

# Biomolecules JEE Main PYQ – 1

Total Time: 1 Hour

Total Marks: 100

## Instructions

### Instructions

1. Test will auto submit when the Time is up.
2. The Test comprises of multiple choice questions (MCQ) with one or more correct answers.
3. The clock in the top right corner will display the remaining time available for you to complete the examination.

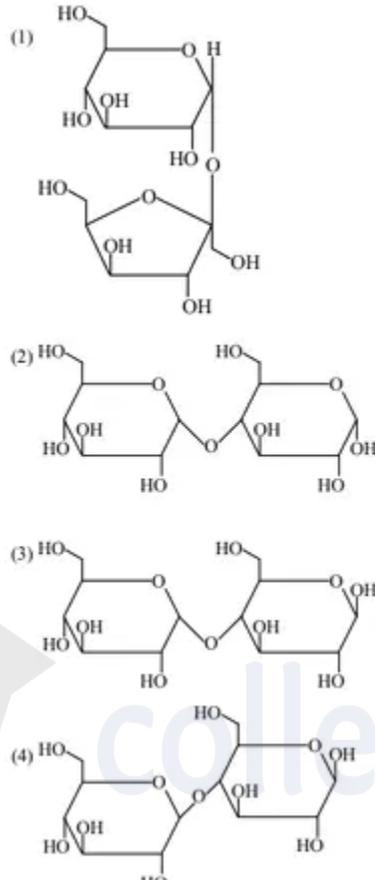
### Navigating & Answering a Question

1. The answer will be saved automatically upon clicking on an option amongst the given choices of answer.
2. To deselect your chosen answer, click on the clear response button.
3. The marking scheme will be displayed for each question on the top right corner of the test window.

## Biomolecules

1. Which of the following is nonreducing sugar?

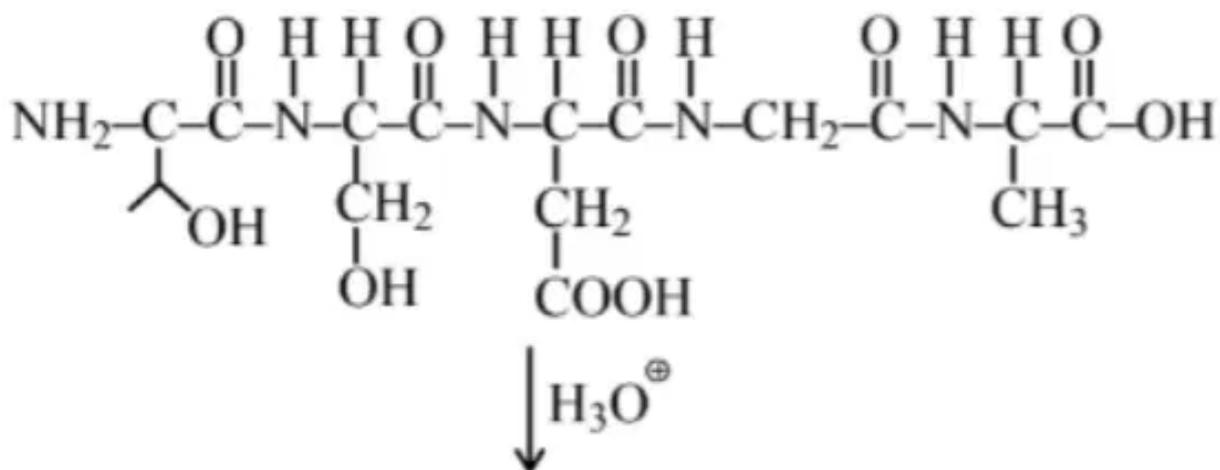
(+4, -1)



- a. Option 1
- b. Option 2
- c. Option 3
- d. Option 4

2. Find out the sequence of amino acids from N-terminal to C-terminal in given polypeptide chain.

(+4, -1)



- Thr-Ser-Asp-Gly-Ala
- Ser-Thr-Asp-Gly-Ala
- Ser-Asp-Thr-Gly-Ala
- Thr-Ser-Asp-Gly-Ala

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3. How many tripeptides are possible when following three amino acids make tripeptide? (No amino acid should repeat twice) (+4, -1)
- (A) Glycine  
 (B) Alanine  
 (C) Valine

- 4
- 6
- 8
- 9

4. Both DNA and RNA are chiral molecules. The chirality in DNA and RNA arises due to the presence of : (+4, -1)

- a. D-sugar component
- b. Phosphodiester linkage
- c. L-sugar component
- d. Nitrogenous bases

5. Given below are two statements: (+4, -1)

**Statement I:** All the pairs of molecules ( $\text{PbO}$ ,  $\text{PbO}_2$ ); ( $\text{SnO}$ ,  $\text{SnO}_2$ ) and ( $\text{GeO}$ ,  $\text{GeO}_2$ ) contain amphoteric oxides.

**Statement II:** Glycine does not have any chiral carbon.

In the light of the above statements, choose the correct option.

- a. Both Statement I and Statement II are correct.
- b. Both Statement I and Statement II are incorrect.
- c. Statement I is correct and Statement II is incorrect.
- d. Statement I is incorrect and Statement II is correct.

6. Given below are two statements: (+4, -1)

**Statement I:** Arginine and Tryptophan are essential amino acids.

**Statement II:** Glycine does not have any chiral carbon.

In the light of the above statements, which is the correct option?

- a. Both statement-I and statement-II are correct
- b. Both statement-I and statement-II are incorrect
- c. Statement-I is correct and statement-II is incorrect
- d. Statement-I is incorrect and statement-II is correct

7. Given below are two statements:

(+4, -1)

**Statement I:** Arginine and Tryptophan are essential amino acids.

**Statement II:** Glycine does not have any chiral carbon.

In the light of the above statements, which is the correct option?

