30 Chapter

BIOMOLECULES (Carbohydrates & Aminoacids)

A SINGLE CORRECT CHOICE TYPE

Each of these questions has 4 choices (a), (b), (c) and (d) for its answer, out of which ONLY ONE is correct.

1. (+)-Glucose and (–)-fructose can be differentiated by

(a) Tollens' reagent (b) Benedict solution

(c) bromine water (d) none of these

2. D-(+)-Glucose $\xrightarrow{5\,(CH_3CO)_2O}$ D-(+)-Glucose pentaacetate

Which statement is true about glucose pentaacetate ?

(a) It will react with phenylhydrazine but not with Tollens' reagent.

(b) It will react with Tollens' reagent but not with phenylhydrazine.

(c) It will react with both of the above mentioned reagents.

(d) It will react neither with phenylhydrazine nor with Tollens' reagent.

3. Which of the following statement is true ?

(a) Epimers are also anomers

(b) Anomers are also epimers

(c) Both of the above statements are true

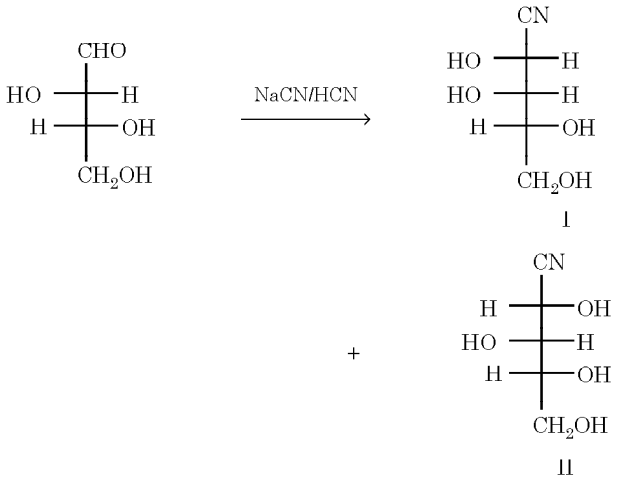
(d) Neither of the two statement is true

4. The enantiomer of α-D-(+)-glucose is

(a) β-D-(+)-glucose (b) α-D-(–)-glucose

(c) α-L-(–)-glucose (d) β-L-(–)-glucose.

5.



Compounds I and II may be grouped as

(a) diastereomers (b) epimers

(c) C–2 epimers (d) all of the three.

6. Which one is the absolutely specific term ?

(a) A diastereomer (b) An epimer

(c) An anomer (d) None of the three.

7. When an aqueous solution of D-glucose is treated with a base, it is converted into D-fructose and D-mannose, this conversion (isomerisation) involves

(a) enolization (b) tautomerization

(c) both (a) and (b) (d) none of the two.

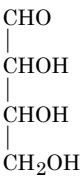
8. Fructose on reduction gives a mixture of two alcohols which are related as

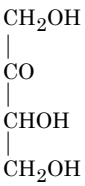
(a) diastereomers (b) epimers

(c) both (a) and (b) (d) anomers.

MARK YOUR RESPONSE					
	1. ⓐⓑⓒⓓ	2. ⓐⓑⓒⓓ	3. ⓐⓑⓒⓓ	4. ⓐⓑⓒⓓ	5. ⓐⓑⓒⓓ
	6. ⓐⓑⓒⓓ	7. ⓐⓑⓒⓓ	8. ⓐⓑⓒⓓ		

9. Which of the following evolves carbon dioxide, on oxidation with periodate ?

(a) 

(b) 

(c) Both (d) None

10. Which of the following pairs can be distinguished by Fehling's solution ?

(a) Glucose and fructose
(b) Glucose and sucrose
(c) Methanal and ethanal
(d) Hydroxypropanone and benzaldehyde.

11. Benedict's reagent is reduced by which type of carbohydrates ?

(a) Acetals (b) Hemiacetals
(c) Glucose pentaacetate (d) None of the three

12. What will happen when D-(+)-glucose is treated with methanolic –HCl followed by Tollens' reagent?

(a) A black ppt. will be formed
(b) A red ppt. will be formed
(c) A green colour will appear
(d) No characteristic colour or ppt. will be formed.

13. Which is true about the acidic character of hydroxyl groups of sugars and hydroxyl group of an alcohol?

(a) The OH's of sugars are more acidic than that of a typical alcohol.
(b) The OH's of sugars are less acidic than that of a typical alcohol.
(c) Both have similar acidic character.
(d) The OH's of sugars are neutral while that of an alcohol is acidic.

14. Which of the following statement(s) is (are) true ?

(i) All amino acids contain one chiral center.
(ii) Some amino acids contain one, while some contain more chiral center or even no chiral center.
(iii) All amino acids found in proteins have L configuration.
(iv) All amino acids found in proteins have 1° amino group.

(a) (ii), (iii) & (iv) (b) (ii) & (iii)
(c) (i), (iii) & (iv) (d) (i) & (iv).

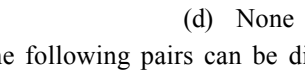
15. The nature of carboxylic group in the solid glycine is

(a) acidic (b) basic
(c) both (d) none.

16. A strongly alkaline solution of a monoaminodicarboxylic acid contains how many basic groups ?

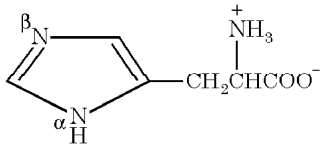
(a) 1 (b) 2
(c) 3 (d) 4.

17. Which of the following dipolar structure of the amino acid is considered to be more correct ?

(a)  (b) 

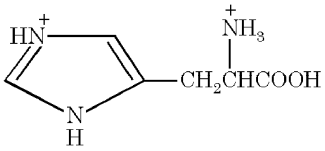
(c) Both (d) None.

18. Which of the nitrogen of histidine is first protonated ?

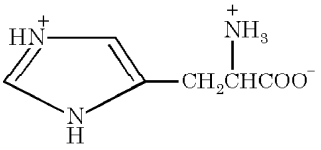


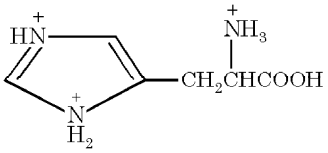
(a) α (b) β
(c) both (d) None.

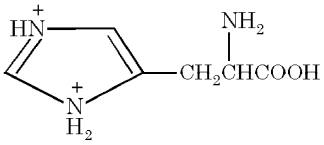
19. Histidine, a heterocyclic amino acid has following structure at pH < 1.82,

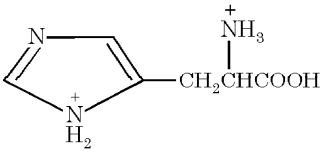


at pH > 1.82 it should have which structure ?

