Biomolecule

SOLUTIONS

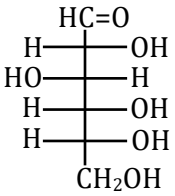
EXERCISE - O

1. **Ans. (D)**

D is configuration.

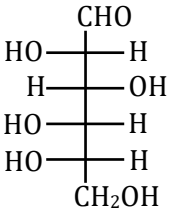
2. **Ans. (C)**

D-glucose is



3. **Ans. (A)**

L-glucose is



4. **Ans. (B)**

α-D-glucose and β-D-glucose differ in configuration at C-1.

5. **Ans. (A)**

The above phenomenon is called as mutarotation.

6. **Ans. (B)**

Inverted sugar is 1 : 1 mixture of glucose and fructose.

7. **Ans. (A)**

Glycosidic linkage is an acetal linkage as it connects two (hemiacetal) monosaccharide units.

8. **Ans. (B)**

(A) It is trisaccharide

(B) It is a disaccharide with hemiacetal linkage which is responsible for reducing nature of sugar.

(C) It is disaccharide but does not have hemiacetal linkage.

(D) It is a disaccharide but does not have hemiacetal linkage.

9. **Ans. (D)**

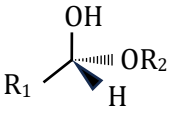
D-glucose and D-mannose on reaction with phenylhydrazine result in formation of above osazone.

10. **Ans. (D)**

D-glucose $\xrightarrow[\Delta]{HNO_3}$ D-Glucaric acid.

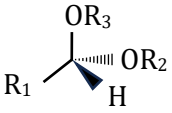
11. **Ans. (D)**

The general form of hemiacetal



Hemiacetal

The general form of acetal



acetal

12. **Ans. (D)**

Phenylalanine has aromatic side chain.

13. **Ans. (B)**

Acidic amino acid is Aspartic acid.

14. **Ans. (B)**

Serine has –OH (alcoholic) group in side chain.

15. **Ans. (B)**

α-amino acid is that in which $-NH_2$ group is present at α-carbon.

16. **Ans. (C)**

Aspartic acid has lowest iso-electric point.

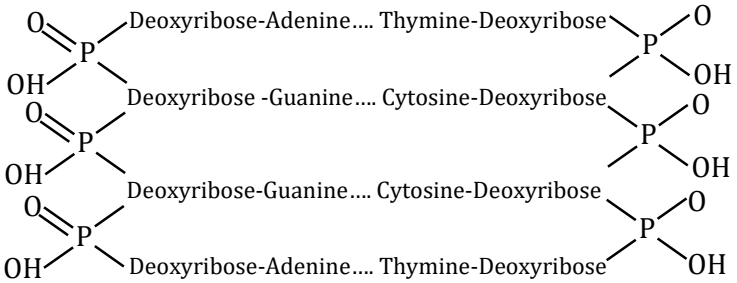
17. **Ans. (C)**

The force of attraction between the neighbouring peptide chains is hydrogen bonding.

18. **Ans. (D)**

Sakaguchi test is given by Arginine.

19. **Ans. (D)**



The hydrogen bonds are formed between the base (shown by dotted lines). Because of size and geometrics of the bases, the only possible pairing in DNA are between G(Guanine) and C(Cytosine) through three H-bonds and between A (Adenine) and T (Thymine) through two H-bonds.

20. **Ans. (C)**

The base pairs of the two strands of DNA are linked together through H-bonds.

21. **Ans. (A)**

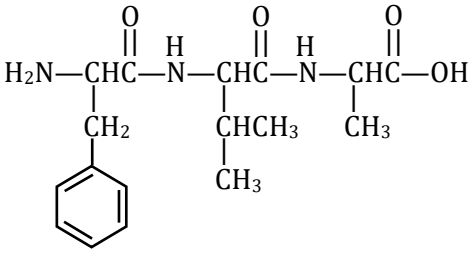
DNA mainly consist of a nitrogenous base, phosphate group and a pentose sugar.

So, hydrolysis of DNA produces a pentose sugar.

22. **Ans. (D)**

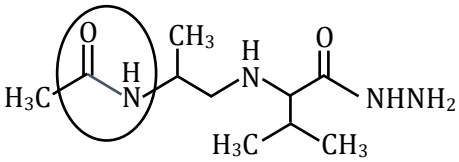
Vitamin A, D, E, K are fat soluble.

23. **Ans. (A)**



24. **Ans. (A)**

In the below structure only one peptide linkage.



EXERCISE - S

1. **Ans. (28)**

Let the amount of α-form in equilibrium mixture is X.

then the amount of β-form in the equilibrium mixture is (1 – X).

so,

$150.7(X) + 52.8(1 - X) = +80.2$

$150.7X + 52.88 - 52.8X = + 80.2$

$97.9X = 27.4$

$X = 0.279 = 0.28$

% X = 28%

2. **Ans. (3)**

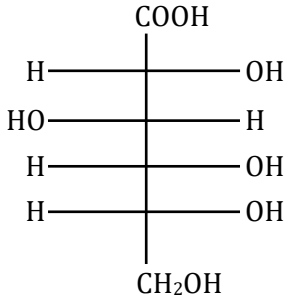
D-glucose + $3PhNH_2 \longrightarrow$ osazone

3. **Ans. $(\frac{2}{1})$**

Stereoisomers of aldoheptose is 2^5 and stereoisomers of ketoheptose is 2^4

so, $a/b = \frac{2^5}{2^4} = 2$

4. **Ans. (4)**



5. **Ans. (4)**

(e, f, g and h)

6. **Ans. (3)**

Reducing sugar will give mutarotation hence (ii), (iii) and (v) follows.

7. **Ans. (4)**

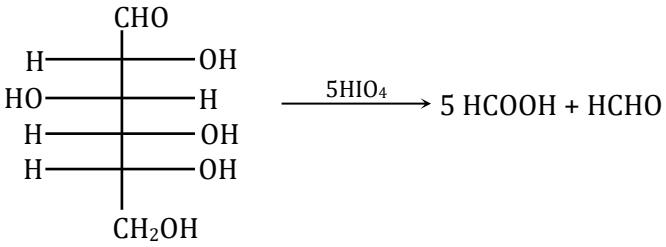
Reducing sugar will give mutarotation hence (ii), (iii), (iv) and (vii) follows.

8. **Ans. (3)**

Carbohydrate containing hemiacetal linkage will show positive tollens' test.

So (iii), (iv) and (v) follows.

