المحاضرة الثانية/Charbohydrates

Optical activity

1. All monosaccharides (except dihydroxyacetone) are optically active, due to presence of chiral centers.
2. Able to rotate the plane of polarized light either clockwis (Dextrorotatory – D(+)) or counter clockwise (Levorotatory-L(-)).
3. Specific rotation (α) is the number of degrees by which an optically active compound rotates the plane of polarized light.
4. Polarimeter is the instrument used to measure the specific rotation.

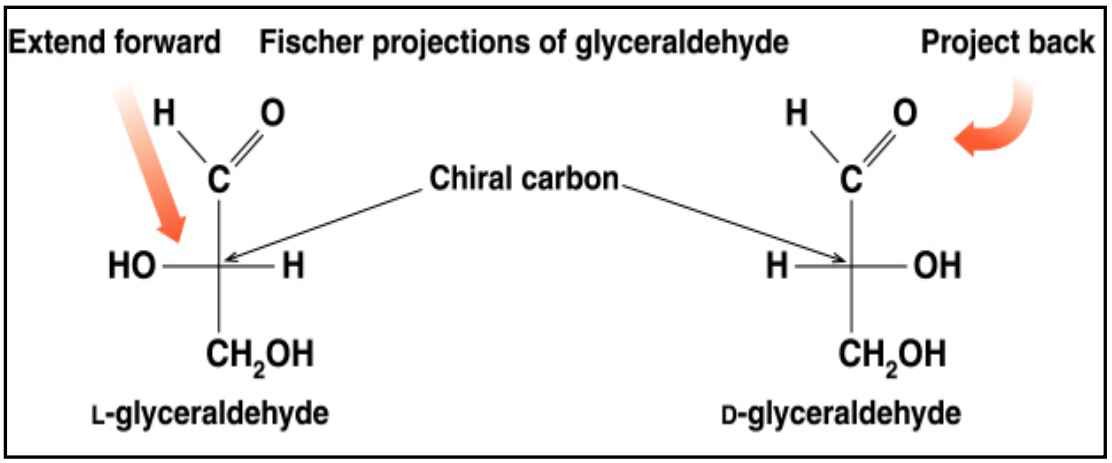
Structures of monosaccharides

A. Fischer Projection: straight chain representation.

B. Haworth projection: simple ring in perspective.

A. Fischer Projection

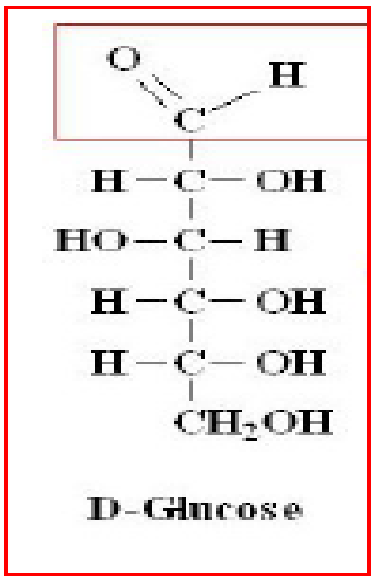
- Is used to represent carbohydrates .
- Places the most oxidized group at the top.
- Shows chiral carbons as the intersection of vertical and horizontal lines.



Monosaccharides

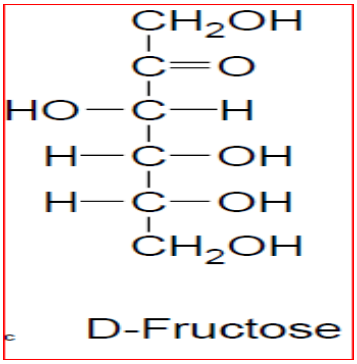
1. D-glucose

As one of monosaccharides, an aldohexose with the formula $C_6H_{12}O_6$known as blood sugar in the body and has a normal blood level of 70-110 mg/dl. Glucose is found in fruits, Corn, Syrup and honey. The monosaccharide in polymers of starch, cellulose and glycogen. The structure of glucose:



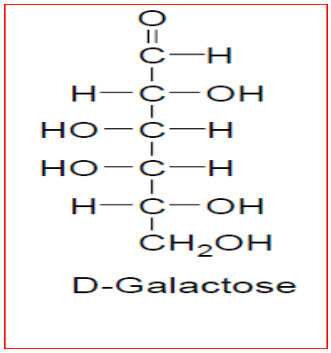
2.D-fructose

Is a ketohexose $C_6H_{12}O_6$. Fructose is the sweetest carbohydrates and found in fruit juices and honey.Itconverts to glucose in the body.



