statement aspartame is an ester derivative of a dipeptide, made by aspartic acid and phenylalanine.

62. In osazone formation first phenyl hydrazine molecule forms hydrazone at C – 1 second phenyl hydrazine molecule Oxidises the second carbon to carbonyl and third phenyl hydrazine molecule forms hydrazone with C– 2.

63. Glucose shows mutarotation.

64. In the formation of osazone C–1 and C–2 react with phenyl hydrazine to form phenyl hydrazone. If C–3, C–4, C–5 have same configuration the carbohydrates will form same osazone even if they differ in configuration at C–1 or C–2.

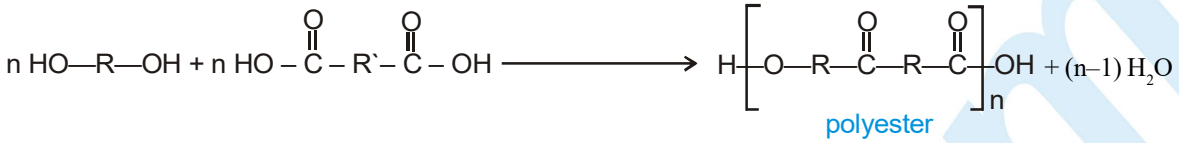
65. Since proline has 2° amino group.

66. Given polymer is formed by Urea and formaldehyde, hence is called Urea formaldehyde resine.

67. Natural rubber contains isoprene unit.

68. $CH_2 = CH - CH = CH_2$ is conjugated diene which forms stable intermediate hence polymerises fastest.

69.

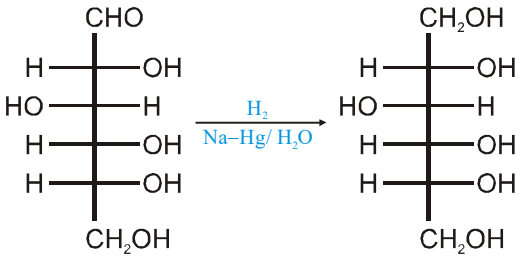


70. Final product shown in the reaction is natural rubber (iso prene).

71. All are free radical initiators and catalyse the free radical polymerisation.

72. Cellulose is found maximum (out of four given) in nature because it is present in plants

73.



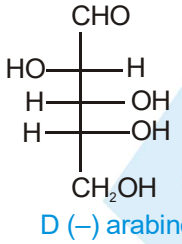
74. $C_6H_{12}O_6 \xrightarrow[3O_2]{\text{Zymase}} C_2H_5OH + 4CO_2 + 3H_2O$

75. Glucose is a monosaccharide where as oligosaccharides are those which have 2-10 monosaccharide units

76. Lactose is found in milk so also called as milk sugar.

77. **(A)** Carbohydrate are polyhydroxy carbonyl compounds hence they contain – OH, – CHO, >C = O group

78. Arabinose is a pentose



D (–) arabinose

79. Fehling solution on reaction with aldehyde, gives red coloured solution

80. Commonest disaccharide (sucrose) has molecular formula $C_{12}H_{22}O_{11}$.

81. **(A)** Starch is hydrolysed by the enzyme diastase (also called β-amylase) to maltose

82. Ninhydrin test is for amino acids. Benedicts test is for aldehydes. Hence the compound must be a monosaccharide.

83. In alkaline medium sugar undergo rearrangement

84. Phenylhydrazine (3 moles) is required to form osazone.

85. Glucose contain – CHO group so used for silvering of mirror.

86. Glucose is a hydrate of carbon $C_6(H_2O)_6$ and dehydration on heating with conc, H_2SO_4

87. Tollen's reagent and fehling's solution can be used to distinguish between aldose and ketose

88. Cyclic acetals are commonly used to protect vicinal cis hydroxyl groups of sugars while reactions are carried out on the other parts of the molecule.

89. Maltose will give positive test with fehling reagent but benzaldehyde does not give fehling's test.

EXERCISE - 2

Part # I : Multiple Choice

1. 6 membered ring with oxygen making a center is pyranose form.

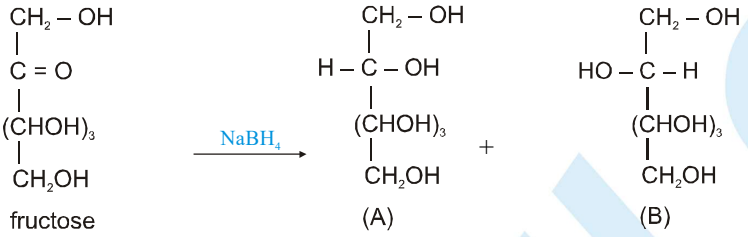
2. Starch is the mixture of two polysaccharides - Amylose and amylopectine

3. I is L-sugar whereas II & III is D-sugar.

4. Nylon-6, Nylon-6,6 and protein are a polyamide molecule.

5. Glucose and fructose can reduce Tollen's reagent.

6.



A and B differ in configuration at C–2 hence they are epimers, also they are non mirror images as C–3, C–4, C–5 have same configurations, hence they are diastereomers. A and B both are optically active.