9. **Ans. (5)**



10. **Ans. (5.9)**

$$\text{I.P.} = \frac{pK_{a_1} + pK_{a_2}}{2}$$

$$\text{So I.P.} = \frac{(14.0 - 4.4) + 2.2}{2}$$

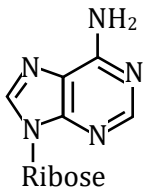
$$= \frac{11.8}{2} = 5.9$$

11. **Ans. (2)**

Water soluble vitamins: B group vitamins and vitamin C are soluble in water so they are grouped together. Water soluble vitamins must be supplied regularly in diet because they are readily excreted in urine and cannot be stored (except vitamin B12) in our body.

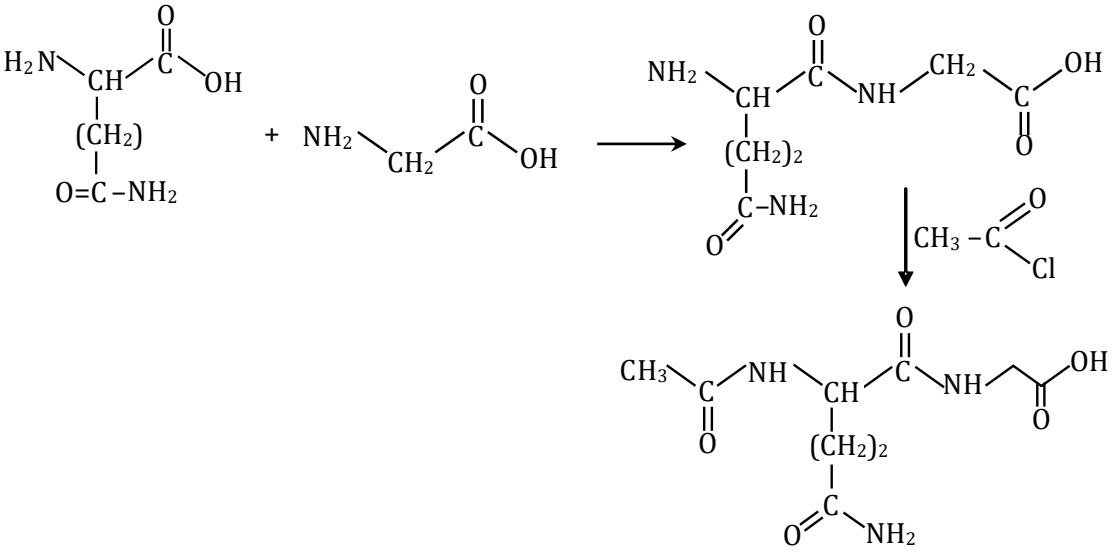
EXERCISE - JEE (Main) PYQ

1. **Ans. (1)**

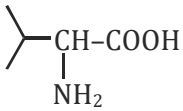


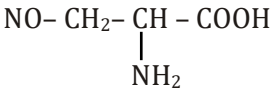
2. **Ans. (3)**

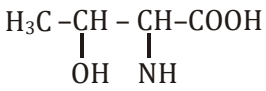
Gln = Glutamine. Gly = Glycine



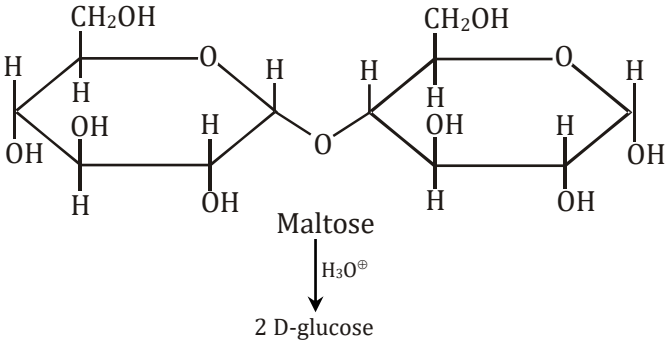
3. **Ans. (4)**

Leusine 

Serine 

Thrconine 

4. **Ans. (2)**

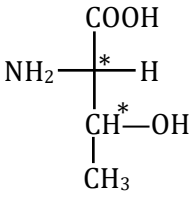


5. **Ans. (4)**

Seliwanoff's test is used to distinguished aldose and ketose group.

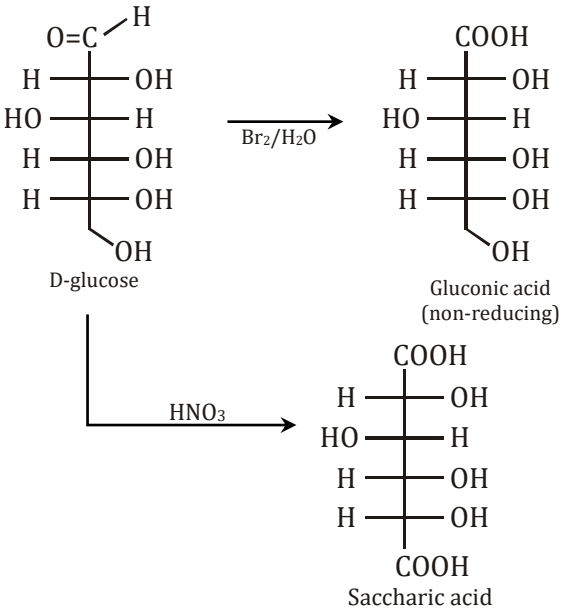
6. **Ans. (2)**

Structure of Threonine is :



S. 2-chiral center is present

7. **Ans. (2)**



8. **Ans. (2)**

Vitamin-A & Vitamin-D.

9. **Ans. (3)**

The secondary structure of protein includes two type :

(a) α-Helix

(b) β-pleated sheet

In α-Helix structure, the poly peptide chain is coil around due to presence of Intramolecular H-Bonding.

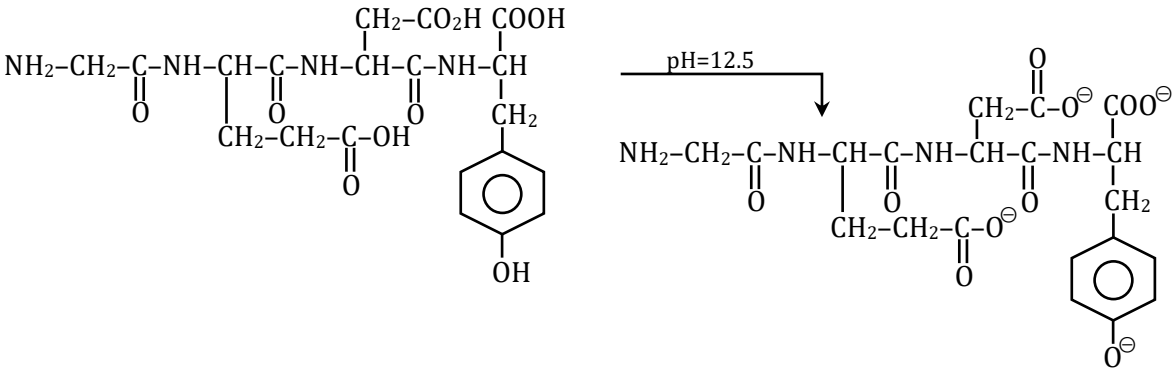
10. **Ans. (1)**

Amylose is a linear chain polymer of α-D-glucose while amylopectine is branched chain polymer of α-D-glucose.

