

Topic 1

Carbohydrates

Previous Years' Examination Questions

Practice the Real Questions

1 Mark Questions

1. What is a glycosidic linkage? [Delhi 2013]
2. What are the products of hydrolysis of sucrose? [All India 2013, 2010]
3. What are the products of hydrolysis of lactose? [All India 2013, Delhi 2010C]
4. What is meant by biocatalysts? [Delhi 2012]
5. Write a reaction which shows that all the carbon atoms in glucose are linked in a straight chain. [All India 2012]
6. What is meant by invert sugars? [Foreign 2012, 2010; Delhi 2010]
7. Give an example each for reducing and non-reducing sugars. [Delhi 2010C]
8. What are monosaccharides? [All India 2010]
9. What is meant by reducing sugars? [All India 2010]
10. What is the structural feature characterising reducing sugars? [Delhi 2009C]
11. Why are carbohydrate generally optically active? (Delhi 2008C)
12. What are the two functions of carbohydrates in plants? [All India 2008]

2 Marks Questions

13. Explain what is meant by
 - (i) pyranose structure of glucose?
 - (ii) glycosidic linkage?
 [Delhi 2012; All India 2011C]

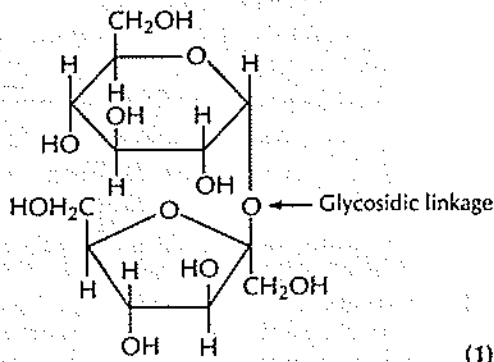
14. Write such reactions and facts about glucose which cannot be explained by its open chain structure. [Delhi 2012, 08; Foreign 2011, 10; All India 2011C, 11, 10C]
15. What is essentially the difference between the α -form of glucose and β -form of glucose? Explain. [Delhi 2011]
16. How are carbohydrates classified? [All India 2007]
17. Define the following and give one example of each.
 - (i) Mutarotation
 - (ii) Enzymes
 [Foreign 2007, 2006]

3 Marks Questions

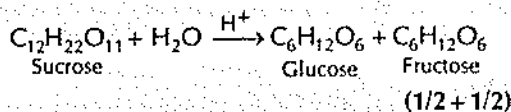
18. What is essentially the difference between α -glucose and β -glucose? What is meant by pyranose structure of glucose? [All India 2012]
19. What is glycogen? How is it different from starch? How is starch structurally different from cellulose? [Foreign 2012]
20. Enumerate the reaction of D-glucose which cannot be explained by the open chain structure. [Delhi 2011C; All India 2009]
21. How can reducing and non-reducing sugars be distinguished? Mention the structural feature characterising reducing sugars. [Delhi 2011C]
22. What happens when D-glucose is treated with the following reagents?
 - (i) HI
 - (ii) Br_2 -water
 - (iii) HNO_3
 [All India 2008]

Step-by-Step Solutions

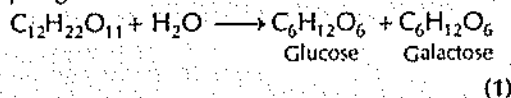
1. Two monosaccharide units are linked through oxygen atom accompanied by the loss of a water molecule. This linkage is called glycosidic linkage. (1/2 + 1/2)



2. One molecule each of glucose and fructose.

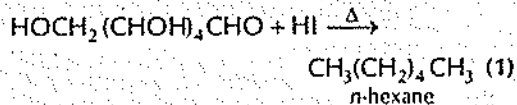


3. Lactose on hydrolysis gives β -D-galactose and β -D-glucose.



4. There are the biological catalyst, needed to catalyse biochemical reactions; e.g., maltase, lactase, invertase etc. (1)

5. On prolonged heating with HI, glucose gives *n*-hexane which suggest that all the six carbon atoms in glucose are linked linearly.



