TOPIC : BIOMOLECULES & POLYMERS
EXERCISE # 1

Section (A)

4. Fructose is not hydrolysed simple compounds hence called monosaccharide.

5. Glucose has aldehyde group and six carbon chain.

6. Ribose have five carbon atoms.

9. Aldehyde and α-hydroxy ketones reduces the Tollen's reagent.

10. Sucrose has acetal glycosidic linkage so it can't reduce the Tollen's reagent and called non-reducing sugars.

13. Aldehyde and α-hydroxy ketone can give osazone with phenylhydrazine.

16. A disaccharide on hydrolysis gives two molecules of the same or one molecule each of two different monosaccharides.

17. Acid or enzymatic hydrolysis of sucrose to given an equimolar mixture of glucose and fructose is called inversion of sugar.

18. Factual

Section (B)

4. Structure of Glycine is $H_2N–CH_2–COOH$.

5. Amino acids mostly exist in zwitter ion (dipolar ion) because acidic "H" of –COOH accept by the basic $\ddot{N}H_2$ group.

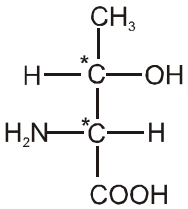
7. Denaturation of proteins : Protein may be coagulated and precipitated from aqueous solution by heat, acids, alkali, salt, organic solvents miscible with H_2O. Ex. egg on heating and formation of paneer.

10. The bond that determines the secondary structure of a protein is hydrogen bond.

11. Proteins are denatured in the stomach.

13. Myoglobin contains iron as a transition metal ion as in Fe^{2+} form.

14. Factual

15.  Two chiral centres.

16. PI = $\frac{2.32+9.62}{2}=5.97$

17. Factual

18. PI = 5.65 so. it exits

Section (C)

1. Starch is polymer of α - D - glucose.

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

3. Nylon - 6,6 has amide linkage.

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

5. The monomer is 2-methylpropene.

9. Preparation of nylon-6,6 is an example of condensation polymer, as it is formed by elimination of H_2O molecules from hexamethylenediamine and adipic acid.

11. Factual

12. Factual

13. Factual

14. Factual

15. Factual

16. Factual

17. Factual

18. Factual

19. Factual

20. Factual

EXERCISE # 2

1. Amino acid are the building block of proteins.

2. Sucrose reacts with acetic anhydride to form octa-acetate.

3. 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.

4. glucose pentacetate → 2, 4 DNP → _
→ $NH_2OH/H^{\oplus}$ → _
→ Tollen's reagent → _
→ $NaHSO_3$ → _

5. Factual

6. Factual

7. Factual

10. Proteins is an important constituent of our diet. It functions mainly as a construction material

11. The coagulation of protein is called denaturation.

12. Aldose sugars are always present in the form of hemiacetal.

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

14. Proteins contain polypeptide linkages

15. On heating glucose with Fehling's solution, we get a precipitate whose colour is red due to Cu_2O.

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

17. Vitamins are essntial in small amount for well-being of all human being.

18. Protein has nitrogen in amide linkage.

19. Reducing sugars that exist in hemiacetal and hemiketal forms, undergo mutarotation in aqueous solution.
Among the given carbohydrates, only sucrose is a non-reducing sugar as in it the hemiacetal and hemiketal groups of glucose and fructose are linked together through O-atom and thus, not free. Due to the absence of free hemiacetal or hemiketal group, sucrose does not exhibit mutarotation.

20. haemoglobin transports oxygen in the blood stream.

22. Since in (1) the number of amino groups is more than that of carboxylic groups. Therefore it is basic.

23. α – amino acid is that in which – NH_2 group is present at α – carbon.

24. The most important energy carrier in the living cell is ATP.

25. Test of the presence of amino acid is done by Ninhydrin reagent.

26. Biurets test is used for the detection of proteins.

27. Lipase hydrolysis triglyceride into fatty acids and glycerol.

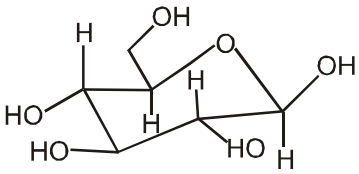
28. Cellulose is a linear polymer of β-glucose.

