Biomolecules

Case Study Based Questions

Case Study 1

Polysaccharides may be very large molecules. Starch, glycogen, cellulose and chitin are examples of polysaccharides. Starch is the stored form of sugars in plants and is made up of amylose and amylopectin (both polymers of glucose). Amylose is soluble in water and can be hydrolysed into glucose units breaking glycosidic bonds, by the enzymes a-amylase and B-amylase. It is straight chain polymer. Amylopectin is a branched chain. polymer of several D-glucose molecules. 80% of amylopectin is present in starch. Plants are able to synthesize glucose and the excess glucose is stored as starch in different plant parts, including roots and seeds. The starch that is consumed by animals is broken down into smaller molecules, such as glucose. The cells can then absorb the glucose. Glycogen is the storage form of glucose in humans and other vertebrates and is made up of monomers of glucose. It is structurally quite similar to amylopectin. Glycogen is the animal equivalent of starch. It is stored in liver and skeletal muscles.
Cellulose is one of the most abundant natural biopolymers. The cell walls of plants are mostly made of cellulose, which provides structural support to the cell. Wood and paper are mostly cellulosic in nature.
Like amylose, cellulose is a linear polymer of glucose. Cellulose is made up of glucose monomers that are linked by bonds between particular carbon atoms in the glucose molecule. Every other glucose monomer in cellulose is flipped over and packed tightly as extended long chains. This gives cellulose its rigidity and high tensile strength which is so important to plant cells. Cellulose passing through our digestive system is called dietary fiber.

Read the given passage carefully and give the answer of the following questions:

Q1. In animals, glycogen is stored in:

a. liver

b. spleen

c. lungs

d. small intestine

Q 2. Amylose is:

a. straight chain, water insoluble component of starch, which constitutes 20% of it.

b. straight chain, water soluble component of starch, which constitutes 20% of it.

c. branched chain, water insoluble component of starch, which constitutes 80% of it.

d. branched chain, water insoluble component of starch, which constitutes 80% of it.

Q3. The linkages which join monosaccharides to form long chain polysaccharides:

a. peptide linkage

b. disulphide bonds

c. hydrogen bonds

d. glycosidic linkage

Q4. Cellulose on complete hydrolysis yields:

a. amylose

b. amylopectin

c. glucose

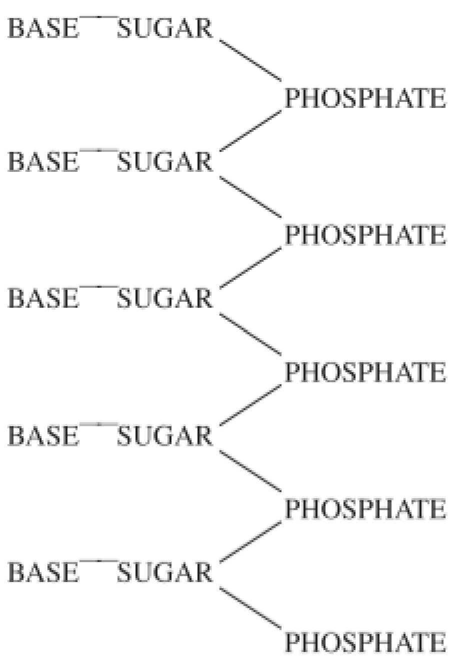
d. amylose and amylopectin

Answers

1. (a) liver
2. (b) straight chain, water soluble component of starch, which constitutes 20% of it.
3. (d) glycosidic linkage
4. (c) glucose

Case Study 2

The basic chemical formula of DNA is now well established. As shown in figure, it consists of a very long chain, the backbone of which is made up of alternate sugar and phosphate groups, joined together in regular 3'5' phosphate di-ester linkages. To each sugar is attached a nitrogenous base, only four different kinds of which are commonly found in DNA. Two of these- adenine and guanine are purines and the other two thymine and cytosine-are pyrimidines. A fifth base, 5-methyl cytosine, occurs in smaller amounts in certain organisms, and a sixth, 5-hydroxy-methyl-cytosine is found instead of cytosine in the T even phages. It should be noted that the chain is unbranched, a consequence of the regular internucleotide linkage. On the other hand, the sequence of the different nucleotides is, as far as can be ascertained, completely irregular. Thus, DNA has some features which are regular and some which are irregular. A similar conception of the DNA molecule as a long thin fiber is obtained from physicochemical analysis involving sedimentation, diffusion, light scattering and viscosity measurements. These techniques indicated that DNA is a very asymmetrical structure approximately 20. A wide and many thousands of angstroms long. Estimates of its molecular weight currently center between 5×10^6 and 10^7 (approximately 3×10^4 nucleotides). Surprisingly each of these measurements tend to suggest that the DNA is relatively rigid, a puzzling finding in view of the large number of single bonds (5 per nucleotide) in the phosphate-sugar back bone. Recently these indirect inferences have been confirmed by electron microscopy.