(a) 

(b) 

(c) 

(d) 

MARK YOUR RESPONSE					
	9. ⓐⓑⓒⓓ	10. ⓐⓑⓒⓓ	11. ⓐⓑⓒⓓ	12. ⓐⓑⓒⓓ	13. ⓐⓑⓒⓓ
	14. ⓐⓑⓒⓓ	15. ⓐⓑⓒⓓ	16. ⓐⓑⓒⓓ	17. ⓐⓑⓒⓓ	18. ⓐⓑⓒⓓ
	19. ⓐⓑⓒⓓ				

20. An electric current is passed through an aqueous solution (buffered at pH = 6.0) of alanine (pI = 6.0) and ariginine (pI = 10.2). The two amino acids can be separated because
(a) alanine migrates to anode, and arginine to cathode.
(b) alanine migrates to cathode, and arginine to anode.
(c) alanine does not migrate, while arginine migrates to cathode.
(d) alanine does not migrate, while arginine migrates to anode.

21. A mixture of two amino acids having pI 9.60 and 5.40 can be separated
(a) by adjusting the pH of the solution at 9.60
(b) by adjusting the pH of the solution at 4.20
(c) by adjusting the pH of the solution at 7.0
(d) by adjusting the pH of the solution at 7.5.

22. Preparation of glycine by Strecker synthesis involves..... as one of the starting compounds.
(a) Formaldehyde (b) Acetaldehyde
(c) Methanol (d) Either (a) or (c).

23. In the following series of reactions, compound Z can be

$$Z + NH_3 \xrightarrow{H_2 \text{ (catayst)}} CH_3CH(\overset{+}{N}H_3)COO^-$$

(a) CH_3CHO (b) CH_3COCH_3
(c) $CH_3COCOOH$ (d) None of these

24. How many dipeptides are possible from two molecules of a typical α-amino acid ?
(a) 1 (b) 2
(c) 3 (d) 4

25. Which one of the following statement is false ?
(a) Gly-Ala and Ala-Gly have same structure
(b) A dipeptide bond has two peptide bonds
(c) Glycine and alanine form two dipeptides
(d) All the above three statements are false

26. Fructose is
(a) a hemiacetal (b) an acetal
(c) a hemiketal (d) a ketal

27. Anomers are those stereoisomers which differ in the configuration at
(a) C_1 (b) C_2
(c) both (d) glycosidic carbon

28. In osazone formation, glucose reacts with three molecules of phenylhydrazine. Which statement is true regarding this?
(a) All the three molecules react in similar fashion
(b) Two molecules react in similar manner, while the third reacts in different way
(c) All the three molecules react in different ways
(d) None of the above is true

29. α-Amino acids are
(a) acidic due to –COOH group and basic due to $-NH_2$ group
(b) acidic due to $-NH_3^+$ group and basic due to $-COO^-$ group.
(c) neither acidic nor basic.
(d) none is true.

30. Identify the structures of products A and B in the following reaction

$$CH_3COCHOHCOCH_3 \xrightarrow{\text{Periodic acid}} A + B$$

(a) $CH_3COOH + CH_3COCOOH$
(b) $CH_3COCOOH + CH_3CHO$
(c) $2\,CH_3COOH + HCOOH$
(d) no reaction

31. The pair of compounds in which both the compounds gives positive test with Tollen's reagent are
(a) glucose and sucrose
(b) fructose and sucrose
(c) acetophenone and hexanal
(d) glucose and fructose

32. The two forms of D–glucopyranose obtained from the solution of D-glucose are better called
(a) isomers (b) anomers
(c) epimers (d) enantiomers

33. An organic compound consumes 4 moles of periodic acid to form following compounds per mole of the starting compound HCHO, 3HCOOH and CHOCOOH. The organic compound is
(a) glucose (b) fructose
(c) gluconic acid (d) sorbitol

34. Mutarotation of glucose is observed in
(a) pyridine (b) *p*-cresol
(c) a mixture of (a) and (b) (d) none of the above

MARK YOUR RESPONSE					
	20. ⓐⓑⓒⓓ	21. ⓐⓑⓒⓓ	22. ⓐⓑⓒⓓ	23. ⓐⓑⓒⓓ	24. ⓐⓑⓒⓓ
	25. ⓐⓑⓒⓓ	26. ⓐⓑⓒⓓ	27. ⓐⓑⓒⓓ	28. ⓐⓑⓒⓓ	29. ⓐⓑⓒⓓ
	30. ⓐⓑⓒⓓ	31. ⓐⓑⓒⓓ	32. ⓐⓑⓒⓓ	33. ⓐⓑⓒⓓ	34. ⓐⓑⓒⓓ

35. An optically pure compound A, gave an $[\alpha]_D^{25} = +30°$, while a mixture of A and its enantiomer B, gave $[\alpha]_D^{25} = +15°$. The ratio of A to B in the mixture is

(a) 1 to 3 (b) 3 to 1
(c) 1 to 2 (d) 2 to 1

36. The possible number of diastereomers for D-glucose is

(a) 14 (b) 15
(c) 16 (d) 7

37. Which is the least stable form of glucose ?

(a) α-D-Glucose (b) β-D-Glucose
(c) Open chain structure (d) All are equally stable

38. Which of the following carbohydrate does not correspond to the general formula $C_x(H_2O)_y$?

(a) Glucose (b) 2-Deoxyribose
(c) Fructose (d) Arabinose

39. Glucose-D has a great tendency to be converted into cyclic isomer. Which two carbon atoms get joined through 'O' to form this hemiacetal ?

(a) C_1 and C_4 (b) C_1 and C_5
(c) C_1 and C_6 (d) C_2 and C_6

40. Increase in pH of the solution converts $\underset{|}{\overset{+}{N}H_3}\\ RCHCOOH$ to

(a) $\underset{|}{NH_2}\\ RCHCOOH$ (b) $\underset{|}{\overset{+}{N}H_3}\\ RCHCOO^-$

(c) Both (d) None

MARK YOUR RESPONSE	35. ⓐⓑⓒⓓ	36. ⓐⓑⓒⓓ	37. ⓐⓑⓒⓓ	38. ⓐⓑⓒⓓ	39. ⓐⓑⓒⓓ
	40. ⓐⓑⓒⓓ				

B COMPREHENSION TYPE

This section contains groups of questions. Each group is followed by some multiple choice questions based on a paragraph. Each question has 4 choices (a), (b), (c) and (d) for its answer, out of which ONLY ONE is correct.