29. Aqueous solution of starch give a dark blue colour with iodine.

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

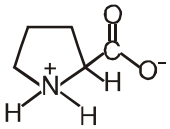
31. Glucose when reacts with acetic anhydride forms pentaacetate derivative which indicates the presence of
5-OH groups in glucose.

32. (1) is the Haworth projection of α–D–glucose it is also known as glucopyranose.

33.  is structure of β-D-glucopyranose.

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

35. Natural rubber contains isoprene unit.

36.  is proline.

37. Isoelectric point is defined as pH at which anionic ion is balanced by cationic forms

38. Factual

39. Factual

40. Factual

41. Leu-Leu, Leu-Ala, Ala-Leu, Ala-Ala.

42. Phospholipids are diesters of phosphoric acid

43. Number of H-bond between base pairs A and T and the base pair G and C are respectively 2 and 3.

44. Cellulose has severval thousand D-glucose units linked by 1 – 4. β-glycoside bond.

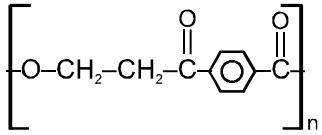
45. Factual

46. Factual

47. Factual

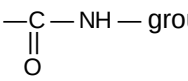
48. Factual

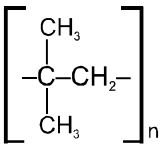
EXERCISE # 3
PART - I

1. Terylene 

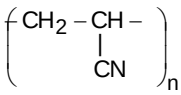
2. A–T, G–C has H-bonding in nucleotide.

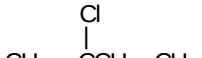
3. Strarch is a polymer of α -glucose.

4. C—N bond length in proteins is longer than usual bond length of C—N bond.
Spectroscopic analysis show planar structure of  group.

5. Monomer of  is 2-methyl propene.

6. Cellulose is a polymer of glucose.

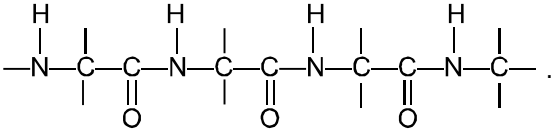
7.  It is acrolien.

8.  (chloroprene) is monomer unit of polymer neoprene.

9. Phospholipids are esters of glycerol with two carboxylic acid residues and one phosphate groups.

10. Oxidation of glucose to pyruvate is glycolysis.

11. Polystyrene is a chain growth polymer.

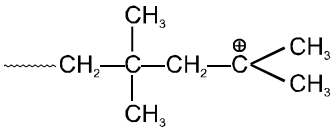
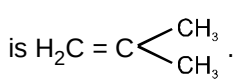
12. The peptide chain is  .

13. Protein haemoglobin act as an oxygen carrier in the blood.

14. Number of chiral carbon atoms in β D (+) glucose is five.

15. The helical structure of protein is stabilised by hydrogen bonds.

16. The enzyme lipase hydrolyses triglycerides to fatty acids and glycerol.

17. The monomer of the polymer  is  .

18. Thiol functional group participates in disulphide bond formation in proteins.

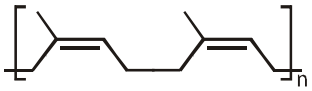
19. Proteins $\xrightarrow{\text{Enzyme (A)}}$ Polypeptides $\xrightarrow{\text{Enzyme (B)}}$ Amino acids
two enzymes involved in the process are pepsin and trypsin.

20.  is a copolymer.

21. **Condensation polymerization :** In this type of polymerization, a large number of monomer molecules combine together usually with the loss of simple molecules like water, alcohol, ammonia, carbon dioxide, hydrogen chloride etc. to form a macromolecule in which the molecular formula of the repeating structural unit is generally not same as that of the monomer. The polymers thus formed are called condensation polymers. These are also called **step-growth polymers** since they are formed as result of stepwise reactions.

