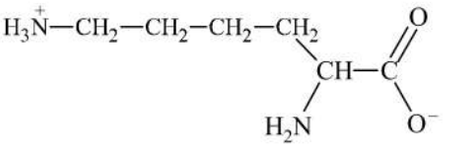
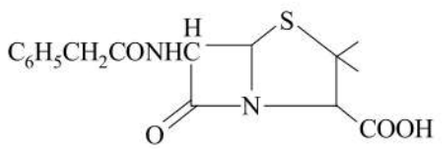
Biomolecules

1. For 'invert sugar', the total number of correct statement(s) is(are)
   (Given : specific rotations of (+) -sucrose, (+)-maltose, L-(-)-glucose and L-(+) fructose in aqueous solution are + 66°, +140°, –52° and +92°, respectively)
   (I) 'invert sugar' is prepared by acid catalyzed hydrolysis of maltose.
   (II) 'invert sugar' is an equimolar mixture of D-(+)-glucose and D-(-)-fructose.
   (III) specific rotation of 'invert sugar' is –20°.
   (IV) on reaction with Br_2 water, 'invert sugar' forms saccharic acid as one of the products.
2. How many dipeptides are possible from two molecules of a typical α-amino acid ?
3. The total number of basic groups in the following form of lysine is



4. A decapeptide (Mol. wt. 796) on complete hydrolysis gives glycine (Mol. wt. 75), alanine and phenylalanine. Glycine contributes 47.0% to the total weight of the hydrolysed products. Calculate the number of glycine units present in the decapeptide.
5. When the following aldohexose exists in its D-configuration, the total number of stereoisomers in its pyranose form is :

   $CHO — CH_2 — CHOH — CHOH — CHOH — CH_2OH$
6. A tetrapeptide has —COOH group on alanine. This produces glycine (Gly), valine (Val), phenyl alanine (Phe) and alanine (Ala), on complete hydrolysis. For this tetrapeptide, find the number of possible sequences (primary structures) with $—NH_2$ group attached to a chiral center.
7. The specific optical rotations of pure a- and b-D-mannopyranose are + 29.3° and –17.0, respectively. When either form is dissolved in water, specific optical rotation of the equilibrium mixture is found to be + 14.2°. Calculate the percentage of a anomer at equilibrium.
8. Penicillin, the common antibiotic, has following structure :



   Find the number of different functional groups present in it.
9. The enzyme cytochrome C, involved in oxidation-reduction processes in the living system, has 0.43% Fe and 1.48% S. Calculate the number of S atoms in the enzyme per Fe atom.
10. A strongly alkaline solution of a monoaminodicarboxylic acid contains how many basic groups ?

SOLUTIONS

1. (2) Invert sugar is an equimolar mixture of D-(+) glucose and D(–) glucose.

$$\underset{\text{+ sucrose}}{C_{12}H_{22}O_{11}} + H_2O \xrightarrow{H^+} \underbrace{\underset{\substack{\text{D (+)–glucose}\\(+52^\circ)}}{C_6H_{12}O_6} + O_2 \xrightarrow{+} \underset{\substack{\text{D (+)–glucose}\\(-92^\circ)}}{C_6H_{12}O_6}}_{\text{Invert sugar}}$$

$$\text{Specific rotation of invert sugar} = \frac{-92^\circ + 52^\circ}{2} = -20^\circ$$

D-glucose on oxidation with Br_2-water produces gluconic acid and not saccharic acid.

2. (1) Two molecules of an α-amino acid will form only one dipeptide, the four different dipeptides are formed when two α-amino acids are different.

3. (2) The basic groups in the given form of lysine is NH_2 (not $\overset{+}{N}H_3$) and CO_2^-.

4. (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 products

= 796 + 162 = 958 g

Total weight % of glycine (given) = 47%

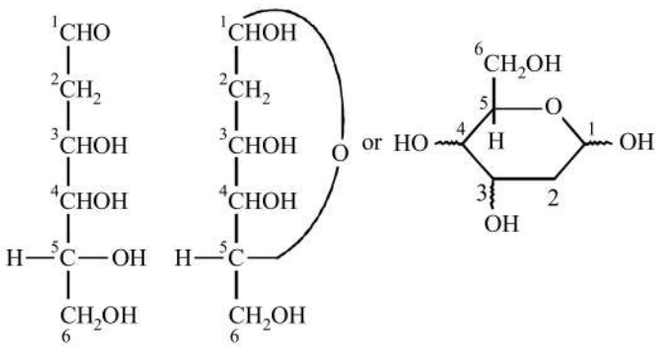
Total weight of glycine in product

$$= \frac{958 \times 47}{100} \text{g} = 450\text{g}$$

Molecular weight of glycine = 75 g/mol

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

5. (8)



D- Aldohexose D- Aldohexopyranose

Thus, total number of stereoisomers in pyranose form of D-configuration = $2^3 = 8$

6. (4) According to question C – Terminal must be alanine and N – Terminal do have chiral carbon means it should not be glycine. So possible sequence is :

Val Phe Gly Ala

Val Gly Phe Ala

Phe Val Gly Ala

Phe Gly Val Ala

7. (67) Let fraction of a-anomer = x

$\therefore$ Fraction of b-anomer = $(1 - x)$

Hence $x(+29.3^\circ) + (1-x)(-17.0^\circ) = +14.2^\circ$

$29.3^\circ x + (-17^\circ + 17^\circ x) = +14.2^\circ$

$29.3^\circ x + 17^\circ x = 14.2^\circ + 17^\circ$

$46.3^\circ x = 31.2^\circ$

$x = 0.67$

$\therefore$ Fraction of a-anomer = 0.67 or 67%

8. (4) Amide, lactam, carboxylic and thioether linkage are present.

9. (6) The minimum atom of Fe in the enzyme is one.

0.43 g of Fe is present in 100 g of enzyme

$$\text{56 g of Fe is present in } \frac{100}{0.43} \times 56$$

$$= 1.3 \times 10^4 \text{ g of enzyme}$$

Thus the minimum mol. wt. of the enzyme = 13000

$$\text{Similarly, 32 g of S is present in } \frac{100 \times 32}{1.48} = 2.16 \times 10^3$$

Thus the minimum mol. wt. corresponding to 1 S atom = 2160

$\therefore$ No of S atoms in the enzyme per Fe atom

$$= \frac{13000}{2160} \approx 6$$

10. (3) 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, —NH_2 is more basic than a –COO^- group.