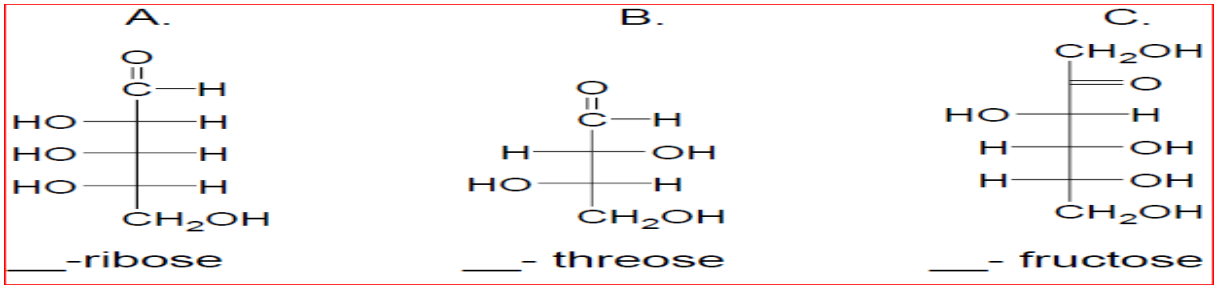
3.D. Galactose

D- galactosean aldohexose$C_6H_{12}O_6$. Galactosenot found free in nature but obtained from lactose (disaccharide). The structure galactose as similar structure to glucose except for the OH on C4.



Questions

Q1.Identify each as the D or L isomer?



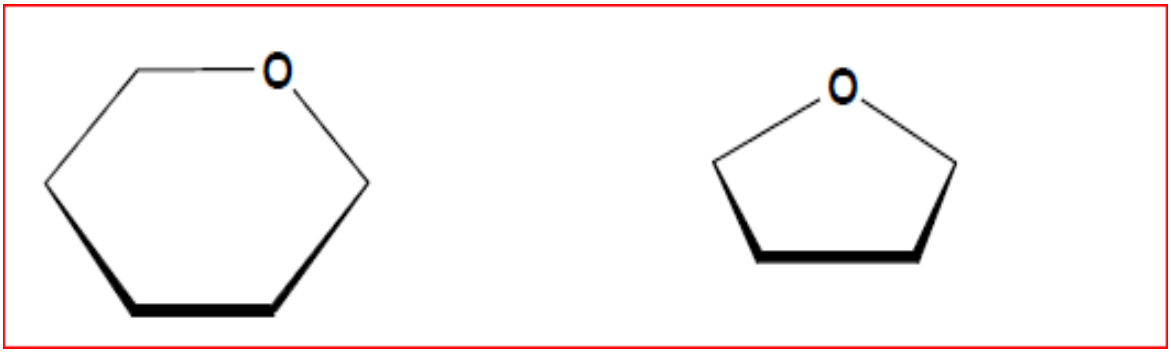
Solution :
A. L- Ribose
B. L- threose
C. D-Fructose

Q2. Draw the fischer projection of D- fructose ?

Cyclic structures of monosaccharides

Cyclic structures:Are the prevalent form of monosaccharides with 5 or 6 carbon

Form when the hydroxyl group on C-5 reacts with aldehyde group or ketone group.



B.Haworth Projection (Cyclic Haworth structures)

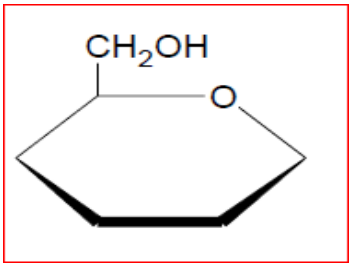
Haworth: Projections represent the cyclic structures of monosaccharides.

Stable cyclic hemiacetal form:

– When the carbonyl group C=O and the OH are part of the same molecule.

