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LECTURE **Biochemistry**

SUBJECT Lecture 6
second

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PAGES

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للتصفح

Chapter 16

"Carbohydrates CHO"

↳ main source of Energy in Our Bodies

CHO
Carbohydrates

Monosaccharides
سكريات احادية
↓
اي تركيب بسيط
علبة

Formula الصيغة

$C_n(H_2O)_n$

n = 3, 4, 5 ...
اي عدد

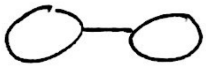
n = 3 $C_3H_6O_3$

n = 5 $C_5H_{10}O_5$

n = 6 $C_6H_{12}O_6$

Oligosaccharides
↓
عدد قليل من
السكريات الاحادية

↓
منها / أهمها
Disaccharides
السكريات الثنائية



Polysaccharides
سكريات متعددة
↓
عدد كبير من
السكريات
الاحادية
100s – 1000s
↓
وظيفتها

① Storage

or

② Structural

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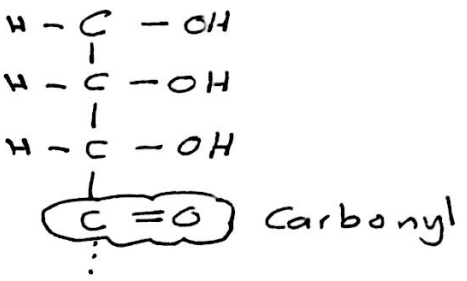
Monosaccharide

Formula $C_n(H_2O)_n$

سكر إحادي في الطبيعة

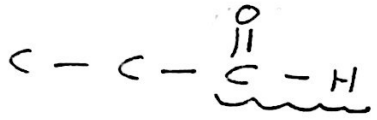
500 حد كبير

تختلف في

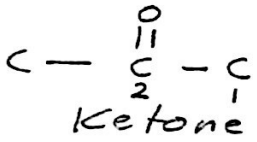


One Carbonyl and many hydroxyls

1 Functional Group



→ Aldose ← more common in nature



→ Ketose

2 Number of Carbon

3C → triose $C_3H_6O_3$

4C → tetrose $C_4H_8O_4$

5C → pentose $C_5H_{10}O_5$

6C → Hexose ← most common in Nature

7C → Heptose

* 5C sugars → found in DNA, RNA

4C, 7C sugars → important in photosynthesis & others.

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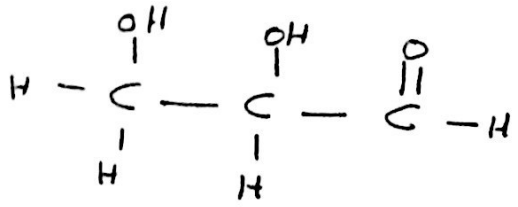
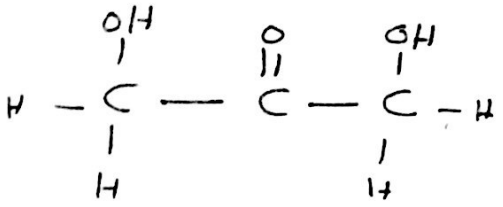
Sugar was

* Aldose & triose ⇒ (Aldotriose)



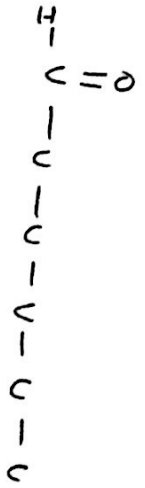
Glyceraldehyde & الوحيد الذي ينتمي لهذه الفئة Aldotriose

if Ketose & triose ⇒ (Ketotriose)



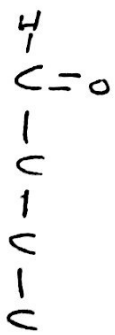
Dihydroxyacetone

* Aldose & Hexose ⇒ (Aldohexose)



* Ketose & pentose ⇒ (Ketopentose)

* Aldose & tetrose ⇒ (Aldotetrose)



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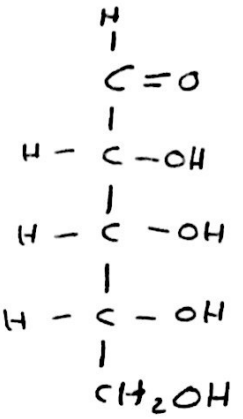
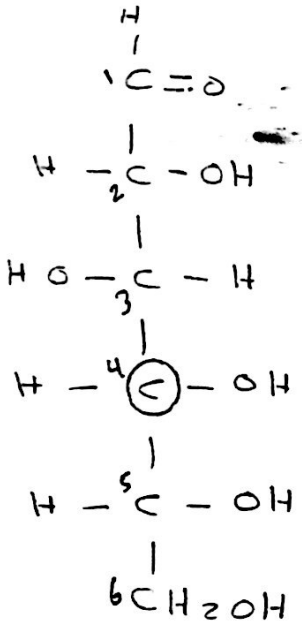
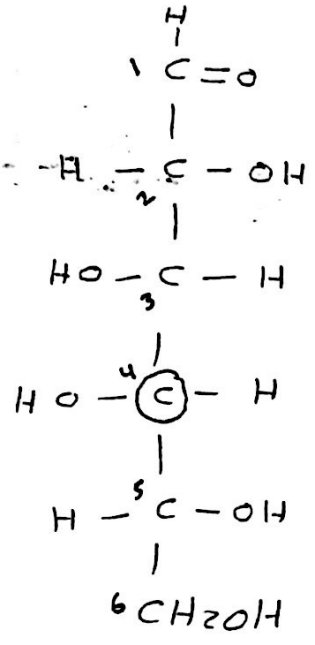
Ex:- the following sugar is :

a. Aldo heptose
b. Ketopentose
c. Aldopentose
d. Aldotetrose.