- a. Both statement-I and statement-II are correct
- b. Both statement-I and statement-II are incorrect
- c. Statement-I is correct and statement-II is incorrect
- d. Statement-I is incorrect and statement-II is correct

8. A non-reducing sugar "A" hydrolyses to give two reducing mono saccharides. (+4, -1)

Sugar A is :

- a. Glucose
- b. Fructose
- c. Galactose
- d. Sucrose

9. The water soluble protein is :

(+4, -1)

- a. Myosin
- b. Fibrin
- c. Collagen
- d. Albumin

10. Compound A gives D-Galactose and D-Glucose on hydrolysis. The compound A is :

(+4, -1)

- a. Maltose

- b. Lactose
- c. Sucrose
- d. Amylose

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11. Deficiency of vitamin K causes : (+4, -1)

- a. Increase in blood clotting time
- b. Decrease in blood clotting time
- c. Cheilosis
- d. Increase in fragility of RBC's

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12. Out of the following, which type of interaction is responsible for the stabilisation of  $\alpha$ -helix structure of proteins ? (+4, -1)

- a. van der Waals forces
- b. Covalent bonding
- c. Ionic bonding
- d. Hydrogen bonding

---

13. Which of the glycosidic linkage between galactose and glucose is present in lactose ? (+4, -1)

- a. C-1 of galactose and C-4 of glucose
  - b. C-1 of galactose and C-6 of glucose
  - c. C-1 of glucose and C-4 of galactose
  - d. C-1 of glucose and C-6 of galactose
-

14. The compound 'A' is a complementary base of \_\_\_\_\_ in DNA strands. (+4, -1)



- a. Guanine
- b. Adenine

c. Cytosine

d. Uracil

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15. Which one among the following chemical tests is used to distinguish monosaccharide from disaccharide ? (+4, -1)

a. Seliwanoff's test

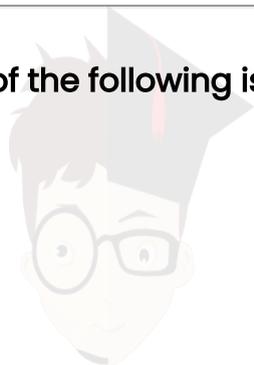
b. Barfoed test

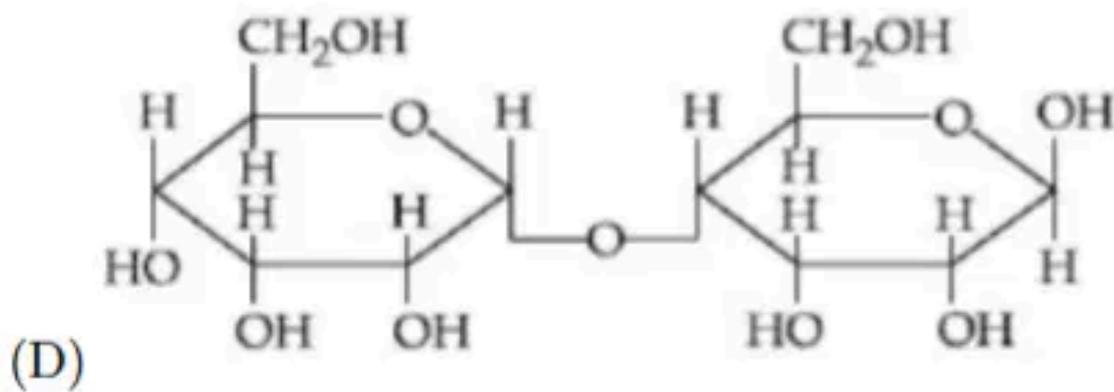
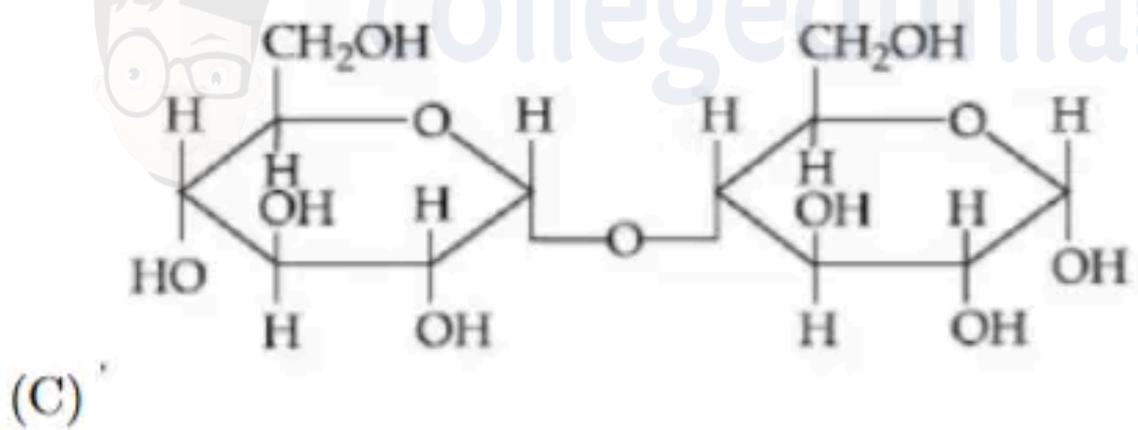
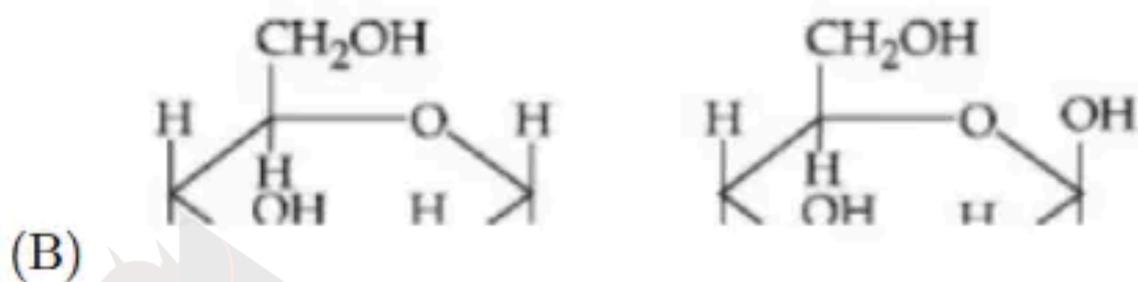
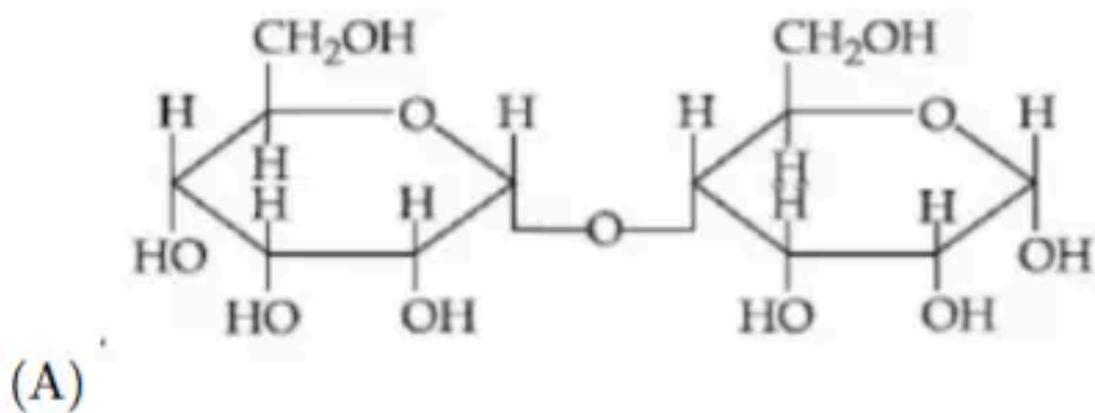
c. Tollen's test