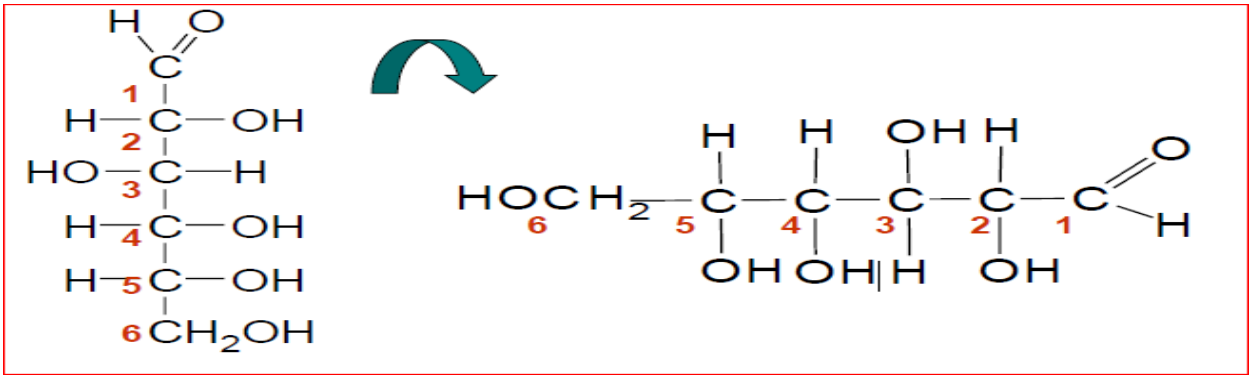
– For hexoses, the hydroxyl group on C-5 reacts with aldehyde group or ketone group.

– The cyclic structure of D-isomer has the last CH_2OH group located above the ring.



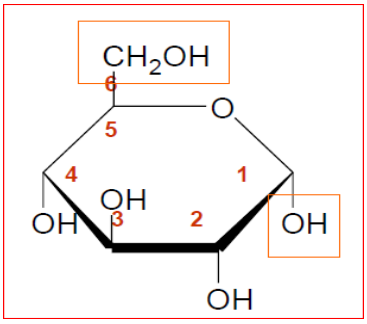
Drawing the Cyclic structure for glucose

Step 1: Number the carbon chain and turn clockwise to form linear open chain.



Step 2: Bend the chain to make a hexagon

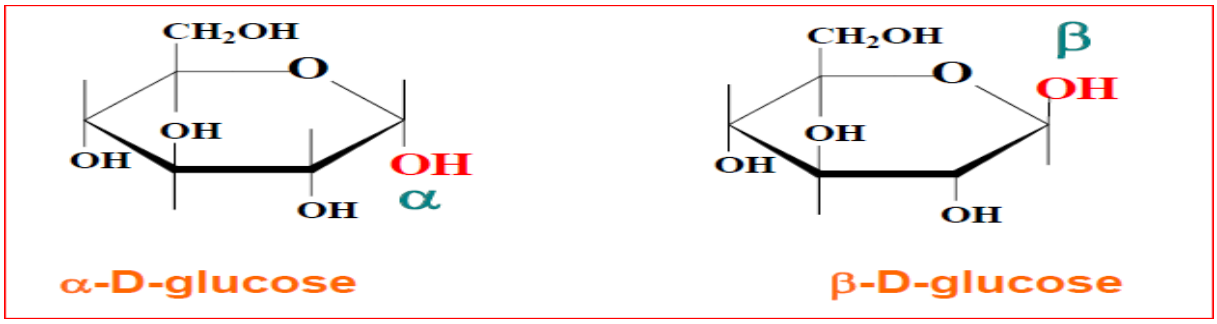
-Bond the C_5-O-to C_1.
-Place the C_6 group above the ring.
-Writethe – OHgroups on $C_2$and C4 belowthe ring.
-Writethe – OHgroupson C_3abovethe ring.
-Write a new OH on C_1.