PASSAGE-1

Amino acids contain an $-NH_2$ (basic) as well as a –COOH (acidic) group. They exist as zwitter ions

$$H_2N-\underset{|}{\overset{R}{C}}H-COOH \qquad H_3\overset{+}{N}-\underset{|}{\overset{R}{C}}H-COO^-$$

which explain their several characteristic properties, like decomposition on heating, solubility in water, large dipole moment.
Thus in solution, amino acids may exist as dipolar (neutral pH), cation (in strongly acidic solution), or anion (in strongly basic solution).

Amino acids undergo usual reactions of the – COOH group as well as $-NH_2$ group.

1. At intracellular pH (~6–7), amino acids can be divided into four types : positively charged, negatively charged, hydrophobic and hydrophilic. Which is the correct classification of the following four amino acids?

$\underset{|}{\overset{+}{N}H_3}\\ C_6H_5CH_2CHCOO^-$ [I] $\qquad \underset{|}{OH}\ \underset{|}{\overset{+}{N}H_3}\\ CH_3CH\ CHCOO^-$ [II] $\qquad \underset{|}{\overset{+}{N}H_3}\\ H_2N-(CH_2)_3-CH-COO^-$ [III] $\qquad \underset{|}{NH_3^+}\\ HOOCCH_2CH-COO^-$ [IV]

	I	II	III	IV
(a)	hydrophobic	+ vely charged	– vely charged	hydrophilic
(b)	hydrophobic	hydrophilic	+ vely charged	– vely charged
(c)	hydrophilic	hydrophobic	+ vely charged	– vely charged
(d)	+ vely charged	– vely charged	hydrophobic	hydrophilic

MARK YOUR RESPONSE	1. ⓐⓑⓒⓓ				

2. Amino acid are

(a) basic as a typical amine and acidic as a carboxylic acid

(b) less basic than a typical amine and less acidic than a – COOH

(c) more basic than a typical amine and more acidic than a – COOH

(d) nothing is certain

3. Base treatment of an amino acid usually results in the conversion of the acid to a derivative via the amino carboxylate salt. The above procedure

(a) decreases the rate of electrophilic reaction of the free amino group

(b) decreases the rate of nucleophilic reaction of the free amino group

(c) enhances the rate of nucleophilic reaction of the free amino group

(d) enhances the rate of electrophilic reaction of the free amino group

4. Benzoylation of an amino acid can best be done by treating the amino acid with benzoyl chloride

(a) in presence of dil. NaOH (b) in presence of conc. NaOH

(c) in absence of NaOH (d) in presence of HCl

5. $\underset{\text{R}-\underset{|}{\overset{+}{\text{N}}\text{H}_3}\text{CH}-\text{COO}^-}{\overset{+}{\text{N}}\text{H}_3} \xrightarrow{\text{pH}\approx 12} \underset{\text{R}-\underset{|}{\text{NH}_2}\text{CH}-\text{COO}^-}{\text{NH}_2} \xrightarrow{\text{H}^+} \text{Z}$

Compound Z is

(a) $\underset{|}{\text{NH}_2}$ $\text{R}-\text{CH}-\text{COO}^-$ (b) $\underset{|}{\overset{+}{\text{N}}\text{H}_3}$ $\text{R}-\text{CH}-\text{COO}^-$ (c) $\underset{|}{\overset{+}{\text{N}}\text{H}_3}$ $\text{R}-\text{CH}-\text{COOH}$ (d) $\underset{|}{\text{NH}_2}$ $\text{R}-\text{CH}-\text{COOH}$

PASSAGE-2

Monosaccharides have –CHO (or C = O) and –OH groups, so they undergo usual oxidation and reduction. Further, monosaccharides form osazone when treated with excess of phenylhydrazine (3 equivalents). In osazone formation only the first two carbon atoms are involved. Thus monosaccharides having identical configuration on rest of C atoms except first two will form same osazone, as is the case with glucose and fructose.

A, B and C are three hexoses and form same osazone D. Compounds A to D behave as below :

(i) $\text{D} \xrightarrow{\text{HCl}} \xrightarrow[\text{CH}_3\text{COOH}]{\text{Zn}} \text{D} - \text{Fructose}$ (ii) $\text{A} \xrightarrow{\text{Ni, H}_2} \xrightarrow{\text{HNO}_3} \xrightarrow[\text{H}_3\text{O}^+]{\text{Na–Hg}} \text{B} + \text{C}$

(iii) $\text{B} \xrightarrow{\text{HNO}_3}$ Optically active glycaric acid (iv) $\text{C} \xrightarrow{\text{HNO}_3}$ Optically inactive glycaric acid

6. Compound D is an osazone which can be obtained from

(a) only one compound (b) two compounds (c) three compounds (d) four compounds

7. Compound A should be

(a) D-glucose (b) D-fructose (c) L-glucose (d) L-fructose

8. Compound B and C, respectively, are

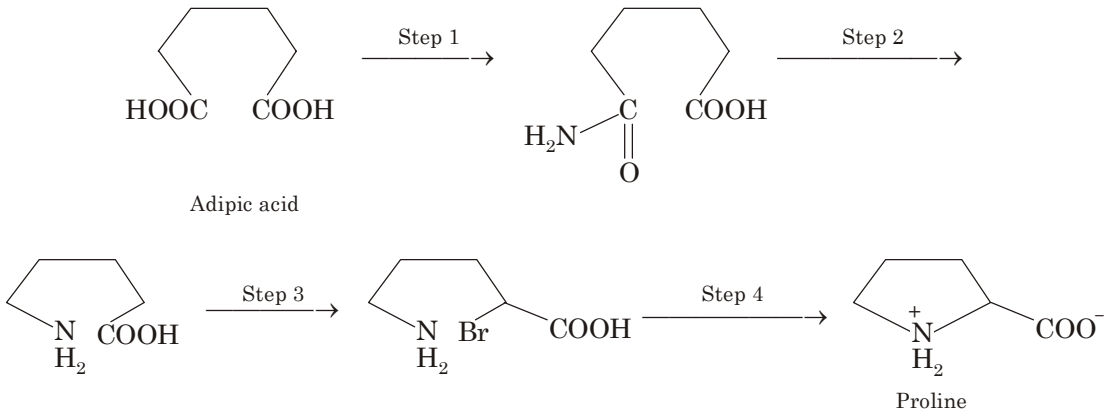
(a) D-glucose and D-mannose (b) D-mannose and D-glucose