d. Iodine test

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16. Which of the following is correct structure of  $\alpha$ -anomer of maltose? (+4, -1)





- b. B
- c. C
- d. D

---

17. Which of the following is NOT an example of fibrous protein ? (+4, -1)

- a. Keratin
- b. Albumin
- c. Myosin
- d. Collagen

---

18. Which one of the following compounds contains  $\beta$ -C<sub>1</sub>-C<sub>4</sub> glycosidic linkage? (+4, -1)

- a. Lactose
- b. Amylose
- c. Sucrose
- d. Maltose

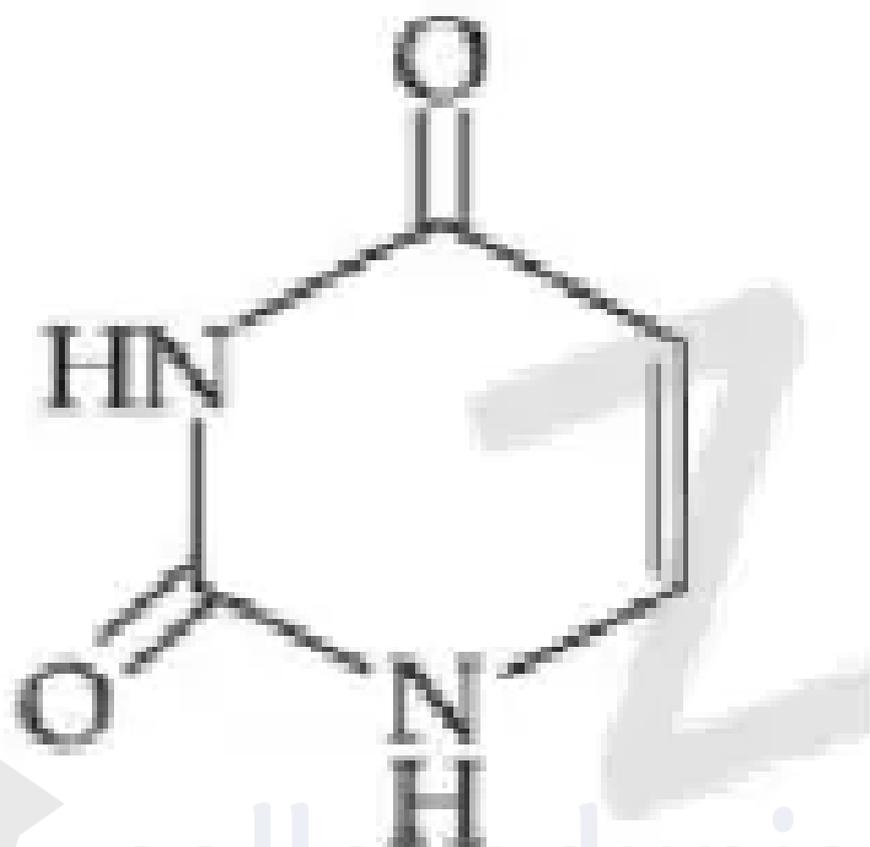
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19. Hydrolysis of sucrose gives : (+4, -1)

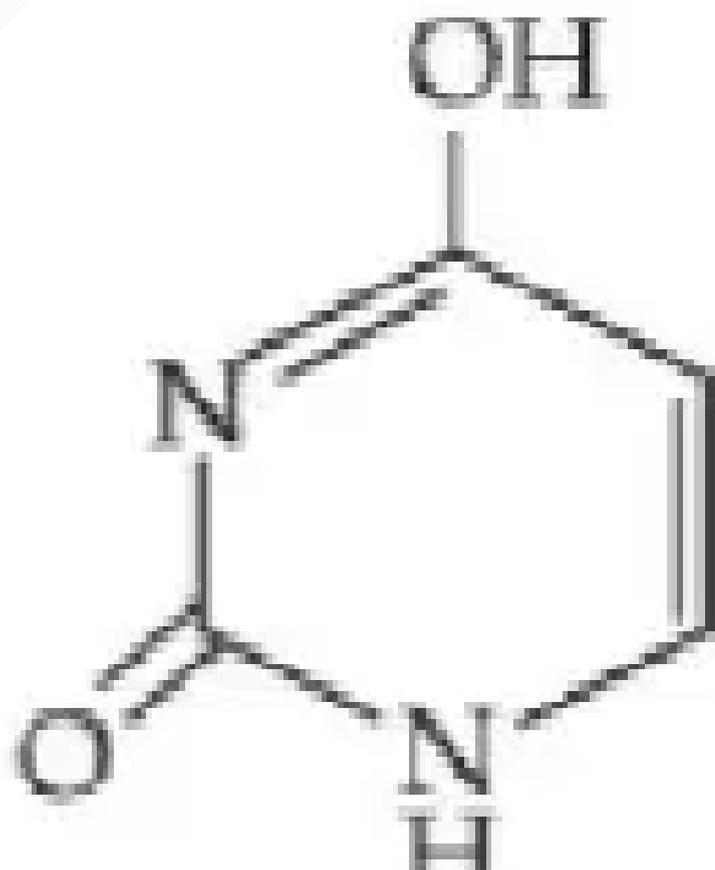
- a.  $\alpha$ -D-(-)-Glucose and  $\beta$ -D-(-)-Fructose
- b.  $\alpha$ -D-(+)-Glucose and  $\beta$ -D-(-)-Fructose
- c.  $\alpha$ -D-(+)-Glucose and  $\alpha$ -D-(-)-Fructose
- d.  $\alpha$ -D-(-)-Glucose and  $\alpha$ -D-(+)-Fructose