Read the given passage carefully and give the answer of the following questions:

Q1. Purines present in DNA are:

a. adenine and thymine
b. guanine and thymine
c. cytosine and thymine
d. adenine and guanine

Q 2. DNA molecules has .... internucleotide linkage and .... sequence of the different nucleotides.

a. regular, regular
b. regular, irregular
c. irregular, regular
d. irregular, irregular

Q3. DNA has .... backbone..

a. phosphate -purine
b. pyrimidines- sugar
c. phosphate- sugar
d. purine- pyrimidine

Q4. Out of the four different kinds of nitrogenous bases which are commonly found in DNA, ...has been replaced in some organisms.

a. adenine
b. guanine
c. cytosine
d. thymine

Answers

1. (d) adenine and guanine
2. (b) regular, irregular
3. (c) phosphate- sugar
4. (c) cytosine

Case Study 3

Strengthening the Foundation: Chargaff Formulates His "Rules"

Many people believe that James Watson and Francis Crick discovered DNA in the 1950s. In reality, this is not the case. Rather, DNA was first identified in the late 1860s by Swiss chemist Friedrich Miescher. Then, in the decades following Miescher's discovery, other scientists-notably, Phoebus Levene and Erwin Chargaff-carried out a series of research efforts that revealed additional details about the DNA molecule, including its primary chemical components and the ways in which they joined with one another. Without the scientific foundation provided by these pioneers, Watson and Crick may never have reached their groundbreaking conclusion of 1953: that the DNA molecule exists in the form of a three-dimensional double helix. Chargaff, an Austrian biochemist, as his first

step in this DNA research, set out to see whether there were any differences in DNA among different species. After developing a new paper chromatography method for separating and identifying small amounts of organic material, Chargaff reached two major conclusions:
(i) The nucleotide composition of DNA varies among species.
(ii) Almost all DNA, no matter what organism or tissue type it comes from maintains certain properties, even as its composition varies. In particular, the amount of adenine (A) is similar to the amount of thymine (T) and the amount of guanine (G) approximates the amount of cytosine (C). In other words, the total amount of purines (AG) and the total amount of pyrimidines (C + T) are usually nearly equal. This conclusion is now known as 'Chargaff's
rule.'
Chargaff's rule is not obeyed in some viruses. These either have single-stranded DNA or RNA as their genetic material.

Read the given passage carefully and give the answer of the following questions:

Q1. A segment of DNA has 100 adenine and 150 cytosine bases. What is the total number of nucleotides present in this segment of DNA?

Q2. A sample of hair and blood was found at two sites. Scientists claim that the samples belong to same species. How did the scientists arrive at this conclusion?

Q3. The sample of a virus was tested and it was found to contain 20% adenine, 20% thymine, 20% guanine and the rest cytosine. Is the genetic material of this virus (i) DNA-double helix, (ii) DNA-single helix, (iii) RNA? What do you infer from this data?

OR

How can Chargaff's rule be used to infer that the genetic material of an organism is double- helix or single-helix? (CBSE SQP 2022-23)

Answers

1. Given: Number of adenine bases, A = 100
So, Number of thymine bases, T = 100
Again, Number of cytosine bases, C = 150

So, Number of guanine bases, G = 150
Total nucleotides = 100+ 100+ 150 + 150 = 500

2. Scientists studied the nucleotide composition of DNA. It was the same so they concluded that the samples belong to same species.

3. Since AT 20% but G is not equal to C so double helix is ruled out. The base pairs are ATGC and not AUGC so it is not RNA. So, it can be inferred that the virus is a single helix DNA virus.

OR

According to Chargaff rule, all double helix DNA will have the same amount of A and T as well as C will be of same amount as G. If this is not the case, then the helix is single stranded.

Case Study 4

Carbohydrates are optically active polyhydroxy aldehydes and ketones. They are also called saccharides. All those carbohydrates which reduce Fehling's solution and Tollen's reagent are referred to as reducing sugars. Glucose, the most important source of energy for mammals, is obtained by the hydrolysis of starch. Vitamins are accessory food factors required in the diet. Proteins are the polymers of a-amino acids and perform various structural and dynamic functions in the organisms. Deficiency of vitamins leads to many diseases.

Read the given passage carefully and give the answer of the following questions:

Q1. The pentaacetate of glucose does not react with hydroxylamine. What does it indicate?