8. Carbohydrate having different stereochemistry at C-1 are termed as Anomers, whereas when stereochemistry at any other carbon is different then those carbohydrates are known as epimers.

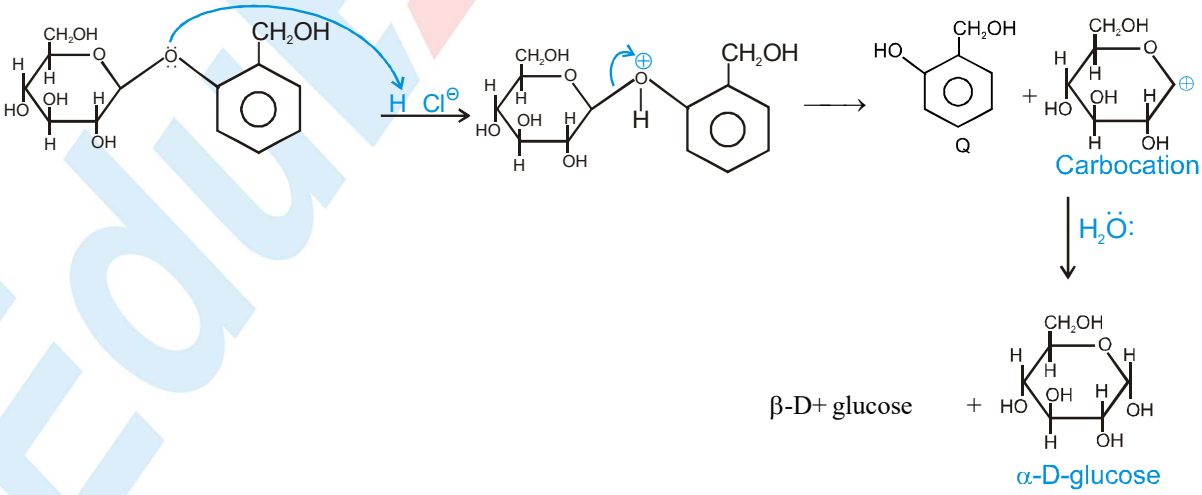
10. Preparation of nylon-66 is an example of condensation polymer, as it is formed by elimination of H_2O molecules from hexamethylenediamine and adipic acid.

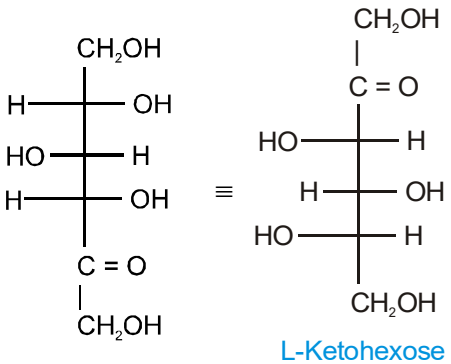
12. Glucose shows mutarotation, sucrose gives glucose and fructose on hydrolysis.

13. Sucrose and lactose are disaccharides.

14. At acidic pH, glycine will convert to cation and at basic pH glycine will convert to anion.

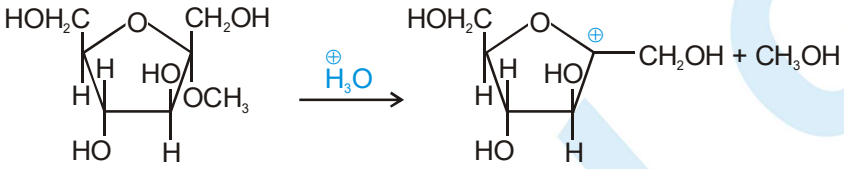
15.



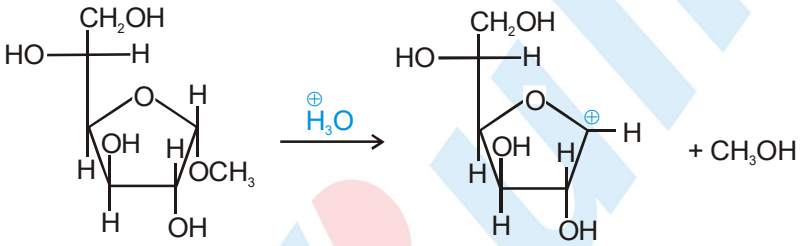
16. 

L-Ketohexose

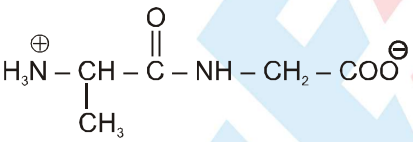
Part # II : Assertion & Reason

1. 

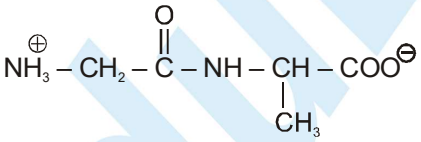
3º carbocation



2º carbocation

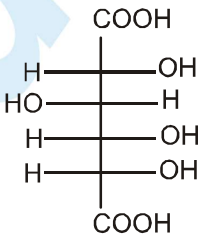
2. 

