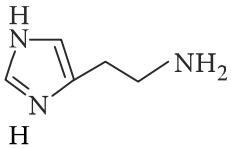
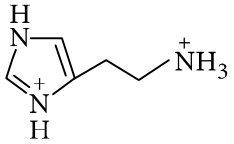
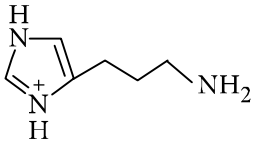
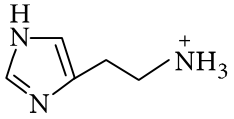
CHAPTER

28 Biomolecules

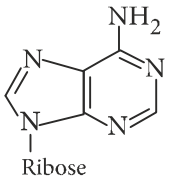
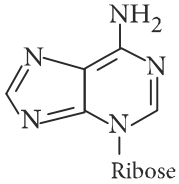
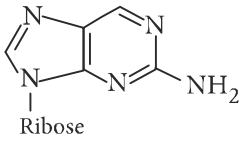
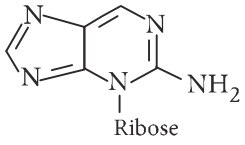
1. Glucose on prolonged heating with HI gives
(a) *n*-hexane (b) 1-hexene
(c) hexanoic acid (d) 6-iodohexanal. *(2018)*

2. The predominant form of histamine present in human blood is (pK_a, Histidine = 6.0)

(a) 
(b) 
(c) 
(d) 

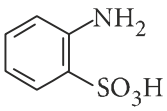
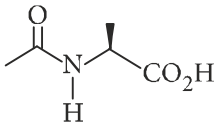
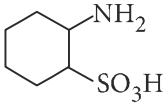
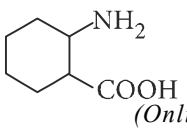
(2018)

3. Which of the following is the correct structure of Adenosine?

(a) 
(b) 
(c) 
(d) 

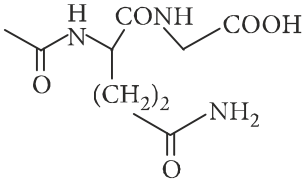
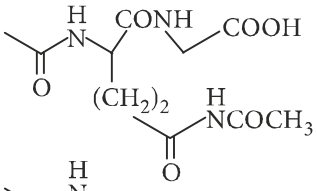
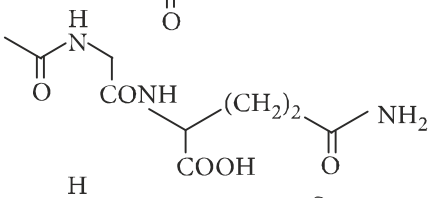
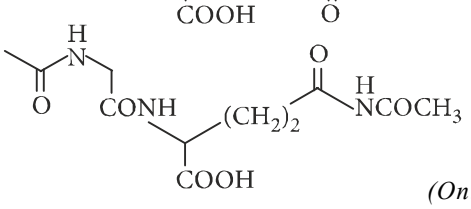
(Online 2018)

4. Which of the following will not exist in zwitter ionic form at pH = 7 ?

(a) 
(b) 
(c) 
(d) 

(Online 2018)

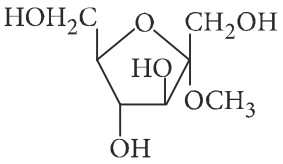
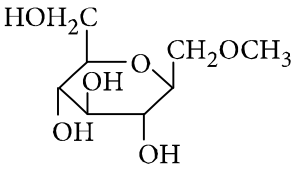
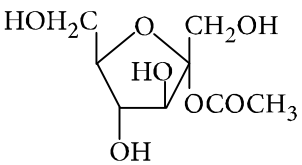
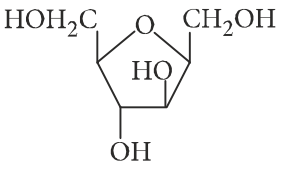
5. The dipeptide, Gln-Gly, on treatment with CH_3COCl followed by aqueous work up gives

