Biomolecules

EXERCISE [PAGES 320 - 321]

Exercise | Q 1.1 | Page 320

Select the most correct choice.

CH_2OH-CO-$(CHOH)_4$ -CH_2OH is an example of

1. Aldohexose
2. Aldoheptose
3. Ketotetrose
4. **Ketoheptose**

Solution: Ketoheptose

Exercise | Q 1.2 | Page 320

Select the most correct choice.

Open chain formula of glucose does not contain

1. formyl group
2. **anomeric hydroxyl group**
3. primary hydroxyl group
4. secondary hydroxyl group

Solution: anomeric hydroxyl group

Exercise | Q 1.3 | Page 320

Select the most correct choice.

Which of the following does not apply to CH_2NH_2 – COOH?

1. Neutral amino acid
2. **L - Amino acid**
3. Exists as zwitter ion
4. Natural amino acid

Solution: L - Amino acid

Exercise | Q 1.4 | Page 320

Select the most correct choice.

Tryptophan is called essential amino acid because

1. it contains aromatic nucleus
2. it is present in all the human proteins
3. **it cannot be synthesised by human body**
4. it is essential constituent of enzymes

Solution: it cannot be synthesised by human body

Exercise | Q 1.5 | Page 320

Select the most correct choice.

A disulphide link gives rise to the following structure of a protein.

1. Primary
2. Secondary
3. **Tertiary**
4. Quaternary

Solution: Tertiary

Exercise | Q 1.6 | Page 320

Select the most correct choice.

RNA has _____.

1. **A - U base pairing**
2. P-S-P-S backbone
3. double helix
4. G - C base pairing

Solution: RNA has **A - U base pairing**.

Exercise | Q 2.1 | Page 320

Give scientific reasons:

The disaccharide sucrose gives negative Tollens test while the disaccharide maltose gives a positive Tollens test.

Solution:

1. The structure of sucrose contains glycosidic linkage between C-1 of α-glucose and C-2 of β-fructose.

2. Since the potential aldehyde and ketone groups of both the monosaccharide units are involved in the formation of the glycosidic bond (i.e., α, β-1,2- glycosidic bond), sucrose is a non-reducing sugar and gives negative Tollen's test.
3. The glycosidic bond in maltose is in between C-1 of one glucose ring and C-4 of the other (i.e., α -1,4-glycosidic linkage).
4. The hemiacetal group at C-1 of the second ring is not involved in the glycosidic linkage. Hence, maltose is a reducing sugar and gives positive Tollen's test.

Exercise | Q 2.2 | Page 320

Give scientific reasons:

On complete hydrolysis DNA gives equimolar quantities of adenine and thymine.

Solution:

1. Both the strands of DNA double helix are complementary to each other.
2. That is a number of bases on each strand are equal and complementary to each other.
3. As adenine pairs with thymine; the number of adenine bases on one strand and thymine on another are equal in number.

Thus, on complete hydrolysis DNA gives equimolar quantities of adenine and thymine.

Exercise | Q 2.3 | Page 320

Give scientific reasons:

α-Amino acids have high melting points compared to the corresponding amines or carboxylic acids of comparable molecular mass.

Solution:

1. This is due to the peculiar structure called zwitter ion structure of α -amino acids.
2. α-Amino acid molecule contains both acidic carboxyl (–COOH) group as well as basic amino ($–NH_2$) group.
3. Proton transfer from the acidic group to the basic group of amino acid forms a salt, which is a dipolar ion called zwitter ion.

Thus, α-amino acids have high melting points compared to the corresponding amines or carboxylic acids of comparable molecular mass.

Exercise | Q 2.4 | Page 320

Give scientific reasons:

Hydrolysis of sucrose is called inversion.

Solution:

1) Sucrose ($C_{12}H_{22}O_{11}$) is dextrorotatory (+66.5°). On hydrolysis with dilute acid or an enzyme called invertase, sucrose gives equimolar mixture of D-(+)-glucose and D-(–)-fructose.

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

2) Since the laevorotation of fructose (–92.4°) is larger than the dextrorotation of glucose (+52.7°), the hydrolysis product has net laevorotation.

Hence, hydrolysis of sucrose is also called inversion of sucrose.

Exercise | Q 2.5 | Page 320

Give scientific reasons:

On boiling egg albumin becomes opaque white.