11. **Ans. (1)**

Fact

12. **Ans. (4)**



Total negative charge produced = 4.

13. **Ans. (3)**

Sucrose is example of disaccharide & non reducing sugar

Assertion : correct

Sucrose involves glycosidic linkage between C_1 of α-D-glucose C_2 of β-D-fructose

Reason : Incorrect

14. Ans. (2)

Cellulose contains β – glycosidic linkages only

15. Ans. (4)

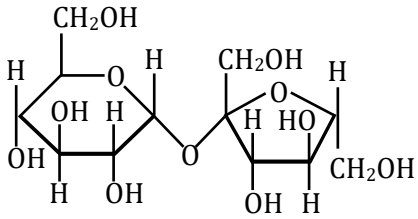
There are Five amino acids and four peptide linkages.

16. Ans. (1)

Primary structure remains intact during denaturation of proteins.

17 Ans. (2)

Theoretical



18. Ans. (25)

Mol. Wt. of $C_4N_2H_4O_2 = 112$

$\%N = \frac{28}{112} \times 100 = 25\%$

19. Ans. (8)

No. of possible tripeptide:

Val & Pro is 2^3

(1) val – val – val (2) pro – pro – pro

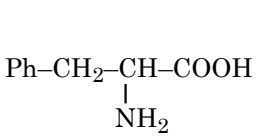
(3) val – pro – pro (4) pro – val – pro

(5) val – val – pro (6) val – pro – val

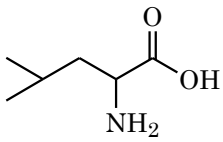
(7) pro – pro – val (8) pro – val – val

20. Ans. (2)

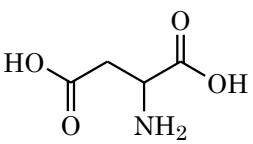
Hydrolysis of the given tetrapeptide will give the following:



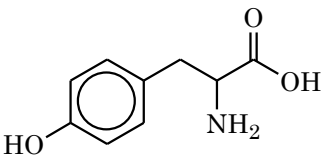
(F)
(Phenylalanine)



(L)
(Leucine)



(D)
(Aspartic acid)



(Y)
(Tyrosine)

EXERCISE - JEE (Advanced) PYQ

1. Ans. (4)

Following combinations are possible for tetrapeptide

Val — Phe — Gly — Ala

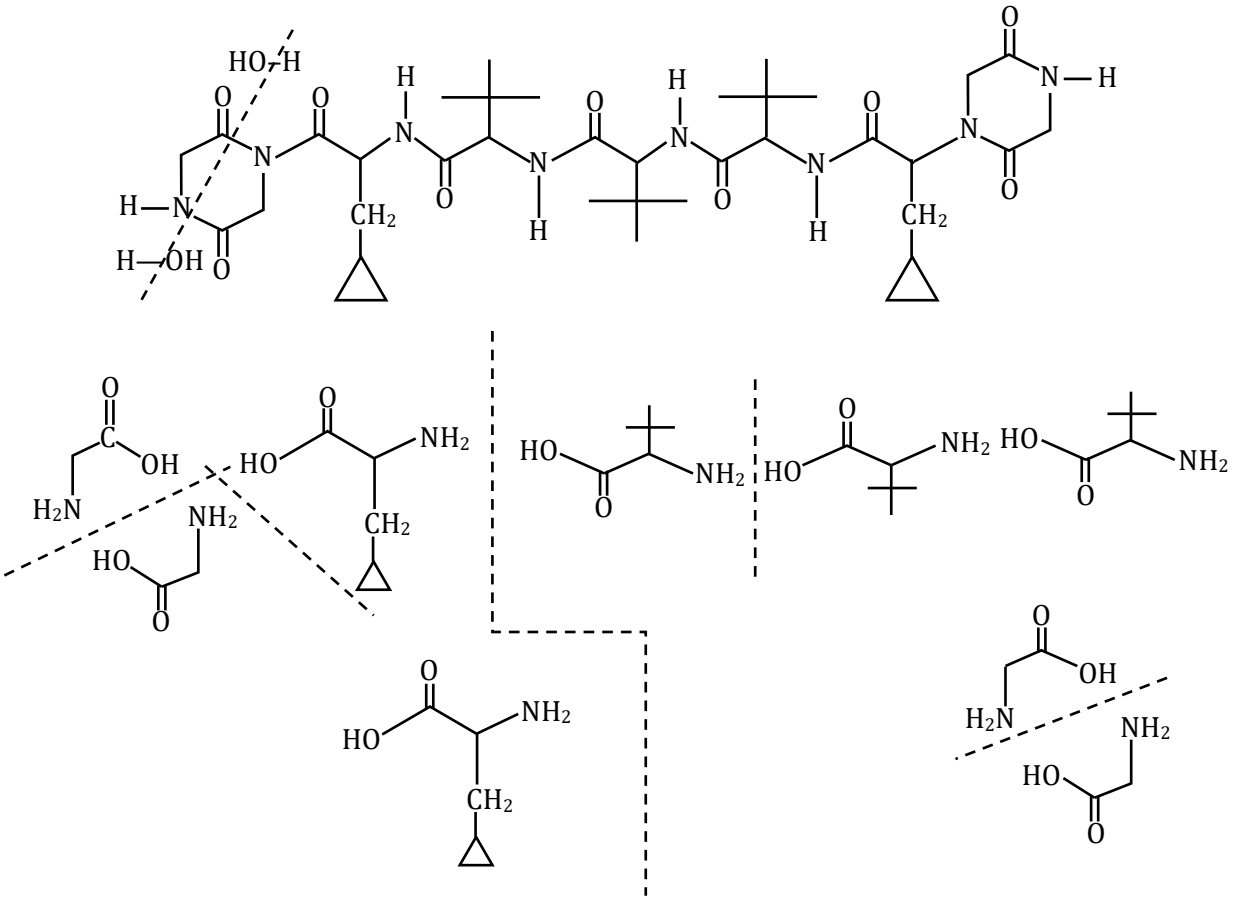
Val — Gly — Phe — Ala

Phe — Gly — Val — Ala

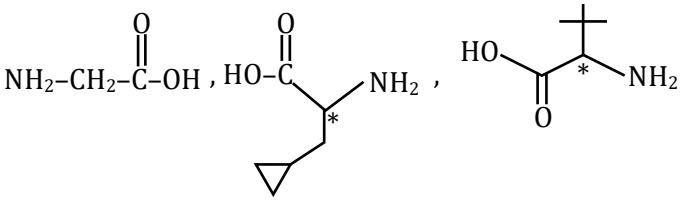
Phe — Val — Gly — Ala

1. In all above sequences C-terminal is alanine
2. Glycine is optically inactive amino acid, hence It should not be N-terminal so, only above combination are possible.