Ex. $n\ H_2N-(CH_2)_6-NH_2$ (Hexamethylenediamine (Monomer)) + $n\ HOOC-(CH_2)_4-COOH$ (Adipic acid (Monomer)) $\xrightarrow{\text{Polymerization}}$ $\left[NH-(CH_2)_6-NH-CO-(CH_2)_4-CO\right]_n + nH_2O$ (Nylon-66 (Polymer))

22. Natural rubber has the cis-configuration at every double bond



Natural rubber

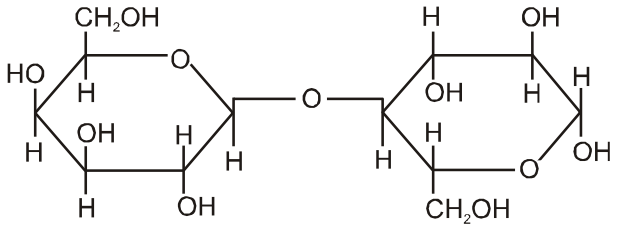
23. $\left[CH_2-\underset{Cl}{\underset{|}{C}}=CH-CH_2\right]_n$ is neoprene.

24. Reducing sugars that exist in hemiacetal and hemiketal forms, undergo mutarotation in aqueous solution.

Among the given carbohydrates, only sucrose is a non-reducing sugar as in it the hemiacetal and hemiketal groups of glucose and fructose are linked together through O-atom and thus, not free. Due to the absence of free hemiacetal or hemiketal group, sucrose does not exhibit mutarotation.

25. During denaturation secondary and tertiary structures of protein destroyed but primary structures remains 7intact.

26.



(Lactose)

All reducing sugar shows mutarotation

27. Enzymes are most reactive at optimum temperature.

28. Sucrose is a disaccharide of α-D-Glucopyranose and β-D-fructofuranose.

29. Neoprene is a addition polymer of chloroprene.

30. Nylon-6,6 is an example of Fibres.

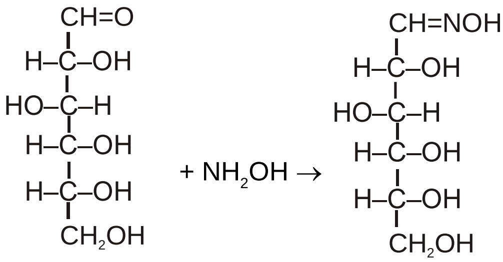
31. Biodegradable polymer is Nylon-2-Nylon-6 which is copolymer of glycine ($H_2N–CH_2–COOH$) and amino caproic acid ($H_2N–(CH_2)_5–COOH$).

32. $CH_2=C(Cl)-CH=CH_2$ is the monomer of neoprene.

Chloroprene Neoprene

33. Nylon is a polyamide polymer.

34.

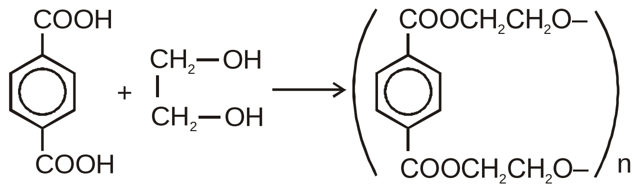


D(+) glucose Oxime

35. (1) Neoprene rubber
(2) PVC is a thermoplastic
(3) Nylon–6,6 is a fibre
(4) Bakelite is a thermosetting polymer

Polyester Dacron

36.

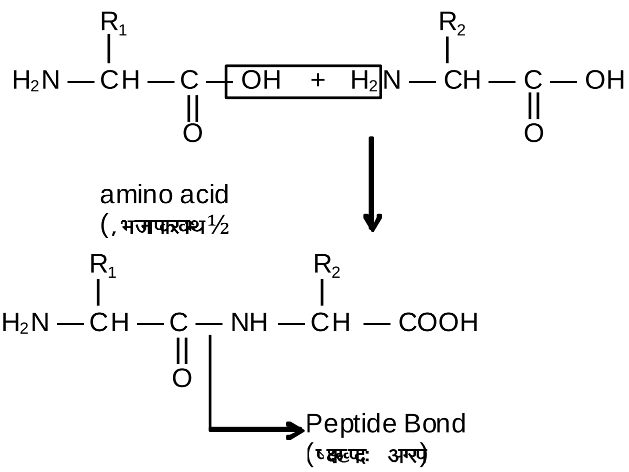


37. $H_2N-CH_2-COOH + H_2N-(CH_2)_5-COOH \longrightarrow \left(-HN-CH_2-CO-NH-(CH_2)_5-CO\right)-$

Glycine aminocaproic acid Nylon-2-nylon-6

38. Caprolactum is used for the manufacturing of Nylon-6

39.