(a) 
(b) 
(c) 
(d) 

(Online 2018)

6. Among the following, the incorrect statement is
(a) cellulose and amylose has 1, 4-glycosidic linkage
(b) lactose contains β-*D*-galactose and β-*D*-glucose
(c) maltose and lactose has 1, 4-glycosidic linkage
(d) sucrose and amylose has 1, 2-glycosidic linkage.
(Online 2018)

7. Which of the following compounds will behave as a reducing sugar in an aqueous KOH solution?

(a) 
(b) 
(c) 
(d) 

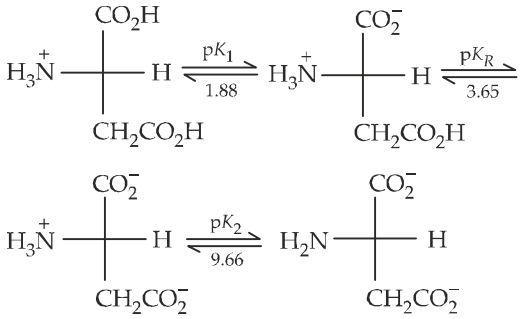
(2017)

8. Among the following, the essential amino acid is
(a) alanine (b) valine
(c) aspartic acid (d) serine. *(Online 2017)*

9. The incorrect statement among the following is
(a) α-*D*-glucose and β-*D*-glucose are anomers
(b) the pentaacetate of glucose does not react with hydroxyl amine
(c) cellulose is a straight chain polysaccharide made up of only β-*D*-glucose units
(d) α-*D*-glucose and β-*D*-glucose are enantiomers.
(Online 2017)

10. Thiol group is present in
(a) cytosine (b) cystine
(c) cysteine (d) methionine. *(2016)*

11. Consider the following sequence for aspartic acid :



The pI (isoelectric point) of aspartic acid is
(a) 3.65 (b) 2.77
(c) 5.74 (d) 1.88 *(Online 2016)*

12. Observation of "Ruhemann's purple" is a confirmatory test for the presence of
(a) starch (b) reducing sugar
(c) protein (d) cupric ion.
(Online 2016)

13. Which of the vitamins given below is water soluble?
(a) Vitamin E (b) Vitamin K
(c) Vitamin C (d) Vitamin D *(2015)*

14. Complete hydrolysis of starch gives
(a) glucose and fructose in equimolar amounts
(b) galactose and fructose in equimolar amounts
(c) glucose only
(d) glucose and galactose in equimolar amounts.
(Online 2015)

15. Accumulation of which of the following molecules in the muscles occurs as a result of vigorous exercise?
(a) Glucose (b) Glycogen
(c) *L*-lactic acid (d) Pyruvic acid
(Online 2015)

16. Which one of the following bases is not present in DNA?
(a) Thymine (b) Quinoline
(c) Adenine (d) Cytosine *(2014)*

17. Synthesis of each molecule of glucose in photosynthesis involves
(a) 6 molecules of ATP (b) 18 molecules of ATP
(c) 10 molecules of ATP (d) 8 molecules of ATP *(2013)*

18. Which of the following compounds can be detected by Molisch's test?
(a) Sugars (b) Amines
(c) Primary alcohols (d) Nitro compounds *(2012)*

19. Which one of the following statements is correct?
(a) All amino acids are optically active.
(b) All amino acids except glycine are optically active.
(c) All amino acids except glutamic acid are optically active.
(d) All amino acids except lysine are optically active.
(2012)

20. The presence or absence of hydroxy group on which carbon atom of sugar differentiates RNA and DNA.
(a) 1st (b) 2nd
(c) 3rd (d) 4th *(2011)*

21. 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 *(2009)*

22. α-D-(+)-glucose and β-D-(+)-glucose are
(a) enantiomers (b) conformers
(c) epimers (d) anomers. *(2008)*