Glucose Galactose





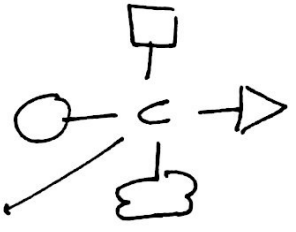
Glucose & Galactose are Hexoses 6C & Aldoses

إذا اختلف فرق آخر بين السكريات الأحادية

هو Configuration الشكل الفراغي

Sterioisomers.

نظائر مركبات لها نفس الذرات وتختلف في الشكل الفراغي



⇐ Chiral Carbon هي نوع Sterioisomer

وترتبط مع ذرة أو مجموعتين

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قانون لحساب عدد Sterioisomers لأي مركب

"عدد Chiral Carbon" = 2

نرمز D ← Predominate "most common"

نرمز L

For Aldose:-

$$\#\text{ of chiral Carbons} = \#\text{ of Carbon atoms} - 2$$

For Ketose:-

$$\#\text{ of chiral Carbons} = \#\text{ of Carbon atoms} - 3$$

Examples:-

① Aldotriose "Glyceraldehyde"

# of chiral C = 3 − 2 = 1

# of sterioisomers = $2^1 = 2$ ← D-Glyceraldehyde, L-Glyceraldehyde

② Ketotriose "Dihydroxyacetone"

# of chiral C = 3 − 3 = Zero

# of sterioisomers = $2^0 = 1$

اذا Dihydroxyacetone موجود بشكل واحد في الطبيعة

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Questions :-

Aldohexose ?

# of chiral Carbons = 4

# of Sterio isomers = 16

Ketopentose ?

# of Chiral Carbons = 2

# of Sterio isomers = 4

انواع الـ Sterioisomers

[1] Enantiomers : Mirror Image / non-superimposable

[2] Diasteriomers : Non - Mirror Image / non-superimposable

[3] Epimers : Diasteriomers نوع من انواع / non-superimposable

لكن يختلفوا عن بعض
على كربونة واحدة

صفة او من
الصور

مثل الـ Glucose و الـ Galactose

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# of Chiral Carbons = 4 - 2 = 2

# of Sterioisomers = 2^2 = 4

2D 2L

D- Erythrose , L- Erythrose , D-Therose , L -thero

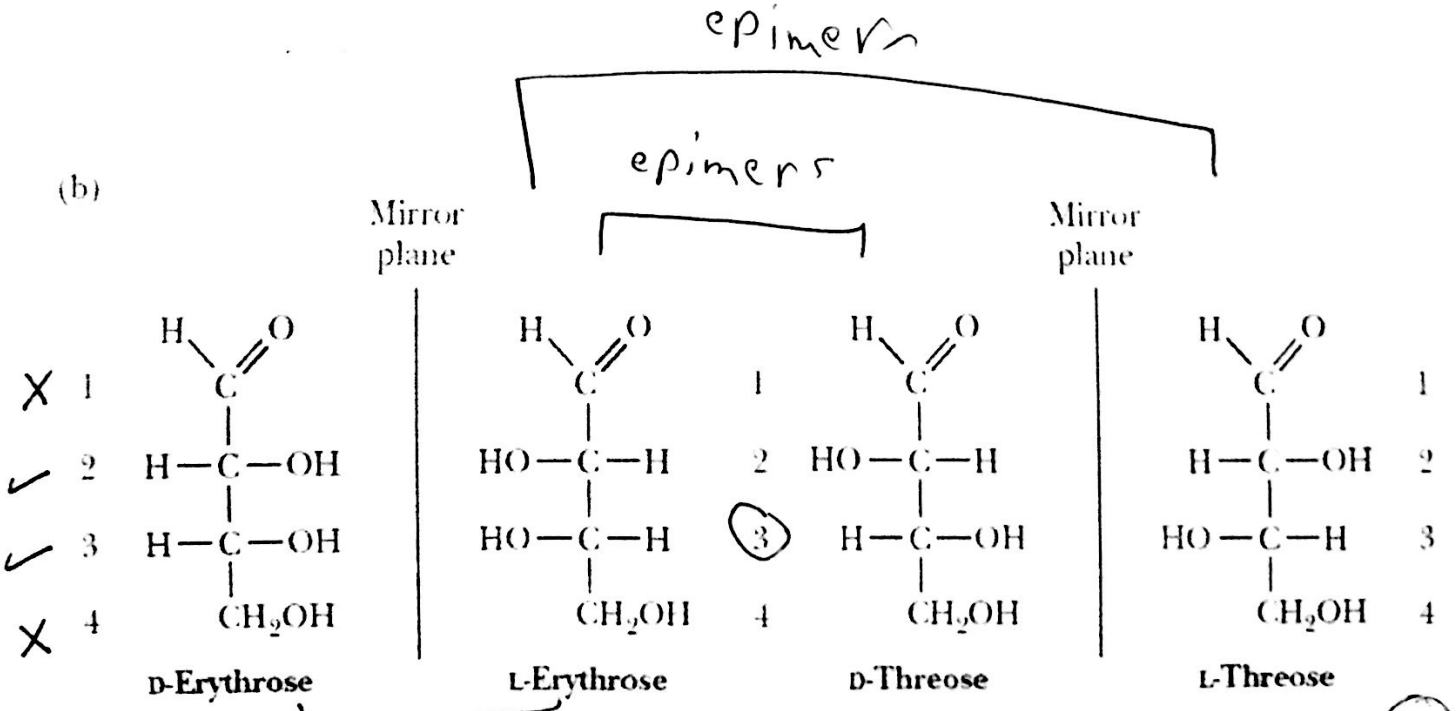
Enantiomers Enantiomers

Diasteriomers

من الجيد نعرف ان كل ال Diasteriomers

في هذه العائلة هي ايضاً Epimer

هذا ينطبق فقط على عائلة Aldotetrose



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enantiomers

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Example : Aldotetrose → Diastereomer
4C

