A/K III

(Hemi-) Acetal Formation

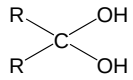
- Rxn w/ ROH
- Carbohydrate Chemistry

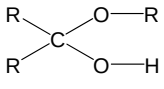
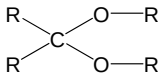
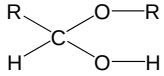
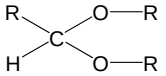
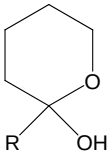
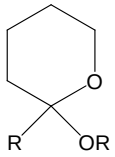
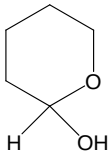
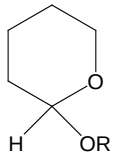
Ref 16: 7 ; (Ch.22)

Prob 16: 9 – 11; HMWK #06

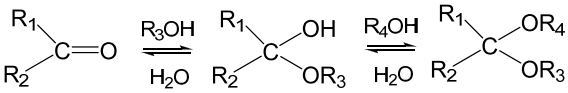
Adv Rdg 16: 8 - 9 ; (12: 3 - 8)

Terminology

Hydrate 

	Hemiacetals	Acetals
"open" general		
aldehyde derived		
"internal" general		
aldehyde derived		

General Rxn



Notes:

1.) R_1, R_2 could be H
open chains
rings

2.) R_3, R_4 could be open chains
rings

3.) R_1, R_4 ⎫
R_2, R_3 ⎭ could be rings

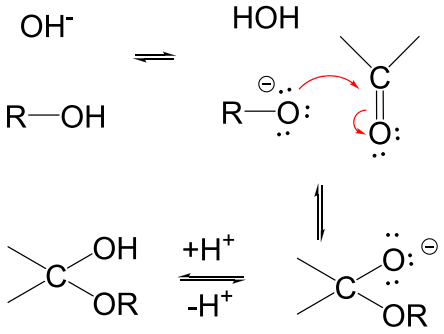
4.) all are equilibrium rxns

5.) rxn slow in neutral medium
can be catalyzed by "acid" or "base"

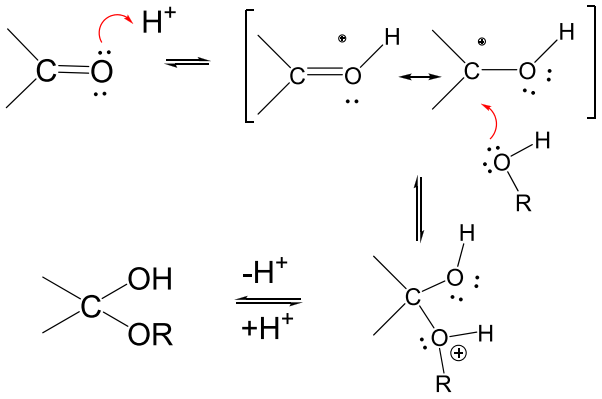
Rxn Mech.'s

1.) Hemiacetal Form^n

a.) base catalyzed



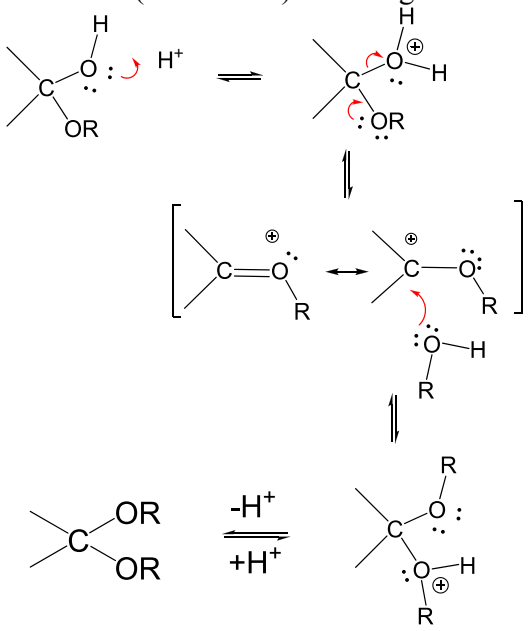
b.) acid catalyzed



Mech.'s ...

2.) Acetal Form^{n}

in acid (**not** in base) rxn can go further



Summary

<u>Hemiacetals</u> formed in acid or base (slowly in neutal medium)
rxn reversible in acid or base

<u>Acetal</u> formed only in acid
reversible in acid
irreversible (stable) in base

Equilibria can be "shifted" acc. to Le Chatelier's Principle:

add extra ROH and remove H_2O → acetal

add extra H_2O : aldehyde/ketone are favored (in equil. with hydrate)

A/K + ROH (xs) $\xrightleftharpoons{H^+}$ acetal; *remove* H_2O

acetal + HOH (xs) $\xrightleftharpoons{H^+}$ A/K

(⇌ hydrate)

Relevance of "Acetals"