Solution:

1. Proteins when subjected to high temperature undergo disruption of noncovalent interactions which are responsible for the specific shape of protein. That is, it undergoes denaturation.
2. Denaturation disturbs the specific structure of egg albumin which causes a change in the physical properties.

Thus, on boiling egg albumin becomes opaque white.

Exercise | Q 3.1 | Page 321

The following statement applies to DNA only, some to RNA only, and some to both. Label them accordingly.

The polynucleotide is double stranded. (_____)

Solution:

The polynucleotide is double-stranded. **(DNA)**

Exercise | Q 3.1 | Page 321

The following statement applies to DNA only, some to RNA only, and some to both. Label them accordingly.

The polynucleotide contains uracil. (_____)

Solution:

The polynucleotide contains uracil. **(RNA)**

Exercise | Q 3.1 | Page 321

The following statement applies to DNA only, some to RNA only, and some to both. Label them accordingly.

The polynucleotide contains D-ribose. (_____)

Solution:

The polynucleotide contains D-ribose. **(RNA)**

Exercise | Q 3.1 | Page 321

The following statement applies to DNA only, some to RNA only, and some to both. Label them accordingly.

The polynucleotide contains guanine. (_____)

Solution:

The polynucleotide contains guanine. **(Both DNA and RNA)**

Exercise | Q 3.2 | Page 321

Write the sequence of the complementary strand for the following segment of a DNA molecule.

5' - CGTTTAAG - 3'

Solution:

Original strand	5'	-	C	G	T	T	T	A	A	G	-	3'
			↓	↓	↓	↓	↓	↓	↓	↓		
Complementary strand	3'	-	G	C	A	A	A	T	T	C	-	5'

Exercise | Q 3.2 | Page 321

Write the sequence of the complementary strand for the following segment of a DNA molecule.

5' - CCGGTTAATACGGC - 3'

Solution:

Original strand	5'	-	C	C	G	G	T	T	A	A	T	A	C	G	G	C	-	3'

			↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓		
Complementary strand	3'	-	G	G	C	C	A	A	T	T	A	T	G	C	C	G	-	5'

Exercise | Q 3.3 | Page 321

Write the names and schematic representations of all the possible dipeptides formed from alanine, glycine and tyrosine.

Solution:

1. Glycylglycine: Gly-Gly
2. Alanylalanine: Ala-Ala
3. Tyrosyltyrosine: Tyr-Tyr
4. Glycylalanine: Gly-Ala
5. Alanylglycine: Ala-Gly
6. Glycyltyrosine: Gly-Tyr
7. Tyrosylglycine: Tyr-Gly
8. Tyrosylalanine: Tyr-Ala
9. Alanyltyrosine: Ala-Tyr

Exercise | Q 3.4 | Page 321

Give two evidences for presence of formyl group in glucose.

Solution:

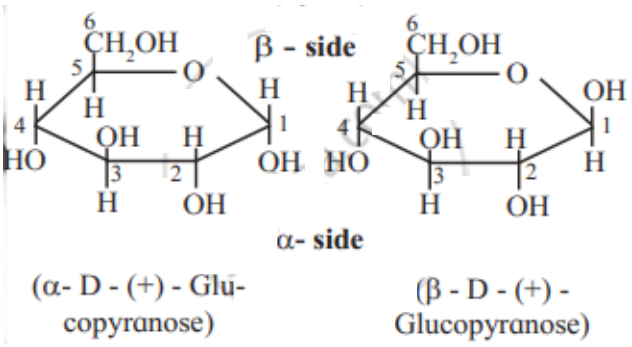
1. Glucose gets oxidized to a six-carbon monocarboxylic acid called gluconic acid on reaction with bromine water which is a mild oxidizing agent. Thus, the carbonyl group in glucose is in the form of formyl (–CHO).
2. Hemiacetal group of glucopyranose structure is a potential aldehyde (formyl) group. It imparts reducing properties to glucose. Thus, glucose gives positive Tollen's test or Fehling test.