# of chiral Carbons = 4 - 2 = 2

# of sterioisomers = $2^2 = 4$

2D 2L

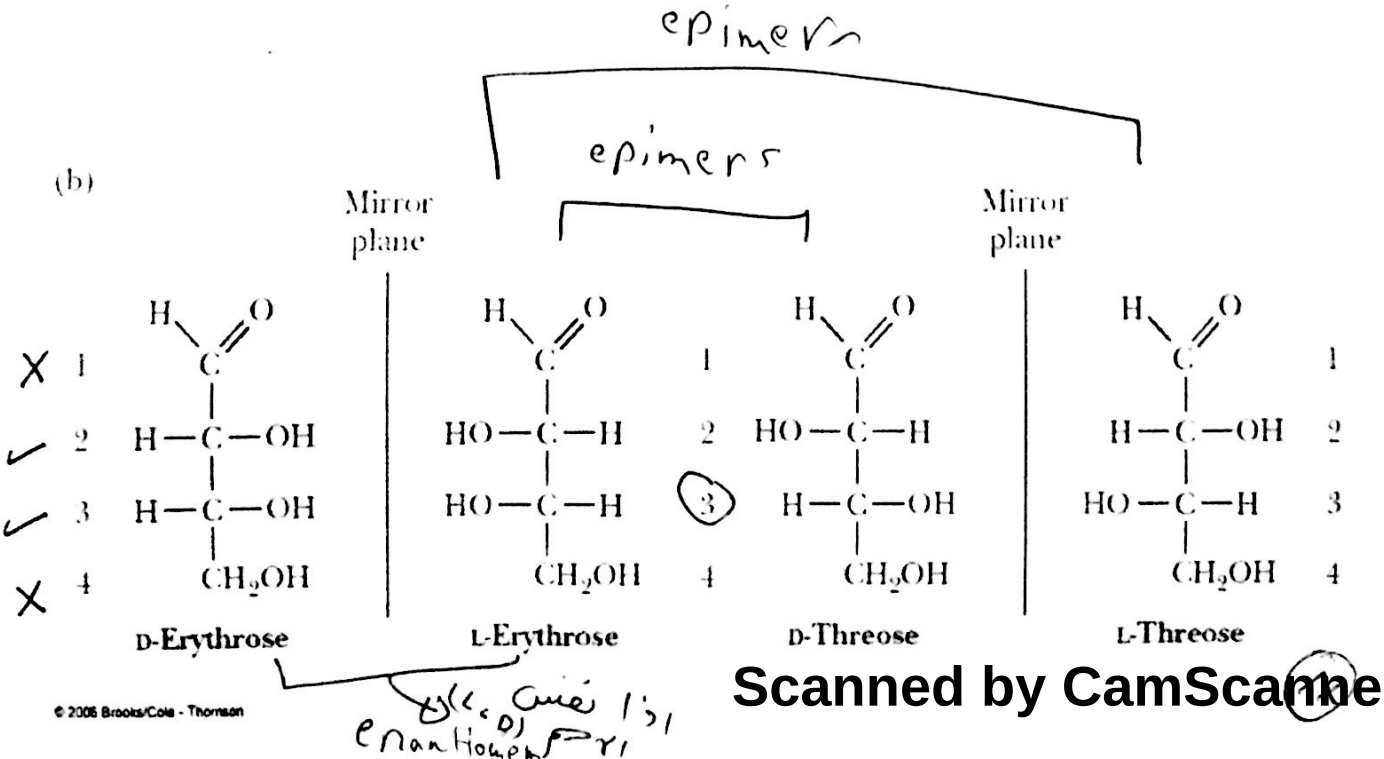
D- Erythrose , L- Erythrose , D- Therose , L -therose

Enantiomers Enantiomers

Diasteriomers

من الجدول نعرف ان كل ال Diasteriomers في هذه العائلة هي ايضاً Epimer

Aldotetrose هذا ينطبق فقط على عائلة



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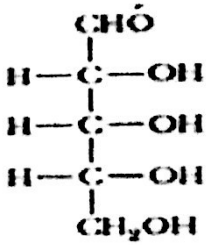
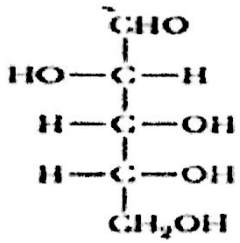
Examples: Aldopentose

# of chiral C = 5 − 2 = 3

# of Steriosomers = $2^3 = 8 <$ 4 D / 4 L

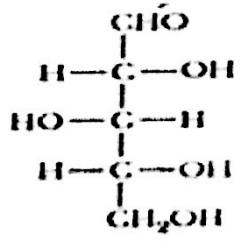


D-Ribose.