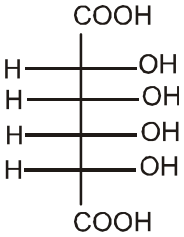
Ala-Gly (I)

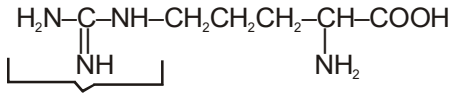


Gly-Ala (II)

I and II are structural isomers

3. Saccharic acid is 

and aldaric acid is 

6. 

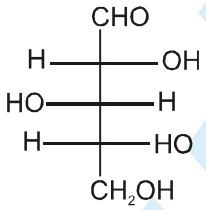
guanidino group

9. Acetic acid has the same general formula but not a saccharides.

EXERCISE - 3

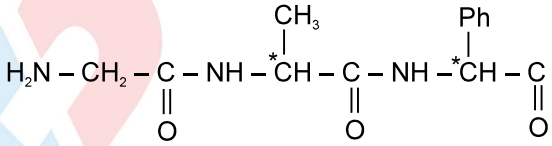
Part # I : Matrix Match Type

1. (A) Monomers of bakelite are : Phenol + formaldehyde.
(B) Monomer of Polypropylene is : Propene
(C) Monomers of Glyptal are : Ethylene glycol + phthalic anhydride
(D) Monomer of Nylon-6 is : ω - caprolactam.

2. (A) has one acetal linkage thus is a disaccharide.
(B) has one amide linkage.
(C) is oxidation product of aldohexose.
(D) is reduction product of 

Part # II : Comprehension

Comprehension # 2 :

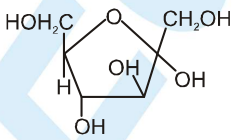
1. The trimer will have structure 

. It has two dissimilar asymmetric atoms, so its total number of stereoisomers will be $2^2 = 4$.

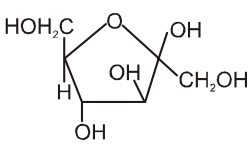
3. The trimer is chiral, it has free COOH group and free primary NH_2 group, so statement A, B, D are correct. It does not have C = O group.

EXERCISE - 4

Subjective Type

1. 

(α-D fructo furanose)



(β-D fructo furanose)

2. Suppose, % composition of $\alpha = x\%$
Suppose, % composition of $\beta = 100 - x$

$\therefore$ Optical rotation of equimixture $= \dfrac{(x \times 110) + (100 - x)19}{100} = 52.7$

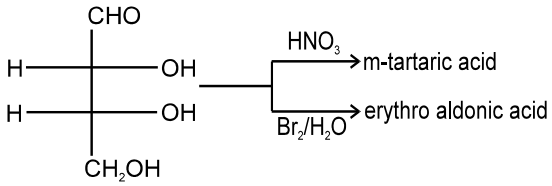
$\therefore$ $x = 37.2\%$

$\therefore$ % for $\alpha = 37.2$
% for $\beta = 62.8$.

3. For each fragment of 400 unit $= \dfrac{4000}{400} = 10$ fragments are obtained of 400 unit length.

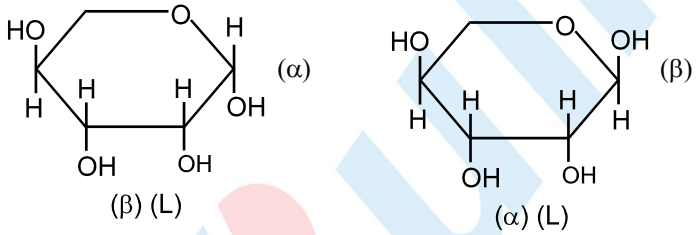
So $(10 - 1) = 9$ glycosidic linkage cleaved.

4.

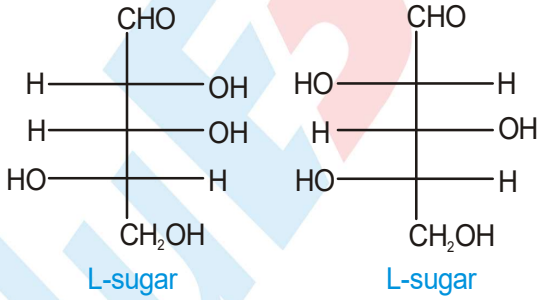


5. **(i)** Aldopentose **(ii)** Aldotetrose **(iii)** Ketopentose **(iv)** Ketohexose

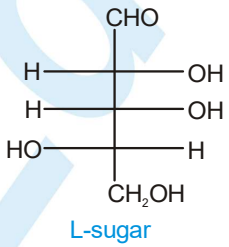
6. **Carbohydrate**
Anomers :



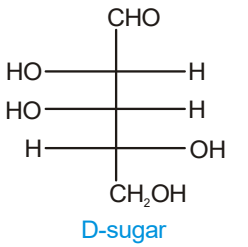
Epimers :

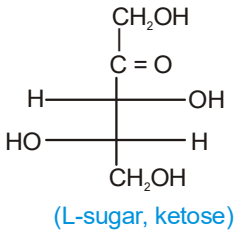


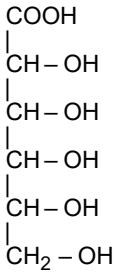
Enantiomers :

