LECTURE: Biochemistry

SUBJECT: Lecture 7
second

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Reactions of monosaccharides

1 * Oxidation - Reduction Reactions

Oxidation : loss of $\bar{e}$

Reduction : Gain of $\bar{e}$

$$Fe^{+2} \underset{\text{Red}}{\overset{\text{oxi}}{\rightleftharpoons}} Fe^{+3}$$

For Simplification

Oxidation	Reduction
* loss of $\bar{e}$ / H	* Gain of $\bar{e}$ / H
* Gain of O	* loss of O
* Gain of +ve charge	* loss of +ve charge

* Oxidation & Reduction Must occur together

$$Zn + Cu^{+2} \rightleftharpoons Zn^{+2} + Cu$$

Oxidation: $Zn \rightarrow Zn^{+2}$

Reduction: $Cu^{+2} \rightarrow Cu$

$Zn \rightarrow 2\bar{e} \rightarrow Cu^{+2}$

دائماً العوامل أول كلمة
لازم تعكس ؟
بالمعنى .

Oxidizing (مُؤكسد) agent (عامل) : مادة تحدث لها Reduction (تكتسب)

Reducing (مُختزل) agent (عامل) : مادة تحدث لها oxidation (تخسر)

Zn is R agent

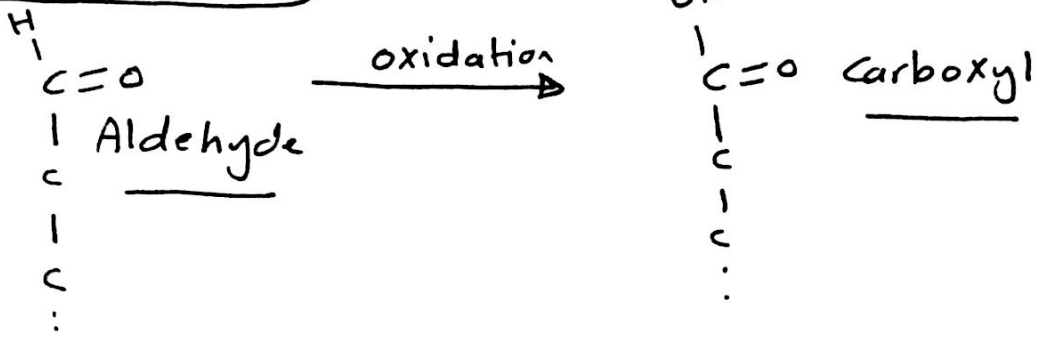
Cu^{+2} is O agent

Reactions of monosaccharides

1 Oxidation

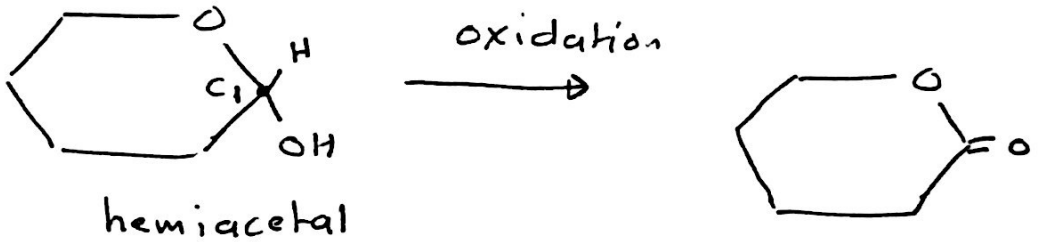
For aldose

linear form



Ring Form

oxidation occurs only on the anomeric C
C_1



hemiacetal
"Aldose ring"

Lactones
"Cyclic Ester"

* Ketoses Undergo oxidation in the same way because they can isomerize (تتحول) to Aldose

⇒ So, both aldoses and ketoses are reducing agents " Called Reducing Sugars"

⇒ Reducing Sugars have Free aldehyde or Free hemiacetal

* All monosaccharides are Reducing Sugars

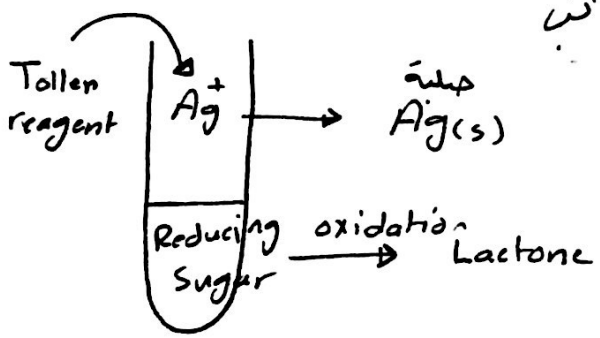
* All Disaccharides are Reducing Sugars
Except Sucrose سكروز

* All polysaccharides are Non-reducing Sugars.