40. Sucrose is Non Reducing sugar. (both the anomeric carbon are bonded to each other than such sugars are non reducing)

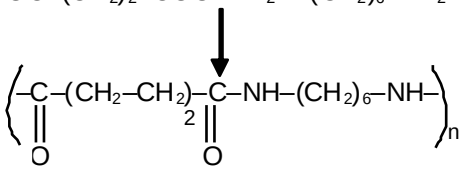
41. DNA → De-oxy Ribose sugar

RNA → Ribose Sugar

42. It is fact

43. Nylon-66 → adipic acid + Hexamethylenediamine

$HOOC–(CH_2)_2–COOH + H_2N–(CH_2)_6–NH_2$



44. DNA – RNA → Protein

45. Denaturation of protein makes the protein inactive as all the preparation of protein are lost.

46. $HOOC–CH_2–NH_2 \longrightarrow {}^{-}OOC–CH_2–N^{+}H_3$

Glycine Zwitter ion

47. Cross linked – polymer formed from bifunctional, tri functional monomer and contain strong convalent bonds between various linear polymer chain eq. Bakalite, melamine

48. Nylon-2-Nylon-6 Biodegradable polymer (XII) Page No. 444(NCERT) Chapter Polymer

49. It is fact

50. Non essential amino acid

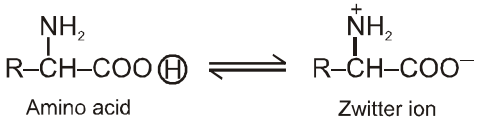
Fact based on NCERT Page No. 421 Chapter Biomolecule

51. Polyacrylonitrile is a polymer of acrylonitrile (CH_2=CH-CH) use to make artificial wool.

52. During Devaliration secondary tergiary structures are destroyed but primary structure remain intact.

PART - II

2. Zwitter ions are dipole ions i.e., the same molecule contains both positive and negative charge e.g., in amino acids a proton from –COOH group magrates to $–NH_2$ group and a dipolar molecule is formed.



Amino acid Zwitter ion

3. Sucrose reactwith conc. HCl to form leavulinic acid.

$$C_{12}H_{22}O_{11} \xrightarrow{\text{conc. HCl}} \underset{\text{Laevulinic acid}}{CH_3COCH_2CH_2COOH}$$

$$C_{12}H_{22}O_{11} \xrightarrow[\text{Enzymes}]{\text{Inversion}} \underset{\text{Glucose}}{C_6H_{12}O_6} + \underset{\text{Fructose}}{C_6H_{12}O_6}$$

4. Teflon is polytetrafluorine ethene (PTFE) is a polymer of tetrafluoro ethene ($CF_2 == CF_2$)

$$\underset{\text{Tetrafluoro ethylene}}{nCF_2 = CF_2} \xrightarrow[\Delta, \text{ pressure}]{(NH_4)_2S_2O_8} \underset{\text{Teflon}}{\left[CF_2 - CF_2 \right]_n}$$

5. Glycosides are formed by treating glucose with methanol is presence of dry HCl gas. They cannot be hydrolysed in acidic medium. Also they are hamiacetals and not acetals.

6. The assertion that activity of an enzyme is pH dependent is true because with charge in pH the enzymes are denatured. The assertion that change in pH affects the solubility of enzymes in water is also true.

7. Cellulose is a biodegradable polymer. Different enzymes secreted by bacteria digest it. Synthetic polymers like polyvinyl chloride, nylon-6, polyester, polyethene etc.) are not acted upon by bacteria and hence, are non-biodegradable.

8. Carboxy peptidase is an exopeptidase because it breaks the peptide chain at carboxy terminal of amino acids.

9. The triplet of nucleotide a having a specific sequence of bases is known as **codon.** Each codon specifics one amino acid. More than one codon can specify same amino acid. According to Wobble hypothesis proposed by FHC Crick, third base of a codon is not very important and specificity of a codon is particularly determined by first two bases. mRNA is involved in copying sequences of bases from DNA strand to RNA molecule.

