

# Chapter 22 - Carbohydrates (sugars, saccharides)

① Sugars: General formula  
 $C_x(H_2O)_x$  "carbohydrate"

ex

(R)-glyceraldehyde (S)-glyceraldehyde

$C_3H_6O_3 \rightarrow C_3(H_2O)_3$  ↑  
 enantiomers

② Naming: common names

glyceraldehyde is a aldotriose

CHO ← aldehyde      aldo = aldehyde

H-C-OH

CH<sub>2</sub>OH ← 1° Alcohol      tri = 3 carbons

ex

← an aldopentose

③ Fisher Projection - special drawing convention  
 (Emil Fisher; 1902 Nobel Prize)

ex

R-glyceraldehyde

- ① Rotate RCHO up
- ② draw OHs horizontal & out
- ③ draw all bonds in plane

Fisher projection

④ Stereochemical Designations.

D & L designate enantiomeric series. (note each rotate ROR light in opposite directions)

erythrose

2 chiral centers      mirror

D-erythrose

L-erythrose

If -OH closest to 1° Alcohol is on Right = D series

Left = L series

⑤ Aldohexoses (aldehyde, six carbons)

In general 4 stereocenters

∴ 24 stereoisomers = 16 stereoisomers

8 in D-series

8 in L-series

- don't need to know names

- 8 more in L-series (enantiomers of those shown)

all diastereomers

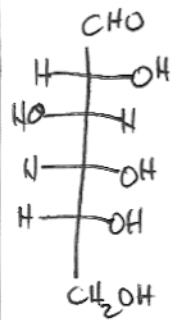
D-series

D-Allose      D-Aldrose      D-glucose      D-fructose      D-mannose      D-Idose      D-galactose      D-tulose

⑦

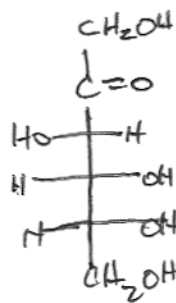
### ketoses (ketosugars)