(c) D-glucose and L-glucose (d) D-glucose and L-mannose

MARK YOUR RESPONSE					
	2. ⓐⓑⓒⓓ	3. ⓐⓑⓒⓓ	4. ⓐⓑⓒⓓ	5. ⓐⓑⓒⓓ	6. ⓐⓑⓒⓓ
	7. ⓐⓑⓒⓓ	8. ⓐⓑⓒⓓ			

PASSAGE-3

Refer the following scheme of reactions and answer the questions that follows :



9. The reagent in the first step is
(*a*) 1 mole of NH_3 (*b*) NH_4OH (*c*) 2 moles of NH_3 (*d*) (i) $SOCl_2$ (ii) NH_3

10. The reaction at step 3 involves the introduction of Br as
(*a*) Br^- (*b*) Br^+ (*c*) Br (*d*) any of the three

11. The reaction at step 3 is
(*a*) regioselective (*b*) regiospecific (*c*) stereospecific (*d*) stereoselective

12. Reaction at step 4 is
(*a*) S_N1 (*b*) S_N2 (*c*) E2 (*d*) E1

13. Which of the following is a constituent of either carbohydrate/protein
(*a*) adipic acid (*b*) proline (*c*) both (*d*) none of these

MARK YOUR RESPONSE	9. ⓐⓑⓒⓓ	10. ⓐⓑⓒⓓ	11. ⓐⓑⓒⓓ	12. ⓐⓑⓒⓓ	13. ⓐⓑⓒⓓ

C REASONING TYPE

In the following questions two Statement-1 (Assertion) and Statement-2 (Reason) are provided. Each question has 4 choices (a), (b), (c) and (d) for its answer, out of which ONLY ONE is correct. Mark your responses from the following options:

(a) Both Statement-1 and Statement-2 are true and Statement-2 is the correct explanation of Statement-1.
(b) Both Statement-1 and Statement-2 are true and Statement-2 is not the correct explanation of Statement-1.
(c) Statement-1 is true but Statement-2 is false.
(d) Statement-1 is false but Statement-2 is true.

1. **Statement-1** : Reducing sugars undergo mutarotation.
Statement-2 : During mutarotation, one pure anomer is converted into an equilibrium mixture of two anomers.

2. **Statement-1** : Proteins are made up of α-amino acids.
Statement-2 : During denaturation, secondary and tertiary structures of proteins are destroyed.

3. **Statement-1** : Galactose is the C_4-epimer of glucose.
Statement-2 : Glucose and galactose differ in configuration at C_4.

4. **Statement-1** : Glucose and fructose give the same osazone.
Statement-2 : During osazone formation stereochemistry only at C_1 and C_2 is destroyed.

MARK YOUR RESPONSE	1. ⓐⓑⓒⓓ	2. ⓐⓑⓒⓓ	3. ⓐⓑⓒⓓ	4. ⓐⓑⓒⓓ	

5. **Statement-1** : A solution of sucrose in water is dextrorotatory but on hydrolysis in presence of little hydrochloric acid, it becomes laevorotatory.

Statement-2 : Sucrose on hydrolysis gives unequal amounts of glucose and fructose as a result of which change in sign of rotation is observed.

6. **Statement-1** : At isoelectric point, the amino group does not migrate under the influence of electric field.

Statement-2 : At isoelectric point, amino acid exists as a zwitterion.

7. **Statement-1** : Treatment of D-glucose with dilute alkali affords an equilibrium mixture consisting of D-mannose, D-fructose and starting substance D-glucose.

Statement-2 : The reaction involves an intermediate in which hybridization of C_2 changes from sp^3 to sp^2.

8. **Statement-1** : All enzymes are proteins but all proteins are not enzymes.

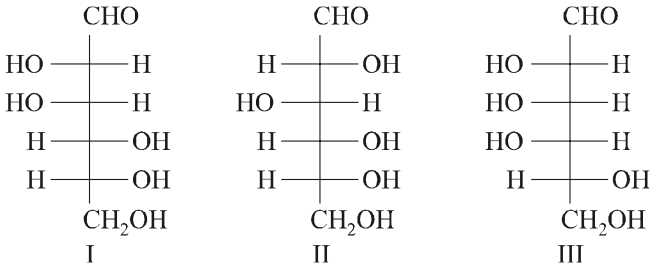
Statement-2 : Keratin is an enzyme.

MARK YOUR RESPONSE	5. ⓐⓑⓒⓓ	6. ⓐⓑⓒⓓ	7. ⓐⓑⓒⓓ	8. ⓐⓑⓒⓓ	

D MULTIPLE CORRECT CHOICE TYPE

Each of these questions has 4 choices (a), (b), (c) and (d) for its answer, out of which ONE OR MORE is/are correct.

1. Which of the statement given below is true regarding following structures?



(a) I and II are epimers

(b) II and III are epimers

(c) I and III are epimers

(d) All are epimers to each other

2. Which of the following is a reducing sugar?

(a) Glucose (b) Lactose

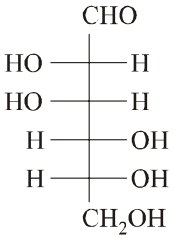
(c) Sucrose (d) Maltose

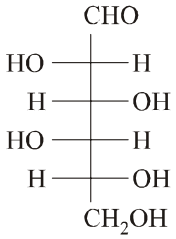
3. Disaccharides are of four types, namely 1,4'-glycosides; 1,6'-glycosides, 1,1'-glycosides and 1,5'-glycosides. Which of these will be reducing?

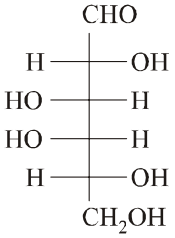
(a) 1, 4'- (b) 1, 6'-

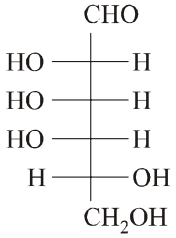
(c) 1, 1'- (d) 1, 5'-

4. Which of the following monosaccharides yields an optically active alditol on $NaBH_4$ reduction?

(a)


(b)


(c)


(d)


5. Which of the following statement is correct?

(a) D-Glucose and D-fructose are dextrorotatory

(b) D-Glucose and L-fructose are dextrorotatory

(c) D-Glucose is dextrorotatory, while D-fructose is laevorotatory

(d) D-Glucose is dextrorotatory, while L-fructose is laevorotatory

MARK YOUR RESPONSE	1. ⓐⓑⓒⓓ	2. ⓐⓑⓒⓓ	3. ⓐⓑⓒⓓ	4. ⓐⓑⓒⓓ	5. ⓐⓑⓒⓓ

6. Which of the following statement is incorrect?

(a) (R)-Alanine is L-alanine

(b) The α-carbon of all L-amino acids has L-configuration

(c) The α-carbon of all L-amino acids has D-configuration

(d) The α-carbon of all D-amino acids except cysteine has R-configuration

7. Which of the following carbohydrates on treatment with excess of phenylhydrazine give the same osazone?

(a) Glucose (b) Fructose

(c) Mannose (d) Galactose

8. Which of the following are oligosaccharides?

(a) Cellobiose (b) Cellulose

(c) Lyxose (d) Sucrose

9. Which of the following statements are correct?

(a) Sucrose is a non-reducing sugar

(b) In sucrose, glucose is present in the pyranose form while fructose is present in the furanose form

(c) In sucrose, glucose and fructose both are present in pyranose form

(d) In lactose, glucose is the non-reducing sugar, while galactose is the reducing sugar

10. Which of the following statements are true?

(a) Maltose forms an osazone

(b) Galactose is a C_4 epimer of glucose

(c) In starch, glucose units are linked by β-linkage

(d) Lactose undergoes mutarotation.

MARK YOUR RESPONSE	6. ⓐⓑⓒⓓ	7. ⓐⓑⓒⓓ	8. ⓐⓑⓒⓓ	9. ⓐⓑⓒⓓ	10. ⓐⓑⓒⓓ

E MATRIX-MATCH TYPE

Each question contains statements given in two columns, which have to be matched. The statements in Column-I are labeled A, B, C and D, while the statements in Column-II are labelled p, q, r, s and t. Any given statement in Column -I can have correct matching with ONE OR MORE statement(s) in Column-II. The appropriate bubbles corresponding to the answers to these questions have to be darkened as illustrated in the following example:
If the correct matches are A–p, s and t; B–q and r; C–p and q; and D–s then the correct darkening of bubbles will look like the given.

	p	q	r	s	t
A	●			●	●
B		●	●		
C	●	●			
D				●	

1.

Column-I	**Column-II**
(A) Natural glucose	p. Optically active
(B) Natural amino acids	q. Optically inactive
(C) Honey	r. L-series
(D) Glucose as synthetic sweetner	s. Invert sugar

2.

Column-I	**Column-II**
(A) α-D-Glucopyranose	p. Mutarotation
(B) β-D-Methylglucopyranoside	q. No mutarotation
(C) Glucose pentacetate	r. Anomerism
(D) β-D-Glucopyranose	s. Reducing character

MARK YOUR RESPONSE

1.

	p	q	r	s
A	ⓟ	ⓠ	ⓡ	ⓢ
B	ⓟ	ⓠ	ⓡ	ⓢ
C	ⓟ	ⓠ	ⓡ	ⓢ
D	ⓟ	ⓠ	ⓡ	ⓢ

2.

	p	q	r	s
A	ⓟ	ⓠ	ⓡ	ⓢ
B	ⓟ	ⓠ	ⓡ	ⓢ
C	ⓟ	ⓠ	ⓡ	ⓢ
D	ⓟ	ⓠ	ⓡ	ⓢ

3.

Column-I	**Column-II**
(A) Glucose	p. Sorbitol
(B) Fructose	q. Soluble calcium salt
(C) Sucrose	r. Dextrorotatory
(D) Sucrose hydrolysate	s. Laevorotatory

4.

Column-I **Reactant**	**Column-II** **Product**
(A) Glucose + OH^-	p. Fructose
(B) Fructose + $3C_6H_5NHNH_2$	q. Glucosazone
(C) Mannose + OH^-	r. Mannose
(D) Glucose + $3C_6H_5NHNH_2$	s. Fructosazone

5.

Column-I	**Column-II**
(A) Reducing sugar	p. Fructose
(B) Non-reducing sugar	q. Sucrose
(C) Epimer of glucose	r. Mannose
(D) Isomer of glucose	s. Ribose

6.

Column-I (***Carbohydrate***)	**Column-II** (***Constituent unit***)
(A) Starch	p. Fructose
(B) Sucrose	q. Galactose
(C) Cellulose	r. β-D-Glucose
(D) Lactose	s. α-D-Glucose

7.

Column-I (***Carbohydrate***)	**Column-II** (***Characteristics***)
(A) Glucose	p. Monosaccharide
(B) Fructose	q. Disaccharide
(C) Lactose	r. Tollen's test
(D) Sucrose	s. Reducing sugar

MARK YOUR RESPONSE

3.

	p	q	r	s
A	ⓟ	ⓠ	ⓡ	ⓢ
B	ⓟ	ⓠ	ⓡ	ⓢ
C	ⓟ	ⓠ	ⓡ	ⓢ
D	ⓟ	ⓠ	ⓡ	ⓢ

4.

	p	q	r	s
A	ⓟ	ⓠ	ⓡ	ⓢ
B	ⓟ	ⓠ	ⓡ	ⓢ
C	ⓟ	ⓠ	ⓡ	ⓢ
D	ⓟ	ⓠ	ⓡ	ⓢ

5.

	p	q	r	s
A	ⓟ	ⓠ	ⓡ	ⓢ
B	ⓟ	ⓠ	ⓡ	ⓢ
C	ⓟ	ⓠ	ⓡ	ⓢ
D	ⓟ	ⓠ	ⓡ	ⓢ

6.

	p	q	r	s
A	ⓟ	ⓠ	ⓡ	ⓢ
B	ⓟ	ⓠ	ⓡ	ⓢ
C	ⓟ	ⓠ	ⓡ	ⓢ
D	ⓟ	ⓠ	ⓡ	ⓢ

7.

	p	q	r	s
A	ⓟ	ⓠ	ⓡ	ⓢ
B	ⓟ	ⓠ	ⓡ	ⓢ
C	ⓟ	ⓠ	ⓡ	ⓢ
D	ⓟ	ⓠ	ⓡ	ⓢ

Answerkey

A Single Correct Choice Type

1.	c	**2.**	d	**3.**	b	**4.**	c	**5.**	d	**6.**	d	**7.**	c	**8.**	c	**9.**	b	**10.**	b
11.	b	**12.**	d	**13.**	a	**14.**	b	**15.**	b	**16.**	c	**17.**	a	**18.**	b	**19.**	a	**20.**	c
21.	a	**22.**	d	**23.**	c	**24.**	a	**25.**	d	**26.**	c	**27.**	d	**28.**	b	**29.**	b	**30.**	c
31.	d	**32.**	b	**33.**	c	**34.**	c	**35.**	b	**36.**	a	**37.**	c	**38.**	b	**39.**	b	**40.**	b