10. Lysine is α, E-diamino caproic acid.
$H_2N - CH_2 - CH_2 - CH_2 - CH_2(NH_2)COOH$
It is least soluble in water in the pH range 6-7.

11. Serine is an amino acid its structure is

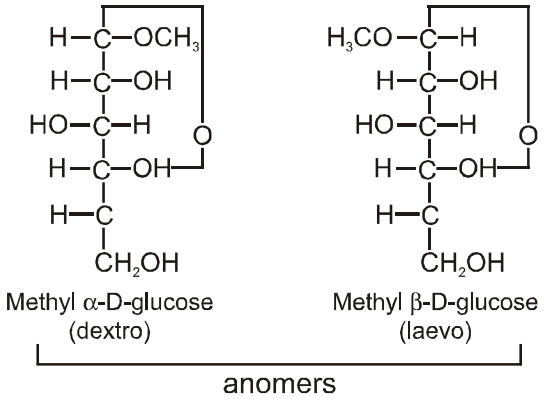
$$HO-CH_2-\underset{\displaystyle NH_2}{\underset{|}{CH}}-COOH$$

As per exchange rule

L-serine is $H-\underset{\displaystyle CH_2OH}{\overset{\displaystyle NH_2}{\overset{|}{\underset{|}{C}}}}-COOH$.

12. Thymine is an amino acid. It is formed when 5 carbon position of uracil is substitued by methyl group. So it is 5-methyl uracil.

13. Methyl glucosides are obtained when one molecule of methyl alcohol combined with glucose. The resultant cyclic structure will convert the aldehydic carbon asymmetric and hence two methyl glucosides could exist. These isomers are differing in configuration at asymmetric carbon produced due to ring formations are known is anomers.

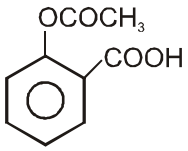


14. 1, 3-butadiene is the monomer unit of styrene-butadiene rubber of Bunna-S, for natural rubber monomer unit is isoprene. Ethylene, acrylic acid derivatives, vinyl derivatives, styene, butadiene, isoprene and chloropene are the examples of monomers which undergo polymerisation by free radical addition polymer. Examples of anionic addition polymerisation is vinylidene cyanide, vinylidene ester derivatives of acrylonitrile, α-methylstyene,etc.

15. o – and p – amniobenzoic acids do not exist as a Zwitter ion. The lone pair of electrons on the $-NH_2$ group is donated towards the benzene ring due to resonance effect. As a result, acidic character of – COOH group and basic character of $-NH_2$ group decrease. Therefore, the weakly acidic – COOH group cannot transfer a H^+ ion to the weakly basic $-NH_2$ group. Thus o–or p– aminobenzoic acids do not exist as Zwitter ion.

16. Plexiglass is a commerical name of polymethyl methacryclate (PMMA). It is used in lenses, light covers, light shadeds and transparent domes, air craft window etc.

17. Protein can be denatured by heat.

18.  (Aspirin) is used as analgesic.

19. "Rayon" is man made firbe which consist of purified cellulose in the form of long threads. Rayon resembles silk in appearance. Hence, called as artifical silk.

$$\underset{\text{(from wood pulp)}}{\text{Cellulose}} \xrightarrow[CS_2]{NaOH} \underset{\text{(syrup like pulp)}}{\text{Viscose}} \xrightarrow[\text{dil. } H_2SO_4]{\text{Pass through spinnert into}} \underset{\text{(fine silk thread)}}{\text{Rayon}}$$

20. Acid hydrolysis of an ester gives two different organic compounds.

$$CH_3COOC_2H_5 + H_2O \longrightarrow CH_3COOH + C_2H_5OH$$

while the acid hydrolysis of an amide gives one organic and one inorganic product as

$$CH_3CONH_2 + H_2O \longrightarrow \underset{\text{organic compound}}{CH_3COOH} + \underset{\text{Inorganic compound}}{NH_3}$$

21. The β and α-glucose have different rotations. When either is dissolved in water, their rotation changes until the same fixed values results. This is called mutarotation.