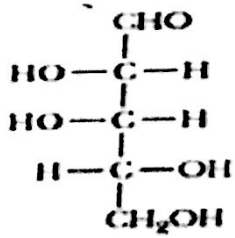


D-Arabinose

1
2
3
4
5



D-Xylose



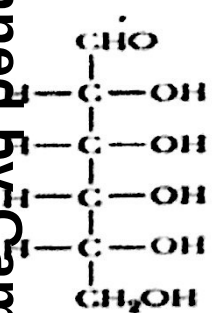
D-Lyxose

هذه ستيريو

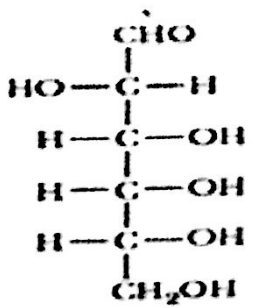
Example: Aldohexose

# of chiral C = 6 − 2 = 4

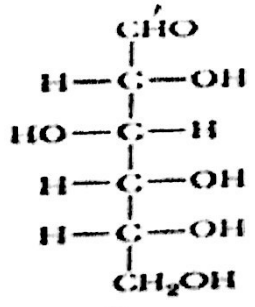
# of Steriosomers = $2^4 = 16 <$ 8 D / 8 L



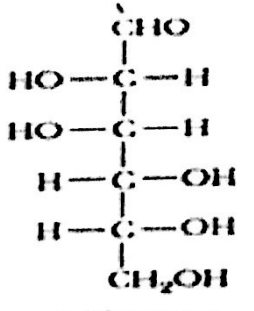
D-Allose



D-Altrose

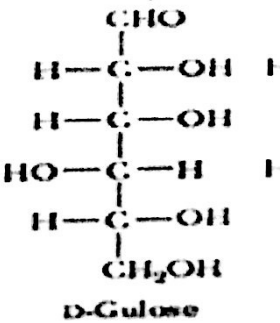


D-Glucose

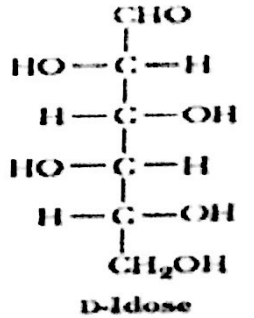


D-Mannose

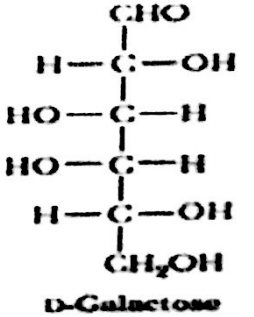
1
2
3
4
5
6



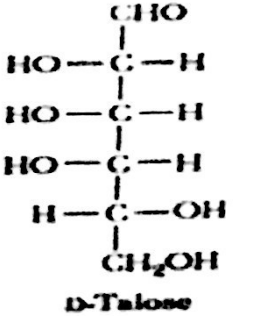
D-Gulose



D-Idose



D-Galactose



D-Talose

هذه

D-glucose X D-Galactose Epimer on C_4

D-glucose X D-Allose Epimer on C_3

D glucose X D-mannose Epimer on C_2

هذه

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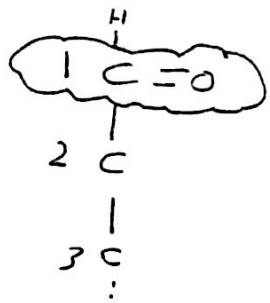
Fisher-projection طريقة لرسم Sterioisomers

1 ——— Horizontal افقي → in Front لبرا

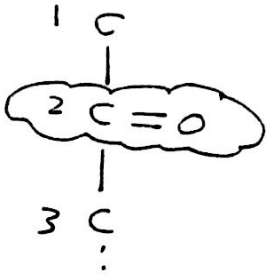
| Vertical عمودي → Behind لجوا

2 Give Each C a Number

Aldose



Ketose



C=O Aldose (1)

C=O Ketose (2)

3 L & D

chiral Carbon with highest # قبل الاخيرة

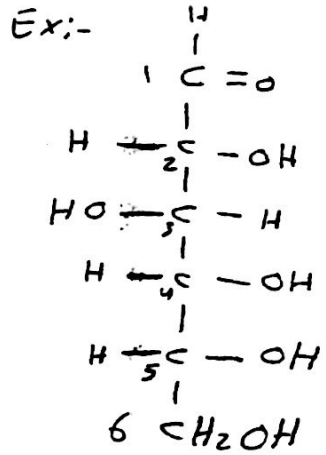
Q حسب اللي على OH

لل chiral كاربون اللي الـ OH أعلى رقم

—OH يمين D

HO— يسار L

Ex:-



ماتوع هذا الـ Glucose

L or D

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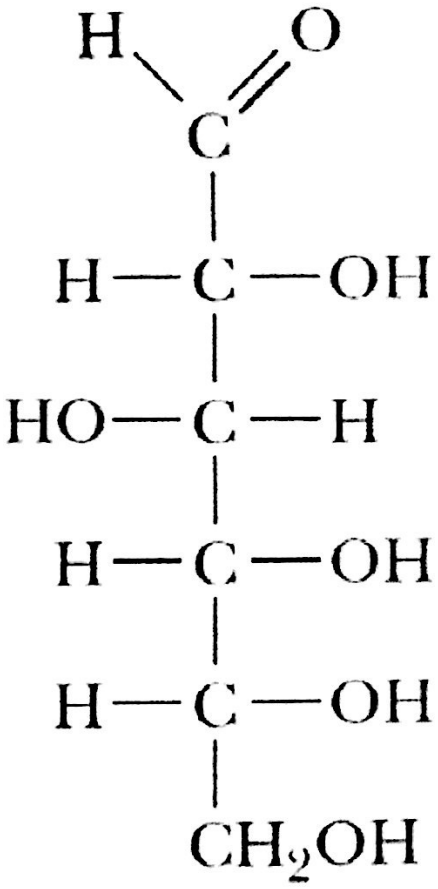
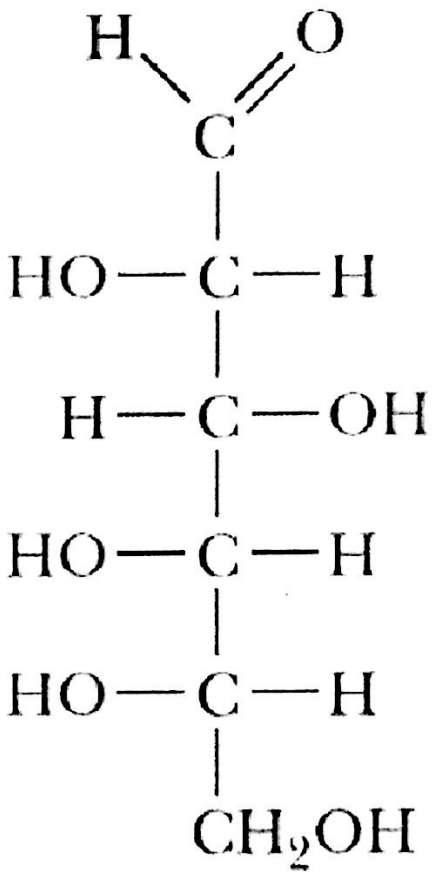