6. Hydrolysis of sucrose brings about a change in sign of rotation from dextro (+) to laevo (-) and hence, it is known as invert sugar. (1)

7. Reducing sugar—D-fructose (1/2)
Non-reducing sugar—Sucrose (1/2)

8. Simplest carbohydrates that cannot be hydrolysed to smaller molecules are monosaccharides. e.g., glucose, fructose etc. (1)

9. The sugar which reduce Tollen's reagent, Fehling's solution etc., are called reducing sugars. e.g., all monosaccharides, disaccharides except sucrose. (1)

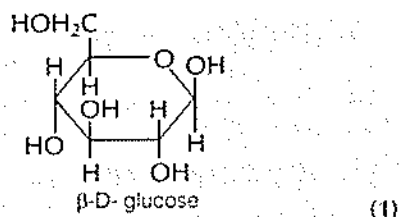
10. The reducing sugars have free aldehydic or ketonic groups. (1)

11. Because of the presence of chiral or asymmetric carbon atom and absence of plane of symmetry, carbohydrates are generally optically active. (1)

12. (i) Carbohydrates are used as storage molecules as starch in plants.

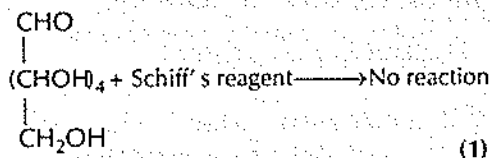
- (ii) Cell wall of bacteria and plants is made up of cellulose. (1/2 \times 2 = 1)

13. (i) The six membered cyclic structure of glucose is called pyranose structure (α - or β -), in analogy with pyran. Pyran is a cyclic compound with one oxygen atom and five carbon atoms in the ring.

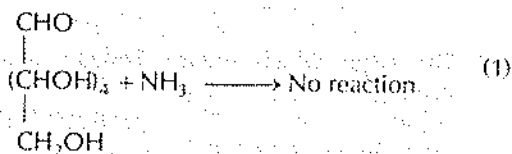
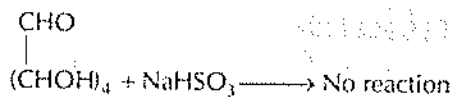


- (ii) Refer ans 1. (1)

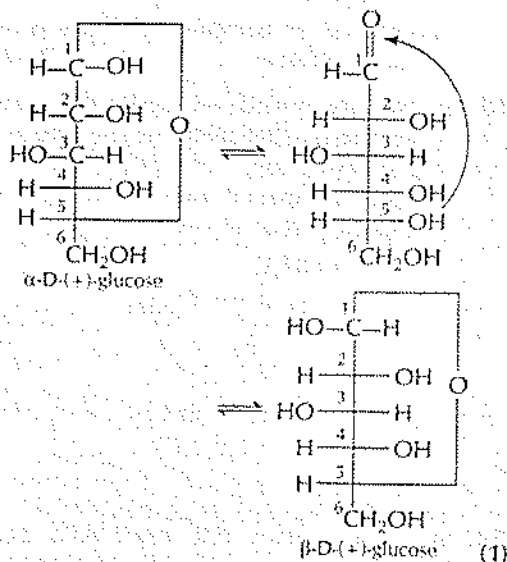
14. (i) Glucose does not react with Schiff's reagent



- (ii) Glucose does not react with sodium bisulphite and ammonia.