23. The secondary structure of a protein refers to
(a) fixed configuration of the polypeptide backbone
(b) α-helical backbone
(c) hydrophobic interactions
(d) sequence of α-amino acids. *(2007)*

24. The pyrimidine bases present in DNA are
(a) cytosine and adenine
(b) cytosine and guanine
(c) cytosine and thymine
(d) cytosine and uracil. *(2006)*

25. 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). *(2006)*

26. In both DNA and RNA, heterocyclic base and phosphate ester linkages are at
(a) C_5' and C_2' respectively of the sugar molecule
(b) C_2' and C_5' respectively of the sugar molecule
(c) C_1' and C_5' respectively of the sugar molecule
(d) C_5' and C_1' respectively of the sugar molecule
(2005)

27. Insulin production and its action in human body are responsible for the level of diabetes. This compound belongs to which of the following categories?
(a) A co-enzyme (b) A hormone
(c) An enzyme (d) An antibiotic *(2004)*

28. Which base is present in RNA but not in DNA?
(a) Uracil (b) Cytosine
(c) Guanine (d) Thymine *(2004)*

29. Identify the correct statement regarding enzymes.
(a) Enzymes are specific biological catalysts that can normally function at very high temperatures ($T \sim 1000$ K).
(b) Enzymes are normally heterogeneous catalysts that are very specific in action.
(c) Enzymes are specific biological catalysts that cannot be poisoned.
(d) Enzymes are specific biological catalysts that possess well-defined active sites. *(2004)*

30. The reason for double helical structure of DNA is operation of
(a) van der Waals forces (b) dipole-dipole interaction
(c) hydrogen bonding (d) electrostatic attractions. *(2003)*

31. Complete hydrolysis of cellulose gives
(a) D-fructose (b) D-ribose
(c) D-glucose (d) L-glucose. *(2003)*

32. The functional group, which is found in amino acid is
(a) – COOH group (b) – NH_2 group
(c) – CH_3 group (d) both (a) and (b). *(2002)*

33. RNA is different from DNA because RNA contains
(a) ribose sugar and thymine
(b) ribose sugar and uracil
(c) deoxyribose sugar and thymine
(d) deoxyribose sugar and uracil. *(2002)*

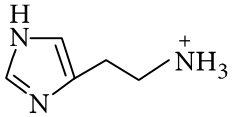
ANSWER KEY

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

Explanations

1. (a)

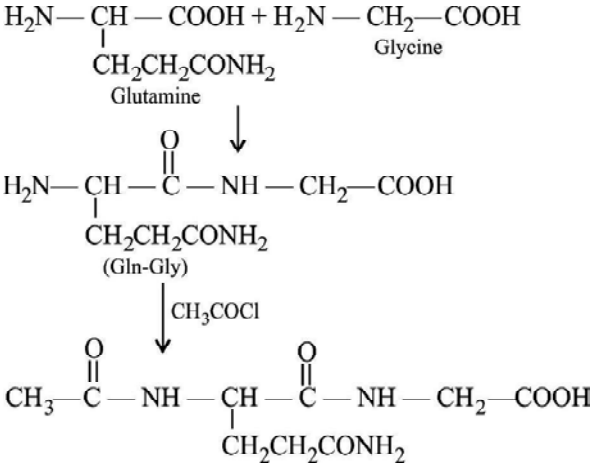
2. (d) : Histamine has two basic centres namely the aliphatic amino group and nitrogen of imidazole ring that does not already have a proton. In human blood, the aliphatic amino group (pK_a around 9.4) will be protonated whereas the second nitrogen of imidazole ring (pK_a = 5.8) will not be protonated.



3. (a)

4. (b) : The dipolar structure of amino acid is called zwitter ion. In structure (b), the nitrogen atom is not basic as it is an amide nitrogen. Thus, it cannot form zwitter ion.