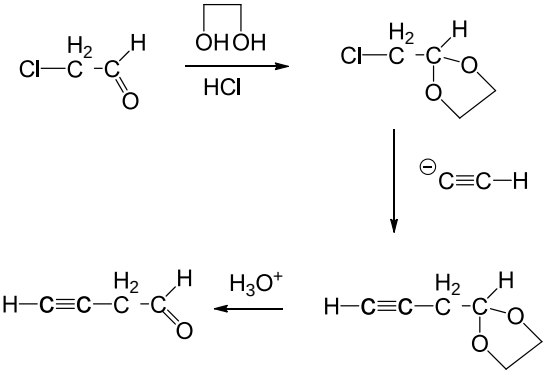
1.) • describes general reactivity of A/K's
• important structural element in carbohydrates/ other natural products

2.) can function as **protecting group** in synthetic schemes

General:

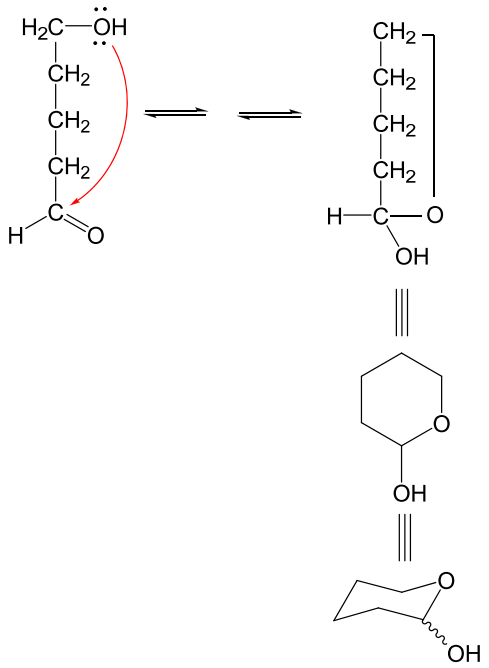
A/K → acetal, prepared in acid
→ do rxn elsewhere on molecule, in base
→ regenerate modified A/K

Ex.



Internal (Cyclic) Hemiacetals

Ex.

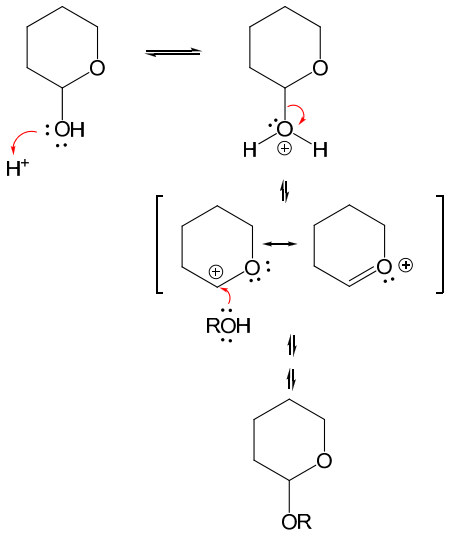


Do detailed mech. as HMWK.

Internal Acetals

- can be formed in presence of ROH/H^+
- hemiacetal → acetal
- mech. as before

Outline of an Ex.



Again, detailed steps as HMWK.

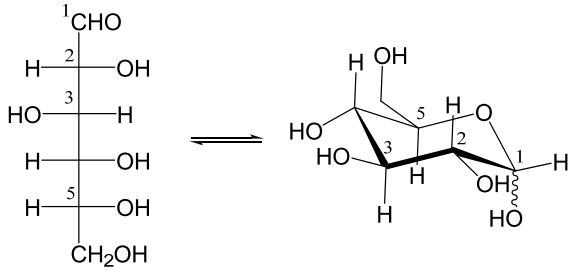
Intro. to Carbohydrate Chem.

(see Solomons Ch. 22 for more details)

e.g.,: sugar, starch, glycogen, cellulose ...

MF: $\approx C_n(H_2O)_n$

Ex. D-Glucose



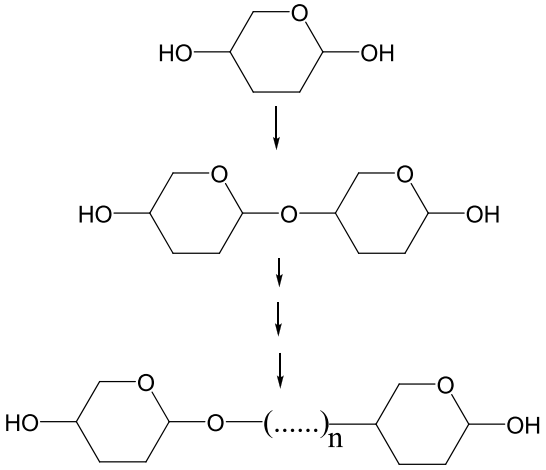
open form internal hemiacetal

Large Carbohydrates

e.g.,: sugar, starch, glycogen, cellulose ...

are "poly" acetals

concepts about basic structure of carbohydrates:



in truth:
there are 5-and 6- membered rings
most carbons carry substituents: OH, CH_2OH
stereochem. is important (ignored here)