15. Glucose is found to exist in two different crystalline forms which are named as α and β . The two forms differ from each other in orientation of $-\text{OH}$ group at C-1. Moreover, the α -form (mp 419K) is obtained by crystallisation from concentrated solution of glucose at 303 K while β -form (mp 423 K) is obtained by crystallisation from hot and saturated solution at 371K. (1)

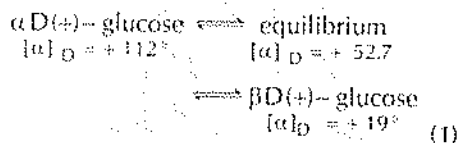


16. On the basis of their behaviour towards hydrolysis, carbohydrates have been classified into three main classes

1. Monosaccharides These are the simplest molecules and cannot be further hydrolysed e.g., glucose, fructose etc.
2. Oligosaccharides These give 2 to 10 monosaccharides when subjected to hydrolysis. These can further be classified as disaccharides (like, sucrose, maltose) trisaccharides etc.

3. Polysaccharides These give more than 10 monosaccharides on hydrolysis, e.g., starch, cellulose etc. (2)

17. (i) Mutarotation The change in specific rotation of an optically active compound in aqueous solutions is called mutarotation. e.g., in aqueous solution glucose exists as



- (ii) Enzymes are essential biological catalysts which are needed to catalyse biochemical reactions e.g., amylase, invertase etc. (1)

18. Refer ans. 15 and 13 (i). (3)

19. Glycogen is a polysaccharide which is stored in animal body. It is highly branched, also known as animal starch. (1)

Starch is also a polysaccharide which is stored in plants. It has amylose (linear structure) and amylopectin (highly branched). (1)

Starch is a branched-chain polymer of α -glucose, while cellulose is a linear polymer of β -glucose. It is present in the cell walls of plants. (1)

20. Open chain structure of D-glucose could not explain the following reactions. ($1 \times 3 = 3$)

- (i) Despite having the aldehyde group, glucose does not give Schiff's test and 2,4-DNP test.
- (ii) Glucose does not react with sodium hydrogen sulphite to form addition product.
- (iii) The pentaacetate of glucose does not react with hydroxyl amine showing the absence of free $-\text{CHO}$ group.

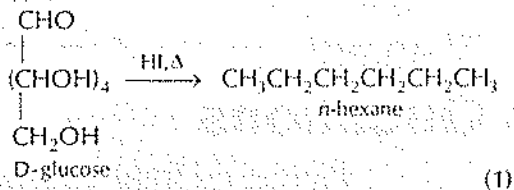
21. Reducing sugar The sugars which reduce Fehling's solution and Tollen's reagent are called reducing sugars. For example; all monosaccharides containing free $-\text{CHO}$ or $-\text{C}=\text{O}$ group are reducing sugars. (1)

Biomolecules

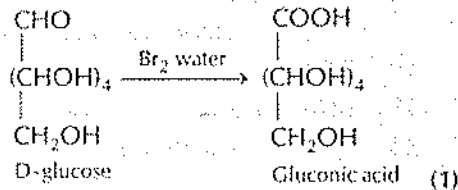
Non-reducing sugar The sugars which do not reduce Fehling's solution or Tollen's reagent are called non-reducing sugar. For example sucrose. (1)

Presence of free aldehydic or ketonic group is the main feature of reducing sugars. (1)

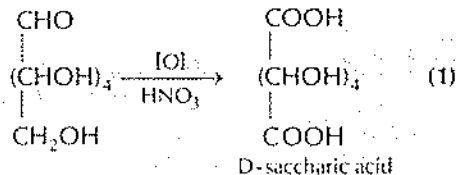
22. (i) It forms *n*-hexane.



(ii) It gives gluconic acid.



(iii) It gives saccharic acid.