Step 3: The new OHon $C_1$is drawn:

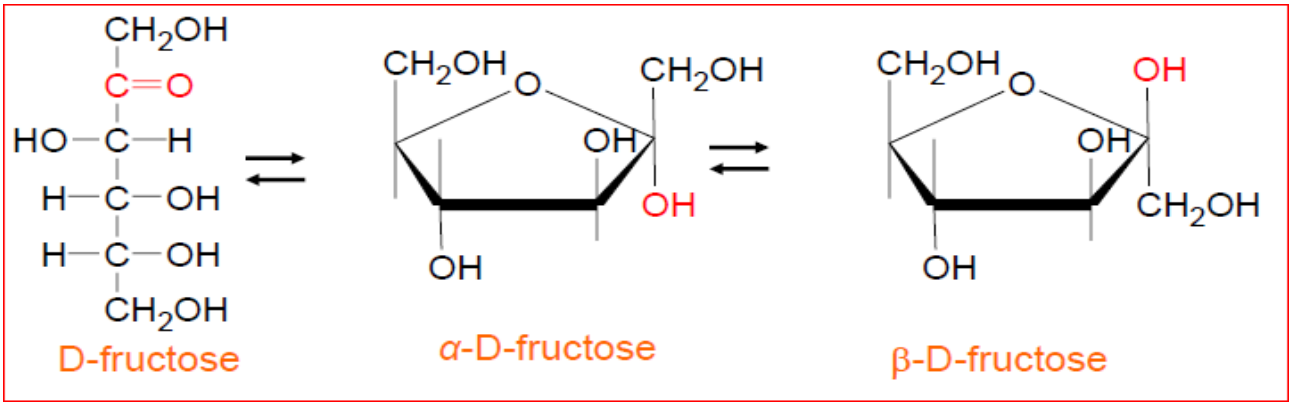
– Down for the αanomer.

– Up for the βanomer.



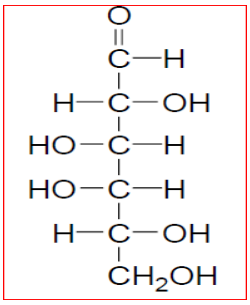
Cyclic structure of Fructose

- Is a ketohexose
- forms a cyclic structure.
- Reacts the - OH on C5 with C=O on C-2.

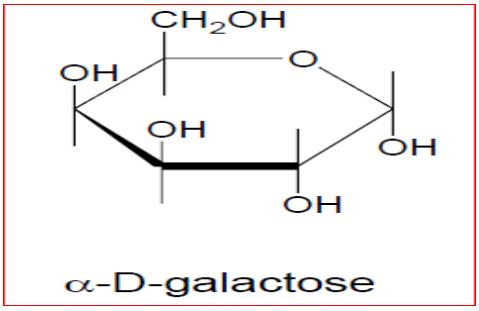


Question

Write the Cyclic form of α-D-galactose?



Solution



Properties of monosaccharides

*** Reducing Sugars**

1- Monosaccharides with carbonyl group that oxidized to give carboxylic acid.

2.Undergo reaction with Benedict's reagent (Cu^{+2}) to give corresponding carboxylic acid.

3. Monosaccharides include glucose, galactose and fructose.

***Note : Benedict's reagent consist of (Cupric sulphate , Sodium carbonate and Sodium citrate).**

1.Oxidation of monosacchrides

Aldoses may be oxidized to 3types of acids:

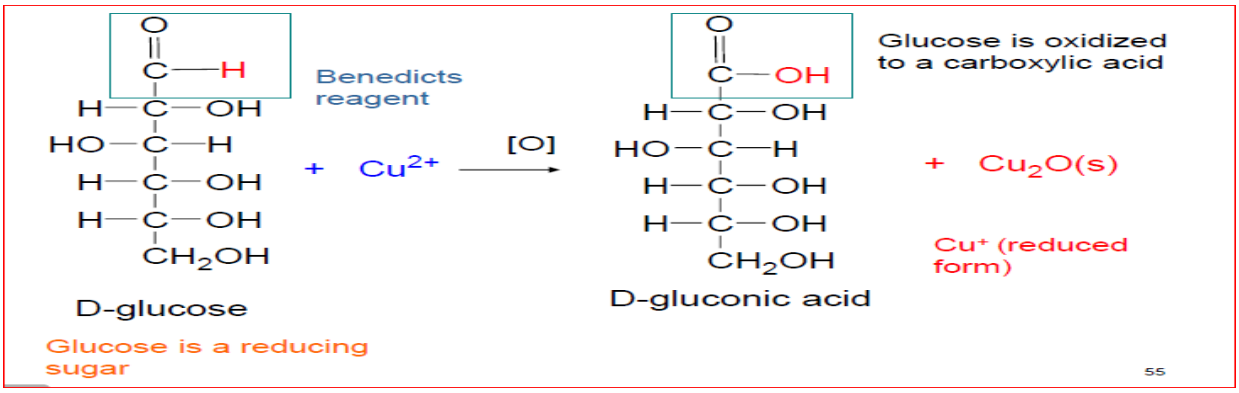
1.Aldonic acid: aldehyde group is converted to a carboxyl group.