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20. Out of following isomeric forms of uracil, which one is present in RNA? (+4, -1)

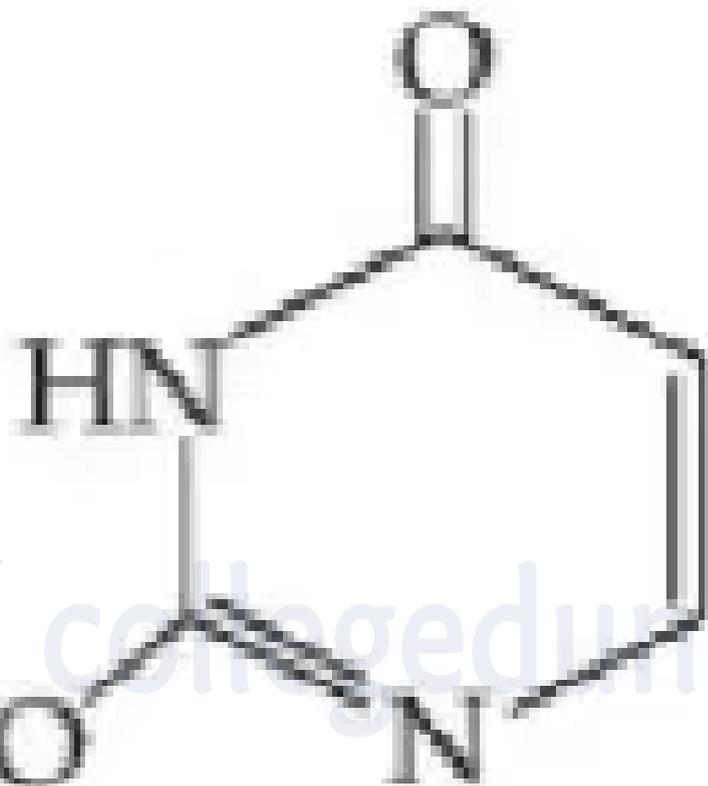


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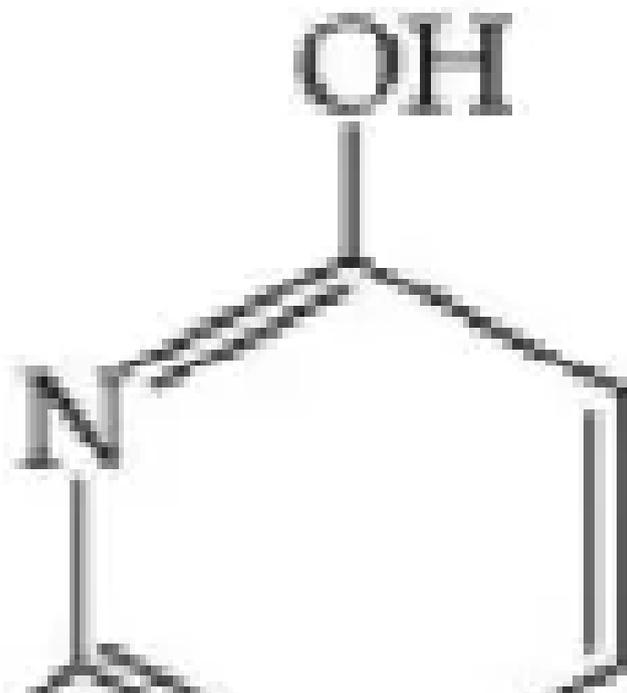


(B)

11



(C)





- a. A
- b. B
- c. C
- d. D

21. The total number of negative charge in the tetrapeptide, Gly-Glu-Asp-Tyr, at pH 12.5 will be \_\_\_\_\_. (Integer answer) (+4, -1)

22. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R). (+4, -1)

Assertion (A): Sucrose is a disaccharide and a non-reducing sugar.

Reason (R) : Sucrose involves glycosidic linkage between C<sub>1</sub> of β-glucose and C<sub>2</sub> of α-fructose.

Choose the most appropriate answer from the options given below :

- a. Both (A) and (R) are true and (R) is the true explanation of (A).
- b. Both (A) and (R) are true but (R) is not the true explanation of (A).
- c. (A) is true but (R) is false.
- d. (A) is false but (R) is true.

23. Fat soluble vitamins are : (+4, -1)

- A. Vitamin B<sub>1</sub>
- B. Vitamin C
- C. Vitamin E
- D. Vitamin B<sub>12</sub>

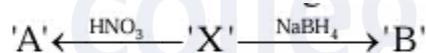
E. Vitamin K

Choose the correct answer from the options given below :

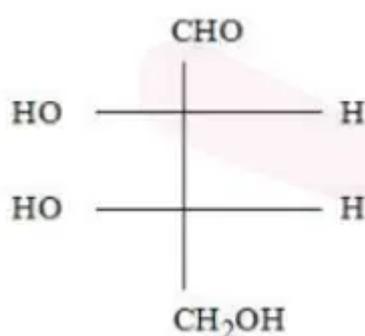
- a. C and D Only
- b. A and B Only
- c. B and C Only
- d. C and E Only

24. The total number of hydrogen bonds of a DNA-double Helix strand whose one strand has the following sequence of bases is \_\_\_\_\_ . 5' - G - G - C - A - A - A - T - C - G - G - C - T - A - 3' (+4, -1)

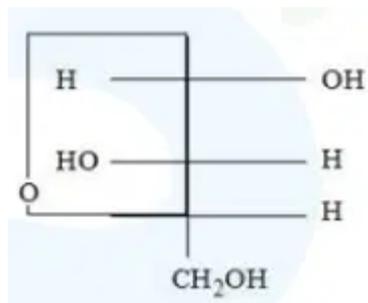
25. L-isomer of tetrose X ( $C_4H_8O_4$ ) gives positive Schiff's test and has two chiral carbons. On acetylation, 'X' yields triacetate. 'X' undergoes following reactions (+4, -1)



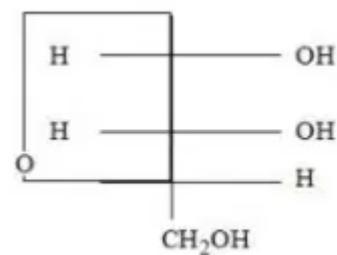
Chiral compound 'X' is



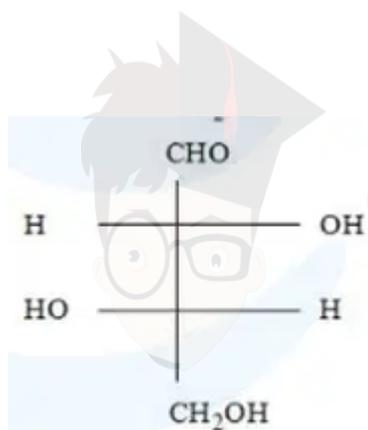
a. )



b.



c.



d.