2. Ans. (1)



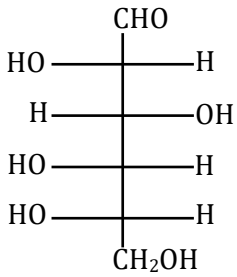
Thus, the acids are



Amongst hence, only glycine is naturally occurring.

3. **Ans. (A)**

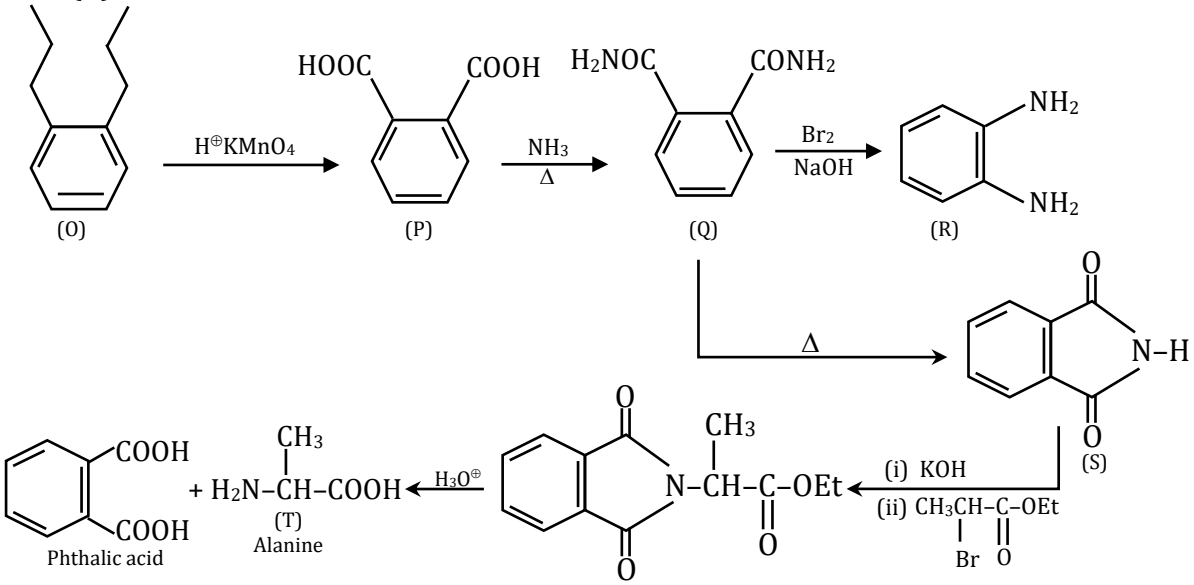
The structure of L-(–)- glucose is



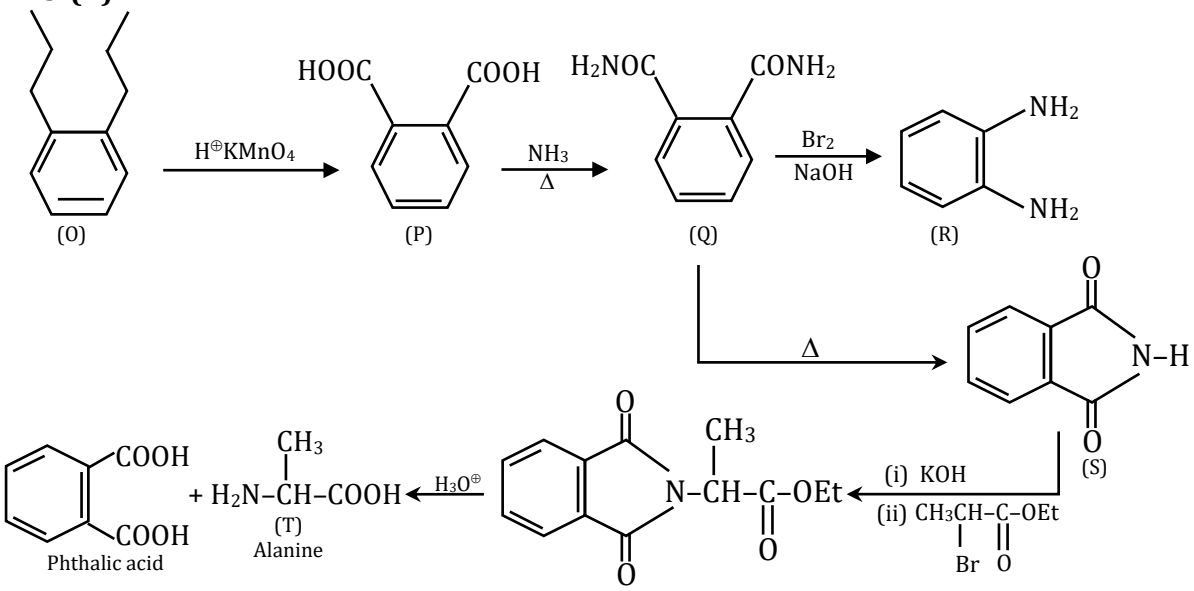
4. **Ans. (B,C)**

'Invert sugar' is an equimolar mixture of D-(+) glucose and D-(–)-fructose Specific rotation of 'invert sugar' is –20°

5. **Ans. (A)**



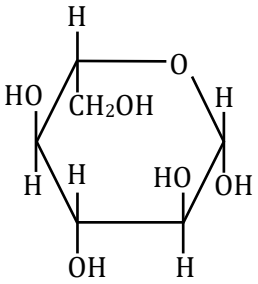
6. **Ans. (B)**



Q to R is Hoffmann's bromamide degradation reaction

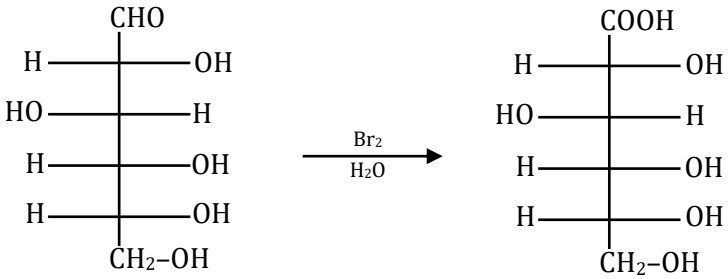
S to T is Gabriel's phthalimide synthesis.