α - D - glucose specific rotation = +111° $\rightleftharpoons$ open chain form of equilibrium mixture specific rotation = + 52.5° $\rightleftharpoons$ β - D - glucose specific rotation = +19.2°

22. α- keratin is insoluble in water.

23. Buna-S rubber is a polymer of buta-1, 3-diene and styrene.

$$nCH_2 = CH - CH = CH_2 + nC_6H_5CH = CH_2 \xrightarrow{\text{Addition polymerization}} \left[-CH_2 - CH = CH - CH_2 - \underset{\displaystyle C_6H_5}{\underset{|}{CH}} - CH_2-\right]_{\text{Buna-S}}$$

24. Anomers have different configuration at the glycosidic or anomeric carbon atoms.

27. (1) $C_{12}H_{22}O_{11} + H_2O \xrightarrow[\text{Or}]{H^+} C_6H_{12}O_6 + C_6H_{12}O_6$

Maltose Glucose Glucose

28. Isoprene is a monomer of natural rubber.

$$H_2C=\underset{\displaystyle CH_3}{\underset{|}{C}}-CH=CH_2$$

2-Methyl-1,3-butadiene

32. Vinyl alcohol, CH_2=CHOH (monomer of polyvinyl alcohol) exists mainly as CH_3CHO; hence polyvinyl alcohol is best prepared by the alkaline hydrolysis of polyvinyl acetate which in turn is prepared by the polymerisation of Vinyl acetate

35. Poly-β-hydroxy butyrate –CO–β–hydroxyl valerate

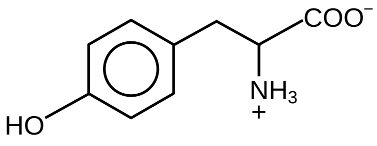
$$\text{(PHBV)} \left[-O-\underset{\displaystyle R}{\underset{|}{CH}}-CH_2-\underset{\displaystyle O}{\underset{\|}{CH}}-\right]$$

in used as packaging material in orthopaedic devices and for controlling drug release

36. Proteins starch and rubber molecules have strong interaction with the dispersion medium. So, act as lyophilic colloids.

38. D-oxyribose sugar present in DNA is correct sugar.

39. (i) Biodegaradble polymer $\rightarrow$ PHBV (3-Hydroxybutanoic acid + 4-Hydroxypentanoic acid)
(ii) Bakalite $\rightarrow$ Phenol + Formaldehyde
(iii) Neoprene $\rightarrow$ 2-chlorobuta-1,3-diene
(iv) Glyptal $\rightarrow$ Phthalic acid + Ethylene glycol

40. 

Side chain of tyrosine it acidic due to phenol (pK_a > 7) so Tyrosine is acidic in pH = 7

42. CH_3(methyl group) can not form bridge bond, so $(CH_3)_2$ Mg can not exist in polymeric form.

43. $CH_2 = C(CH_3) - CH = CH_2$ (Monomer of neutral rubber) $\quad$ $CH_2 = C(Cl) - CH = CH_2$ (Monomer of neoprene)

PART - III

1. An amino acid is a bifunctional organic molecule that contains both a carboxylic group, –COOH, as well as an amine group, $-NH_2$.

2. Polymerization takes place either by condensation or addition reactions.

3. $(C_6H_{10}O_5)n + nH_2O \xrightarrow{H^+} nC_6H_{12}O_6$

Cellulose D-glucose

Cellulose is a straight chain polysaccharide composed of D-glucose units which are joined by β-glycosidic linkages. Hence cellulose on hydrolysis produces only D-glucose units.