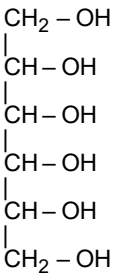


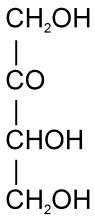
Ketose :

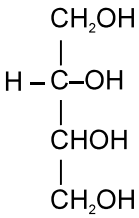


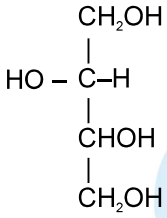


7. **(A)** 

(B) 

8. **(A)** 

(B) 

(C) 

9. Self explanatory.

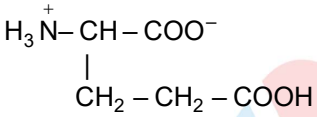
10. $n_{N_2} = \frac{0.224}{22.4} = 10^{-2}$

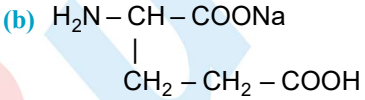
✈ 1 mole of amino acid = mole of N_2

$\therefore$ 10^{-2} mole of N_2 is liberated = 10^{-2} moles of amino acid.

$\therefore$ 10^{-2} mole of amino acid weigh = 0.89 g

$\therefore$ 1 mole of amino acid weigh = 89 g.

11. **(a)** 

(b) 

12. Let 'n' number of glycine are used to form polypeptide.
(n – 1). H_2O molecule are eliminated to form it.
Molecular mass of glycine is = 75 g
Molecular mass of H_2O = 18 g
n × 75 – (n – 1) 18 = 360
75n – 18n + 18 = **360**
n = 6.
So 6 (six) glycine units are used to form peptide so it is a hexapeptide.

13. Molecular weight of octapeptide is 516 g/mole.
Total bonds to be hydrolysed (8 – 1) = 7.
Total weight of H_2O added = 7 × 18 = 126 gm/mole
Total weight of hydrolysed product = 126 + 516 = 642 gm.

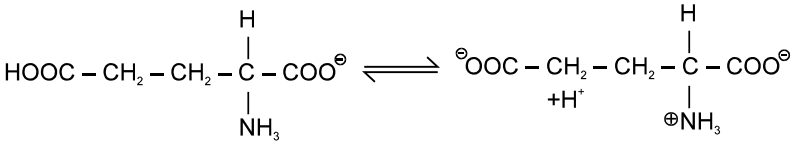
Total weight of alanine in product = $\frac{642 \times 41.59}{100}$ = 267 gm.

Molecular weight of alanine = 89 g/mole.

Number of alanine unit = $\frac{267}{89}$ = 3.

14. **(a)** Pro –Ser–Thr–Hyp **(b)** Leu–Ala –Cys–Arg–Val

15. Glutamic acid undergoes deprotonation as :

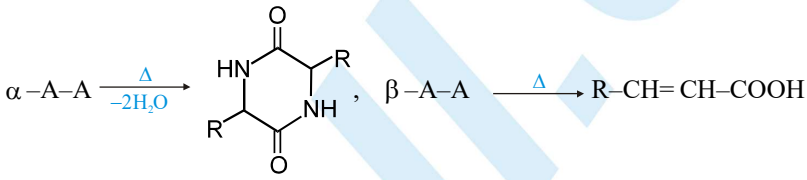


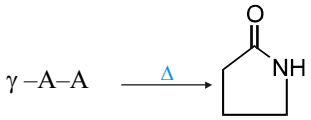
In order to suppress the above ionization so that zwitter ion predominate, higher $[H^+]$ will have to be maintained and there for isoelectric pH will be lower. Glutamine is a monocarboxylic acid and hence no extra H^+ is released to suppress above type of ionization and hence isoelectric pH is higher.

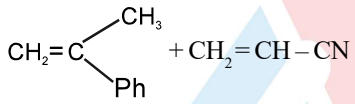
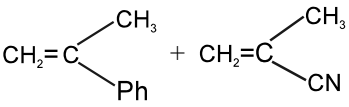
16.  (optically active)

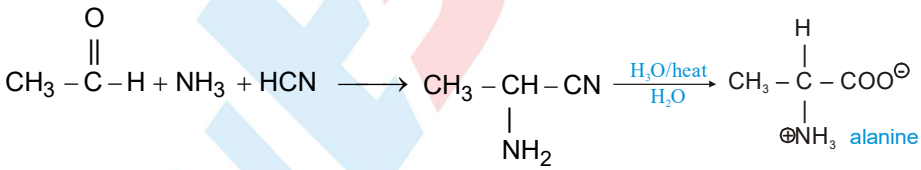
(A.A)

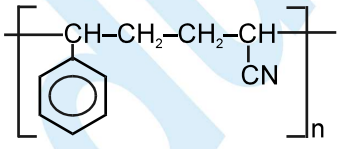
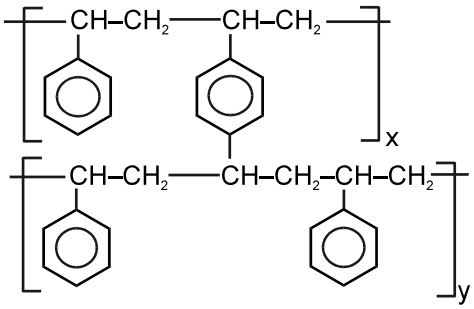
17. **(a)** By $NaHCO_3$ (By ninhydrin test)

(b) By Heating 



18. **(a)**  **(b)** $CH_2=CCl_2$ **(c)** 

19. 