Topic 2

Proteins, Vitamins and Nucleic Acids

Previous Years' Examination Questions

Practice the Real Questions

1 Mark Questions

- Write the name of linkage joining two amino acids. [All India 2013]
- What type of bonding helps in stabilising the α -helix structure of proteins? [Delhi 2013]
- What are the different types of RNA molecules which perform different functions? [Delhi 2013]
- Write the full forms of DNA and RNA. [Foreign 2012]
- Of the two bases named below, which one is present in RNA and which one is present in DNA?
(i) Thymine
(ii) Uracil [Foreign 2012]
- The deficiency of which vitamin causes the disease pernicious anaemia? [All India 2011C]
- Name the deficiency diseases resulting from lack of vitamin A and E in the diet. [Delhi 2011C, 2005]
- What are polypeptide? [Delhi 2010]
- What is the biological effect of denaturation of proteins? [All India 2009C]
- B-complex is an often prescribed vitamin. What is complex about it and what is its usefulness? [All India 2007]
- Name the location where protein synthesis occurs in our body? [Delhi 2007]

- Name the purines present in DNA. [Delhi 2007]

2 Marks Questions

- Write the main structural difference between DNA and RNA. Of the two bases, thymine and uracil, which one is present in DNA? [Delhi 2012]
- Explain the meaning of the following terms
(i) Polypeptide (ii) Enzymes [Foreign 2012]
- Write the main structural difference between DNA and RNA. Of the four bases name those which are common to both DNA and RNA. [All India 2011; Delhi 2011]
- Describe what do you understand by primary and secondary structure of proteins? [Delhi, Foreign 2011; All India 2008]
- Name the bases present in RNA. Which one of these is not present in DNA? [Delhi 2011]
- What are vitamins? Deficiency of which vitamins causes convulsions and pernicious anaemia? [All India 2011C, 2010C]
- What is meant by denaturation of proteins? [All India 2010]
- Name the four bases present in DNA. Which one of these is not present in RNA? [All India 2009]

Thymine, adenine, cytosine

Biomolecules

21. Name two fat soluble vitamins, their sources and the diseases caused due to their deficiency in diet. [All India 2009]
22. Name two water soluble vitamins, their sources and diseases caused by their deficiency in diet. [Delhi 2009]
23. What are essential and non-essential amino acids? Give one example of each type. [All India 2008C; 2006]
24. Mention the type of linkages responsible for the formation of the following.
(i) Primary structure of proteins
(ii) Cross-linking of polypeptide chains
(iii) α -helix formation
(iv) β -sheet-structure [All India 2008C]
25. How are the vitamins classified? Mention the chief sources of vitamin A and C.
26. List any four vitamins, mention the chief sources and functions of two of them. [Foreign 2008]
27. After watching a programme on TV about the adverse effects of junk food and soft drinks on the health of school children, Sonali, a student of Class XII, discussed the issue with the school principal. Principal immediately instructed the canteen contractor to replace the fast food with the fibre and vitamins rich food like sprouts, salad, fruits etc. This decision was welcomed by the parents and the students. After reading the above passage, answer the following questions.
(i) What values are expressed by Sonali and the principal of the school?
(ii) Give two examples of water-soluble vitamins. [Value Based Question Delhi 2013]
28. Shanti, a domestic helper of Mrs. Anuradha, fainted while mopping the floor. Mrs. Anuradha immediately took her to the nearby hospital where she was diagnosed to be severely 'anaemic'. The doctor prescribed an iron rich diet and multivitamins supplement to her. Mrs. Anuradha supported her financially to get

the medicines. After a month, Shanti was diagnosed to be normal.

After reading the above passage, answer the following questions.

- (i) What values are displayed by Mrs. Anuradha?
- (ii) Name the vitamins whose deficiency causes 'pernicious anaemia'.
- (iii) Give an example of a water soluble vitamin. [Value Based Question All India 2013]

3 Marks Questions

29. Define the following giving one example of each. [All India 2011C; 2008C]
(i) Zwitter ion
(ii) Glycosidic linkage
30. (i) What type of bonding helps in stabilising the α -helix structure of proteins?
(ii) Differentiate between globular and fibrous proteins. [All India 2010C, 2010]
31. (i) What is the structural difference between a nucleoside and a nucleotide?
(ii) "The two strands of DNA are not identical but are complementary." Explain. [Delhi 2010C, 2009]
32. Amino acids may be acidic, alkaline or neutral. How does this happen? What are essential and non-essential amino acids? Name one of each type. [All India 2010; Delhi 2010]
33. Define the following as related to proteins.
(i) Peptide linkage
(ii) Primary structure
(iii) Denaturation [Delhi 2008]
34. Answer the following briefly.
(i) What are the good sources of vitamin A?
(ii) What are nucleotides?
(iii) Why is vitamin C essential to us? Give its important sources. [All India 2007]