Aldose



D-glucose

Ketose

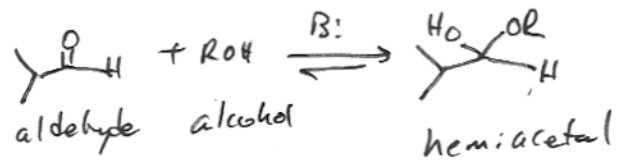


D-fructose

⑦

### Chemistry of sugars

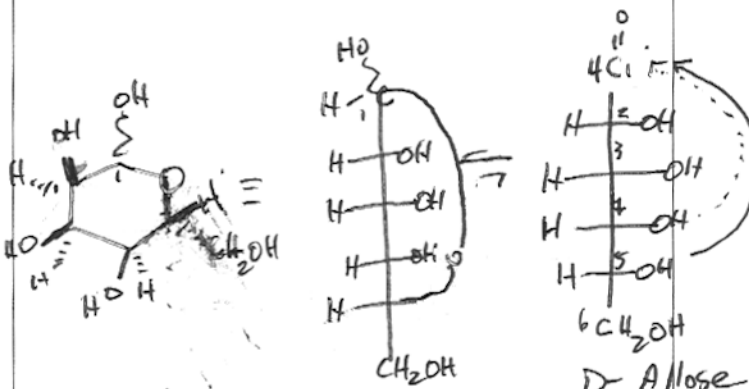
Recall



sugars can form 5 & 6 membered cyclic hemiacetals

⑧

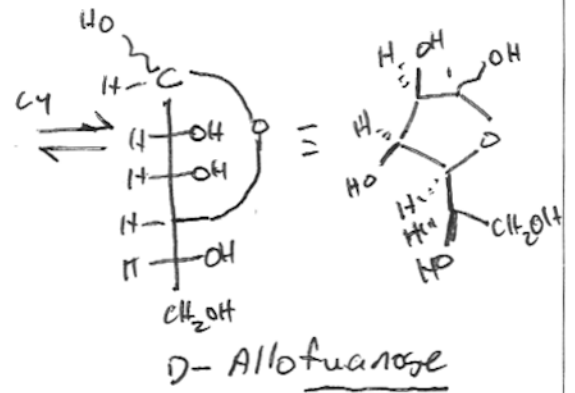
6-membered ring = pyranose



D-allopyranose

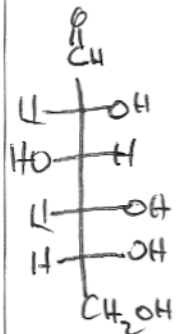
general favored 192

5-membered Ring = furanose

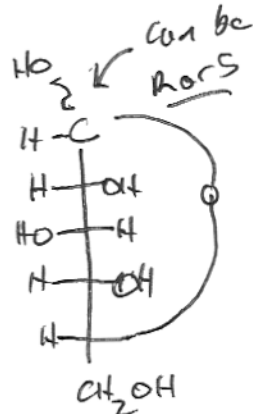


D-allotriose

⑨ Anomers



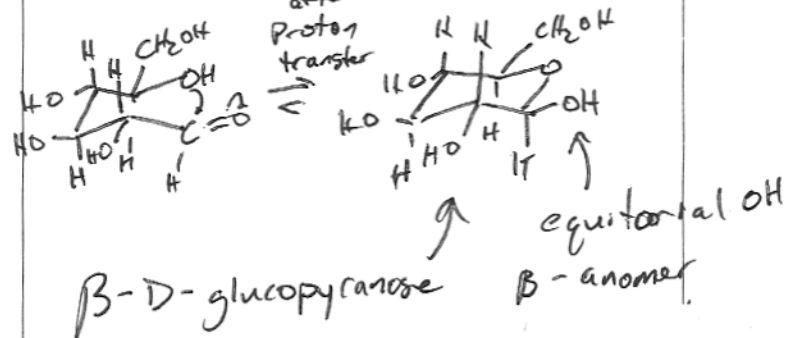
D-glucose



D-glucopyranose

Diastereomers at hemiacetal are called anomers

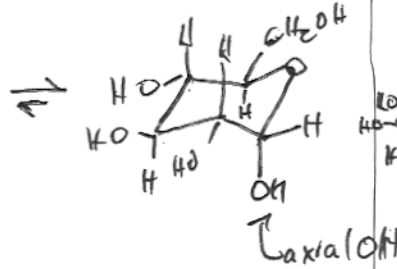
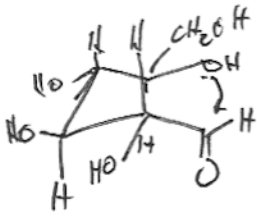
⑩ In 3D - 2 possibilities



$\beta$ -D-glucopyranose

equatorial OH  
 $\beta$ -anomer

11)  $\alpha$ -isomer most stable cat.

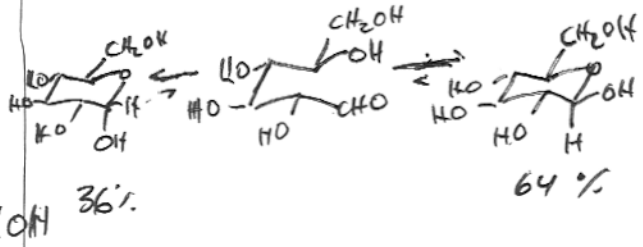


$\alpha$ -D-glucopyranose

$\alpha$ -anomer

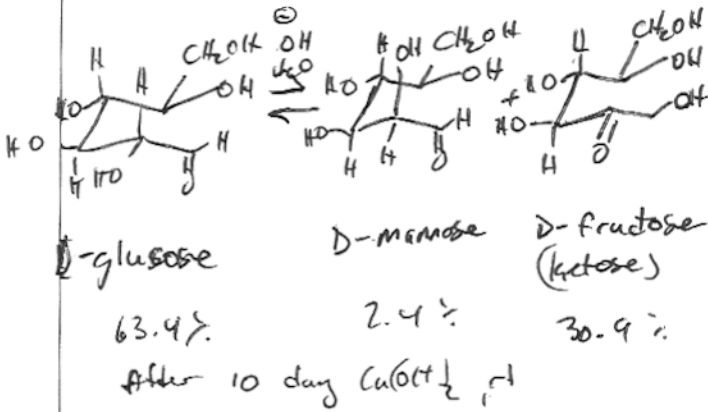
for glucose in water at 25°C  
 $\alpha$  Pyranose 36  
 $\beta$  Pyranose 64  
 $\alpha$  furanose <1  
 $\beta$  furanose <1