20. **(a)**  **(b)** 

24. A sugar in which an amino group replaces the anomeric –OH is called glycosylamine. Also a sugar in which an amino group replaces a non anomeric –OH is called an amino sugar.

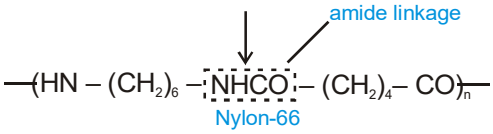
EXERCISE - 5

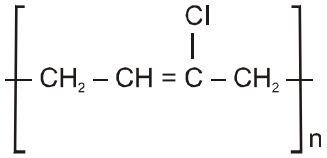
Part # I : AIEEE/JEE-MAIN

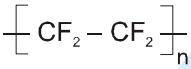
1. Polymers having amide linkages are known as polyamides.

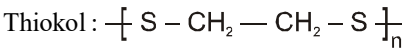
$n(H_2N-(CH_2)_6-NH_2) + n(HOOC-(CH_2)_4-COOH)$

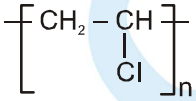
hexamethylene diamine adipic acid



2. Neoprene : 

Teflon : 

Thiokol : 

PVC : 

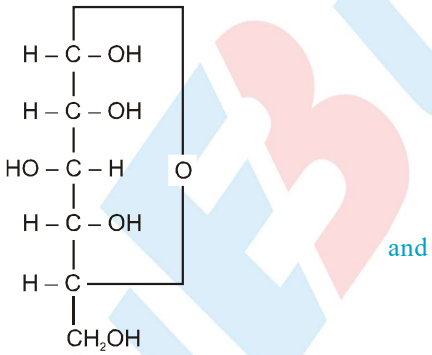
3. DNA contains cytosine and thymine as a pyrimidine bases and guanine and adenine as purine bases.z

4. Due to cyclic hemiacetal or cyclic hemiketal structures, all the pentoses and hexoses exist in two stereoisomeric forms i.e., a form in which the OH at C_1 in aldose and C_2 in ketoses lies towards the right and b form in which it lies towards left. Thus glucose, fructose, ribose etc, all exist in a and b form. Glucose exists in to forms a -D-glucose and b -D glucose.

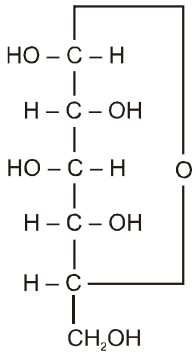
α -D-(+) $\rightleftharpoons$ equilibrium mixture $\rightleftharpoons$ β -(D)

glucose (+) glucose

As a result of cyclization of anomeric (C – 1) becomes asymmetric and the newly formed – OH group may be either on left or on right in Fischer projection thus resulting in the formation to two isomers (anomers). The isomers having – OH group of the left of the C – 1 designated β -D glucose and the other having – OH group on the right as α -D-glucose.



and



5. Secondary structure of proteins is mainly of two types.

(i) α -helix : This structure is formed when the chain of α-amino acid coils as a right handed screw (called α - helix) because of the formation of the hydrogen bonds between amide group of the same peptide chain.

(ii) β - plated sheet : In this structure the chains are held together by a very large number of hydrogen bonds between C = O and NH of different chains.

6. Bakelite is polymer of phenol and formaldehyde.

7. Buna-N is copolymer of CH_2=CH—CN and CH_2=CH—CH=CH_2.

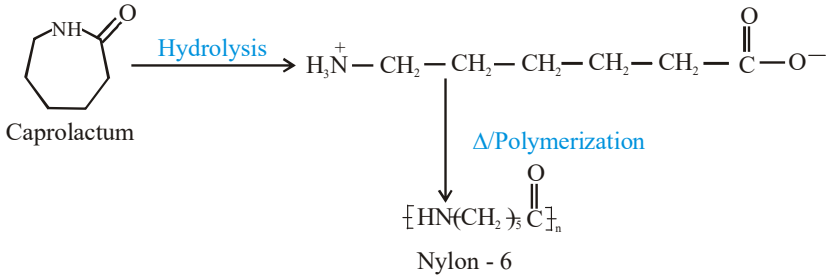
8. In a typical carbohydrate –CHO and –OH groups are present.

9. Nylon 6,6 has  group which forms intermolecular H-bonding.

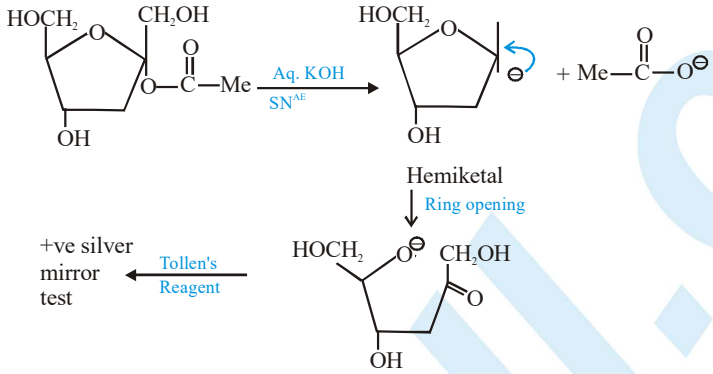
10. RNA and DNA has ribose and deoxyribose sugars, which differs in absence of hydroxy group at 2nd carbon.