), guanine

35. Name the different type of RNA found in the cell. Mention their functions.

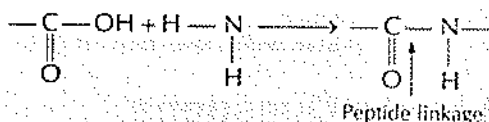
[All India 2006]

36. Name the main disease caused due to lack of the vitamin and source of each of vitamin A, B₆ and E.

[All India 2006]

Step-by-Step Solutions

1. Peptide bond links two amino acids. (1)



2. Hydrogen bonding present between the —NH group of each amino acid residue and the >C=O of an adjacent turn of the helix mainly helps in stabilising the α-helix structure of proteins. (1)

3. Three different types of RNA molecules are as follows. (1)

(i) Messenger RNA (mRNA)

(ii) Transfer RNA (tRNA)

(iii) Ribosomal RNA (rRNA)

4. DNA → Deoxyribonucleic acid (1)
RNA → Ribonucleic acid

5. (i) Thymine is present in DNA. (1/2)

(ii) Uracil is present in RNA. (1/2)

6. Vitamin B₁₂. (1)

7. (i) Night blindness. (1/2)

(ii) Loss of reproduction power. (1/2)

8. The polymers of amino acids are known as polypeptides. (1)

9. During denaturation, the protein molecule uncoils from an ordered and specific conformation into a more random conformation. The primary structure does not change. (1)

10. B-complex is a group of vitamins B₁, B₂, B₆, B₁₂, biotin, folic acid, pantothenic and nicotinic acid. It is required to release energy from food and to promote healthy skin and muscles. (1)

11. Protein synthesis takes place in cytoplasm. (1)

12. Adenine and guanine. (1/2 + 1/2 = 1)

13. The structural differences between DNA and RNA are

(i) The sugar in DNA is deoxyribose lacking oxygen atom at 2° C, while that in RNA is ribose having oxygen atom at 2° C. (1/2)

(ii) DNA has a double-stranded helical structure, while RNA has a single-stranded helical structure. (1/2)

(iii) DNA is generally found inside nucleus while RNA is found in cytoplasm. (1/2)

(iv) DNA contains the base thymine, while RNA contains uracil. (1/2)

14. (i) Proteins are the polymers of α-amino acids and they are connected to each other by peptide bond or peptide linkage. Chemically, peptide linkage is an amide formed between —COOH group and —NH₂ group. When the number of such amino acids is more than ten, the products are called polypeptides. (1)

(ii) Biological catalysts are known as enzymes. They are made up of proteins. Enzymes are very specific for a particular reaction and for a particular substrate. Example: Invertase, zymase etc. (1)

15. Refer ans. 13. (1)

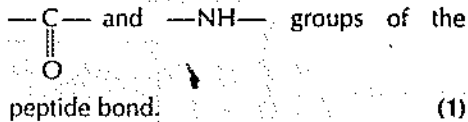
The common bases are adenine, guanine and cytosine. (1)

16. (i) Primary structure The specific sequence in which the various α-amino acids present in a protein are linked to one another is called its primary structure. (1)

DNA contains Thymine
RNA contains Uracil

Biomolecules

(ii) **Secondary structure** It refers to the shape in which a long polypeptide chain can exist. They are found to exist in two different types of structures : α -helix and β -pleated sheet structure. These structures arise due to the regular folding of the backbone of the polypeptide chain due to hydrogen bonding between



17. Uracil, cytosine, guanine and adenine are present in RNA.

Uracil is not present in DNA. (2)