D-Glucose



L-Glucose

Carbon number

1

2

3

4

5

6

* Enantiomers differ on all chiral carbons

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Fig. 16-2b, p.436

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Q: How many carbon atoms are in the simplest carbohydrate?

a. 1 c. 3 e. 5

b. 2 d. 4

Q: Diastereomers are:-

a. mirror image, non-superimposable stereoisomers

b. non-mirror image, non-superimposable stereoisomers

c. Stereoisomers with one or more double bonds

d. none of the above.

Q: How many enantiomeric pairs are possible for aldohexose?

a. 2 c. 8 e. 32

b. 4 d. 16

Q: Isomers of sugars in which the position of aldehyde and Ketone groups have been changed are called

a. anomers

b. diastereomers

c. enantiomers

d. epimers

e. none of these.

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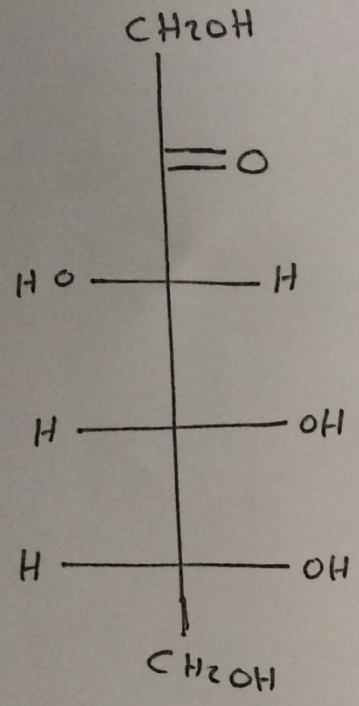
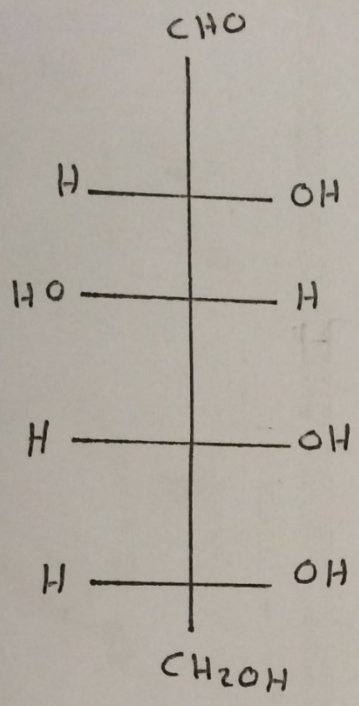
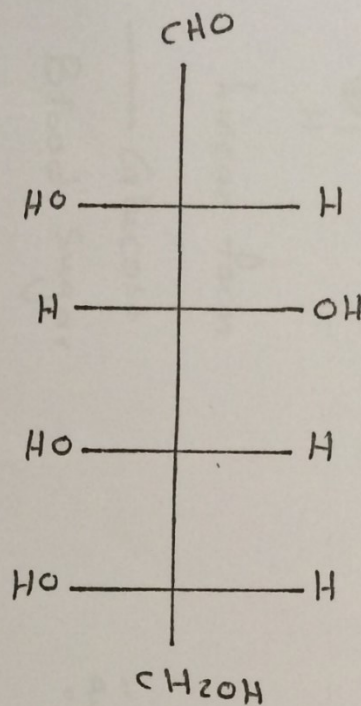