* بما ان السكريات يحدث لها oxidation
فتعتبر مادة تعمل لها Reduction (oxidizing agent)

- oxidizing agents used to detect reducing sugars:-
الكشف

① Tollen Reagent $[Ag(NH_3)_2]^+$ Silver amonia ion
الاسم
ذائب Ag^+ ← oxidation Reagent



⇒ 

اذا حدث التفاعل تترسب الفضة على الانبوب
Silver Mirror
هذا دليل على وجود Reducing Sugar

② Glucose Oxidase : An Enzyme
Specific for Glucose

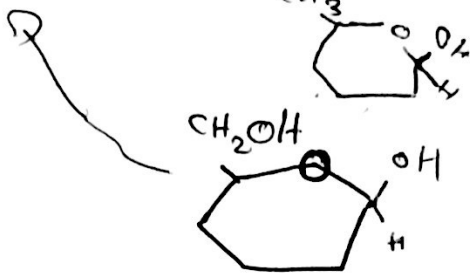
[2] Reduction

(a) Formation of deoxysugar (Removing O)

Ex1 :-

β-L-Galactose ⟶ 6-Deoxy-β-L Galactose (β-L-Fucose)

إزالة O من الكربون 6



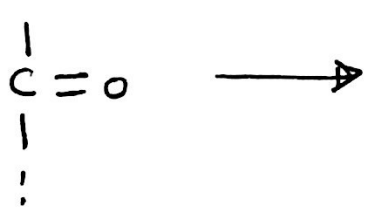
found in Glycoprotein of Red blood cells (ABO blood Group)

Ex2 :-

β-D-Ribose in RNA ⟶ 2-Deoxy-β-D Ribose in DNA

إزالة O من الكربون 2

(b) Reduction of Carbonyl to Alcohol



(Alditols)

D-Sorbose ⟶ Sorbitol

D-Xylulose ⟶ Xylitol

} Alditols used as sweeteners.

Q: Two samples containing identical mixture of sugars are analyzed, one using Tollen's reagent, the other with glucose oxidase, which will give stronger reaction?

a. Tollen's reagent (only glucose — بس بتفاعل مع)
b. Glucose oxidase
c. They will have identical strength
d. it's impossible to predict from the information provided

a

Q: a reducing sugar is one that:-

a. has free hemiacetal group
b. Can reduce Cu^{+2} but not Ag^{+}
c. makes you lose weight

1/9

Q: Deoxyribose is best describe as:-

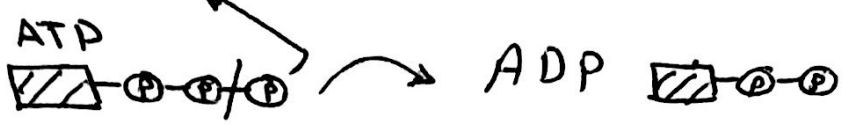
a. oxidized form of ribose
b. reduced pyranose
c. polyhydroxyl alcohol
d. reduced form of pentose

1/9

[3] Esterification Reaction

- Binding phosphate group to the Sugar by Phosphate - Ester Bond.
- Usually phosphate from ATP