4. Nylon threads are polyamides. They are the condensation polymers of diamines and dibasic acids.

$$nHOOC(CH_2)_4COOH + n\,H_2N\,(CH_2)_6NH_2 \xrightarrow[\text{high pressure}]{280^\circ C} \left[OC - (CH_2)_4 - CONH(CH_2)_6NH \right]_n$$

nylon (polyamide)

adipic acid hexamethylene diamine

5. Polymers havig amide linkages are known as polyamides.

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

hexamethlene diamine adipic acid

amide linkage

$$-\!\!\left(HN - (CH_2)_6 - NHCO - (CH_2)_4 - CO\right)_n\!\!-$$

Nylon-66

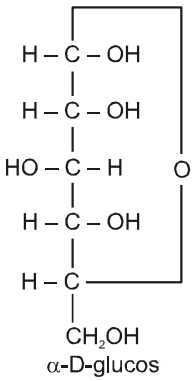
6. Neoprene : $\left[- CH_2 - CH = C(Cl) - CH_2 - \right]_n$ Teflon : $\left[CF2 - CF2 \right]_n$

$- CH_2 - \left[CH_2 - S - CH_2 \right]_n CH_2 - S - S - CH_2CH_2 -$ PVC : $\left[- CH_2 - CH(Cl) - \right]_n$

7. 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 aldoese 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 α and β form. Glucose exists in to forms α -D-glucose and β -D glucose.

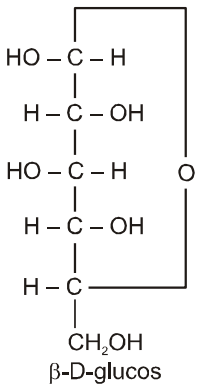
α -D-(+) $\rightleftharpoons$ equilibrium mixture $\rightleftharpoons\beta$ -(D)
glucose (+) glucose

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 ot the left of the C – 1 designated β -D glucose and the other having – OH group on the right as α -D-glucose.



α-D-glucos

and



β-D-glucos

8. 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) becaues of the formation of the hydrogen bonds between amide groupe 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.

9. Bakelite is polymer of phenol and formaldehyde.

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

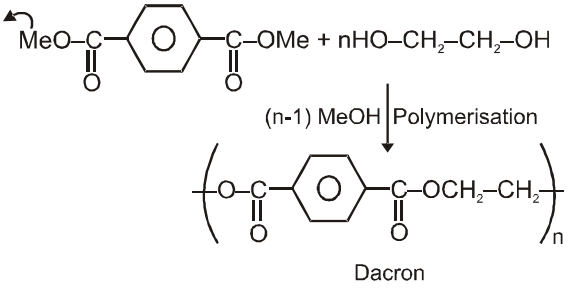
11. In a typical carbohydrate –CHO and –OH groups are present.

12. Nylon 6,6 has $-\overset{O}{\overset{\|}{C}}-NH-$ group which forms intermolecular H-bonding.

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

14. $6CO_2 + 12NADPH + 18\ ATP \longrightarrow C_6H_{12}O_6 + 12NADP + 18\ ADP$

15. Dacron is a condensation polymer of ethylene glycol and methyl terpthalate

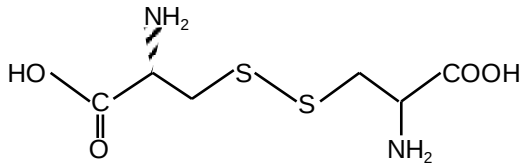


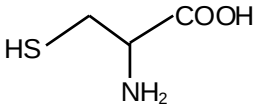
Dacron

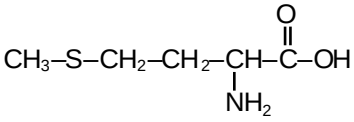
16. Glyptal is used in the manufacture of paints and lacquers.

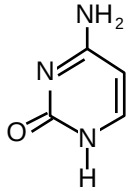
17. Vitamin B and C are water soluble and Vitamin A, D, E and K are water insoluble.

18. Phenelzine is tranquilizer. It is not an antacid.

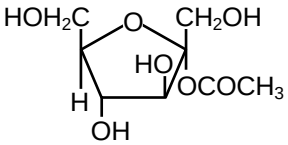
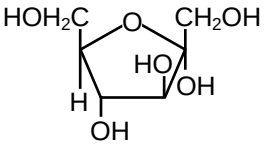
19. Cystine 