7. **Ans. (D)**



8. **Ans. (B,C,D)**

(1) **FALSE :**



D(+) glucose Gluconic acid

(2) **TRUE :** Six member hemiacetal on anomeric carbon gives α-D glucose & β-D glucose.

(3) **TRUE :** $C_{12}H_{22}O_{11} + H_2O \xrightarrow{\text{Invertase}} C_6H_{12}O_6 + C_6H_{12}O_6$

Glucose (+) Fructose (–)

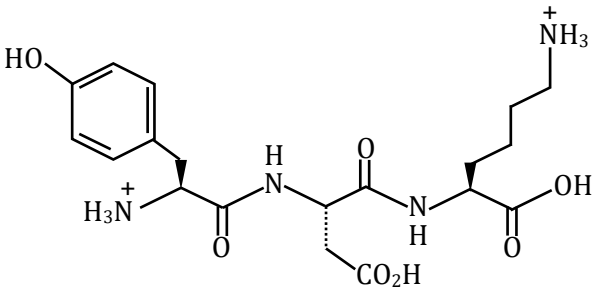
(4) **TRUE :** Monosaccharide cannot be hydrolysed to give polyhydroxy aldehydes and ketones

9. **Ans. (5)**

$(|Z_1| + |Z_2| + |Z_3| = 2 + 0 + 3)$

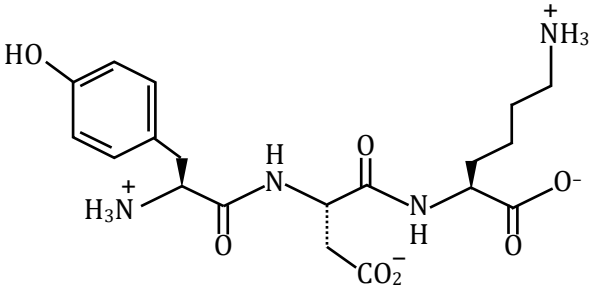
At pH = 2 ; given peptide form will be converted into dictation form

$\therefore Z_1 = 2$



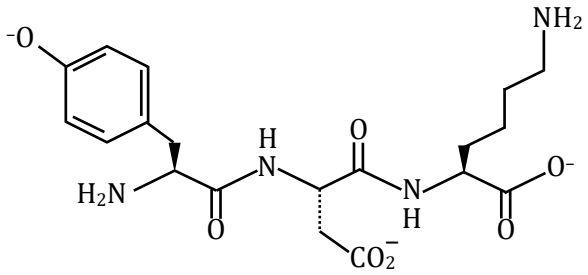
At pH = 6 ; given peptide form will be converted into dication and dianion form

$\therefore Z_2 = 0$

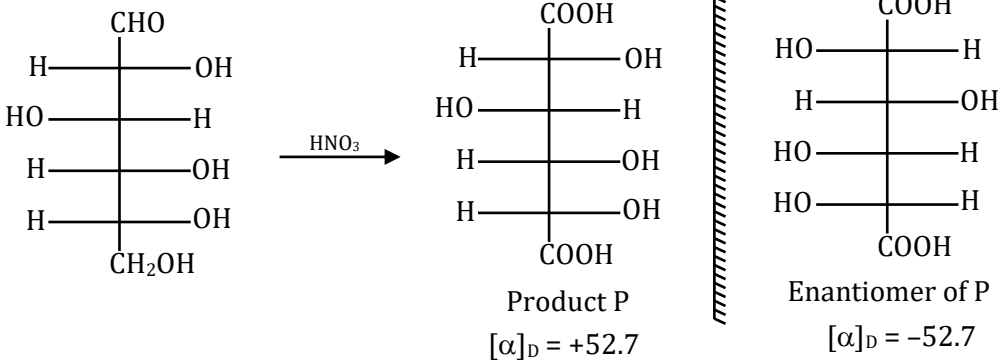


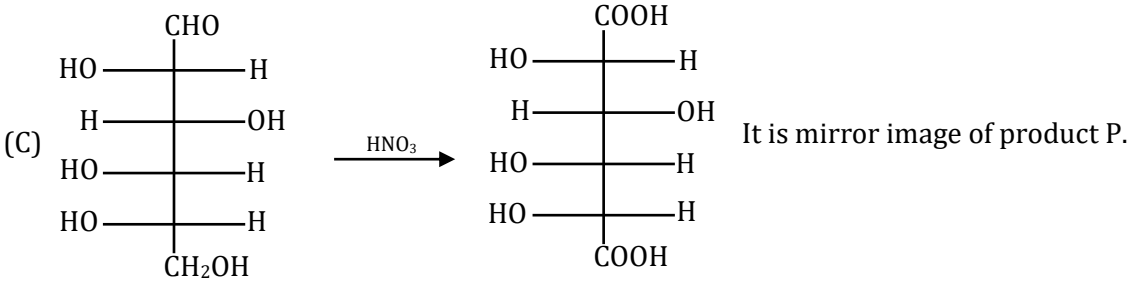
At pH = 11 ; given peptide form will be converted into trianion form

$\therefore Z_3 = 3$

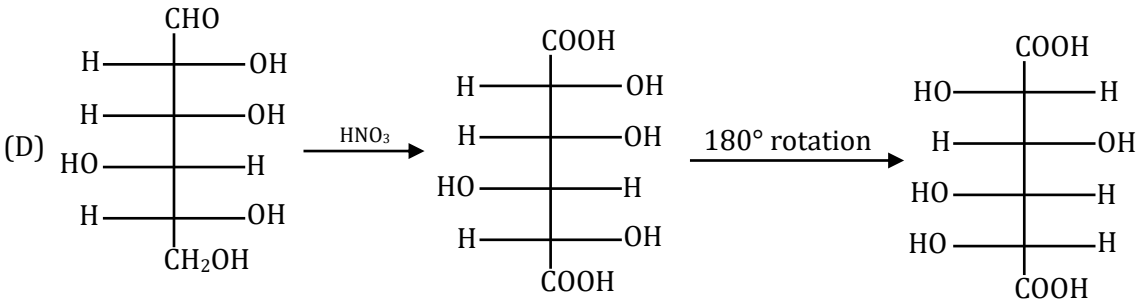


10. Ans. (C,D)



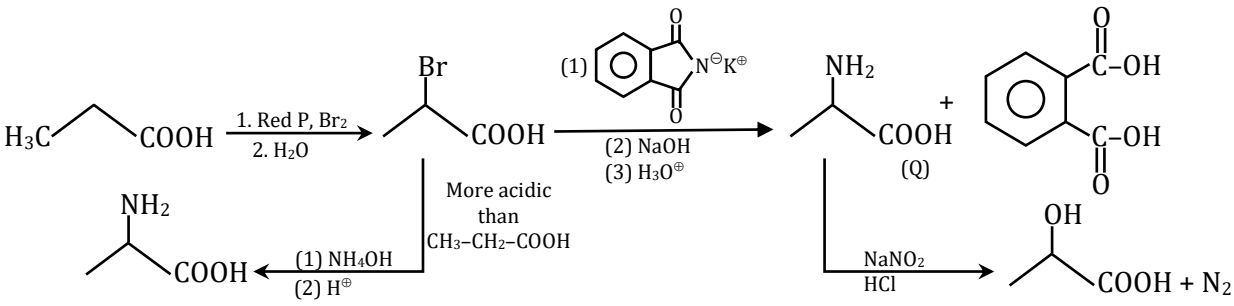


It is mirror image of product P.