18. The organic compounds which cannot be produced by the body and must be supplied in small amounts in diet to perform specific biological functions for the normal health, growth and maintenance of body are called vitamins. (1)

Convulsions are caused by the deficiency of vitamin B₆ and pernicious anaemia is caused by vitamin B₁₂. (1)

19. When proteins are subjected to a change in pH, temperature etc., the secondary and tertiary structure breakdown but primary structure remains the same, this is known as denaturation e.g., coagulation of egg white on boiling. (2)

20. DNA has adenine, thymine, guanine and cytosine.

Thymine is not present in RNA. Instead of thymine, it has uracil. (2)

21. Vitamin A and vitamin D are two fat soluble vitamins.

For vitamin A, Fish liver oil, carrots, butter and milk are sources.

Deficiency disease Night blindness. (1)

For vitamin D, Fish and egg yolk are sources.

Deficiency disease Rickets and Osteomalacia (1)

22. (i) Vitamin B₁ Source is yeast, milk, green vegetables and carrots.

Deficiency disease is beri-beri. (1)

(ii) Vitamin C Citrus fruits, amla and green leafy vegetables are sources.

Deficiency disease is scurvy. (1)

23. (i) Essential amino acids are the α -amino acids which are needed for health and growth of human beings but are not synthesized by the human body. Example : valine, leucine. (1)

(ii) Non-essential amino acids are the α -amino acids which are needed for health and are synthesized by the human body. Example. glycine, aspartic acid. (1)

24. (i) Peptide linkage
(ii) Hydrogen bond, sulphate linkage, van der Waals' forces
(iii) Hydrogen bonds
(iv) Inter molecular hydrogen bonds (1/2 \times 4 = 2)

25. Vitamins are classified into two groups :
(i) Fat soluble vitamins
(ii) Water soluble vitamins (1)

Sources of vitamin A Fish liver oil, carrot, butter and milk. (1/2)

Sources of vitamin C Citrus fruits, amla and green leafy vegetables. (1/2)

26. Vitamin A, vitamin B, vitamin C and vitamin D are four vitamins.

| Vitamins | Sources | Disease due to deficiency |
|----------|------------------|---------------------------|
| B | Milk, nuts, eggs | Beri-Beri |
| C | Citrus fruits | Scurvy |

(1)

Functions

(i) Vitamin B prevents Beri-Beri and loss of appetite.

(ii) Vitamin C prevents scurvy, pyorrhoea and dental caries etc. (1)

27. Expressed by Sonali

(i) Values Awareness regarding detrimental consequences of junk food and also

inclined towards the health of her school mates. (1)

Values expressed by principal He showed responsible attitude in hearing to opinion and taking immediate action for the health of students.

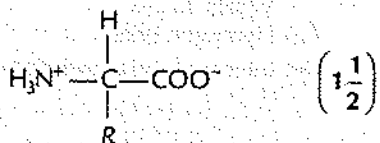
(ii) Vitamin B complex and vitamin C are two water soluble vitamins. (1)

28. (i) Values Concern for health of other person, kind, intelligent. (1)

(i) Vitamin B₁₂ (1/2)

(ii) Vitamin B₁₂ (1/2)

29. (i) Zwitter ion When the —H of —COOH group goes to —NH₂ group of amino acid, a salt like structure is created that is known as Zwitter ion e.g.,



(ii) See ans. 12 (ii) from topic 1. (1/2)

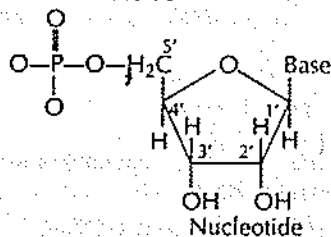
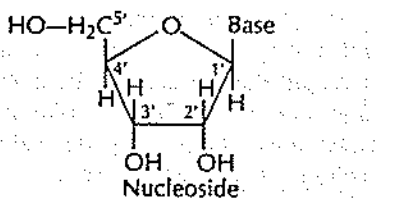
30. (i) α -helix is one of the most common ways in which a polypeptide chain forms. It is stabilised possible hydrogen bonds. (1)