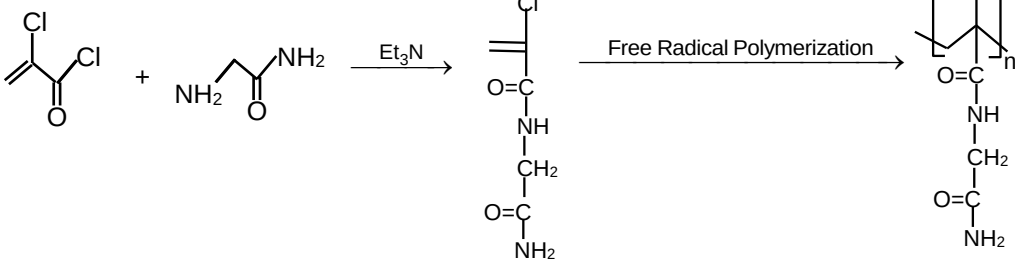
Cysteine  Thiol group (SH) is present in cysteine

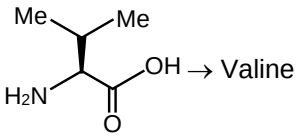
Methionine 

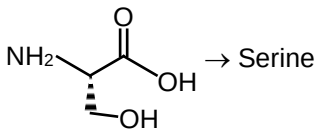
Cytosine 

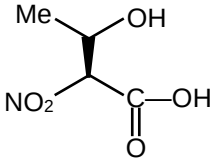
20. Nylon-6 is produced by hydrolysis of ε-caprolactum followed by condensation polymerisation.

21.  on hydrolysis in aq. KOH will produce  which behave as reducing agent, due to hemiacetal group.

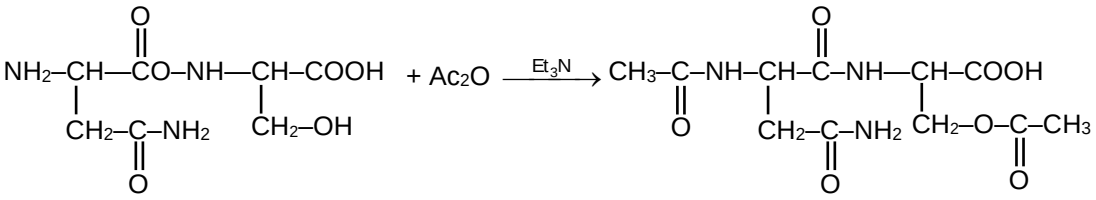
23. 

24.  → Valine

 → Serine

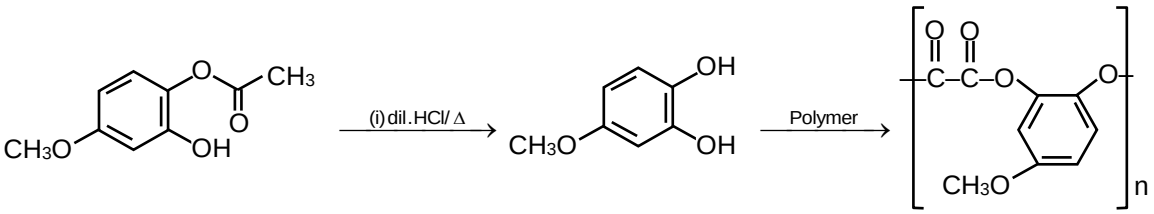
 → Threonine

25.

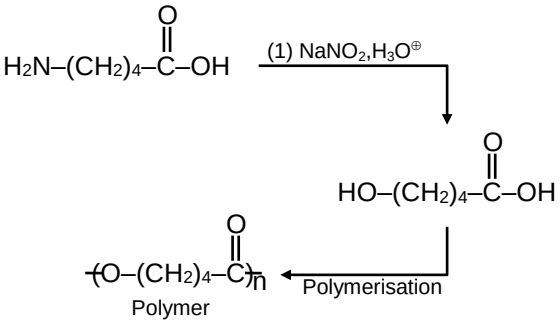


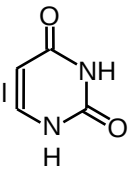
26. Barfoed test is given by reducing sugar.

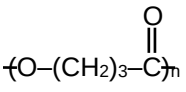
27.



28.



29. Uracil  is present in RNA.

30. HO–CH2–CH2–CH2–COOH $\xrightarrow{\text{Polymerisation}}$  (PHB)

PHB is biodegradable polymer

31. It is Fact