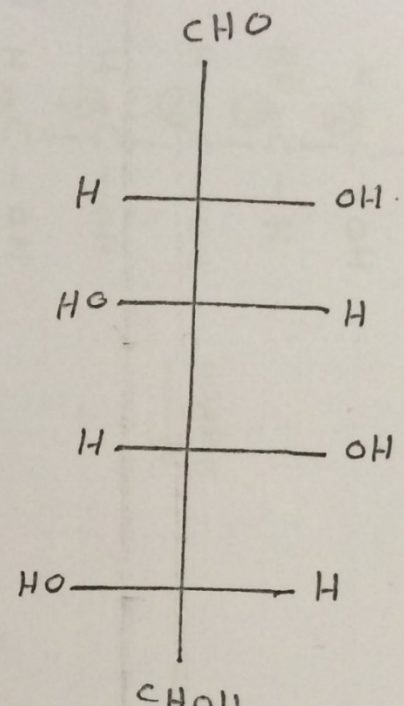
D - Fructose



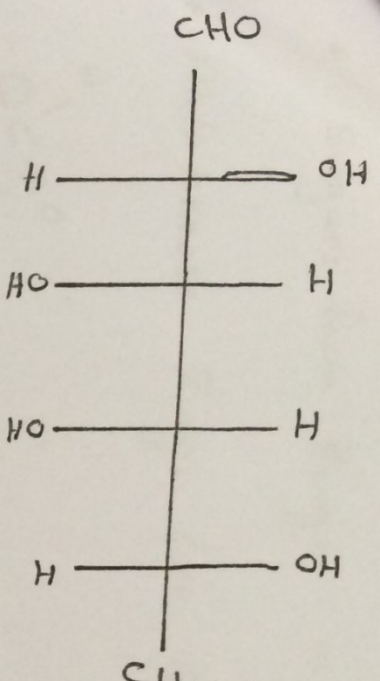
D - Glucose



L - Glucose



L - Idose



D - Galactose

Q: the enantiomers of D-glucose is L-Glucose

Q: Epimers of D-glucose are L-Idose and D-Galactose

Q: L-Glucose and L-Idose are Diasteriomers.

Q: How many chiral carbons are in D-Fructose 3

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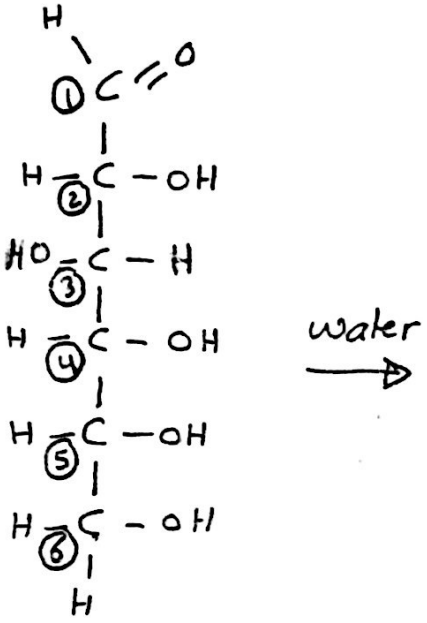
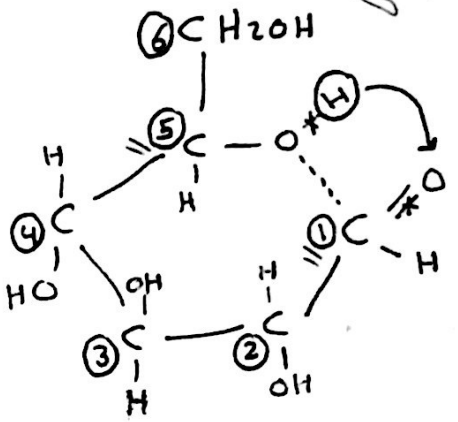
Cyclic Sugars

* Sugars form Rings in water

* Aldo hexose Rings (ex: Glucose, Galactose ..)



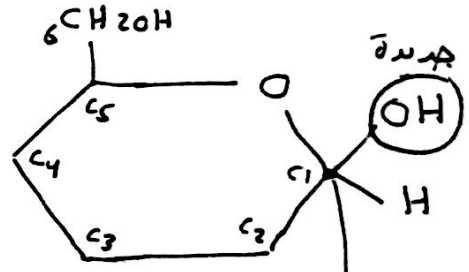
water →



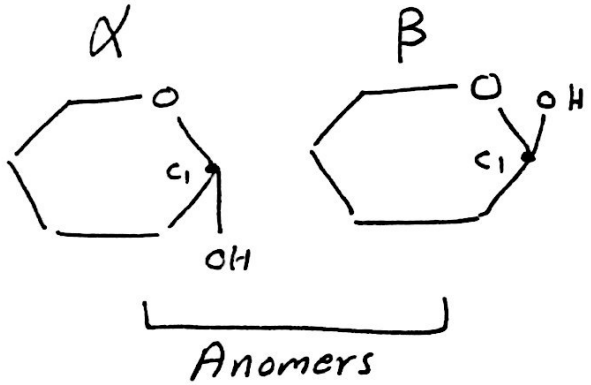
Linear form

— Glucose

Blood Sugar



Ring form



Anomers

Chiral

Anomeric Carbon

C=O

C_1 in aldose

* To form aldose ring

aldehyde + alcohol → Hemiacetal

(1) (5)

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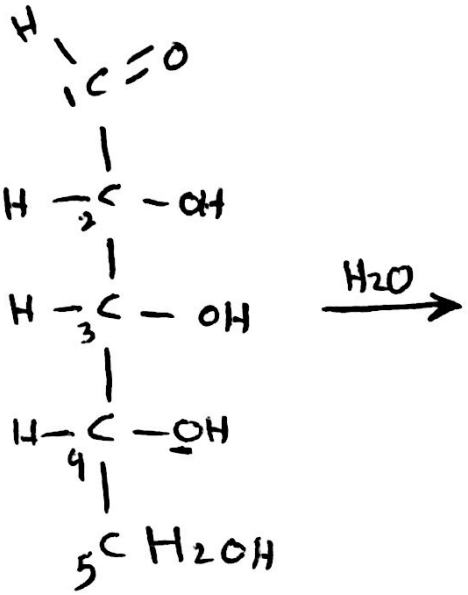
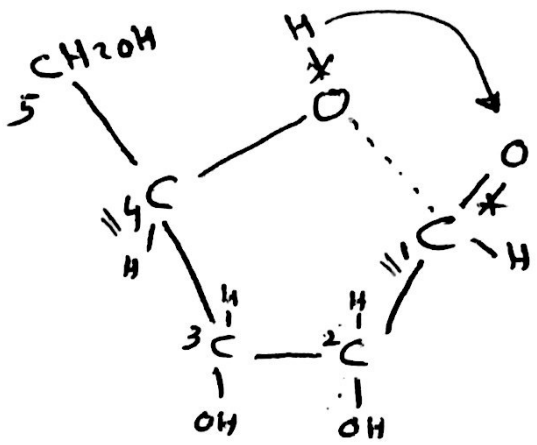
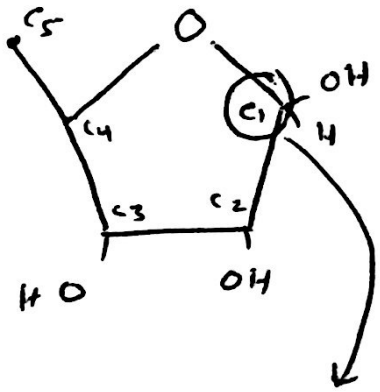
5C
Aldopentose Ex: Ribose