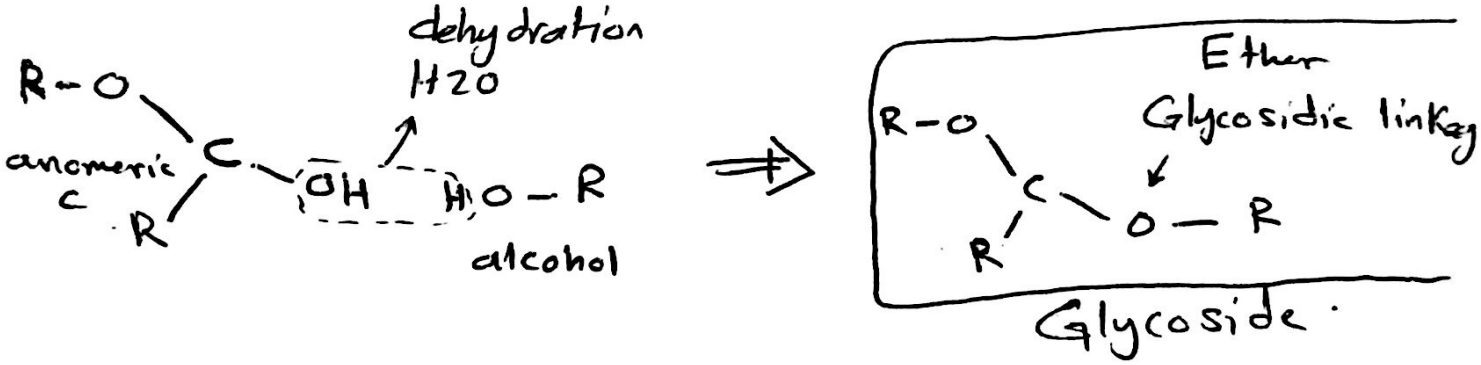
Ex:- Glucose ⟶ Glucose - 6 - Ⓟ



* these reactions are important in Sugar Metabolism

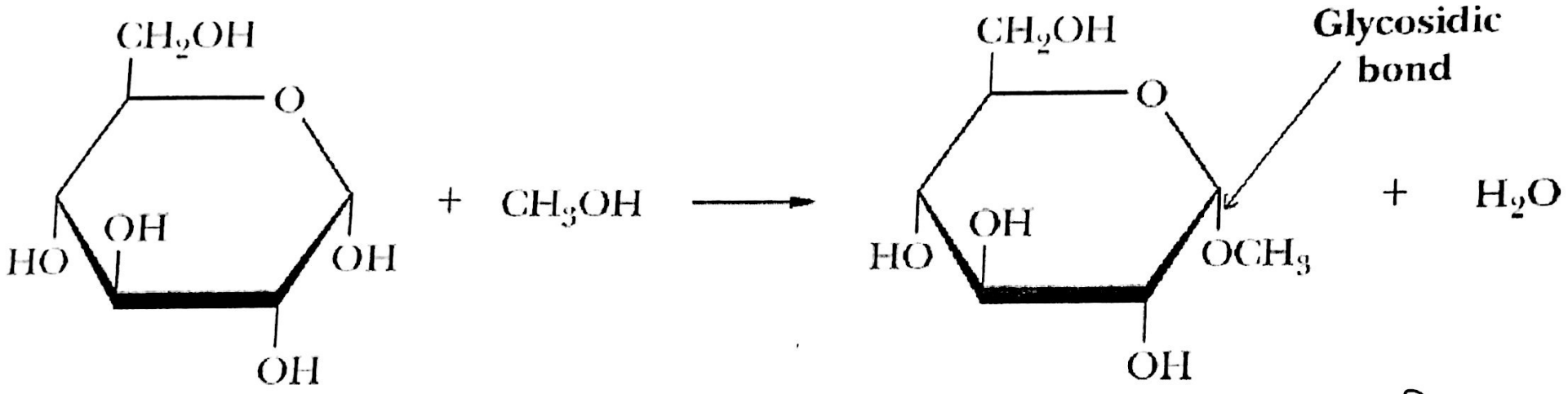
[4] Glycoside formation

Reaction of OH on anomeric C with other OH < from alcohol / from other Sugar



* Glycoside from Hemiacetal (Aldose ring) → Full acetal
* Glycoside from Hemiketal (Ketose ring) → Full ketal
* Glycoside from pyranose → pyranoside
* Glycoside from Furanose → Furanoside.