5. (a) : Dipeptide Gln-Gly is formed as :



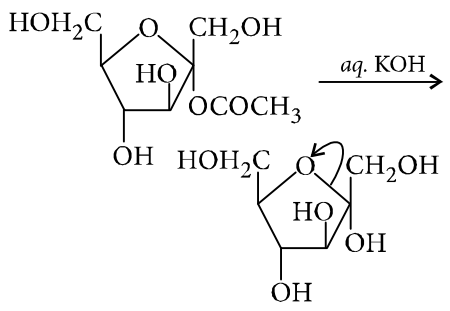
6. (d) : (a) Cellulose has 1,4-β-*D*-glycosidic linkage, but amylose has 1,4-α-*D*-glycosidic linkage.

(b) In lactose, C_1-β of galactose is linked to C_4-β of glucose.

(c) Both maltose and lactose have 1,4-glycosidic linkage.

(d) In sucrose, C_1-α of glucose is connected to C_2-β of fructose. In amylose, C_1 of one glucose unit is attached to C_4 of other glucose through α-glycosidic linkage.

7. (c) :

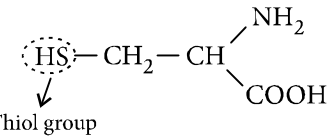


(Free anomeric – OH group, reducing sugar)

8. (b)

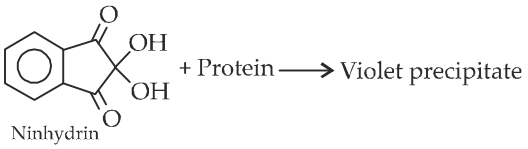
9. (d) : α-*D*-glucose and β-*D*-glucose are anomers not enantiomers.

10. (c) : Cysteine :



11. (b) : $pI = \frac{pK_1 + pK_R}{2} = \frac{1.88 + 3.65}{2} = \frac{5.53}{2} = 2.765 \approx 2.77$

12. (c) : Ruhemann's purple is ninhydrin.



13. (c) : Vitamin C is water soluble while vitamin E, K and D are fat soluble.

14. (c) : Starch is a mixture of amylose and amylopectin polysaccharides and monomer is glucose.

15. (c) : *L*-Lactic acid is formed in muscles during vigorous exercise. This is due to anaerobic respiration.

Glucose → Lactic acid + Energy

16. (b) : DNA contains adenine (A), thymine (T), guanine (G) and cytosine (C) bases.

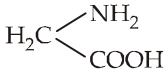
17. (b) : $6CO_2 + 18ATP + 12NADPH + 6RuBP \longrightarrow$

$6RuBP + Glucose + 18ADP + 18P + 12NADP^+$

One molecule of glucose is formed from $6CO_2$ by utilising 18ATP and 12NADPH.

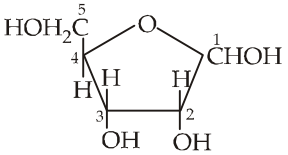
18. (a) : Molisch's test is a sensitive chemical test for the presence of carbohydrates, based on the dehydration of carbohydrate by sulphuric acid to produce an aldehyde, which condenses with two molecules of phenol resulting in red or purple coloured compound.

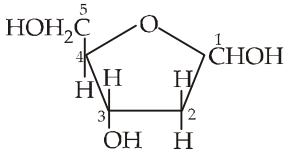
19. (b) : Glycine is optically inactive while all other amino acids are optically active.



Glycine (optically inactive)

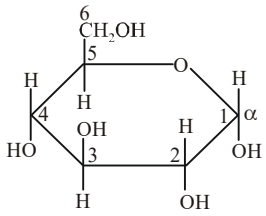
20. (b) : The sugar molecule found in RNA is D-ribose while the sugar in DNA is D-2-deoxyribose. The sugar D-2-deoxyribose differs from ribose only in the substitution of hydrogen for an – OH group at 2-position as shown in figure.