11. $6CO_2 + 12NADPH + 18\,ATP \longrightarrow C_6H_{12}O_6 + 12NADP + 18\,ADP$

14. Formation of Nylon-6 involves hydrolysis of its monomer (caprolactum) in initial state.

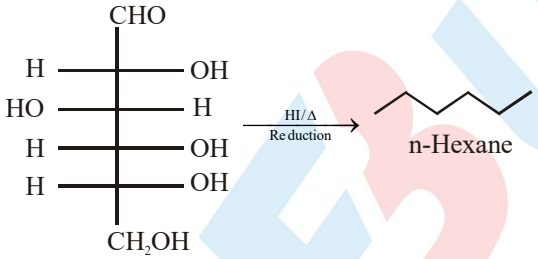


15. (1) Ester in presence of Aqueous KOH solution give SN^{AE} reaction so following reaction takes place



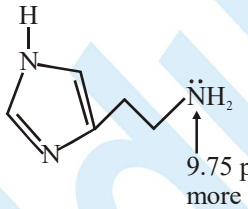
(2) In above compound in presence of Aq. KOH (SN^{AE}) reaction takes place & $\propto$ – Hydroxy carbonyl compound is formed which give +ve Tollen's test So this compound behave as reducing sugar in an aqueous KOH solution.

16.

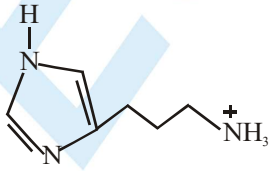


Glucose

17. Structure of Histamine

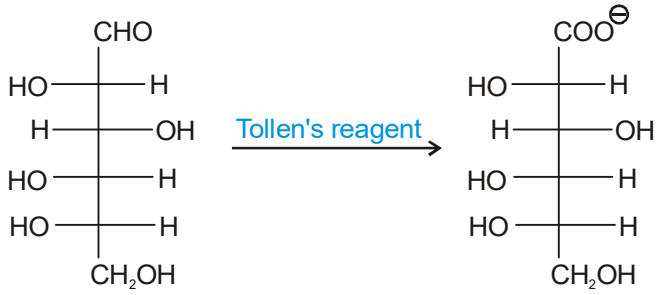


Blood is slightly basic in nature (7.35 pH) approx.
At this pH terminal NH_2 will get protonated due to more basic nature.
∴ Predominant structure of Histamine is



Part # II : IIT-JEE ADVANCED

1. Aldehyde and α- hydroxy ketones give positive tollen's test .

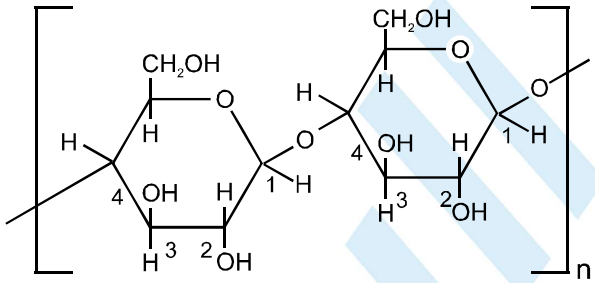
2. 

L-glucose

3. α-D-Glucopyranose and β-D-Glucopyranose are anomers.

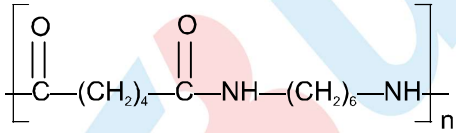
4. P is a reducing sugar as one monosaccharide has free reducing group because glycosidic linkage is (1, 4). Whereas in Q both the reducing groups are involved in glycosidic bond formation

5. **(A)** Cellulose



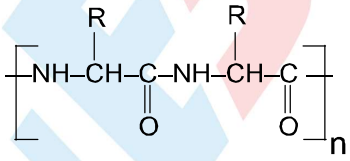
glycosidic linkage (1 → 4) natural polymer

(B) Nylon-6, 6



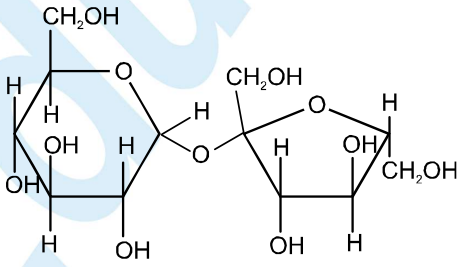
amide linkage, synthetic polymer

(C) Protein



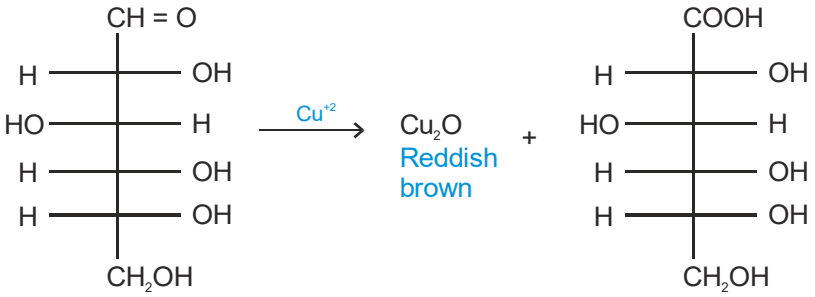
amide linkage in natural polymer

(D) Sucrose (disaccharide)