Q2. Why cannot vitamin C be stored in our body?

Q3. Define the following as related to proteins:
(i) Peptide linkage
(ii) Denaturation

OR

Define the following as related to carbohydrates:
(i) Anomers
(ii) Glycosidic linkage (CBSE 2023)

Answers

1. The pentaacetate of glucose does not react with hydroxylamine indicates the absence of free -CHO group.

2. Vitamin C cannot be stored in our body because it is a water-soluble vitamin and gets excreted from the body with sweat or urine.

3. (i) Peptide linkage: It is a peptide bond that connects the polymers of a-amino acids i.e., proteins. Chemically, peptide linkage is an amide formed between-COOH group and-NH_2 group.
(ii) Denaturation: When a protein in its native form, is subjected to physical change like change in temperature or chemical change like change in pH, the hydrogen bonds are disturbed. Due to this, globules unfold and helix gets uncoiled and protein loses its biological activity. This is called as denaturation.

OR

(i) Anomers: These are cyclic monosaccharides differing from each other in the configuration of C-1 or C-2 carbon. It is C-1 for aldoses and C-2 for ketoses.
(ii) Glycosidic linkage: Glycosidic linkage is a bond used to link different monosaccharides in disaccharides and polysaccharides through oxygen atom. For example, glycosidic linkage is present in sucrose, lactose, maltose, etc. These are all disaccharides.

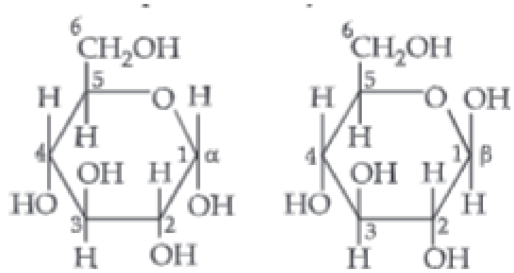
Solutions for Questions 5 to 12 are Given Below

Case Study 5

Read the passage given below and answer the following questions :

Pentose and hexose undergo intramolecular hemiacetal or hemiketal formation due to combination of the –OH group with the carbonyl group. The actual structure is either of five or six membered ring containing an oxygen atom. In the free state all pentoses and hexoses exist in pyranose form (resembling pyran). However, in the combined state some of them exist as five membered cyclic structures, called furanose (resembling furan).

The cyclic structure of glucose is represented by Haworth structure :



α and β-*D*-glucose have different configuration at anomeric (C-1) carbon atom, hence are called anomers and the C-1 carbon atom is called anomeric carbon (glycosidic carbon).

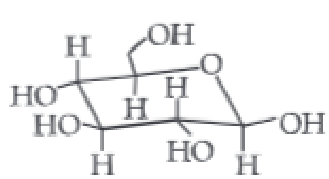
The six membered cyclic structure of glucose is called pyranose structure.

The following questions are multiple choice questions. Choose the most appropriate answer :

(i) α-*D*(+)-glucose and β-*D*(+)glucose are

(a) enantiomers (b) conformers (c) epimers (d) anomers.

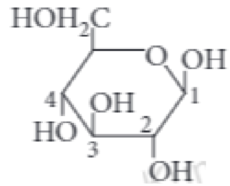
(ii) The following carbohydrate is



(a) a ketohexose (b) an aldohexose

(c) an α-furanose (d) an α-pyranose.

(iii) In the following structure,



anomeric carbon is

(a) C-1 (b) C-2 (c) C-3 (d) C-4

(iv) The term anomers of glucose refers to

(a) isomers of glucose that differ in configurations at carbons one and four (C-1 and C-4)

(b) a mixture of (*D*)-glucose and (*L*)-glucose

(c) enantiomers of glucose

(d) isomers of glucose that differ in configuration at carbon one (C-1).

OR

What percentage of β-*D*-(+) glucopyranose is found at equilibrium in the aqueous solution?

(a) 50% (b) ≈ 100% (c) 36% (d) 64%

Case Study 6

Read the passage given below and answer the following questions :

When a solution of an α-amino acid is placed in an electric field depending on the pH of the medium, following three cases may happen.

$$\underset{\text{II}}{H_2NCHRCOO^-} \underset{OH^-}{\overset{H^+}{\rightleftharpoons}} \underset{\text{I}}{H_3\overset{+}{N}CHRCOO^-} \underset{OH^-}{\overset{H^+}{\rightleftharpoons}} \underset{\text{III}}{H_3\overset{+}{N}CHRCOOH}$$

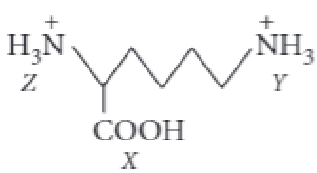
(i) In alkaline solution, α-amino acids exist as anion II, and there is a net migration of amino acid towards the anode.