Exercise | Q 4.1 | Page 321

Draw a neat diagram for the following:

Haworth formula of glucopyranose

Solution:

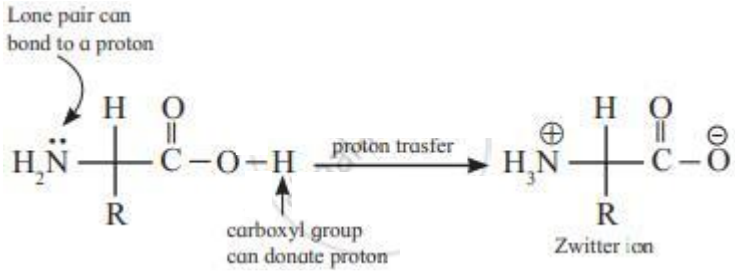


Exercise | Q 4.2 | Page 321

Draw a neat diagram for the following:

Zwitter ion

Solution:

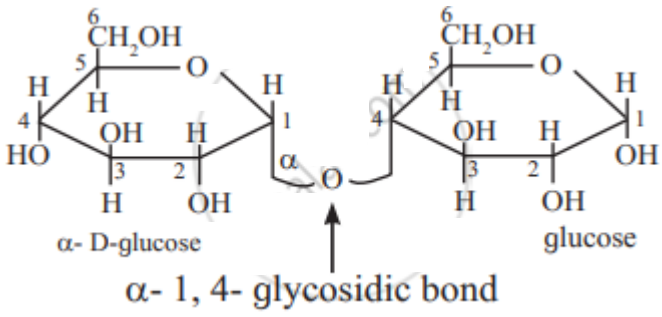


Exercise | Q 4.3 | Page 321

Draw a neat diagram for the following:

Haworth formula of maltose

Solution:



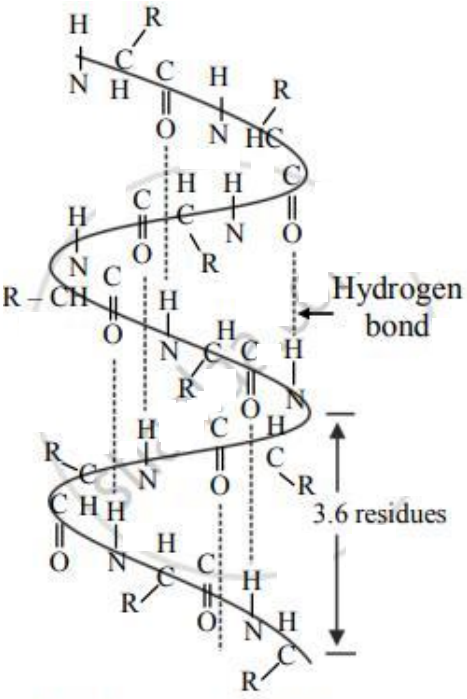
Exercise | Q 4.4 | Page 321

Draw a neat diagram for the following:

Secondary structure of protein

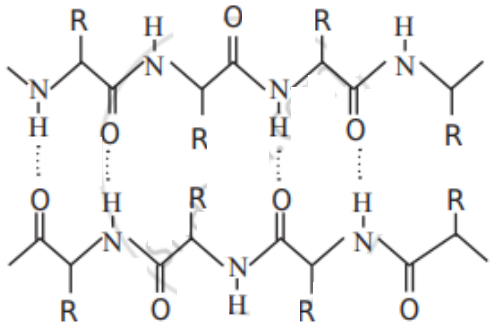
Solution:

∝ - Helix:



Backbone of α-Helix

β - pleated sheet

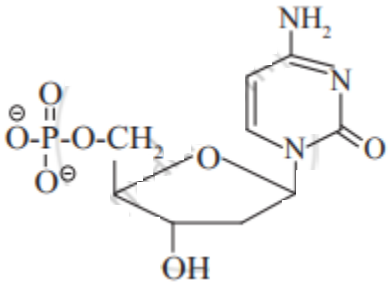


Exercise | Q 4.6 | Page 321

Draw a neat diagram for the following:

dCMP

Solution:



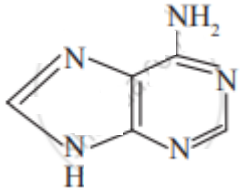
Exercise | Q 4.7 | Page 321

Draw a neat diagram for the following:

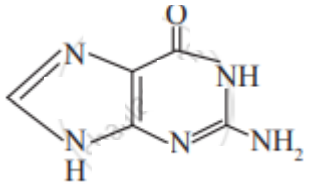
One purine base from nucleic acid

Solution:

Adenine A:



Guanine G:



Exercise | Q 4.8 | Page 321

Draw a neat diagram for the following:

Enzyme catalysis

Solution: