SACCHARIDES = CARBOHYDRATES

Carbohydrates are a group of substances that are important in many biological processes. The following questions should help you to state what the biological functions of carbohydrates are.

1. *What are some foods you eat that contain carbohydrates?*

2. *What carbohydrates are present in table sugar, milk, and wood?*

3. *What is meant by a "high-fibre" diet?*

Biological roles of carbohydrates:

-
-
-
-
-

All carbohydrates contain the atoms of ….., …... and …... They have the general formula .....

Classification of carbohydrates:

- monosaccharides = simple sugars
- disaccharides: ..... monosaccharide units
- polysaccharides: ..... monosaccharide units

4. *Indicate the number of monosaccharide units (1, 2, or many) in each of the following carbohydrates.*

Sucrose	……..…..	Cellulose	……..……
Amylose	……..	Maltose	……
Fructose	……..	Glucose	……

MONOSACCHARIDES

Monosaccharides are simple sugars. White crystalline solids, dissolve in water because their −OH groups form …….. with water.

They all have the general formula $(CH_2O)_n$, showing that the elements are always present in the same ratio (*n* can be any number from 3 to 7). Monosaccharides are grouped according to the value of *n:*

a. in trioses *n* = 3
b. in tetroses *n* = ……
c. in …… *n* = 5
d. in …… *n* = 6
e. in …… *n* = …….

Chemically, monosaccharides are classified as

- **Aldoses** = polyhydroxyaldehydes
- **Ketoses** = polyhydroxyketones

5. *What functional groups can you find in them?*

	ALDOSE	KETOSE
n = 3	Molecular formula:……	

There are conventions for drawing the structure of monosaccharides which often have puckered rings difficult to represent on a 2D piece of paper. They also have …… centres (= asymmetric C atoms attached to four different groups) so there are rules for representing the different ***D and ..... forms***.

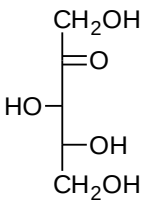
FISHER PROJECTIONS

e.g. Glyceraldehyde

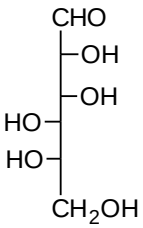
In the D-form the OH group on the bottom chiral centre is on the RIGHT!

Note: Naturally occurring sugars all D-forms!!!!!!

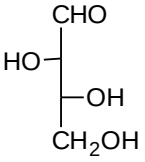
6. *Identify each of the following sugars as the D or L isomer.*



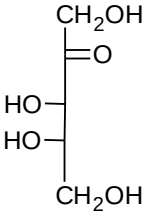
___-Xylulose



___- Mannose



___- Threose



___- Ribulose

7. *Write the mirror image of each of the sugars in the previous task and give the D or L name.*

n = 4 Molecular formula …… Let's only consider ALDOTETROSES.

8. *Write down the formulae for all possible aldotetroses.*

9. *How many chiral centres do aldotetroses have?*

…..…… chiral C atoms, it means ……..…… isomers = **2 pairs of enantiomers**.

n = 5 Molecular formula ..…….. Let's only consider the important ALDOPENTOSE - ribose.

10. *Write down both L and D forms of ribose and 2-deoxyribose.*

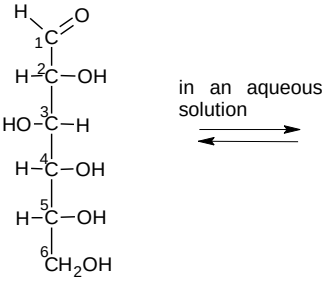
How many chiral centres do aldopentoses have? ……. chiral C atoms, it means ……..……
isomers = **4 pairs of enantiomers**.

n = 6 Molecular formula ……..

ALDOHEXOSES

How many chiral centres do aldohexoses have? ……. chiral C atoms, it means ……..……
isomers = **8 pairs of enantiomers**.

The most important isomer is ***D*-GLUCOSE**.



in an aqueous solution ⇌

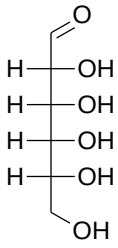
Haworth projection

Importance of glucose:

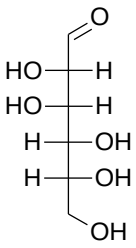
In blood it is in the form of glucose-6-phosphate (ester of .....)

Industrial use of glucose:

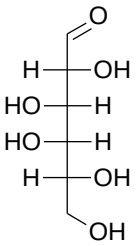
11. Draw Haworth structures for the following aldohexoses:



D-allose



D-mannose

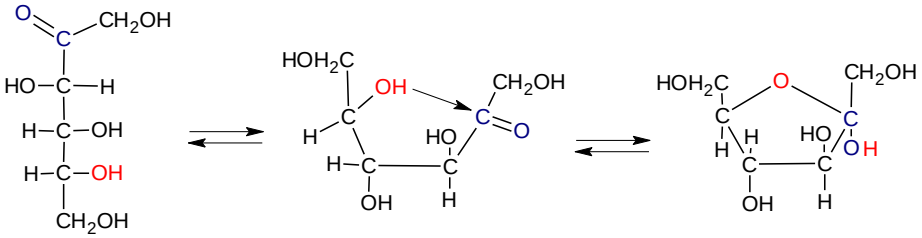


D-galactose

KETOHEXOSES

How many chiral centres do ketohexoses have? ……..…. chiral C atoms, it means ……..…… isomers = **…….. pairs of enantiomers**.