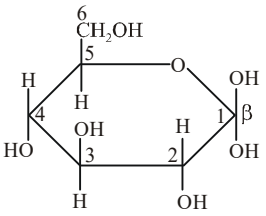

D-ribose (RNA)


D-2-deoxyribose (DNA)

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

22. (d) : Structures of α-D-(+)-glucose and β-D-(+)-glucose are:


α-D-(+)-glucopyranose


β-D-(+)-glucopyranose

A pair of stereoisomers which differ in configuration at C-1 are known as anomers.

23. (b) : Secondary structure of proteins is mainly of two types.

(i) α-helix : This structure is formed when the chain of α-amino acid coils as a right handed screw (called α-helix) because of the formation of hydrogen bonds between amide groups of the same peptide chain.

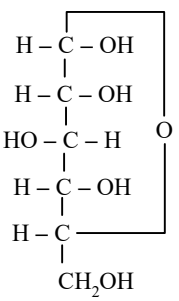
(ii) β-plated sheet : In this structure the chains are held together by a very large number of hydrogen bonds between $C=O$ and NH of different chains.

24. (c) : DNA contains cytosine and thymine as pyrimidine bases and guanine and adenine as purine bases.

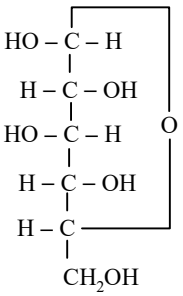
25. (d) : Due to cyclic hemiacetal or cyclic hemiketal structures, all the pentoses and hexoses exist in two stereoisomeric forms *i.e.* α form in which the OH at C_1 in aldoses and C_2 in ketoses lies towards the right and β form in which it lies towards left. Thus glucose, fructose, ribose, etc., all exist in α and β form. Glucose exists in two forms α-D-glucose and β-D glucose.

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

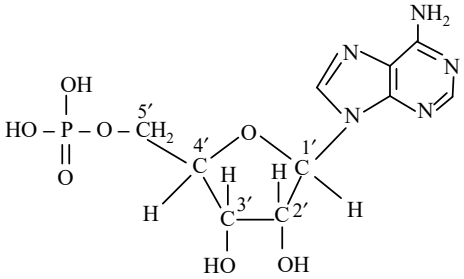
As a result of cyclization the anomeric (C-1) becomes asymmetric and the newly formed – OH group may be either on left or on right in Fischer projection thus resulting in the formation of two isomers (anomers). The isomers having – OH group to the left of the C-1 is designated β-D-glucose and other having – OH group on the right as α-D-glucose.


α-D-glucose

and


β-D-glucose

26. (c) :



27. (b) : Insulin is a proteinaceous hormone secreted by β-cells by islet of Langerhans of pancreas in our body.

28. (a) : RNA contains cytosine and uracil as pyrimidine bases while DNA has cytosine and thymine. Both have the same purine bases *i.e.* guanine and adenine.

29. (d) : Enzymes are shape selective specific biological catalysts which normally functions effectively at body temperature.

30. (c) : The two polynucleotide chains or strands of DNA are linked up by hydrogen bonding between the nitrogenous base molecules of their nucleotide monomers.

Adenine $=$ Thymine (two hydrogen bonds) Cytosine $\equiv$ Guanine (three hydrogen bonds)

31. (c) : $\underset{\text{Cellulose}}{(C_6H_{10}O_5)_n} + nH_2O \xrightarrow{H^+} \underset{\text{D-glucose}}{nC_6H_{12}O_6}$

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

32. (d) : An amino acid is a bifunctional organic molecule that contains both a carboxyl group, –COOH, as well as an amino group, $–NH_2$.

33. (b) :

		DNA	RNA
(a)	Pyrimidine derivatives	Cytosine Thymine	Cytosine Uracil
(b)	Purine derivatives	Adenine Guanine	Adenine Guanine
(c)	Sugar	Deoxyribose	Ribose