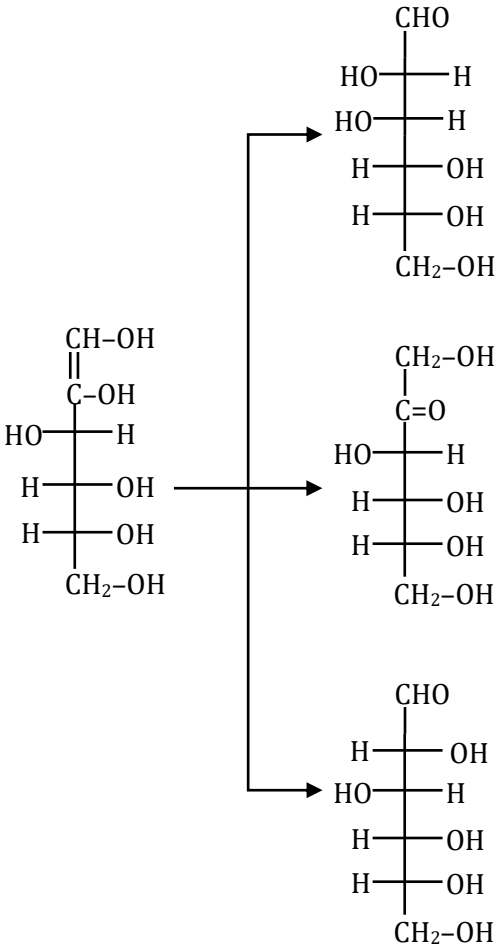
It is also mirror image of product P by rotation at 180°.

11. Ans. (B,C,D)



12. **Ans. (C)**

Basic catalyse tautomerism through enediol intermediate



13. **Ans. (A)**

Sucrose $\xrightarrow{H_3O^+}$ Glucose + Fructose

Specific rotation + 52.5° –92° (mixture of products is laevorotatory)

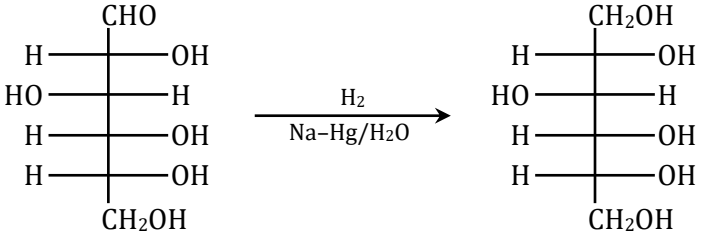
Sucrose $\xrightarrow{Br_2+H_2O}$ No reaction

BCD $\Rightarrow$ reducing sugars, will get oxidized by $Br_2 + H_2O$

JEE (Main) Practice Paper

SECTION–A

1. **Ans. (1)**



2. **Ans. (4)**

$C_6H_{12}O_6 \xrightarrow[3O_2]{\text{Zymase}} C_2H_5OH + 4CO_2 + 3H_2O$

3. **Ans. (1)**

Starch is hydrolysed by the enzyme diastase (also called β-amylase) to maltose

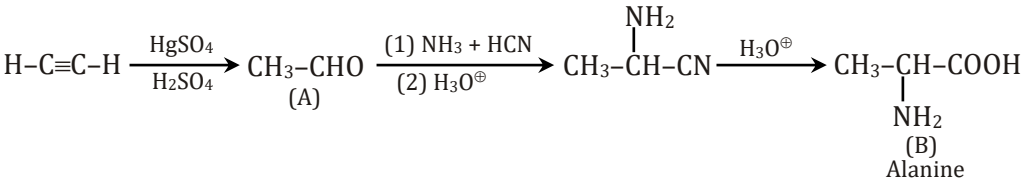
4. **Ans. (2)**

It is a β-pyranose hence it is an aldohexose.

5. **Ans. (3)**

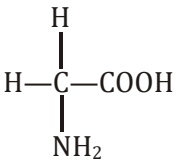
at pH = 6, maximum concentration of alanine will be present

6. **Ans. (2)**



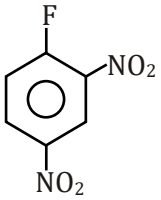
7. **Ans. (3)**

Glycine amino acid does not contain chiral centre



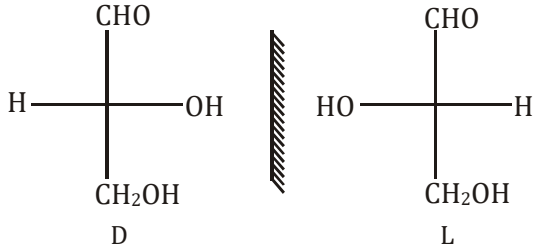
8. **Ans. (1)**

Sanger reagent is 2,4- Dinitrofluoro benzene



it is use to determination of N-terminal amino acid

9. **Ans. (3)**



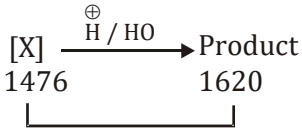
10. **Ans. (4)**

Glucose, Mannose and Fructose give same osazone because structure of last carbons in these carbohydrates is same

11. **Ans. (1)**

Posphodiester linkage

12. **Ans. (1)**



Mass of H_2O used

= (1620 – 1476) gm

Number of moles of H_2O used

$= \frac{1620-1476}{18} = 8$

= number of Glycosidic linkage

13. Ans. (2)

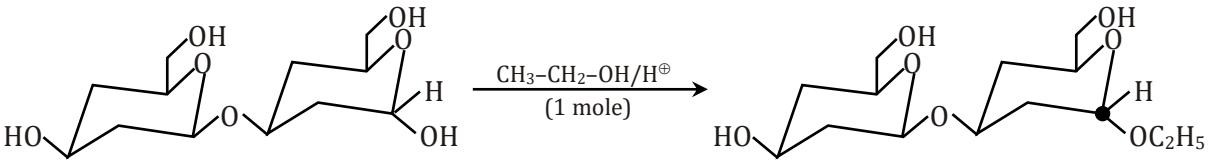
Diastereomerisation

14. Ans. (3)

Glucose $\xrightarrow{Br_2/H_2O}$ Gluconic acid

Glucose $\xrightarrow{HNO_3}$ Saccharic acid

15. Ans. (1)



16. Ans. (2)

Pro–Leu–Gly–Pro–Arg–Pro

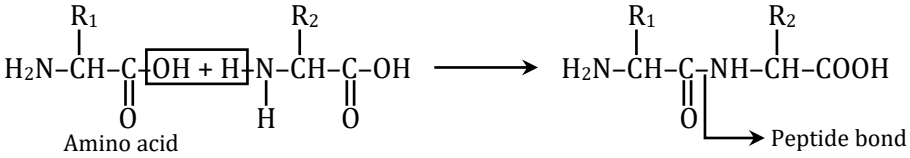
17. Ans. (2)

Antiparallel β-pleated sheet structure is slightly stable than the parallel sheet structure.