(ii) In acidic solution, α-amino acids exist as cation III, and there is a net migration of amino acid towards the cathode.

(iii) If II and III are exactly balanced there is no net migration; under such conditions any one molecule exists as a positive ion and as a negative ion for exactly the same amount of time, and any small movement in the direction of one electrode is subsequently cancelled by an equal movement back toward the other electrode. The pH of the solution in which a particular amino acid does not migrate under the influence of an electric field is called the isoelectric point of that amino acid.

The following questions are multiple choice questions. Choose the most appropriate answer :

(i)



Arrange in order of increasing acid strengths.

(a) $X > Z > Y$ (b) $Z < X < Y$ (c) $X > Y > Z$ (d) $Z > X > Y$

(ii) In aqueous solutions, amino acids mostly exist as

(a) $NH_2—CHR—COOH$ (b) $NH_2—CHR—COO^-$

(c) $\overset{+}{N}H_3CHRCOOH$ (d) $H_3\overset{+}{N}CHRCOO^-$

(iii) Amino acids are least soluble

(a) at pH 1
(b) at pH 7
(c) at their isoelectric points
(d) none of these.

(iv) The pK_{a_1} and pK_{a_2} of an amino acid are 2.3 and 9.7 respectively. The isoelectric point of the amino acid is

(a) 12.0
(b) 7.4
(c) 6.0
(d) 3.7

OR

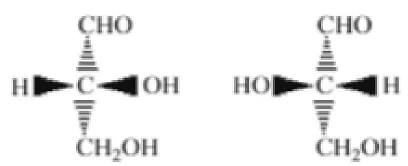
A tripeptide (*X*) on partial hydrolysis gave two dipeptides Cys-Gly and Glu-Cys. Identify the tripeptide.

(a) Glu-Cys-Gly
(b) Gly-Glu-Cys
(c) Cys-Gly-Glu
(d) Cys-Glu-Gly

Case Study 7

Read the passage given below and answer the following questions :

Carbohydrates can exist in either of two conformations, as determined by the orientation of the hydroxyl group about the asymmetric carbon farthest from the carbonyl.



D-Glyceraldehyde *L*-Glyceraldehyde

(Structures of glyceraldehyde enantiomers)

By convention, a monosaccharide is said to have *D*-configuration if the hydroxyl group attached to the asymmetric carbon atom adjacent to the —CH_2OH group is on the right hand side irrespective of the positions of the other hydroxyl groups. On the other hand, the molecule is assigned *L*-configuration if the —OH group attached to the carbon adjacent to the —CH_2OH group is on the left hand side.

The following questions are multiple choice questions. Choose the most appropriate answer :

(i) *D*-Glyceraldehyde and *L*-Glyceraldehyde are

(a) epimers
(b) enantiomers
(c) anomers
(d) conformational diasteriomers.

(ii) Which of the following monosaccharides, is the majority found in the human body?

(a) *D*-type
(b) *L*-type
(c) Both of these
(d) None of these

(iii) The two functional groups present in a typical carbohydrate are

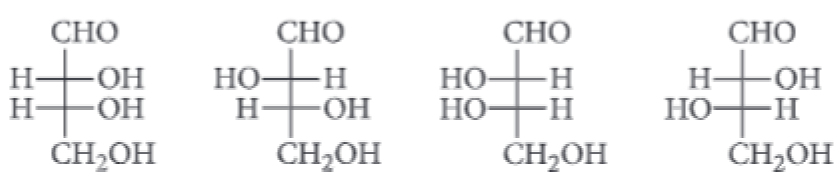
(a) –OH and –COOH
(b) –CHO and –COOH
(c) $>C=O$ and –OH
(d) –OH and –CHO

OR

Monosaccharides contain

(a) always six carbon atoms
(b) always five carbon atoms
(c) always four carbon atoms
(d) may contain 3 to 7 carbon atoms.

(iv) The correct corresponding order of names of four aldoses with configuration given below



respectively, is

(a) *L*-erythrose, *L*-threose, *L*-erythrose, *D*-threose
(b) *D*-threose, *D*-erythrose, *L*-threose, *L*-erythrose
(c) *L*-erythrose, *L*-threose, *D*-erythrose, *D*-threose
(d) *D*-erythrose, *D*-threose, *L*-erythrose, *L*-threose.