B Comprehension Type

1	(b)	**4**	(a)	**7**	(b)	**10**	(b)	**13**	(b)
2	(b)	**5**	(b)	**8**	(a)	**11**	(a)		
3	(c)	**6**	(c)	**9**	(d)	**12**	(b)		

C Reasoning Type

1	(a)	**3**	(a)	**5**	(c)	**7**	(a)
2	(c)	**4**	(a)	**6**	(a)	**8**	(c)

D Multiple Correct Choice Type

1.	a,c	**2.**	a,b,d	**3.**	a,b,d	**4.**	a,b,d	**5.**	b,c	**6.**	a,b,c	**7.**	a,b,c	**8.**	a,b,d	**9.**	a,b	**10.**	a,b,d

E Matrix-Match Type

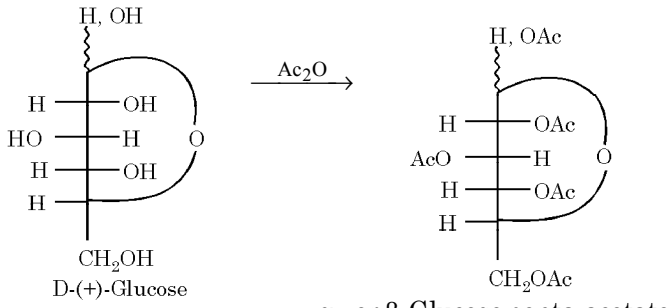
1. **A-p, s; B-p, q, r; C-p, s; D-p, r**
2. **A-p, r, s; B-q, r; C-p, r, s; D-p, r, s**
3. **A-p, q, r; B-p, s; C-r; D-s**
4. **A-p, r; B-q, s; C-p, r; D-q, s**
5. A-p, r, s; B-q; C-r; D-p, r
6. **A-s; B-p, s; C-r; D-q, R**
7. **A-p, r, s; B-p, r, s; C-q, r, s; D-q**

Solutions

A Single Correct Choice Type

1. (c) Bromine, a mild oxidising agent, oxidises only glucose (aldoses, in general) to gluconic acid. Tollens' reagent and Fehling solution, being alkaline in nature, cause isomerization of fructose to glucose hence both of them react with these reagents.

2. (d) During acetylation of (+)-glucose, it is the C_1 —OH of the hemiacetal that is acetylated and not the C_5—OH that forms the ring (cyclic structure). Since equilibrium with the open-chain aldehyde is prevented, the penta-acetate does not respond the aldehydic reactions.



3. (b) Epimers are those diastereomers which differ in the configuration of only one chiral carbon which may be C_1, C_2, C_3, etc.; while anomers are diastereomers that differ in the configuration of a specific chiral carbon which is C_1 in aldoses and C_2 in ketoses.

4. (c) In the D family the more dextrorotatory anomer is named α-D-. In the L family the more laevorotatory anomer is named α L.

5. (d) When structures I and II are C–2 epimers, it implies that these are epimers and diastereomers too.

6. (d) Since diastereomers are all those isomers which are not enantiomers, there may be more than one diastereomer of a compound. An epimer differs in the configuration of only one chiral carbon, so an epimer can be C—2, C—3, C–4, etc. An anomer may be α- or β- ; so no term is absolutely specific.

7. (c) When an aqueous solution of D-glucose, D-mannose or D-fructose is treated with a base, it undergoes enolization and a series of keto-enol tautomerization to form a mixture of the three monosaccharides (*Lobry de Bruyn van Ekenstein transformation*). For reactions, consult text.

8. (c) Ketoses on reduction produce a new chiral carbon leading to the formation of two isomeric alcohols which are diastereomeric as well as C–2 epimers.

9. (b) A ketonic group having —OH group on both sides is removed as CO_2 during oxidation with periodate.

10. (b) Glucose is a hemiacetal, so in presence of a base (alkaline medium is provided by Fehling's solution) it can develop —CHO group in the form of open chain structure which responds Fehling's solution. Sucrose is a glycoside (acetal), *i.e.* its hemiacetal OH groups (one due to glucose and another due to fructose) are not free, so it can't attain —CHO group. Hence it will not respond Fehling's solution.

11. (b) Same explanation as that of Q. 10. Also see Q. 2.

12. (d) Reaction of D-(+)-glucose with methanolic –HCl leads to formation of methyl glucoside (C_1–OH group is methylated) which, being acetal, is not hydrolysable by base, so it will not respond Tollens' reagent.

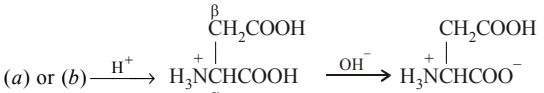
13. (a) The OH's of sugars are more acidic than that of a typical alcohol because of their mutual electron-withdrawing inductive effect.

14. (b) Although D-alanine is a constituent of a bacterial cell walls, it is not found in proteins.

15. (b) In solid state, amino acids exist as zwitterions, which contain $-NH_3^+$ (acidic in nature) and $-COO^-$ (basic in nature).

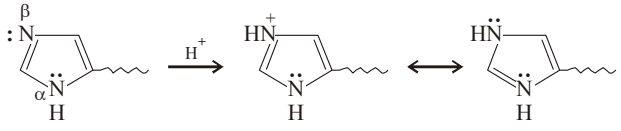
16. (c) In strongly alkaline solution of an amino acid, all of its –COOH groups are converted into $-COO^-$. Thus a strongly alkaline solution of a monoaminodicarboxylic acid will have one $-NH_2$ and two $-COO^-$ groups, all of which are basic in nature. Further remember that a $-NH_2$ is more basic than a $-COO^-$ group.

17. (a) Consider the parent compound of the species adding H^+ to $-COO^-$, and then observe the relative acidic character of the two –COOH groups keeping in mind that $-\overset{+}{N}H_3$ group is electron-withdrawing and hecne acid-strengthening.



(–COOH on α carbon is more acidic due to – I effect of $\overset{+}{N}H_3$).

18. (b) Protonation at β–N leads to imidazolium ion, which is stabilized by two equivalent resonating structures.



Equivalent resonating structures

19. (a) On increasing the pH by adding an alkali ; H^+ will be lost from —COOH.

20. (c) At the given pH (6) of the solution, alanine (pI = 6.0), exists as a dipolar ion while arginine (pI = 10.2) exists as a cation. Hence on passing an electric current, alanine will not migrate to any electrode, while arginine will migrate to cathode.