## Answers

### 1. Answer: a

#### Explanation:

##### Concept:

A carbohydrate is called a **nonreducing sugar** if it does not have a free anomeric carbon. This happens when **both anomeric carbons are involved in glycosidic bond formation**

##### Step 1: Identify Anomeric Carbon

Anomeric carbon is bonded to two oxygen atoms.

Presence of free  $-OH$  group on this carbon makes the sugar reducing.

##### Step 2: Analyze Each Option

##### Option (1):

Both monosaccharide units are linked via their anomeric carbons.

No free anomeric  $-OH$  group is present.

Hence, it is a **nonreducing sugar**

##### Option (2):

One anomeric carbon remains free.

Hence, it is a **reducing sugar**

##### Option (3):

Presence of free anomeric  $-OH$  group.

Hence, it is a **reducing sugar**

##### Option (4):

One anomeric carbon is not involved in glycosidic linkage.

Hence, it is a **reducing sugar**

**Final Conclusion:**

Only **option (1)**

represents a **nonreducing sugar**

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## 2. Answer: a

### Explanation:

Identify R-groups in the peptide backbone  $-\text{NH}-\text{CH}(\text{R})-\text{CO}-$ :

1.  $\text{R} = -\text{CH}(\text{OH})\text{CH}_3$ . Amino acid: Threonine (Thr).

2.  $\text{R} = -\text{CH}_2\text{OH}$ . Amino acid: Serine (Ser).

3.  $\text{R} = -\text{CH}_2\text{COOH}$ . Amino acid: Aspartic Acid (Asp).

4.  $\text{R} = \text{H}$ . Amino acid: Glycine (Gly).

5.  $\text{R} = -\text{CH}_3$  (at C-terminal). Amino acid: Alanine (Ala).

Sequence: Thr-Ser-Asp-Gly-Ala.

---

## 3. Answer: b

### Explanation:

**Step 1: Understand tripeptide formation.**

A tripeptide consists of three amino acids linked in a specific order.

Order of amino acids matters.

**Step 2: Identify the amino acids.**

Available amino acids are Glycine (G), Alanine (A) and Valine (V).

No repetition is allowed.

**Step 3: Calculate number of possible arrangements.**

Number of tripeptides = number of permutations of 3 different amino acids.

$$= 3! = 6$$

**Step 4: List the possible tripeptides.**

GAV, GVA, AGV, AVG, VAG, VGA

---

**4. Answer: a**

**Explanation:**

Step 1: DNA and RNA are polymers made up of nucleotide units. Step 2: Each nucleotide consists of: \begin{itemize} \item A nitrogenous base \item A phosphate group \item A pentose sugar \end{itemize} Step 3: The sugars present are:

DNA: 2-deoxy-D-ribose, RNA: D-ribose

Step 4: These sugars contain multiple asymmetric (chiral) carbon atoms. Step 5: The phosphate group and nitrogenous bases are achiral, whereas the sugar unit is chiral. Step 6: Hence, the overall chirality of DNA and RNA originates from the **D-sugar component**. Therefore, correct answer is **(1) D-sugar component**.

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**5. Answer: d**

**Explanation:**

**Step 1: Analyzing the statements.**

- **Statement I:** The molecules  $\text{PbO}$ ,  $\text{PbO}_2$ ;  $\text{SnO}$ ,  $\text{SnO}_2$ ;  $\text{GeO}$ ,  $\text{GeO}_2$  do not all contain amphoteric oxides.  $\text{GeO}$  is distinctly acidic, not amphoteric.

- **Statement II:** Glycine does not have any chiral carbon. This is true because glycine is the only amino acid that lacks a chiral center.

**Step 2: Conclusion.**

Statement I is incorrect, and Statement II is correct. Therefore, the correct answer is **(4)**.

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**6. Answer: a**

**Explanation:**

### Step 1: Analyzing the statements.

- **Statement I:** Both Arginine and Tryptophan are essential amino acids. This statement is true because these amino acids cannot be synthesized by the body and must be obtained from the diet.
- **Statement II:** Glycine does not have any chiral carbon. This is true because glycine is the only amino acid that does not have a chiral center.

### Step 2: Conclusion.

Both statements are correct, so the correct answer is **(1) Both statement-I and statement-II are correct.**

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## 7. Answer: d

### Explanation:

### Given Statements

**Statement I:** Arginine and Tryptophan are essential amino acids.

**Statement II:** Glycine does not have any chiral carbon.

### Analysis of Statements

**Statement I:** Arginine and Tryptophan are essential amino acids.

**Fact:** Both Arginine and Tryptophan are indeed essential amino acids. However, Arginine is considered semi-essential because the body can synthesize it under normal conditions but may require it during periods of stress or growth. Thus, while Tryptophan is an essential amino acid, Arginine is often classified as semi-essential rather than strictly essential.

**Statement II:** Glycine does not have any chiral carbon.

**Fact:** Glycine is the only amino acid that does not have a chiral center. A chiral carbon is a carbon atom bonded to four different substituents. In glycine, both the hydrogen and the amino group are attached to the same carbon, making it achiral.

### Conclusion:

**Statement-I:** Incorrect (since Arginine is semi-essential and not strictly essential).

**Statement-II:** Correct (since Glycine does not have a chiral carbon).

**Answer:**

The correct option is: **Statement-I is incorrect and Statement-II is correct.**

---

**8. Answer: d**

**Explanation:**

**Step 1:** Monosaccharides like Glucose and Fructose are always reducing sugars.

**Step 2:** **Sucrose** is a disaccharide where the reducing groups of both Glucose (C1) and Fructose (C2) are involved in the glycosidic bond.