D-Ribose

H_2O

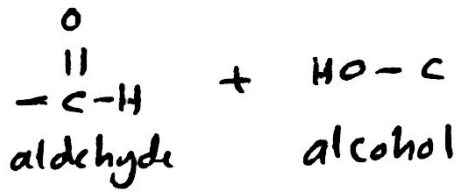




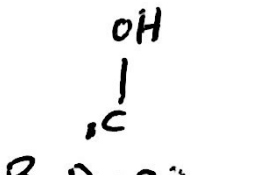
Anomeric Carbon
C_1

① So, In any aldose
Ring
Anomeric Carbon is C_1

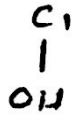
② To form aldose Ring



Hemiacetal



β-D-Ribose



α-D-Ribose

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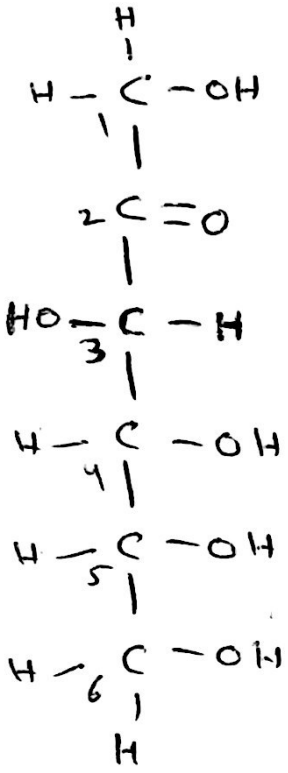
Ketohexose



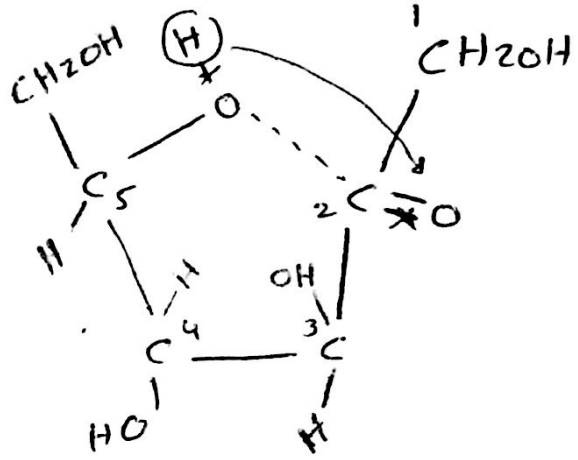
linear form

— Fructose
Fruit sugar

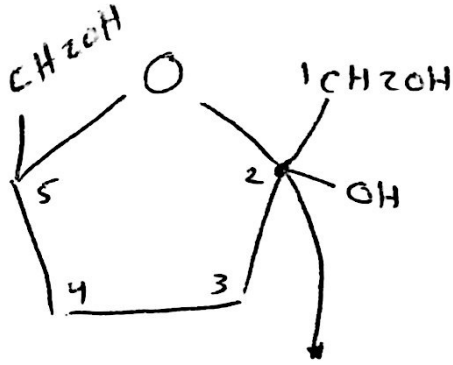
to form
Ketose ring

Ketone + alcohol → Hemiketal

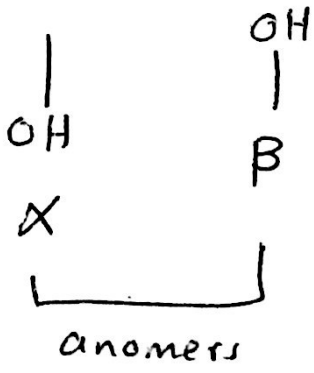
water →



ring form



Anomeric
Carbon
C_2



anomers

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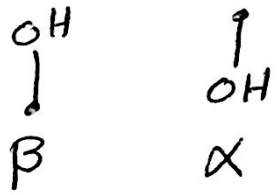
Summary

* In Ring form C=O becomes Chiral Carbon
  Called anomeric Carbon
  C_1 aldose
  C_2 Ketose

* 2 New Sterioisomers in Rings (Anomers) α , β
  according to OH on anomeric C



* Aldohexose ($C_1 \rightarrow C_5$) حلقة سداسية Hemiacetal
* Ketohexose ($C_2 \rightarrow C_5$) حلقة سداسية Hemiketal

* عدد Chiral Carbons في الـ Ring يزداد واحدة

بالتالي عدد Sterioisomers لـ Ring يتضاعف

How many Sterioisomers for **Glucose** rings?