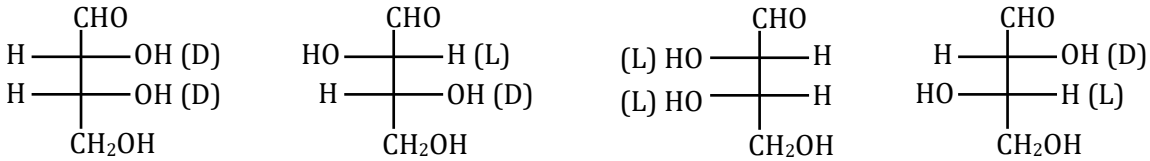
18. Ans. (3)

S_1, S_2 and S_4 are correct. S_3 is incorrect because anomers are those which have difference in configuration at C-1.

19. Ans. (4)



20. Ans. (1)



SECTION–B

1. Ans. (16)

Total no. of optical isomers $=2^4=16$

2. Ans. (9.74)

Average of pKa_2 and pKa_3 is 9.74.

3. Ans. (3)

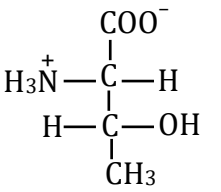
(i), (ii) and (iii) are true but (iv) is False because the glycosides are non-superimposable non-mirror images hence they are diastereomers.

4. Ans. (32)

$pI = \frac{2.19+4.25}{2} = 3.22$

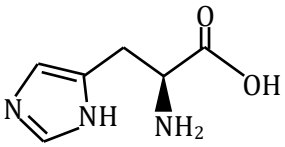
$3.22 \times 10 = 32$

5. Ans. (2)



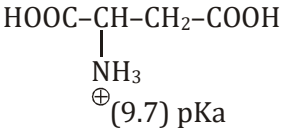
*Threonine

6. Ans. (3)



7. Ans. (3.25)

(2.2) pKa (4.3) pKa

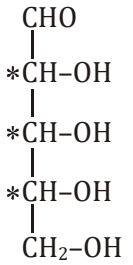


(9.7) pKa

$$\text{I.P.} = \frac{pKa_1 + pKa_2}{2} = \frac{2.2 + 4.3}{2} = 3.25$$

8. Ans. (a) (i) 8 (ii) 4 (iii) 4 (b) (i) 8 (ii) 4 (iii) 4

(a) (i) 8 (ii) 4 (iii) 4



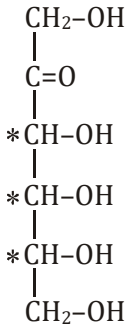
Number of chiral centre = 3

Total possible isomers = 2^3

= 8

So 4 will be D and 4 will be L

(b) (i) 8 (ii) 4 (iii) 4



Number of chiral centre = 3

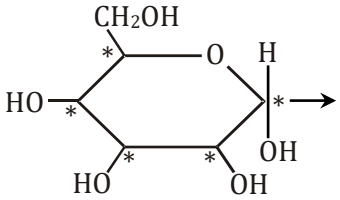
Total possible isomers = 2

= 8

So 4 will be D and 4 will be L

9. **Ans. (16)**

For α-D-glucopyronore, configuration at anomeric carbon will be fixed.



It will be fixed, So n = 4

Number of isomers = $2^4 = 16$

10. **Ans. (30.4)**

(a) I.P. = $\frac{pka_1 + pka_2}{2} = \frac{2.3 + 9.6}{2} = 5.95$

(b) I.P. = $\frac{pka_1 + pka_2}{2} = \frac{2.2 + 9.2}{2} = 5.7$

(c) I.P. = $\frac{2.3 + 9.7}{2} = 6$

(d) I.P. = $\frac{pka_1 + pka_2}{2} = \frac{2.1 + 3.9}{2} = 3$

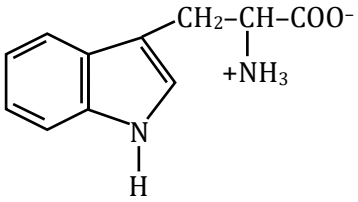
(e) I.P. = $\frac{pka_1 + pka_2}{2} = \frac{9.0 + 10.5}{2} = 9.75$

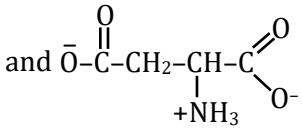
JEE (Advanced) Practice Paper

1. **Ans. (C)**

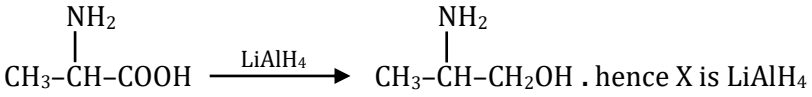
Tollen's reagent and fehling's solution cannot be used to distinguish between aldose and ketose.

2. **Ans. (D)**



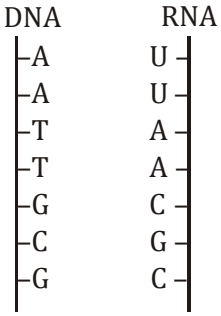
and  respectively

3. **Ans. (C)**



. hence X is $LiAlH_4$

4. **Ans. (A)**



DNA ⇒ ATTGACGCAT

RNA ⇒ UAACUGCGUA

5. Ans. (D)

(A) D-Glucose ⇒ has 4 chiral centre

α-D-Glucose ⇒ has 5 chiral centre

(B) They give different product on oxidation with HIO_4.

(C) They give different product.

(D) D-Glucose and D-Fructose will form same Osazone on reaction with NH_2–NH–Ph.

6. Ans. (BCD)

Starch is the mixture of two polysaccharides - Amylose and amylopectin.

7. Ans. (BC)

X has acetal linkage and Y has hemiacetal linkage. Carbohydrate with hemiacetal linkage are reducing sugars and carbohydrate with acetal linkage are non reducing sugars.