**Step 3:** Since no free aldehydic or ketonic group is available, Sucrose is **non-reducing**.

**Step 4:** Hydrolysis of Sucrose yields Glucose and Fructose, both of which are **reducing**.

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**9. Answer: d**

**Explanation:**

**Step 1: Understanding the Concept:**

Proteins are classified into two types based on their molecular shape: Fibrous proteins and Globular proteins.

**Step 3: Detailed Explanation:**

1. **Fibrous Proteins:** These consist of linear thread-like molecules that lie side by side to form fibers. They are held together by hydrogen and disulphide bonds. They are **insoluble** in water. Examples include Keratin (hair, wool), Myosin (muscles), Collagen (connective tissue), and Fibrin (blood clots).

2. **Globular Proteins:** In these, the polypeptide chain folds around itself to give a spherical shape. The lipophilic (hydrophobic) parts are pushed inside while hydrophilic parts face outside. They are **soluble** in water. Examples include Insulin and Albumin (egg white).

**Step 4: Final Answer:**

Among the given options, Albumin is a globular protein and is thus water-soluble.

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10. **Answer: b**

**Explanation:**

The question states that hydrolysis of compound A yields two different monosaccharides: D-Galactose and D-Glucose. This means compound A is a disaccharide composed of these two units.

Let's examine the hydrolysis products of the options:

(A) Maltose: On hydrolysis, maltose yields two molecules of D-Glucose.

(B) Lactose: On hydrolysis, lactose (also known as milk sugar) yields one molecule of D-Galactose and one molecule of D-Glucose. This matches the description in the question.

(C) Sucrose: On hydrolysis, sucrose yields one molecule of D-Glucose and one molecule of D-Fructose.

(D) Amylose: This is a polysaccharide, a polymer of D-Glucose. On complete hydrolysis, it yields many molecules of D-Glucose.

Therefore, the compound A is Lactose.

---

11. **Answer: a**

**Explanation:**

**Step 1:** Vitamin K is essential for the synthesis of proteins required for blood coagulation (clotting factors).

**Step 2:** Deficiency leads to a condition where blood takes much longer to clot, potentially leading to excessive bleeding.

**Step 3:** Note: Cheilosis is caused by Vitamin  $B_2$  deficiency, and RBC fragility is often linked to Vitamin E deficiency.

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12. **Answer: d**

**Explanation:**

**Step 1:** The  $\alpha$ -helix is a secondary structure of proteins.

**Step 2:** It is stabilized by intramolecular hydrogen bonding between the  $-NH$  group of one amino acid residue and the  $>C=O$  group of an adjacent turn of the helix.

**13. Answer: a****Explanation:**

**Step 1:** Lactose is a disaccharide composed of  $\beta$ -D-galactose and  $\beta$ -D-glucose.

**Step 2:** The linkage is formed between the anomeric carbon (C-1) of the galactose unit and the C-4 hydroxyl group of the glucose unit.

**Step 3:** This is specifically a  $\beta$ -1,4-glycosidic linkage.

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**14. Answer: b****Explanation:**

First, we must identify the given compound 'A'. The structure shown is a pyrimidine base with a methyl group at the 5th position and two carbonyl groups. This is the structure of Thymine (T).

In DNA, the nitrogenous bases form specific pairs between the two strands, held together by hydrogen bonds. This is known as complementary base pairing.

The rules for base pairing in DNA, established by Watson and Crick, are:

1. Adenine (A), a purine, always pairs with Thymine (T), a pyrimidine, via two hydrogen bonds.

2. Guanine (G), a purine, always pairs with Cytosine (C), a pyrimidine, via three hydrogen bonds.

Since compound 'A' is Thymine (T), its complementary base in a DNA strand is Adenine (A).

Uracil is the base that replaces Thymine in RNA and pairs with Adenine.

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**15. Answer: b****Explanation:**

Let's evaluate the purpose of each test:

(A) Seliwanoff's test is used to distinguish between aldose and ketose sugars.

Ketoses give a rapid positive test (a cherry-red color).

(B) Barfoed's test is specifically used to distinguish between reducing monosaccharides and reducing disaccharides. The reagent consists of copper(II)

acetate in a weakly acidic solution. Monosaccharides, being stronger reducing agents, reduce the  $\text{Cu}^{2+}$  ions to red cuprous oxide ( $\text{Cu}_2\text{O}$ ) precipitate much faster (within 2–3 minutes) than disaccharides (which take 10 minutes or more).

(C) Tollen's test (silver mirror test) is a general test for reducing sugars (and aldehydes). Most monosaccharides and many disaccharides (like maltose and lactose) are reducing sugars, so they both give a positive test. It cannot distinguish between them.

(D) The Iodine test is used to test for the presence of starch, which is a polysaccharide. It does not give a positive test for monosaccharides or disaccharides.

Therefore, Barfoed's test is the correct choice to distinguish monosaccharides from disaccharides.

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## 16. Answer: a

### Explanation:

**Step 1: Basic structure of maltose** Maltose is a disaccharide composed of two D-glucose units. Both glucose units exist in the **pyranose (six-membered ring) form**.

**Step 2: Type of glycosidic linkage** In maltose:

The **anomeric carbon (C1)** of the first glucose unit is linked to the **C4 hydroxyl group** of the second glucose unit

Thus, maltose has a **(1→4) glycosidic linkage**. **Step 3: Meaning of  $\alpha$ -(1→4) linkage**

The term  **$\alpha$ -(1→4)** means:

The glycosidic bond formed at C1 of the first glucose has the  **$\alpha$ -configuration**

For D-glucose,  $\alpha$ -configuration means the substituent at C1 is oriented **downwards (axial)** relative to the ring. **Step 4: Meaning of  $\alpha$ -anomer of maltose** Maltose is a

**reducing sugar**, because the second glucose unit has a **free anomeric carbon (C1)**.

The term  **$\alpha$ -anomer of maltose** refers to the configuration of this **free anomeric carbon**:

For the  $\alpha$ -anomer, the **-OH group on C1 of the second glucose** must point **downwards**

**Step 5: Structural features to check** A correct structure of  $\alpha$ -maltose must show:

Two D-glucopyranose rings

$\alpha$ -(1→4) glycosidic bond

Free anomeric carbon on the second glucose

Downward (-OH) orientation at this free anomeric carbon

**Step 6: Identification of the correct option In Option (A):**

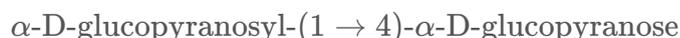
Both rings are D-glucose pyranose units

The linkage is correctly from C1 to C4

The glycosidic bond is  $\alpha$  (downward)

The free anomeric -OH on the second glucose is also  $\alpha$

Hence, option (A) correctly represents



**Final Answer:**

Option (A)

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## 17. Answer: b

### Explanation:

**Step 1: Understanding the Concept:**

Proteins are classified into two broad categories based on their molecular shape and solubility: Fibrous and Globular.