الوحيد اللي بتسألوا عنه



α-D-Glucopyranose (hemiacetal)

Methyl alcohol

Methyl-α-D-glucopyranoside, a glycoside (full acetal)

anomeric carbon

مش حرة كمان هيك

ما بتعرض reduction

Q: which of the following is true concerning this molecule

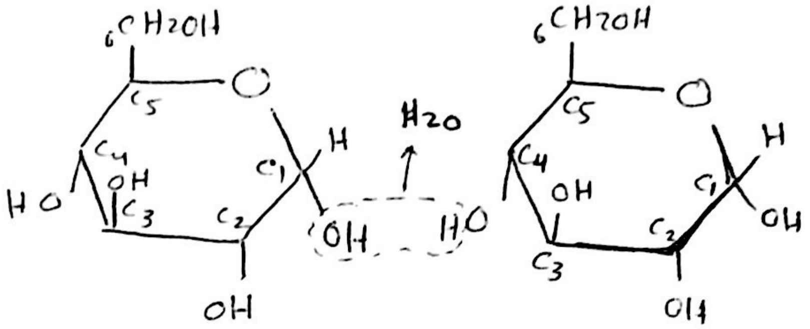
a. it would give a positive reaction not reducing in a Tollen's silver mirror test

b. it's a reducing sugar

c. it's non reducing sugar because it's aldose

(d) it's non reducing sugar because the anomeric carbon is methylated

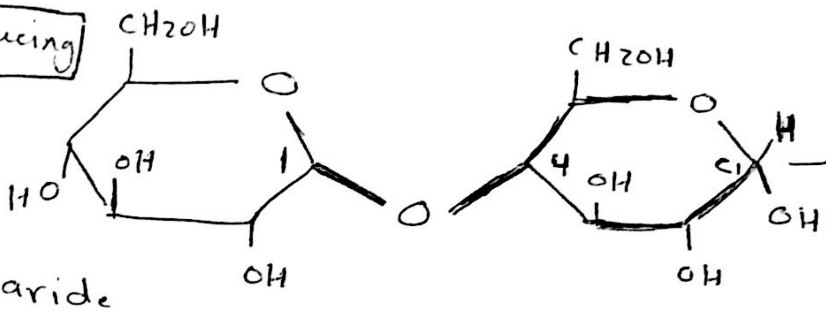
if OH from other Sugar



α- D -glucose
Anomeric
C_1

α- D-glucose
Anomeric C_1

Non-reducing End



Reducing End

→ free anomeric C
⇓
Can be oxidized

Disaccharide

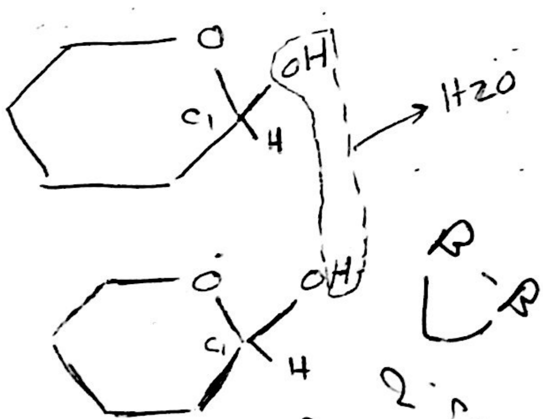
α (1 – 4) Glycosidic linkage

نوع ال كاربون anomeric

* The idea of Glycoside enables us to bind sugars to each other forming Disaccharides and Poly saccharides.

[illegible]

hemiacetal



+

hemiacetal

What is the Type of Bond here.

β-β-(1-1)

[illegible]

[5] Amino - Sugars.

Removing OH from the Sugar and

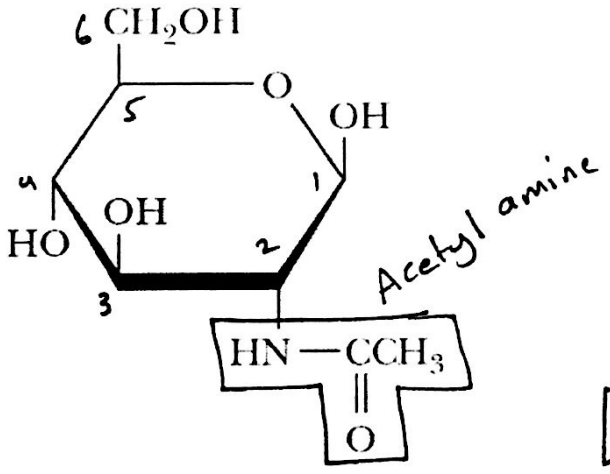
Put — NH_2 (amino-group)