Case Study 8

Read the passage given below and answer the following questions :

Carbohydrates are polyhydroxy aldehydes and ketones and those compounds which on hydrolysis give such compounds are also carbohydrates. The carbohydrates which are not hydrolysed are called monosaccharides. Monosaccharides with aldehydic group are called aldose and those which free ketonic groups are called ketose. Carbohydrates are optically active. Number of optical isomers = 2^n

where n = number of asymmetric carbons. Carbohydrates are mainly synthesised by plants during photosynthesis. The monosaccharides give the characteristic reactions of alcohols and carbonyl group (aldehydes and ketones). It has been found that these monosaccharides exist in the form of cyclic structures. In cyclization, the –OH groups (generally C_5 or C_4 in aldohexoses and C_5 or C_6 in ketohexoses) combine with the aldehyde or keto group. As a result, cyclic structures of five or six membered rings containing one oxygen atom are formed, *e.g.*, glucose forms a ring structure. Glucose contains one aldehyde group, one 1° alcoholic group and four 2° alcoholic groups in its open chain structure.

The following questions are multiple choice questions. Choose the most appropriate answer :

(i) First member of ketos sugar is
(a) ketotriose (b) ketotetrose (c) ketopentose (d) ketohexose.

(ii) In $CH_2OHCHOHCHOHCHOHCHOHCHO$, the number of optical isomers will be
(a) 16 (b) 8 (c) 32 (d) 4

(iii) Some statements are given below :
1. Glucose is aldohexose.
2. Naturally occurring glucose is dextrorotatory.
3. Glucose contains three chiral centres.
4. Glucose contains one 1° alcoholic group and four 2° alcoholic groups.

Among the above, correct statements are
(a) 1 and 2 only (b) 3 and 4 only
(c) 1, 2 and 4 only (d) 1, 2, 3 and 4

(iv) Two hexoses form the same osazone, find the correct statement about these hexoses.
(a) Both of them must be aldoses.
(b) They are epimers at C–3.
(c) The carbon atoms 1 and 2 in both have the same configuration.
(d) The carbon atoms 3, 4 and 5 in both have the same configuration.

OR

Which of the following reactions of glucose can be explained only by its cyclic structure?
(a) Glucose forms cyanohydrin with HCN.
(b) Glucose reacts with hydroxylamine to form an oxime.
(c) Pentaacetate of glucose does not react with hydroxylamine.
(d) Glucose is oxidised by nitric acid to gluconic acid.

Case Study 9

Read the passage given below and answer the following questions :

When a protein in its native form, is subjected to physical changes like change in temperature or chemical changes like change in pH, the hydrogen bonds are disturbed. Due to this, globules unfold and helix get uncoiled and protein loses its biological activity. This is called denaturation of protein.

The denaturation causes change in secondary and tertiary structures but primary structures remains intact. Examples of denaturation of protein are coagulation of egg white on boiling, curdling of milk, formation of cheese when an acid is added to milk.

The following questions are multiple choice questions. Choose the most appropriate answer :

(i) Mark the wrong statement about denaturation of proteins.

(a) The primary structure of the protein does not change.

(b) Globular proteins are converted into fibrous proteins.

(c) Fibrous proteins are converted into globular proteins.

(d) The biological activity of the protein is destroyed.

(ii) Which structure(s) of proteins remains(s) intact during denaturation process ?

(a) Both secondary and tertiary structures
(b) Primary structure only
(c) Secondary structure only
(d) Tertiary structure only

(iii) α-helix and β-pleated structures of proteins are classified as

(a) primary structure
(b) secondary structure
(c) tertiary structure
(d) quaternary structure.

OR

Cheese is a

(a) globular protein
(b) conjugated protein
(c) denatured protein
(d) derived protein.

(iv) Secondary structure of protein refers to

(a) mainly denatured proteins and structure of prosthetic groups

(b) three-dimensional structure, especially the bond between amino acid residues that are distant from each other in the polypeptide chain

(c) linear sequence of amino acid residues in the polypeptide chain

(d) regular folding patterns of continuous portions of the polypeptide chain.

Case Study 10

Read the passage given below and answer the following questions :

The sequence of bases along the DNA and RNA chain establishes its primary structure which controls the specific properties of the nucleic acid. An RNA molecule is usually a single chain of ribose-containing nucleotide. On the basis of X-ray analysis of DNA, J.D., Watson and F.H.C. crick (shared noble prize in 1962) proposed a three dimensional secondary structure for DNA. DNA molecule is a long and highly complex, spirally twisted, double helix, ladder like structure. The two polynucleotide chains or strands are linked up by hydrogen bonding between the nitrogeneous base molecules of their nucleotide monomers. Adenine (purine) always links with thymine (pyrimidine) with the help of two hydrogen bonds and guanine (purine) with cytosine (pyrimidine) with the help of three hydrogen bonds. Hence, the two strands extend in opposite directions, *i.e.*, are antiparallel and complimentary.