21. (a) Every amino acid exists exclusively as dipolar ion when the pH of the solution is equal to its isoelectric point (pI), hence at this pH it does not migrate to either electrode, while at other pH, an amino acid migrates either to cathode or to anode depending upon its pI. Thus at pH 9.60, amino acid with pI 5.40 will exist as an anion and migrate to anode ; while that with pI 9.60 will not migrate to any electrode.

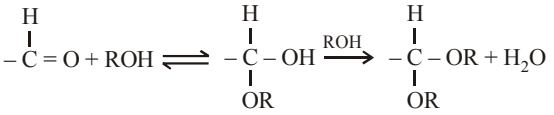
22. (d) Glycine has only two C's ; in Strecker synthesis one of which is supplied by CN^- so the second must be supplied by an aldehyde having one C only *i.e.* HCHO or its precursor CH_3OH ($CH_3OH \longrightarrow HCHO$).

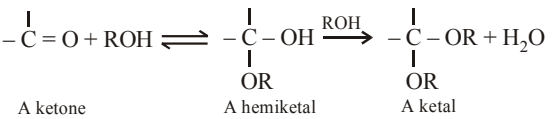
23. (c) The resulting compound is an α-amino acid and the reagent used for its synthesis are NH_3 and H_2/catalyst, so this is an example of preparation of α-amino acid by reductive amination for which α-keto acids are starting compounds.

24. (a) Two molecules of an α-amino acid will form only one dipeptide, recall that four different dipeptides are formed when two α-amino acids are different.

25. (d) In Gly-Ala, glycine is the N-terminal amino acid and alanine is C-terminal amino acid while opposite is the case with Ala-Gly. A dipeptide (peptide formed from two molecules of amino acid) has only one peptide bond. As mentioned above the number of dipeptides formed by two different amino acids is four.

26. (c)



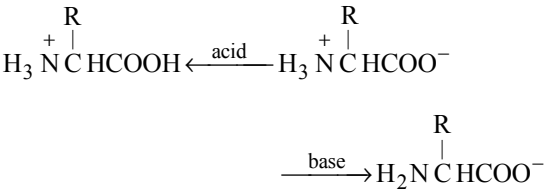


In cyclic structure of fructose, ketonic group has reacted with an alcoholic group, it is said to be an example of an intramolecular cyclic hemiketal.

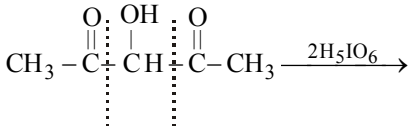
27. (d) In aldoses (e.g. glucose) the two anomers (α- and β-glucoses) differ in configuration at C_1 (carbon having –CHO group), while in ketoses (e.g fructose) the two anomers differ at C_2 (carbon having carbonyl, keto group). Such carbon (–CHO in aldoses which is C_1; and $>C=O$ in ketoses which is C_2) reacts with the –OH group present at another carbon atom to form glycosides, also known as anomers. Thus C_1 in aldoses and C_2 in ketoses constitute the anomeric or glycosidic carbon.

28. (b) First molecule of phenylhydrazine unedrgoes nucleophilic addition on carbonyl (–CHO in glucose and >CO in fructose) group. Second molecule of the reagent oxidizes –CHOH– at position 2(in aldoses) or $–CH_2OH$ at position 1 (in ketoses) to form –CHO or $>C=O$ respectively. The third molecule again undergoes nucleophilic addition on the newly developed carbonyl group to form osazone.

29. (b) Amino acids exist as Zwitterions in which acidic character is due to $-NH_3^+$ and basic due to $–COO^-$ group.



30. (c) Compounds having two –OH groups, or –OH and –CO, or –OH and –CHO on adjacent carbon atoms are oxidised by periodic acid. Thus

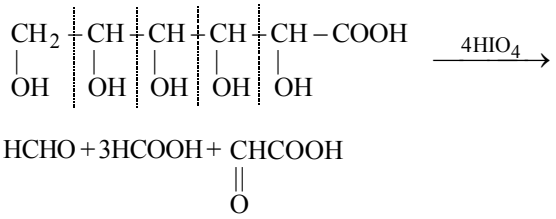


$$CH_3COOH + HCOOH + CH_3COOH$$

31. (d) Glucose, fructose and hexanal are reducing, while sucrose and acetophenone are non-reducing.

32. (b) The two isomeric forms (α – and β–) of D–glucopyranose differ in configuration only at C-1. Hence these are called anomers.

33. (c)



34. (c) Carbohydrates show mutarotation in presence of an amphoteric solvent like water; mixture of pyridine (a base) and *p*-cresol (an acidic compound) acts as an amphoteric solvent.

35. (b) $\frac{15}{30} \times 100 = 50$

Thus the mixture is 50% optically pure. Hence the amount of

A = 50 + 25 = 75

B = 0 + 25 = 25

36. **(a)** Total number of stereoisomers for D-glucose, having four chiral atoms, is $2^4 = 16$; of which two (D-glucose and L-glucose) are enantiomers so number of diastereomers for D-glucose will be 14.

37. **(c)** Open chain structure is unstable and converted to cyclic.

38. **(b)** $CH_2OHCH_2CHOHCHOHCH_2OH$ does not correspond to $C_x(H_2O)_y$.

39. **(b)** Glucose exists as glucopyranose (a six membered ring structure) which is formed through C_1 and C_5.

40. **(b)** $-COOH$ is a better proton donor than $\overset{+}{N}H_3$.

B COMPREHENSION TYPE

1. **(b)** Amino acid I has the side group (C_6H_5) which is neither ionic nor polar-hence hydrophobic.

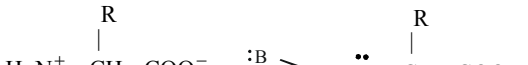
Amino acid II has the side group (–OH) which is polar-hence hydrophilic.

Amino acid III has the amino side group which is protonated at neutral pH- hence positively charged.

Amino acid IV has the carboxylic acid side group which loses a proton at neutral pH-hence negatively charged.

2. **(b)** The acidic character of an amino acid molecule is due to $-NH_3^+$ group, which is less acidic than a –COOH group, while the basic character of an amino acid is due to $-COO^-$ group which is less basic than $-NH_2$ group.

3. **(c)**



I II

Due to presence of lone pair of electrons on N in structure II, it undergoes nucleophilic reaction easily.