**Step 2: Detailed Explanation:**

**Fibrous Proteins:** These consist of polypeptide chains that run parallel and are held together by hydrogen and disulfide bonds to form thread-like or fiber-like structures. They are generally insoluble in water and serve structural roles.

- **Keratin:** Found in hair, wool, and silk.

- **Myosin:** Found in muscles.

- **Collagen:** Found in tendons, skin, and connective tissues.

**Globular Proteins:** These result when the chains of polypeptides fold around to give a spherical shape. They are usually soluble in water and perform functional/regulatory roles.

- **Albumin:** Found in egg white and blood serum.

- **Insulin:** A hormone.

**Step 3: Final Answer:**

Albumin is an example of a globular protein, not a fibrous protein.

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## 18. Answer: a

## Explanation:

### Step 1: Understanding the Concept:

Glycosidic linkages are the oxygen bridges connecting monosaccharide units in disaccharides or polysaccharides. The  $\alpha$  or  $\beta$  prefix refers to the stereochemistry at the anomeric carbon ( $C_1$ ).

### Step 2: Detailed Explanation:

- **Lactose:** Composed of  $\beta$ -D-galactose and  $\beta$ -D-glucose. The linkage is between  $C_1$  of galactose and  $C_4$  of glucose in a  $\beta$  configuration ( $\beta$ -1,4-linkage).
- **Amylose:** A linear polymer of  $\alpha$ -D-glucose units joined by  $C_1$ - $C_4$  glycosidic linkages in an  $\alpha$  configuration.
- **Sucrose:** Composed of  $\alpha$ -D-glucose and  $\beta$ -D-fructose joined by a glycosidic linkage between  $C_1$  of glucose and  $C_2$  of fructose ( $\alpha$ -1,2-linkage).
- **Maltose:** Composed of two  $\alpha$ -D-glucose units joined by a  $C_1$ - $C_4$  glycosidic linkage in an  $\alpha$  configuration.

### Step 3: Final Answer:

Only lactose contains the  $\beta$ - $C_1$ - $C_4$  glycosidic linkage.

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## 19. Answer: b

## Explanation:

### Step 1: Understanding the Question:

We are asked to identify the specific products, including their stereochemistry and optical rotation, obtained from the hydrolysis of sucrose.

### Step 2: Detailed Explanation:

#### 1. Composition of Sucrose:

Sucrose is a common disaccharide. It is formed by a glycosidic bond between two monosaccharides:  $\alpha$ -D-glucose and  $\beta$ -D-fructose. The linkage connects the anomeric carbon of glucose ( $C-1$ ) to the anomeric carbon of fructose ( $C-2$ ).

#### 2. Hydrolysis Reaction:

Hydrolysis, which can be catalyzed by an acid (like HCl) or an enzyme (like invertase or sucrase), breaks the glycosidic bond. This releases the two constituent monosaccharides.



#### 3. Stereochemistry and Optical Rotation of Products:

- The glucose unit is released as  $\alpha$ -D-**glucose**. D-glucose is dextrorotatory, meaning it rotates plane-polarized light to the right. This is indicated by a (+) sign. So, the product is  $\alpha$ -D-(+)-**glucose**. (In solution, it undergoes mutarotation to an equilibrium mixture of  $\alpha$  and  $\beta$  forms, but the initial product is the  $\alpha$ -anomer).
- The fructose unit is released as  $\beta$ -D-**fructose**. D-fructose is levorotatory, meaning it rotates plane-polarized light to the left. This is indicated by a (-) sign. So, the product is  $\beta$ -D-(-)-**fructose**.

#### 4. Conclusion:

The hydrolysis of sucrose yields an equimolar mixture of  $\alpha$ -D-(+)-glucose and  $\beta$ -D-(-)-fructose. Comparing this with the given options, option (B) is the correct choice.

#### Step 3: Final Answer:

Hydrolysis of sucrose gives  $\alpha$ -D-(+)-glucose and  $\beta$ -D-(-)-fructose.

---

## 20. Answer: a

### Explanation:

#### Step 1: Understanding the Concept:

Uracil is a nitrogenous base found in RNA. It can exist in several tautomeric forms (lactam and lactim), but one specific form is biologically active and present in the RNA structure.

#### Step 2: Detailed Explanation:

Uracil (2,4-dioxypyrimidine) exists primarily in the **diketo form** (lactam form) under physiological conditions and in the structure of RNA. This form allows for specific hydrogen bonding with adenine.

Option (A) represents the diketo form with two  $C=O$  groups and two  $NH$  groups in the ring.

Options (B), (C), and (D) represent various enol (lactim) tautomers which are less stable and not the predominant form in nucleic acids.

#### Step 3: Final Answer:

The diketo form shown in Option (A) is the one present in RNA.

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## 21. Answer: 4 - 4

### Explanation:

### Step 1: Understanding the Concept:

The charge on a peptide depends on the pH of the medium and the  $pK_a$  values of its ionizable groups (N-terminal, C-terminal, and side chains). At a pH much higher than the  $pK_a$ , the group is deprotonated.

### Step 2: Detailed Explanation:

Identify ionizable groups in Gly-Glu-Asp-Tyr at pH 12.5:

1. **N-terminal amine (Gly):**  $pK_a \approx 9.6$ . At pH 12.5, it is deprotonated ( $-NH_2$ ). Charge = 0.
2. **C-terminal carboxyl (Tyr):**  $pK_a \approx 2.2$ . At pH 12.5, it is deprotonated ( $-COO^-$ ). Charge = -1.
3. **Glu side chain carboxyl:**  $pK_a \approx 4.2$ . At pH 12.5, it is deprotonated ( $-COO^-$ ). Charge = -1.
4. **Asp side chain carboxyl:**  $pK_a \approx 3.9$ . At pH 12.5, it is deprotonated ( $-COO^-$ ). Charge = -1.
5. **Tyr side chain phenol:**  $pK_a \approx 10.1$ . At pH 12.5, the phenolic group is deprotonated ( $-O^-$ ). Charge = -1.