In these questions (Q. No. i-iv), a statement of assertion followed by a statement of reason is given. Choose the correct answer out of the following choices.

(a) Assertion and reason both are correct statements and reason is correct explanation for assertion.

(b) Assertion and reason both are correct statements but reason is not correct explanation for assertion.

(c) Assertion is correct statement but reason is wrong statement.

(d) Assertion is wrong statement but reason is correct statement.

(i) Assertion : DNA molecules and RNA molecules are found in the nucleus of a cell.
Reason : There are two types of nitrogenous bases, purines and pyrimidines. Adenine (A) and guanine (G) are substituted purines; cytosine (C), thymine (T) and uracil (U) are substituted pyrimidines.

(ii) Assertion : In both DNA and RNA, heterocyclic base and phosphate ester linkages are at C-1′ and C-5′ respectively of the sugar molecule.
Reason : Nucleotides and nucleosides mainly differ from each other in presence of phosphate units.

(iii) Assertion : The backbone of RNA molecule is a linear chain consisting of an alternating units of a heterocylic base, *D*-ribose and a phosphate.
Reason : The segment of DNA which acts as the instruction manual for the synthesis of protein is ribose.

(iv) Assertion : The double helical structure of DNA was proposed by Emil Fischer.
Reason : A nucleoside is an N-glycoside of heterocyclic base.

OR

Assertion : In DNA, the complementary bases are, adenine and guanine; thymine and cytosine.
Reason : The phenomenon of mutation is chemical change in DNA molecule.

Case Study 11

Read the passage given below and answer the following questions :

Proteins are high molecular mass complex biomolecules of amino acids. The important proteins required for our body are enzymes, hormones, antibodies, transport proteins, structural proteins, contractile proteins etc. Except for glycine, all α-amino acids have chiral carbon atom and most of them have *L*-configuration. The amino acids exists as dipolar ion called zwitter ion, in which a proton goes from the carboxyl group to the amino group. A large number of α-amino acids are joined by peptide bonds forming polypeptides. The peptides having very large molecular mass (more than 10,000) are called proteins. The structure of proteins is described as primary structure giving sequence of linking of amino acids; secondary structure giving manner in which polypeptide chains are arranged and folded; tertiary structure giving folding, coiling or bonding polypeptide chains producing three dimensional structures and quaternary structure giving arrangement of sub-units in an aggregate protein molecule.

In these questions (Q. No. i-iv), a statement of assertion followed by a statement of reason is given. Choose the correct answer out of the following choices.

(a) Assertion and reason both are correct statements and reason is correct explanation for assertion.

(b) Assertion and reason both are correct statements but reason is not correct explanation for assertion.

(c) Assertion is correct statement but reason is wrong statement.

(d) Assertion is wrong statement but reason is correct statement.

(i) Assertion : Except glycine, all naturally occurring α-amino acids are optically active.
Reason : All naturally occurring α-amino acids, except glycine, has at least one asymmetric carbon.

OR

Assertion : All amino acids are optically active.
Reason : Amino acids contain asymmetric carbon atoms.

(ii) **Assertion :** In α-helix structure, intramolecular H-bonding takes place whereas in β-pleated structure, intermolecular H-bonding takes place.
Reason : An egg contains a soluble globular protein called albumin which is present in the white part.

(iii) **Assertion :** Secondary structure of protein refers to regular folding patterns of continuos portions of the polypeptide chain
Reason : Out of 20 amino acids, only 12 amino acids can be synthesised by human body.

(iv) **Assertion :** The helical structure of protein is stabilised by intramolecular hydrogen bond between –NH and carbonyl oxygen.
Reason : Sanger's reagent is used for the identification of N-terminal amino acid of peptide chain.

Case Study 12

Read the passage given below and answer the following questions :

Glucose is known as dextrose because it occurs in nature as the optically active dextrorotatory isomer. It is essential constituent of human blood. The blood normally contains 65 to 110 mg of glucose per 100 mL (hence named Blood sugar). The level may be much higher in diabetic persons. The urine of diabetic persons also contain considerable amount of glucose. In combined form, it occurs in cane sugar and polysaccharides such as starch and cellulose.