Examples:-

β-D glucose ⟶ N-acetyl-β-D-glucosamine

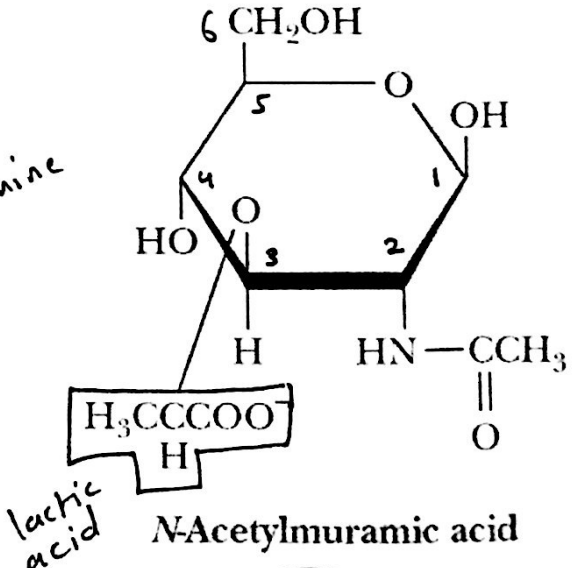
β-D glucose ⟶ N-acetyl-muramic acid

Both are amino-sugars found in Bacterial cell wall.



N-Acetyl-β-D-glucosamine

NAG



N-Acetylmuramic acid

NAM

Never in Eukaryotes

Disaccharides → $C_{12}H_{22}O_{11}$ → ٢ نوعين سكر
بتكونوا منه
سكر أحادي + سكر أحادي
~~سكر~~ ور 2 نخسر H_2O

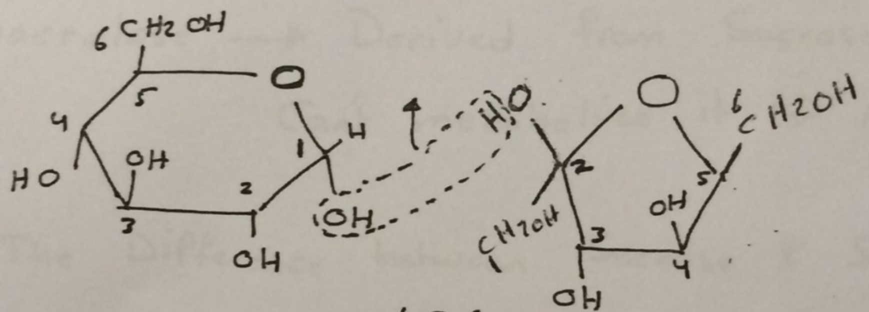
(سكر احادي) — (سكر احادي) → Glycosidic linkage

* Sucrose سكر المائدة
* maltose سكر الشعير
* Lactose سكر الحليب
* Cellobiose سكر ناتج من تكسير ال Cellulose

أهم اشي تعرف
السكريات الأحادية الي
بتكونوا منها
والرابطة بينهم

* Sucrose → Table Sugar

α - D - Glucose + β - D - Fructose → Sucrose



αβ(1-2)

2 anomeric

Anomeric C of Glucose is C_1

aldose لأنه

Anomeric C of Fructose is C_2

Ketose لأنه

Sugar $\xrightarrow{\text{oxidation}}$ lacton

the oxidation will be on the Anomeric Carbon
So, should be free

Sucrose → Both anomeric Carbons participate in the Bond, So no free anomeric Carbon, So it Can NOT undergo oxidation

So, it is NOT Reducing Sugar

Other Substitutes For Sucrose

بدائل للسكر

① Fructose → Sweeter than Sucrose, less Calories
But not widly used because it changes the texture of food

② Saccharine, and Cyclamate → Cause Cancer in animals (Carcinogenic) مسرطن

③ Aspartam → Sweet Dipeptide
Cause Neurological problems for people having phenylKetonuria disease.
Carbohidrat عيش
مشاكل كبيرة للناس اللي عندهم مرض

④ Sacralose → Derived from Sucrose, Body Can't metabolize it ⇒ No Calories.