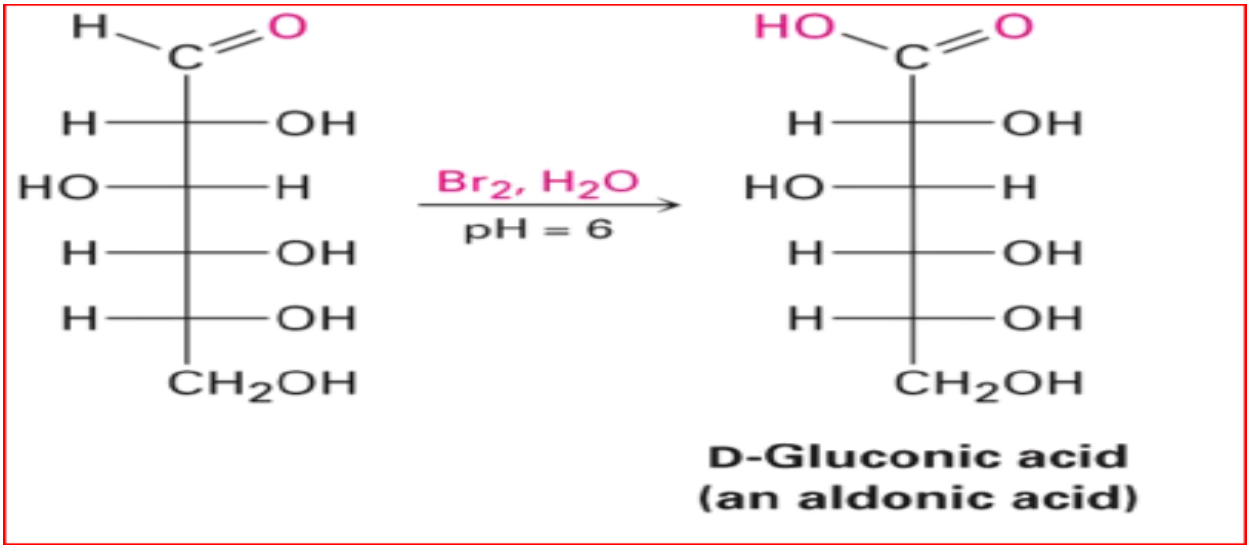
2.Uronic acid: aldehyde is left intact and primary alcohol at the other end is oxidized **to COOH.**

3. Saccharic acids: (glucaric acid)-oxidation at both ends of monosaccharides.

Oxidation of D-glucose.