* α and β can be converted to each other
  Only through the Linear form.
  (the free Carbonyl form)

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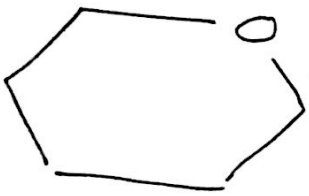
Howrth Projection

طريقة لرسم Rings

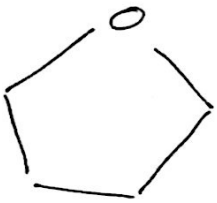
Chair Conformation



الحلقة السداسية Pyranose

chair conformation

Planner



Furanose

planner

Glucose Aldohexose → Glucopyranose حلقة جلوكوز السداسية

Fructose Ketohexose → Fructo Furanose . حلقة الفركتوز الخماسية

Ribose Aldopentose → Ribo Furanose

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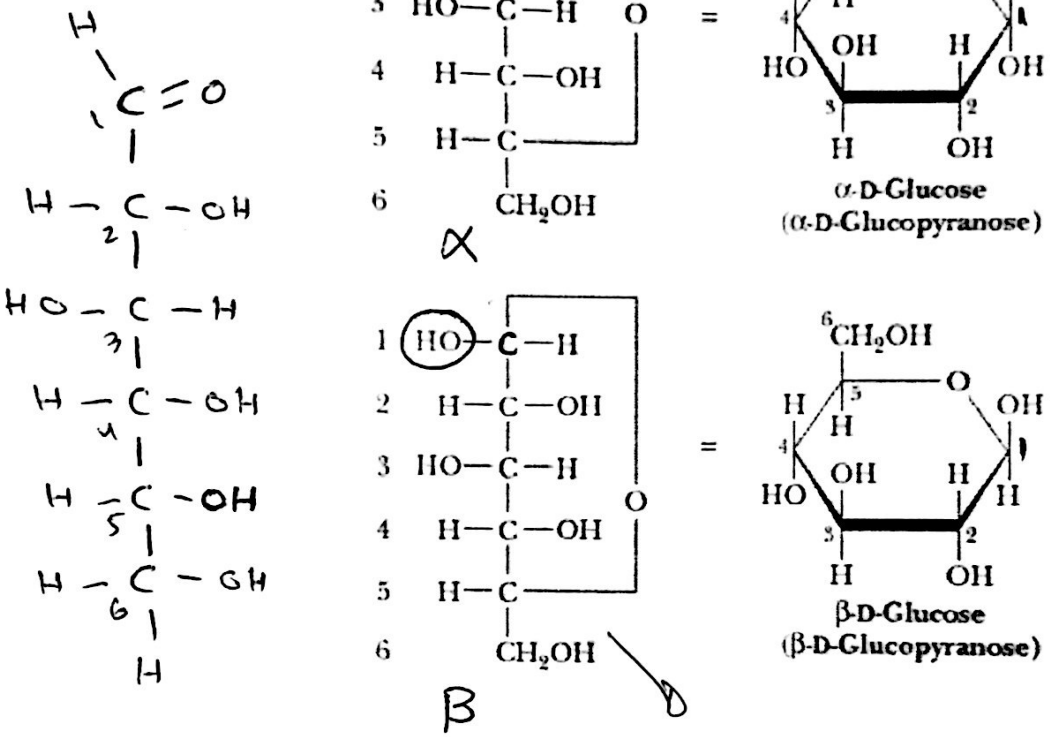
Comparing Fisher and Haworth Rings.

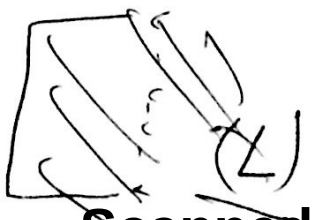


D-glucose

لو كانت ل
بتكون الكلمة على
اليسار

* everything was on Right in Fisher, will be Down in Haworth

* everything was on left in Fisher, will be up in Haworth



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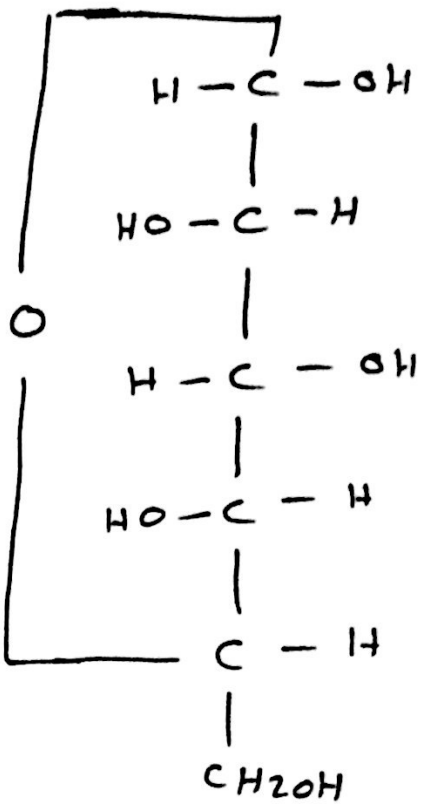
Q: what is the type of this Glucose Ring?



L - α

Q: Haworth projection Formula:-

a. are representations of the Cyclic form of Sugars

b. Can Show the distinction between α and β anomers

c. Both of the above

d. none - of the above

Q: For the α-anomer of D-sugar, the anomeric (OH) in a Haworth projection:-

a. has an upward projection

b. has a downward projection

c. may be up or down depending on the sugar

d. is non-existant, anomers a consideration only in Fisher

Q: Cyclic Form of Sugars :-

a. has one more chiral Carbon than the open chain form

b. loses a chiral Carbon Compared to the open chain form

c. is not usually found in nature

d. has one more Carbon than the open chain form

e. has one less Carbon than the open chain form

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