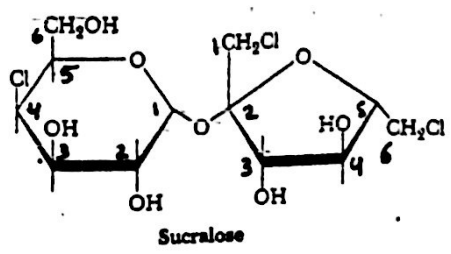
* The Difference between Sucrose & Sacralose

1) the OH on C_4 of Glucose (instead of down → up)
By this Glucose become Galactose

Note: Glucose - Galactose are Epimer on C_4

2) Remove 3 OH and put Cloride instead Cl

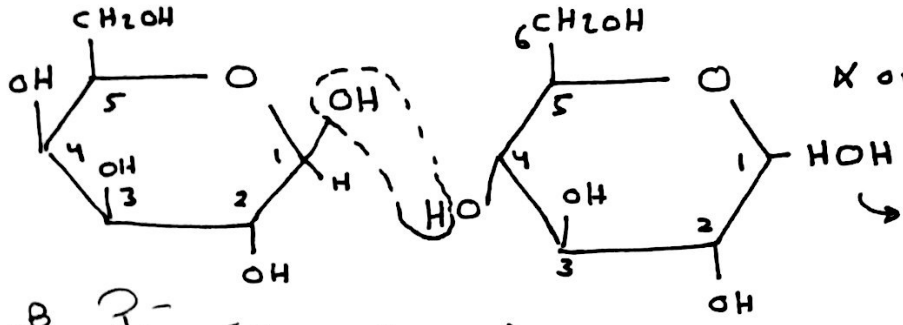
Removed from
C_1, C_6 → Fructose
C_4 → Galactose



Sucralose

* Lactose Milk Sugar

β-D-Galactose + D-glucose

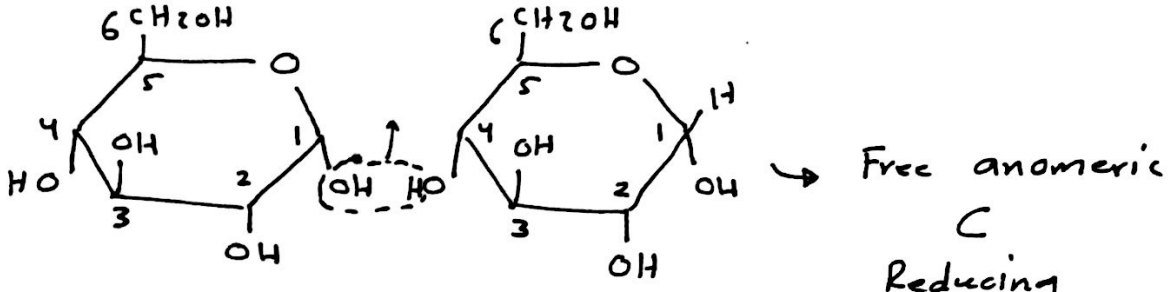


β (1-4)

Gala-glco

* Maltose produced from the hydrolysis of starch

α-D-Glucose + α-D-Glucose

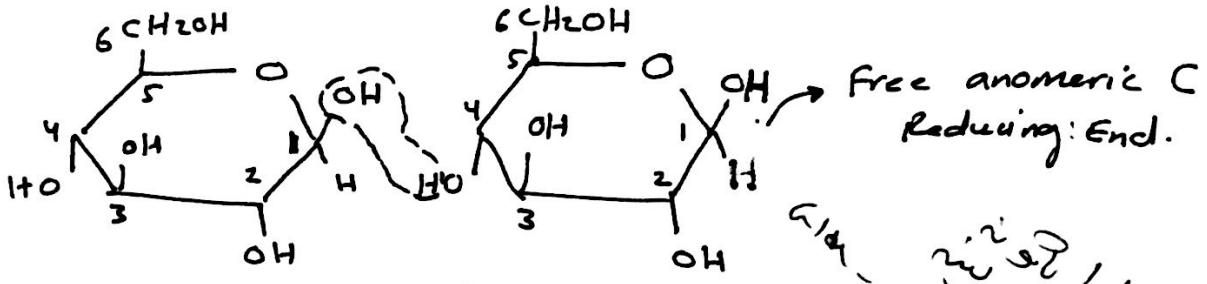


α (1-4)