Glucose has an aldehyde group (–CHO), one primary alcoholic group ($-CH_2OH$) and four secondary alcoholic groups (–CHOH) in their structure. Due to the presence five hydroxyl groups (–OH), glucose undergoes acetylation. Glucose also undergoes oxidation with mild oxidising agents like bromine water as well as with strong oxidising agents like nitric acid. Since glucose is readily oxidised, it acts as a strong reducing agent and reduces Tollen's reagent and Fehling solution. Glucose exists in two crystalline forms : α-*D*-glucose and β-*D*-glucose. If either of the two forms is dissolved in water and allowed to stand, the specific rotation of the solution changes gradually, until a constant value is obtained. This change is called mutarotation.

In these questions (Q. No. i-iv), a statement of assertion followed by a statement of reason is given. Choose the correct answer out of the following choices.

(a) Assertion and reason both are correct statements and reason is correct explanation for assertion.
(b) Assertion and reason both are correct statements but reason is not correct explanation for assertion.
(c) Assertion is correct statement but reason is wrong statement.
(d) Assertion is wrong statement but reason is correct statement.

(i) **Assertion :** A diabetic person carries a packet of glucose with him always.
Reason : Glucose increases the blood sugar level almost instantaneously.

(ii) **Assertion :** On oxidation with nitric acid, glucose as well as gluconic acid both yield saccharic acid.
Reason : The pentaacetate of glucose does not react with hydroxylamine indicating the absence of free —CHO group.

(iii) **Assertion :** Glucose reacts with acetyl chloride to form pentaacetyl glucose.
Reason : The formation of pentaacetyl derivative confirms the presence of five –OH groups in glucose.

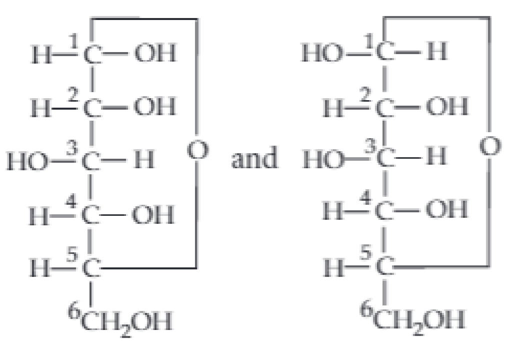
(iv) **Assertion :** A certain compound gives negative test with ninhydrin and positive test with Benedict's solution, the compound is an amino acid.
Reason : Glucose is a monosaccharide.

OR

Assertion : The rapid interconversion of α-*D*-glucose and β-*D*-glucose in solution is known as racemisation.
Reason : Hydrolysis reaction will take place when a mineral acid is treated with sugar.

HINTS & EXPLANATIONS

5. **(i) (d):** α-*D*-(+)-glucose and β-*D*-(+)-glucose differ in configuration at C_1 (*i.e.*, anomeric or glycosidic carbon) and hence are called anomers.



α-*D*(+)-glucose β-*D*(+)-glucose

(ii) (b): This structure is an example of pyranose and aldohexose. Here, the carbohydrate's structure is of the β-pyranose form.

(iii) (a) : C-1 is the anomeric carbon.

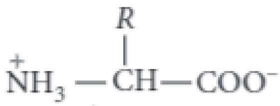
(iv) (d): Anomers are cyclic monosaccharides or glycosides that are epimers, differing from each other in the configuration at C-1, if they are aldoses or in the configuration at C-2 if they are ketoses.

OR

(d) : Ordinary glucose is α-glucose, with a fresh aqueous solution having specific rotation, $[\alpha]_D = +111°$. On keeping the solution for sometime, α-glucose slowly changes into an equilibrium mixture of α-glucose (36%) and β-glucose(64%) and the mixture has specific rotation + 52.5°.

6. **(i) (a):** Carboxylic acids are stronger acids than $-\overset{+}{N}H_3$, therefore *X* is the strongest acid. Since —COOH has –*I* effect which decreases with distance therefore, effect is more pronounced on *Z* than on *Y*. As a result *Z* is more acidic than *Y*, therefore, overall order of increasing acid strength is *X* > *Z* > *Y*.

(ii) (d): In aqueous solutions, amino acids mostly exist as zwitter ion or dipolar ion.



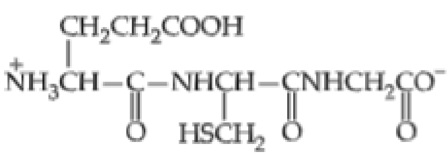
Zwitter ion

(iii) (c) : Amino acids are least soluble at their isoelectric points. At a specific pH, called isoelectric point, the positive and negative charges balance each other and the net charge becomes zero. If there is a charge, the amino acid prefers to interact with water, rather than other amino acid molecules, this charge makes it more soluble.