12) equilibrium

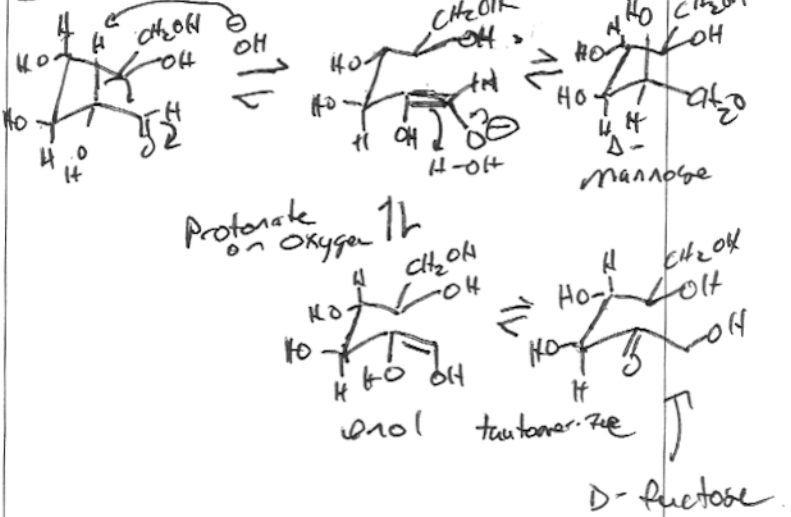


note: Base cat. equilibrium

13) isomerization in base

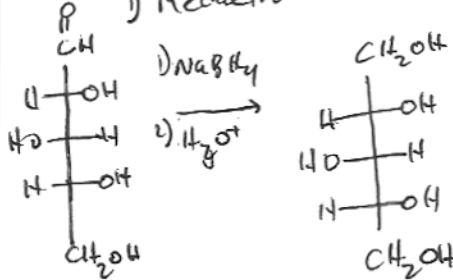


14) Mech:



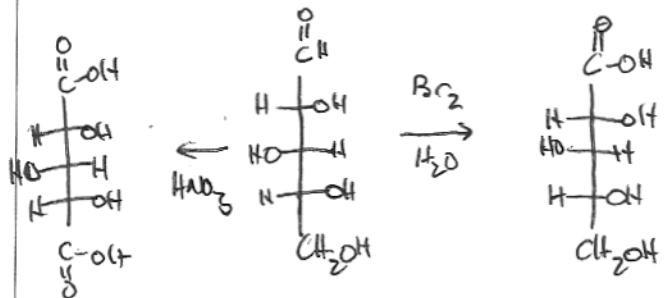
15) Rxns of sugars

1) Reduction



Note must have equilibrium conc. of open form aldehyde = called reducing sugar

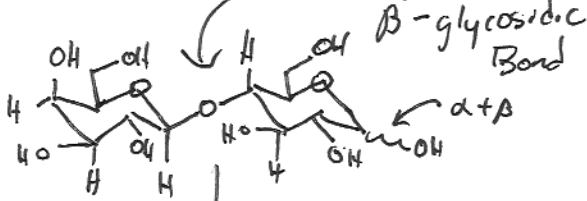
2) Oxidation



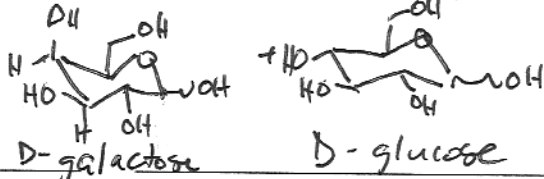
an aldonic acid

17 Disaccharides

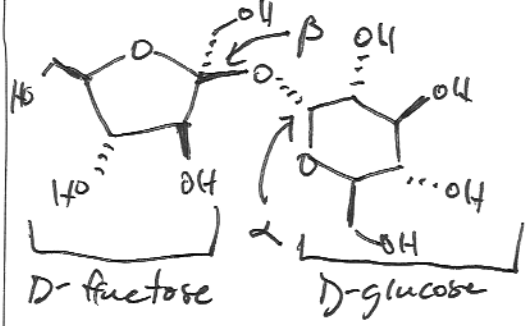
ex (+) lactose



D-galactose      D-glucose  
↓                      ↓  
lactases (or HCl/H<sub>2</sub>O)

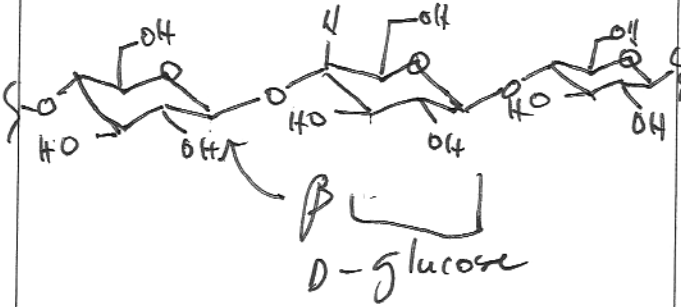


18 ex 2 Sucrose - table sugar

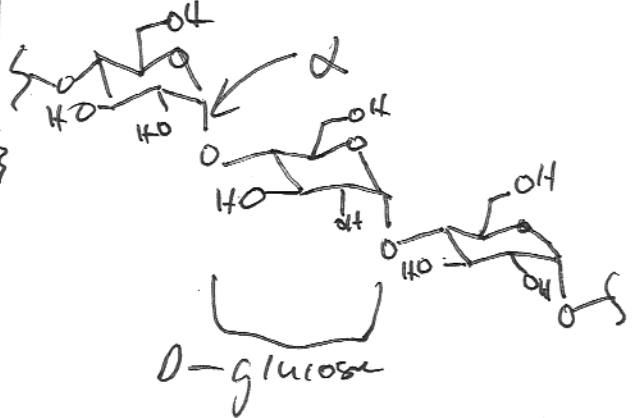


19 Polysaccharides - polymers

Cellulose - wood fiber/cell walls  
plant



20 Amylose - plant starch



16A