- Can be digested By mammals

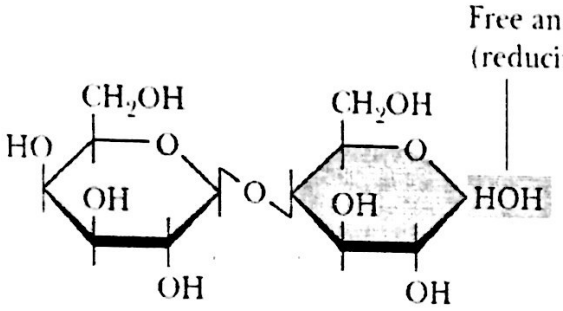
* Cellobiose produce from the hydrolysis of Cellulose

β-D-Glucose + β-D-Glucose

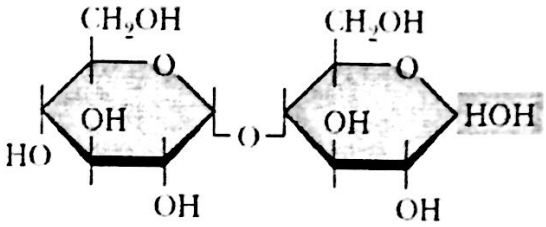


β (1-4)

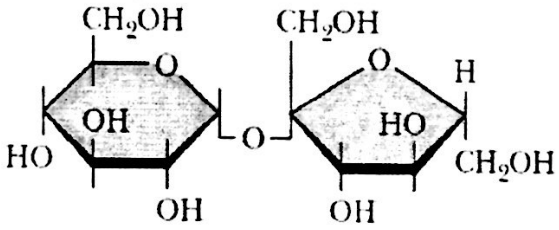
* Can NOT be digested by mammals



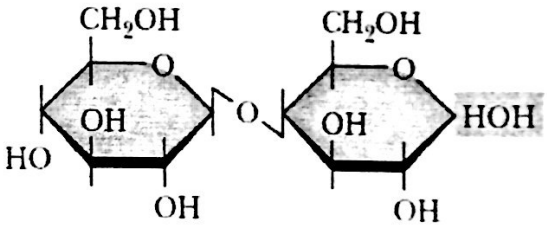
Lactose (galactose-β-1,4-glucose)



Maltose (glucose-α-1,4-glucose)

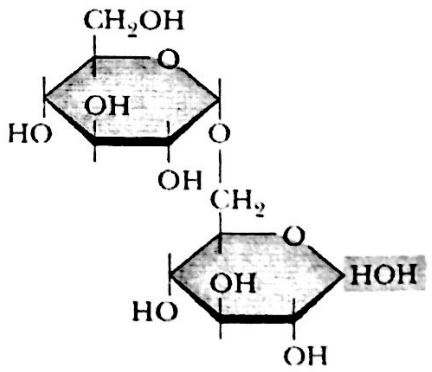


Sucrose (glucose-α-1,2-fructose)



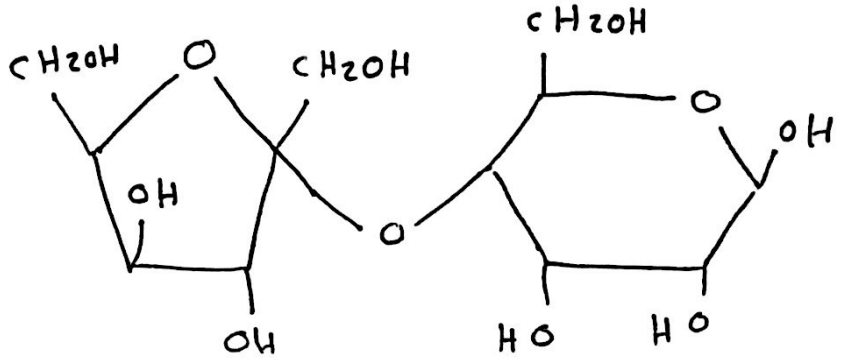
Cellobiose (glucose-β-1,4-glucose)

Glucose α β 1,2 Fructose



Isomaltose (glucose-α-1,6-glucose)

Q: which of the following best describe the glycosidic bond in this disaccharide shown



a. α (1-4)
b. β (1-4)
c. α (2-4)
d. β (2-4)
e. none of these

1/1

Q: The disaccharide shown above has a free anomeric carbon, so it's a reducing sugar

True False

1/1

Q: Glycosidic bond from sugar

a. always link to other molecules through an oxygen atom
b. always link to other molecules through a nitrogen atom
c. may link to other molecules through either O or N atoms

1/1

1/1