(ii)

| S. No. | Fibrous protein | Globular protein |
|--------|--|--|
| 1. | They are fibre like structure. | The chain of polypeptide coil around to give a spherical shape. (1/2) |
| 2. | The molecules are held together by H-bonds in some cases. | The interaction present in these are H-bonds, ionic or salt bridges. (1/2) |
| 3. | These are water e.g., insoluble, keratin, myosin, fibroin etc. | These may be water soluble e.g., insulin, fibrinogen, haemoglobin etc. (1/2) |

31. (i) Nucleoside is formed by the condensation of a purine or pyrimidine base with pentose sugar at position 1. When nucleoside is linked to phosphoric

acid at 5' position of sugar unit, we get a nucleotide.



(1/2)

(ii) DNA is a double stranded molecule. The two strands are complementary to each other because H-bonds are formed by specific pairs of bases, i.e., adenine is attached with thymine (T) by two H-bond and guanine (G) is attached to cytosine (C) by three H-bonds. The other of combination of bases are energetically less favoured and hence, do not occur in normal DNA. (1/2)

32. Amino acids may be acidic, basic or neutral depending upon the relative number of amino and carboxyl group present in their molecule. (1)

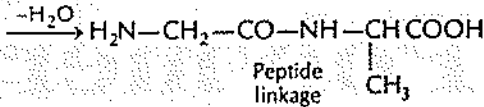
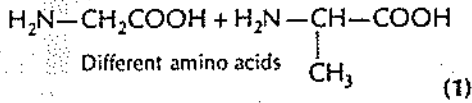
Equal number of amino and carboxyl groups makes it neutral, more amino group means basic and more carboxylic group means acidic amino acid. (1)

Essential and non-essential amino acids See ans. 16. (1)

33. (i) Peptide linkage It is an amide linkage formed between the molecules of two amino acids. The reaction takes place between amino group of one amino acid and carboxylic group of other amino acid

Biomolecules

with the elimination of water molecule.
e.g.,



(ii) **Primary structure** In a protein molecule, one or more polypeptide chains may be present. Each polypeptide chain has a specific sequence of amino acids, termed as primary structure of proteins. Any change in primary structure, i.e., in the sequence of amino acid generates a new protein. (1)

(iii) **Denaturation** When a protein in its native form is subjected to a physical change like change in temperature, pH etc., the hydrogen bond gets disturbed and hence, the globules unfold and helix get uncoiled. The protein loses its biological activity. This process is called denaturation of proteins. It only affects the secondary and tertiary structures of proteins. (1)

34. (i) Milk and butter (1)

(ii) Nucleotide is a unit which consists of a phosphate group, a five carbon sugar and

a nitrogen containing heterocyclic compound, called base. (1)

(iii) Vitamin C is essential because its deficiency causes scurvy (bleeding gums). The important sources are citrus fruits, amla, green leafy vegetables. ($1/2 + 1/2 = 1$)

35. The different types of RNA found in the cells are

(i) **Messenger RNA** It carries the genetic code from DNA to ribosomes where protein is synthesized. (1)

(ii) **Ribosomal RNA** Its function is to provide the site for protein synthesis. (1)

(iii) **Transfer RNA** It transfers amino acids from different parts of cytoplasm to the ribosomes during protein synthesis. (1)

36.

| Vitamin | Deficiency disease | Source |
|----------------|-------------------------|---|
| A | Xerophthalmia | Cod liver oil, carrot, butter etc. ($1/2 + 1/2 = 1$) |
| B ₆ | Convulsions | Cereals, meat, egg, fish. ($1/2 + 1/2 = 1$) |
| E | Infertility (sterility) | Oils like cotton seed oil. ($1/2 + 1/2 = 1$) |