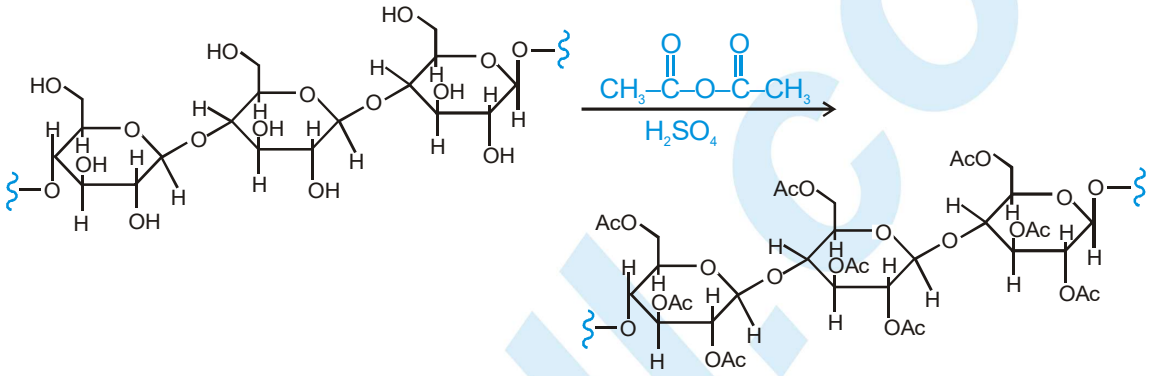


Glucosidic as well as fructosidic linkage.

6.



7. Cellulose is polymer of β-D(+) glucose whose structure is :



8. The natural rubber has intermolecular forces which are weak dispersion force (van-der-waal forces of attraction) and is an example of an elastomer (polymer).

9. X has acetal linkage and Y has hemiacetal linkage. Carbohydrate with hemiacetal linkage are reducing sugars and carbohydrate with acetal linkage are non reducing sugars.

X is α – anomer and Y is β- anomer of D (+) glucose.

10. Molecular weight of decapeptide = 796 g/mol

Total bonds to be hydrolysed = (10 – 1) = 9 per molecule

Total weight of H_2O added = 9 × 18 = 162 g/mol

Total weight of hydrolysis product = 796 + 162 = 958 g

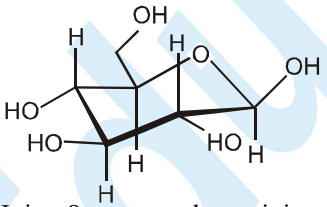
Total weight % of glycine (given) = 47%

$$\text{Total weight of glycine in product} = \frac{958 \times 47}{100}\text{g} = 450\text{ g}$$

Molecular weight of glycine = 75 g/mol

$$\text{Number of glycine molecule} = \frac{450}{75} = 6$$

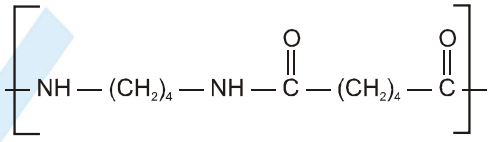
11.



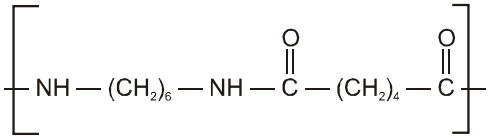
It is a β-pyranose hence it is an aldohexose.

12. **(C)**

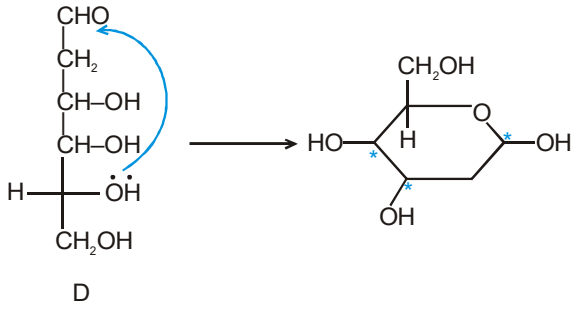
$$NH_2OC-(CH_2)_4-CONH_2 \xrightarrow[NaOH/\Delta]{Br_2} NH_2-(CH_2)_4-NH_2 \xrightarrow[\Delta]{HOOC-(CH_2)_4-COOH}$$



(D) $NC-(CH_2)_4-CN \xrightarrow[\Delta]{H_2/Ni} NH_2-(CH_2)_6-NH_2 \xrightarrow[\Delta]{HOOC-(CH_2)_4-COOH}$



13.