(iv) (c) : Isoelectric point $= \frac{2.3+9.7}{2} = 6$

OR

(a) : Since the tripeptide on hydrolysis gave two dipeptides Glu-Cys and Cys-Gly, hence, cysteine must be in between glutamic acid and glycine as given below :



Glu-Cys-Gly

7. (i) (b)

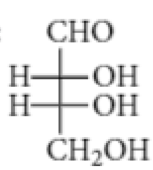
(ii) (a)

(iii) (c) : Carbohydrates are essentially polyhydroxy aldehydes and polyhydroxy ketones. Thus, the two functional groups present are $>C=O$ (aldehyde or ketone) and –OH.

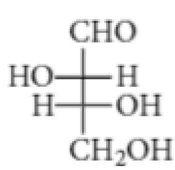
OR

(d)

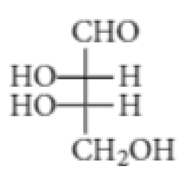
(iv) (d):



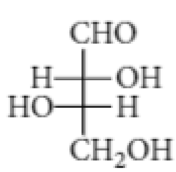
D-erythrose



D-threose



L-erythrose



L-threose

8. (i) (a)

(ii) (a)

(iii) (c) : Glucose contains four chiral centres.

(iv) (d): In the formation of osazone, C–1 and C–2 react with phenylhydrazine to form phenylhydrazone. If C–3, C–4, C–5 have same configuration they will form same osazone even if they differ in configuration at C–1 or C–2.

OR

(c) : Pentacetate of glucose does not react with hydroxylamine showing absence of free –CHO group. This cannot be explained by open structure of glucose.

9. (i) (c)

(ii) (b)

(iii) (b)

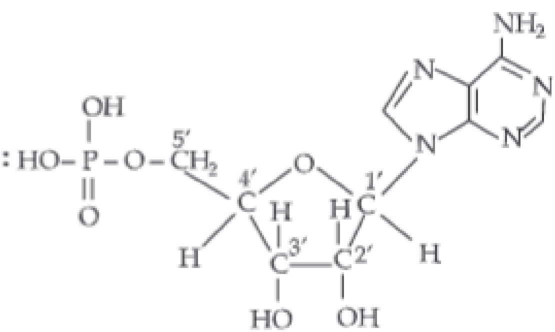
OR

(c) : Cheese is a denatured protein.

(iv) (d)

10. **(i) (d):** DNA occurs in nucleus of the cell while RNA is found mainly in cytoplasm of the cell.

(ii) (b):



Nucleosides contain only sugar and a base whereas nucleotides contain sugar, base and a phosphate group as well.

(iii) (c) : The segment of DNA which acts as the instruction mannual for the synthesis of protein is gene.

(iv) (d): The double helical structure of DNA was proposed by Watson and Crick.

OR

(d) : In DNA, the complementary bases are, adenine and thymine; guanine and cytosine.

11. (i) (a)

OR

(d) : All amino acids except glycine are optically active because they contain, asymmetric carbon atom. They exist in both *D* and *L*-forms. Most naturally occurring amino acids have *L*-configuration.

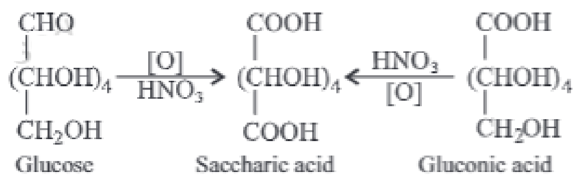
(ii) (b): In α-helix structure, the formation of hydrogen bonds takes place between –CO– and –NH groups, whereas in β-pleated structure, hydrogen bonds are formed between amide groups of two different chains.

(iii) (c) : Out of 20 amino acids, only 10 amino acids can be synthesised by human body.

(iv) (b)

12. **(i) (a)**

(ii) (b):



Strong oxidising agents like nitric acid oxidises both the terminal –CHO and $–CH_2OH$ groups of glucose to give the dibasic acid, saccharic acid.

(iii) (b)

(iv) (d): If a certain compound gives negative test with ninhydrin and positive test with Benedict's solution then the compound should be a monosaccharide.

OR

(d) : The rapid interconversion of α-D-glucose and β-D-glucose in solution is known as mutarotation. Sugar gets hydrolysed with mineral acids.

$$\underset{\text{Sugar}}{C_{12}H_{22}O_{11}} + H_2O \xrightarrow{H^+} \underset{\text{Glucose}}{C_6H_{12}O_6} + \underset{\text{Fructose}}{C_6H_{12}O_6}$$