Total negative charge = 1(C-term) + 1(Glu) + 1(Asp) + 1(Tyr) = 4.

### Step 3: Final Answer:

The total number of negative charges is 4.

## 22. Answer: c

### Explanation:

#### Step 1: Analyzing Assertion (A)

Assertion (A) states that Sucrose is a disaccharide and a non-reducing sugar.

**Disaccharide:** Sucrose is formed by the condensation of two monosaccharide units, glucose and fructose. Therefore, it is a disaccharide.

**Non-reducing sugar:** A sugar is reducing if it has a free hemiacetal or hemiketal group. In sucrose, the anomeric carbon of glucose (C1) and the anomeric carbon of fructose (C2) are involved in the glycosidic bond. Since both anomeric carbons are locked in the bond, there are no free hemiacetal or hemiketal groups. Thus, sucrose cannot open its ring structure to form a free aldehyde or ketone group and does not reduce Tollens' or Fehling's reagent. Hence, it is a non-reducing sugar.

Therefore, Assertion (A) is true.

#### Step 2: Analyzing Reason (R)

Reason (R) describes the glycosidic linkage in sucrose. It states that the linkage is between  $C_1$  of  $\beta$ -glucose and  $C_2$  of  $\alpha$ -fructose.

The actual structure of sucrose consists of a glycosidic linkage between the  $C_1$  of  $\alpha$ -D-glucose and the  $C_2$  of  $\beta$ -D-fructose. The statement in Reason (R) has the anomers of both glucose and fructose incorrect. It should be  $\alpha$ -glucose and  $\beta$ -fructose.

Therefore, Reason (R) is false.

### Step 3: Final Answer

Since Assertion (A) is true and Reason (R) is false, the correct option is (C).

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## 23. Answer: d

### Explanation:

To determine which vitamins are fat-soluble, let's first understand the characteristics of fat-soluble and water-soluble vitamins.

- **Fat-Soluble Vitamins:** These vitamins are absorbed along with fats in the diet and can be stored in the body's fatty tissue. They include Vitamin A, D, E, and K.
- **Water-Soluble Vitamins:** These are not stored in the body and must be consumed more regularly. They include Vitamin B-complex (e.g.,  $B_1$ ,  $B_2$ ,  $B_{12}$ , etc.) and Vitamin C.

In the given options:

- **Vitamin E** is a fat-soluble vitamin.
- **Vitamin K** is also a fat-soluble vitamin.
- **Vitamin  $B_1$  and  $B_{12}$ :** Both are water-soluble vitamins.
- **Vitamin C:** This is a water-soluble vitamin.

Hence, the correct answer is *C and E Only* which corresponds to Vitamin E and Vitamin K, both of which are fat-soluble.

Conclusion: Vitamins that are fat-soluble can be stored in the body and include Vitamins A, D, E, and K. Among the options provided, only Vitamin E and Vitamin K are fat-soluble.

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## 24. Answer: 33 – 33

### Explanation:

To determine the total number of hydrogen bonds in a DNA-double helix strand based on the given sequence, we must consider how base pairing occurs. In DNA, the bases Guanine (G) and Cytosine (C) pair together with 3 hydrogen bonds, while Adenine (A) and Thymine (T) pair with 2 hydrogen bonds.

The provided sequence is:

5'-G-G-C-A-A-A-T-C-G-G-C-T-A-3'

Let's count the hydrogen bonds for each base pair:

- G-G: 2 Guanine bases paired with Cytosine =  $2 \times 3 = 6$  bonds
- C: 1 Cytosine base paired with Guanine = 3 bonds
- A-A-A: 3 Adenine bases paired with Thymine =  $3 \times 2 = 6$  bonds
- T: 1 Thymine base paired with Adenine = 2 bonds
- C: 1 Cytosine base paired with Guanine = 3 bonds
- G-G: 2 Guanine bases paired with Cytosine =  $2 \times 3 = 6$  bonds
- C: 1 Cytosine base paired with Guanine = 3 bonds
- T: 1 Thymine base paired with Adenine = 2 bonds
- A: 1 Adenine base paired with Thymine = 2 bonds

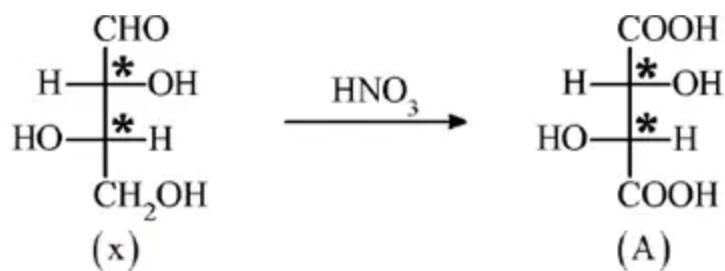
Adding all these together gives the total number of hydrogen bonds:  $6 + 3 + 6 + 2 + 3 + 6 + 3 + 2 + 2 = 33$ .

Thus, the total number of hydrogen bonds is 33, which falls within the specified range (33,33).

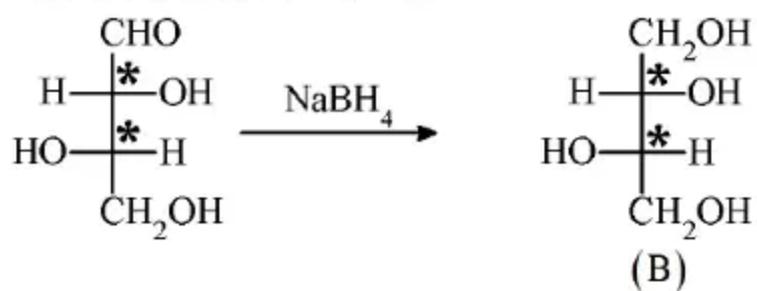
## 25. Answer: d

### Explanation:

The reaction of L-tetrose with  $\text{HNO}_3$  results in the formation of a compound with two chiral centers, and on reduction with  $\text{NaBH}_4$ , a compound (B) is formed which is optically active.



L-tetrose with two chiral centre



Optically active