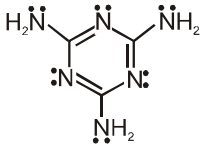


D

Total stereoisomers = $2^3 = 8$

14. For the polypeptide the isoelectric point will be more than 7. That means the given polypeptide is of basic nature so it must contain two or more amino groups. So (iv) , (vi), (viii) and (ix) are the correct options.

15. Structure of melamine is as follows



Total no. of lone pairs of electron is '6'.

16. Following combinations are possible for tetrapeptide

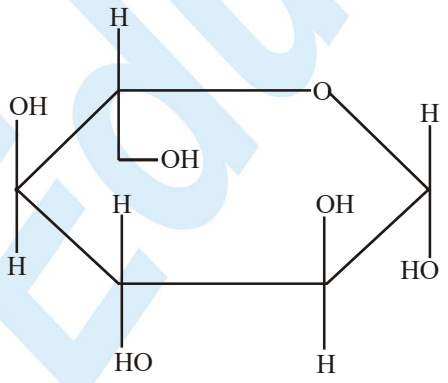
Val — Phe — Gly — Ala
Val — Gly — Phe — Ala
Phe — Gly — Val — Ala
Phe — Val — Gly — Ala

1. In all above sequences C-terminal is alanine
2. Glycine is optically inactive amino acid, hence It should not be N-terminal so, only above combination are possible.

17. **(A)**

Natural Rubber

18.



MOCK TEST

1. **(A)**

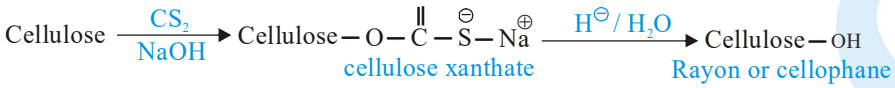
The above phenomenon is called as mutarotation.

2. **(A)**

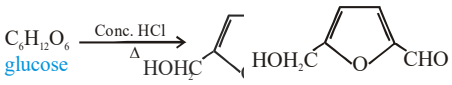
Only 1 mole HIO_4, is needed.

3. **(A)**

4. **(B)**



5. **(D)**



5 - hydroxymethyl furfural (violet colour)

6. **(B)**

Since proline has 2° amino group.

7. **(B)**

8. **(A)**

9. **(C)**

10. **(B)**

In (I) and (II) the 3rd, 4th & 5th carbons are having same configuration hence they will form same osazone

11. **(C)**

Because C-1 of both units are linked through glycosidic linkage.

12. **(D)**

13. **(C)**

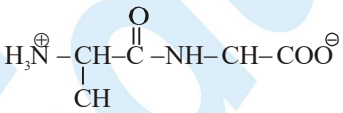
Because C-1 of both units are linked through glycosidic linkage.

14. **(AC)**

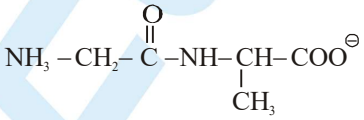
15. **(ACD)**

In fructose, mannose and glucose the 3rd, 4th & 5th carbons are having same configuration hence they will form same osazone

16. **(B)**



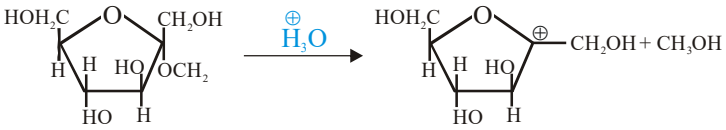
Ala–Gly (I)

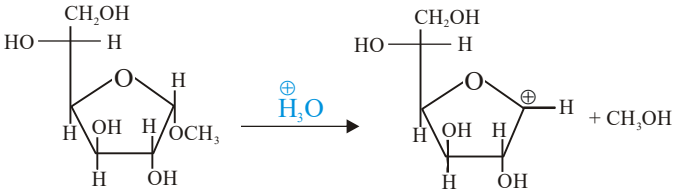


Gly–Ala (II)

I and II are structural isomers.

17. **(A)**





2° carbocation

18. **(A)**

P^{Ka_3} value of side chain determines the nature of amino acid.

19. **(C)**

For acidic amino acid

$$P^{1} = \frac{P^{Ka_1} + P^{ka_3}}{2}$$

$$= \frac{1.88 + 3.65}{2} \qquad = \frac{5.53}{2} \qquad = 2.77$$

20. **(B)**

For basic amino acid

$$P^{1} = \frac{P^{Ka_2} + P^{ka_3}}{2}$$

$$= \frac{8.95 + 10.53}{2} \qquad = \frac{19.48}{2} \qquad = 9.74$$

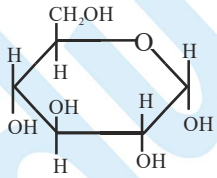
Polymerisation → **Starch (polymer) (III)**

21. **(C)**

22. **(B)**

23. **(D)**

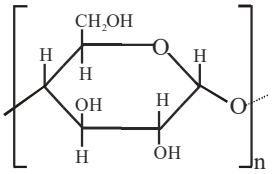
1.



It has a hemiacetal structure

2. Oligosaccharide.

3.



24. **A → i ; B → iv ; C → i, ii ; D → iii**