X is α – anomer and Y is β- anomer of D (+) glucose.

8. Ans. (ABCD)

Cabohydrate having different stereochemistry at C-1 are termed as Anomers, whereas when stereochemistry at any other carbon is different then those carbohydrates are known as epimers.

9. Ans. (ABC)

In reactions A, B & C n-hexane is final product.

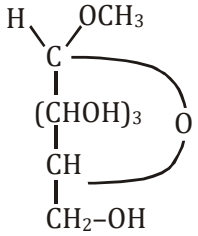
10. Ans. (A,B,C,D)

∴ Poly hydroxy Aldehyde/Ketone or the compound which on hydrolysis give poly hydroxy Aldehyde / Ketone are known as Carbohydrates.

(Sugar, Starch are also carbohydrates)

11. Ans. (A,B,D)

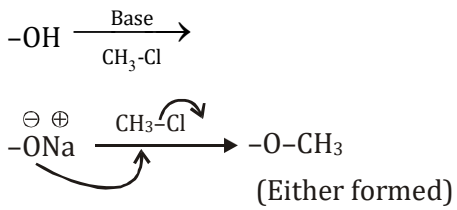
(A) Acetals of carbohydrates are called as glycoside (cyclic acetal), and do not undergoes mustarotation



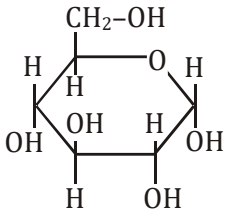
(Non reducing)

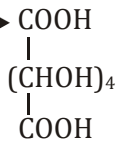
α-methyl glucose

(B) Correct, through williamson's ether synthesis method.

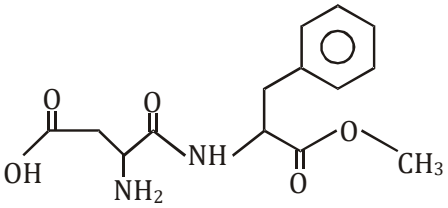


(Either formed)

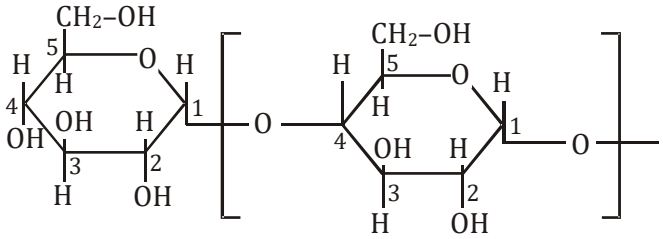
(C)  $\xrightarrow[\text{Excess } CH_3-I]{Ag_2O}$ Penta methyl ether is formed as (5–OH) group are their.

(D) D-Glucose $\xrightarrow{HNO_3}$  D-glucoric Acid or D-Saccharic Acid

12. Ans. (A,B,C)

 $\xrightarrow[\text{Hydrolysis}]{\text{Complete}}$ $Ph-CH_2-\underset{\underset{COOH}{|}}{CH}-NH_2 + CH_3-OH + NH_2-\underset{\underset{CH_2COOH}{|}}{NH}-COOH$

13. Ans. (A,B,D)

(A) 

α-1,4-Glycosidic linkage

(B) In amylopectin bronches are linked to the chain with α-1,6' glycosidic linkage.

(C) Incorrect (linear linkages of amylopectin are formed by α-1,4-glycosidic linkage.

(D) Correct

14. Ans. (A,B,D)

(A) It is definition of isoelectric point.

(B) $\left[pH \text{ or } P.I. = \frac{P_{k_{a_1}} + P_{k_{a_2}}}{2} \right]$

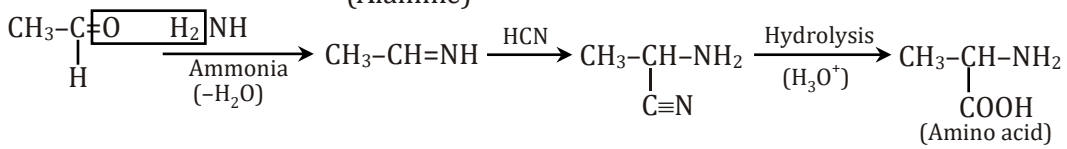
(C) Incorrect

(D) Neutral amino has number of basic groups acid equal to number of acidic group. So, concentration of zwittor ion is maximum at isoelectric point.

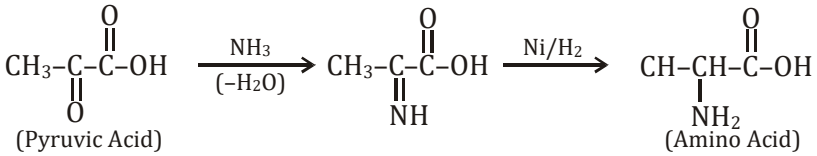
15. Ans. (A,B,C)

(A) $CH_3-\underset{\underset{Cl}{|}}{CH}-\overset{\overset{O}{||}}{C}-OH \xrightarrow{NH_3} CH_3-\underset{\underset{NH_3}{|}}{CH}-\overset{\overset{O}{||}}{C}-OH$

α-Halo Acid (Amino Acid) (Alamine)

(B) 

(Amino acid)

(C) 

(Pyruvic Acid) (Amino Acid)

16. Ans. (B,C)

$\therefore$ Starch consists of two fractions, one being amylose, which gives blue colour with Iodine. This blue colour is believed to be due to the formation of an inclusion complex.

17. Ans. (14)

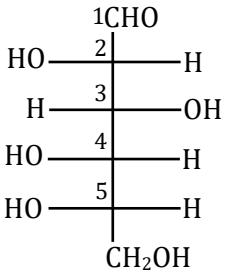
$x = \frac{2+4}{2} = 3$

$y = \frac{9+13}{2} = 11$

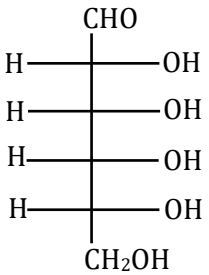
$x + y = 14.$

18. Ans. (11)

D-Allose and L-Glucose differ in configuration along C_2, C_4 and C_5 therefore $\sum C_i = 2 + 4 + 5 = 11$.



L-Glucose



D-Allose

19. Ans. (6)

Molecular weight of decapeptide = 796 g/mol

Total bonds to be hydrolysed = (10 – 1) = 9 per molecule

Total weight of H_2O added = 9 × 18 = 162 g/mol

Total weight of hydrolysis product = 796 + 162 = 958 g

Total weight % of glycine (given) = 47%

Total weight of glycine in product = $\frac{958\times47}{100}$ g = 450 g

Molecular weight of glycine = 75 g/mol

Number of glycine molecule = $\frac{450}{75} = 6$