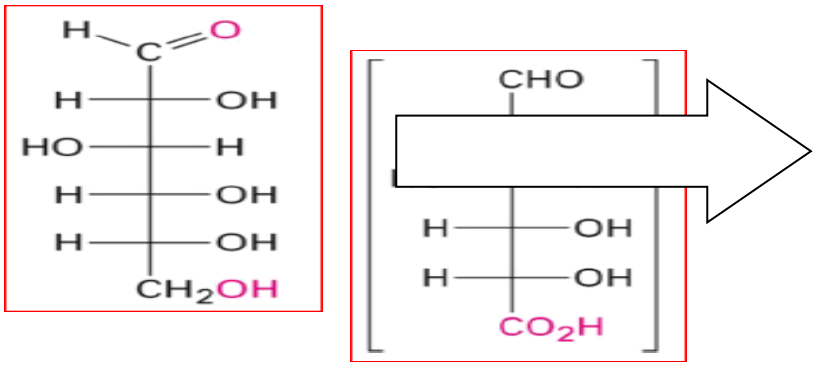
A.Aldonic acid





B. Uronic acid

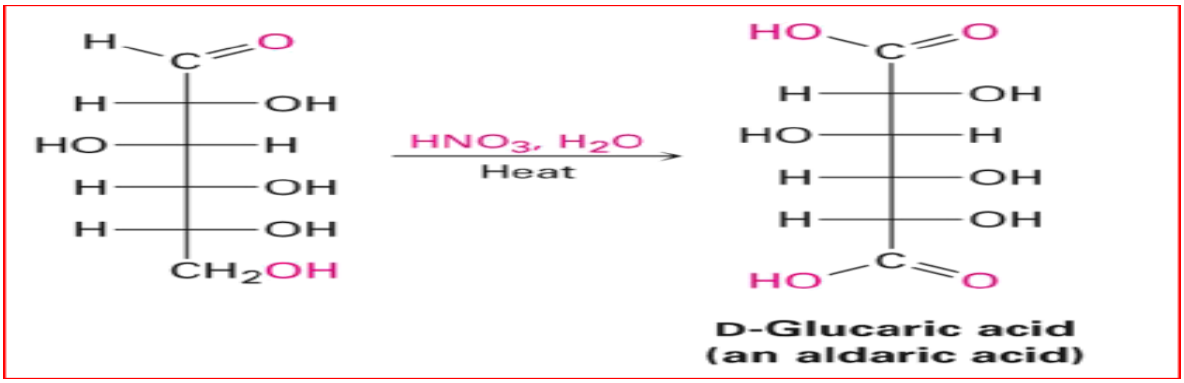
Enzymatic oxidation at the **CH2OH**end of aldose yields **uronic acid.**



D- Glucose **D- Glucuronic acid**

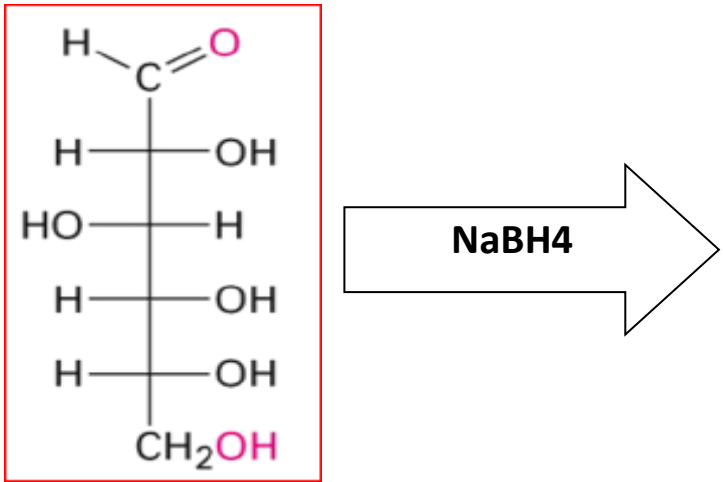
C.Saccharic acids

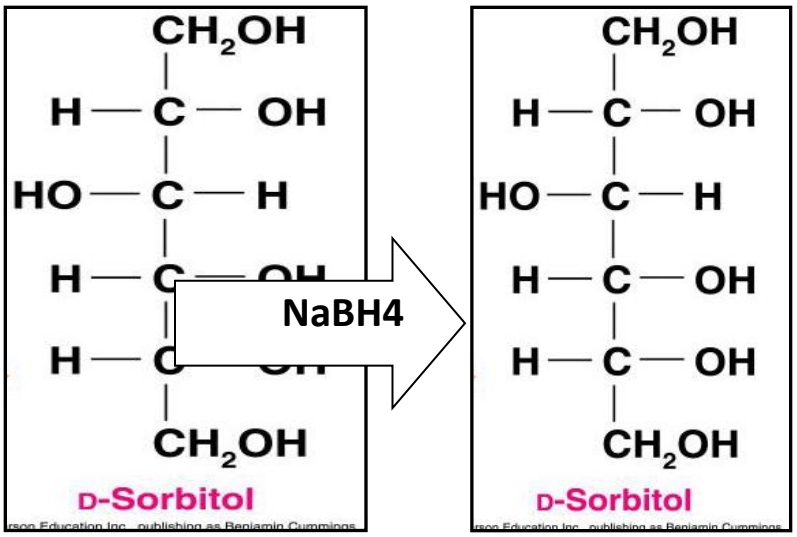
Aldoses are oxidized in warm dilute HNO3, to dicarboxylic acid called **aldaric acid**



2. Reduction of monosaccharides.

The reduction of monosaccharides involvesthe carbonyl group to produce sugar alcohols called alditols such as **D-glucose** gives **D-glucitol** also called Sorbitol.





D- glucose

or D- glucitol