The most important isomer is ***D*-FRUCTOSE**



12. *What anomer of fructose is shown above? Draw the structure of the second possible anomer.*

Properties and occurrence:

DISACCHARIDES

Disaccharides are two monosaccharide units joined together by a **glycosidic bond**.

monosaccharide(1) + monosaccharide(2) → disaccharide+ H_2O

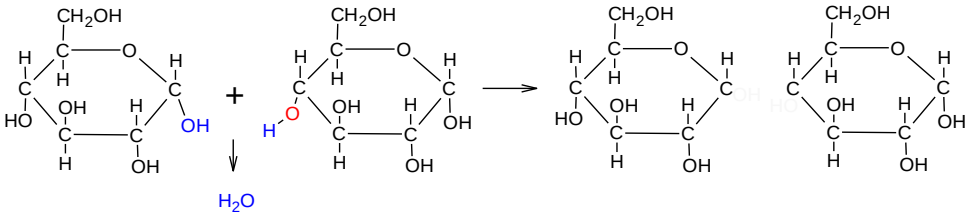
= CONDENSATION REACTION

…… + …… → SUCROSE + H_2O

In the most common disaccharides, maltose, lactose and sucrose, there is at least one glucose unit.

MALTOSE

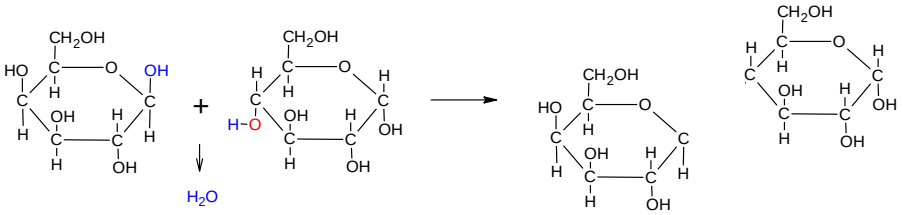
Two glucose units are linked by α-1,4 glycosidic linkage. The numbers 1, 4 indicate that the –OH on carbon 1 was bonded to the -OH on carbon 4 of the other glucose molecule. The symbol α indicates that .....



Note: end anomeric carbon corresponds to –CHO in the open chain. It is a **reducing sugar.**

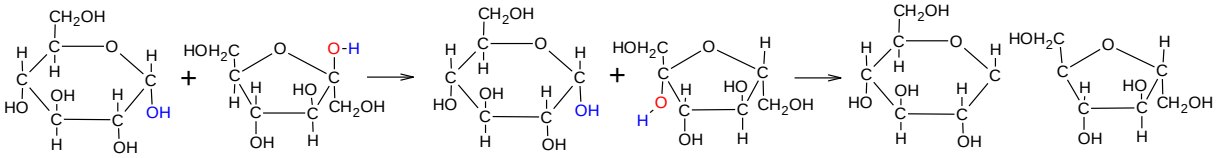
Maltose is an intermediate in the breakdown of starch – happens during the sprouting of barley – important in ..... production.

LACTOSE



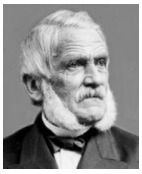
Note: Free anomeric carbon. Therefore a **reducing sugar.**

SUCROSE



Testing for reducing sugars

1. FEHLING'S TEST



Hermann von Fehling (1812 - 1885) was a German chemist, famous as the developer of Fehling's solution used for estimation of sugar.

2 cm^3 of solution Fehling I (……..)
+
2 cm^3 of solution Fehling II (……..……) } ……
+
Reducing sugar

2. TOLLENS' TEST

Bernhard Christian Gottfried Tollens (1841 – 1918) was a German chemist.

2 cm^3 of Tollens'solution (……..)
+
Reducing sugar

POLYSACCHARIDES

Polysaccharides are ……..…….. of monosaccharide units. The most common monosaccharide unit is ……..……

STARCH

Reserve food in plants, stored in granules.

- By complete hydrolysis glucose can be made.
- By partial hydrolysis we can prepare dextrins or maltose.

Used in food industry, production of alcohol – fermentation.

With ……..…… solution (.....) it gives characteristic …….. colour.

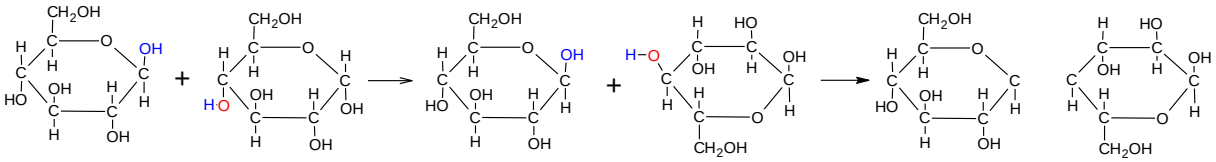
Starch consists of **amylose**, an unbranched chain of glucose; and **amylopectin** which is a branched polymer of glucose.

GLYCOGEN, the storage form of glucose in animals (animal starch), is similar to amylopectin with more branching.

It is present in liver and muscles.

- It helps maintain proper amount of glucose in blood by removing and storing the glucose.

CELLULOSE is also a polymer of glucose, but in cellulose the glycosidic bonds are β bonds rather than α bonds as in the starches. Humans can digest starches to obtain energy, but not cellulose. However, cellulose is important as a source of fibre in our diets.



- Every second molecule flipped over → ..... chains
- Hydrogen bonds between chains → …… and …….. structure
- Component of cell walls
- Ruminants can digest it as they posses rumen =

Uses of cellulose:

http://www.youtube.com/watch?v=yz8qDxkLG2A = synthesis of nitrocellulose