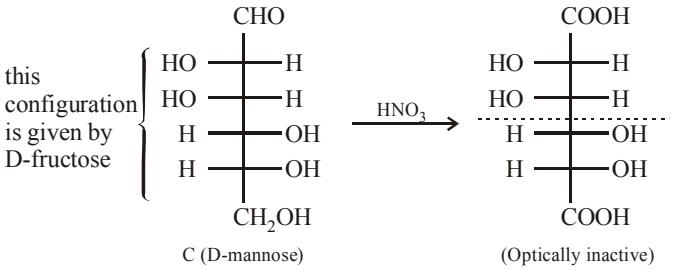
4. **(a)** As mentioned in the above question, addition of a base enhances nucleophilic reaction of the amino group of the amino acid. However, in pessence of conc. NaOH, there will be competition for the benzoyl group between amino group (of the amino acid) and OH^- group (of NaOH). The latter reaction will form C_6H_5COOH.

5. **(b)** $-NH_2$ is a better base than $-COO^-$, resonance in $-COO^-$ decreases basic character of the $-COO^-$ group.

6. **(c)** It is given that D (an osazone) can be obtained from A, B as well as C, i.e. three different compounds.

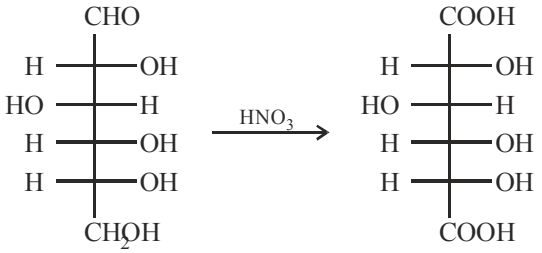
7. **(b)** The (ii) series of reactions points out for the presence of a ketonic group in A, hence A must be D-fructose. The series D- is indicated as we get D-fructose in (i) series of reactions.

8. **(a)** C on oxidation gives an optically inactive glycaric acid, which is indicative of following structure for C.



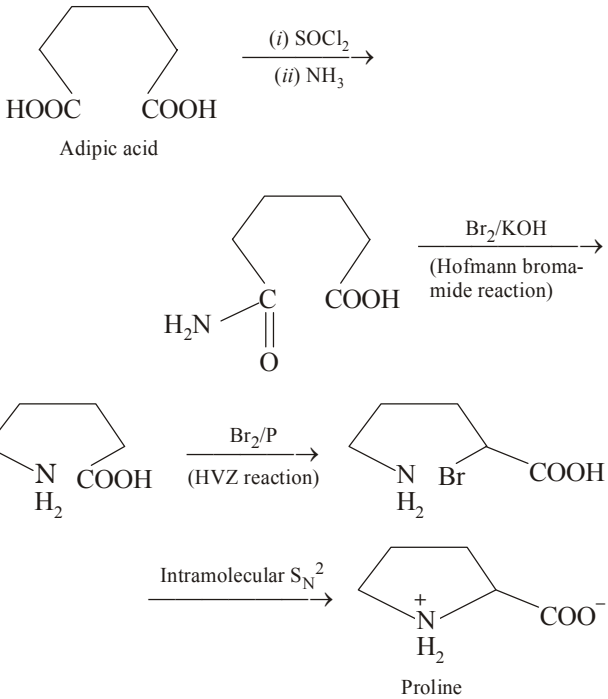
C (D-mannose) (Optically inactive)

Thus B should have following structure.



B (D-glucose) Optically active

9-13.



C REASONING TYPE

1. **(a)** **R** is the correct explanation of **A**.
2. **(c)** **Correct explanation :** During formation of proteins, NH_2 group of one amino acid condenses with CO_2H of the other with elimination of a water molecule to form a peptide bond.
3. **(a)** **R** is the correct explanation of **A**.
4. **(a)** **R** is the correct explanation of **A**.
5. **(c)** **Correct R :** Sucrose on hydrolysis gives equal amounts of glucose and fructose. Since glucose has less +ve and fructose has more –ve magnitude of rotation, therefore, change in sign of rotation is observed.
6. **(a)** **R** is the correct explanation of **A**.
7. **(a)** **R** is the correct explanation of **A**.
8. **(c)** **Correct R :** Only globular proteins which catalyse biochemical reactions are called enzymes.

D MULTIPLE CORRECT CHOICE TYPE

1. **(a,c)** Epimers are those carbohydrates which differ in the configuration around only one asymmetric carbon atom (of course other than C_1). I and II are C-2 epimers, while I and III are C-4 epimers.
2. **(a,b,d)** Although according to common names of sugars, those which have *-ose* ending are reducing like glucose, fructose, cellobiose, etc. sucrose although has *-ose* ending is not a reducing sugar. Thus common names are not reliable indicators of the properties of sugars. Sucrose is 1,1'-glycoside, hence non-reducing.
3. **(a,b,d)** In 1,1'-glycosides, both the sugar units are linked through their anomeric (1 or 1') carbon atoms, hence we get acetals, not hemiacetals; and since acetals do not have –OH group at the anomeric carbon atom, they can't be converted into aldehydes or ketones, hence these are non-reducing.
4. **(a,b,d)** Only the alditol (monosaccharide having $-CH_2OH$ at both ends) from structure (*c*) has a plane of symmetry, hence it will be optically inactive, the other three form optically active alditol.
5. **(b,c)** Statements (b) and (c) are correct.
6. **(a,b,c)** Due to the presence of $-CH_2SH$ group in cysteine, the priority order is changed.

Hence option (d) is correct, while the rest are incorrect.

7. **(a,b,c)** Glucose, fructose and mannose differ only in configuration at C_1 and C_2 and hence give same osazone.
8. **(a,b,d)** Only lyxose is a monosaccharide, i.e. aldopentose. Cellobiose and sucrose are disaccharide, while cellulose is polysaccharide.
9. **(a,b)** Options (a) and (b) are correct. In lactose (d), glucose is the reducing sugar.
10. **(a,b,d)** In starch, different glucose units are linked to each other by α-glycosidic linkage, hence option (d) is false; all the three other options are true.

E MATRIX-MATCH TYPE

1. **A-p, s; B-p, q, r; C-p, s; D-p, r**
2. **A-p, r, s; B-q, r; C-p, r, s; D-p, r, s**
3. **A-p, q, r; B-p, s; C-r; D-s**
4. **A-p, r; B-q, s; C-p, r; D-q, s**
5. **A-p, r, s; B-q; C-r; D-p, r**
6. **A-s; B-p, s; C-r; D-q, r**
7. **A-p, r, s; B-p, r, s; C-q, r, s; D-q**