Al-Mustaqbal University
College of Science
Forensic Evidence Department

جامعة المستقبل
AL MUSTAQBAL UNIVERSITY

كلية العلـــوم
قـسـمـــــــم الادلة الجنائية

المحاضرة الثامنة

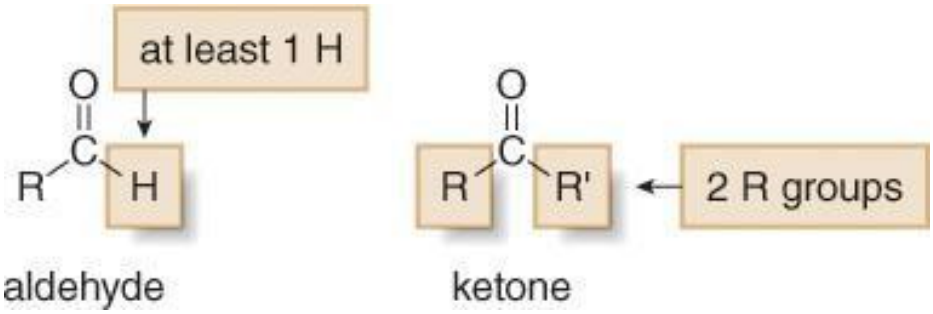
Carbonyl Compounds

المادة : عضوية
المرحلة : الثانية
اسم الاستاذ: م.د. كرار مجيد عبيد

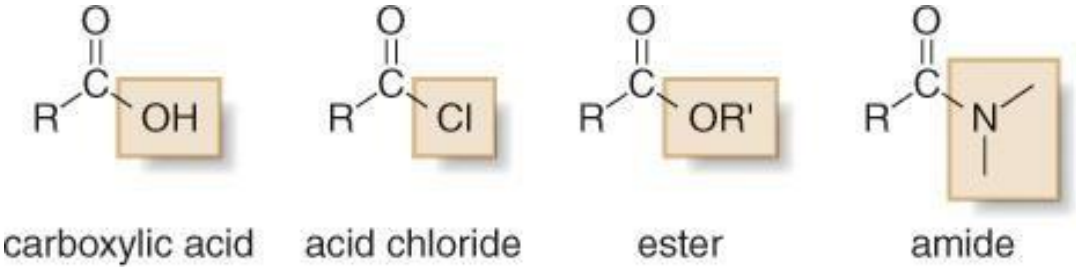
Aldehyde and Ketone

Two broad classes of compounds contain the carbonyl group:

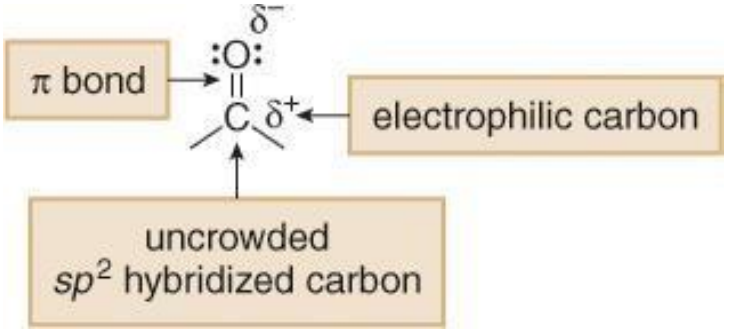
1. Compounds that have only carbon and hydrogen atoms bonded to the carbonyl



2. Compounds that contain an eteroatom (N, O, S, Cl) bonded to the carbonyl

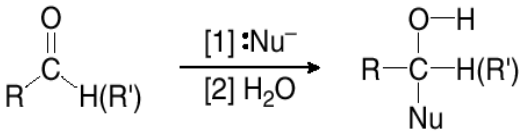


General Reactions of Carbonyl Compounds



- Aldehydes and ketones undergo nucleophilic addition.

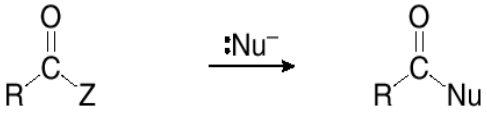
Nucleophilic addition—General reaction



H and Nu are added.

- Carbonyl compounds that contain leaving groups undergo nucleophilic substitution.

Nucleophilic substitution—General reaction

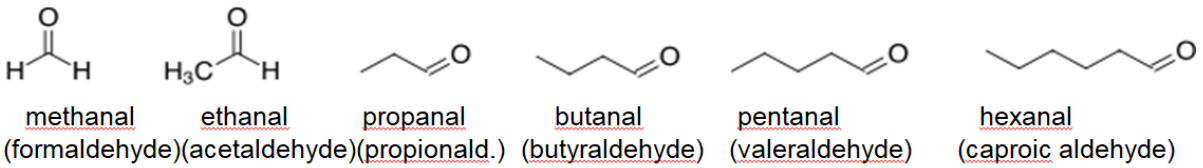


Nu replaces Z.

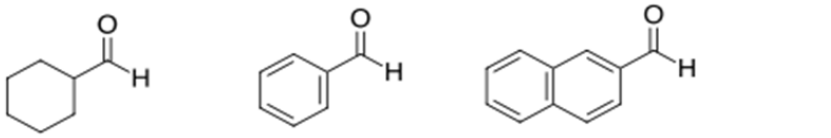
Z = OH, Cl, OR, NH_2

Nomenclature of Aldehydes

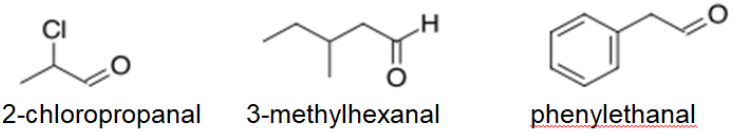
- Find the longest chain containing the CHO group, and change the –e ending of the parent alkane to the suffix –al. If the CHO group is bonded to a ring, name the ring and add the suffix –carbaldehyde.
- A common name for an aldehyde is formed by taking the common parent name and adding the suffix –aldehyde.



methanal (formaldehyde) | ethanal (acetaldehyde) | propanal (propionald.) | butanal (butyraldehyde) | pentanal (valeraldehyde) | hexanal (caproic aldehyde)

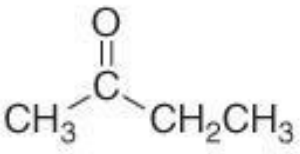


cyclohexanecarbaldehyde | benezenecarbaldehyde (benzaldehyde) | 2-naphthalenecarbaldehyde

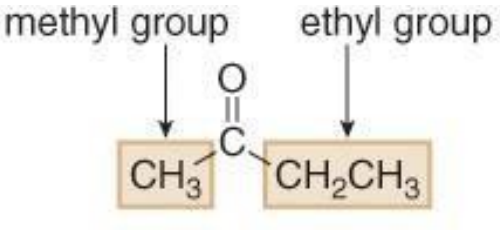


2-chloropropanal | 3-methylhexanal | phenylethanal

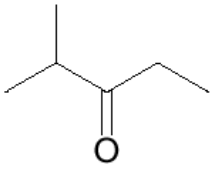
Nomenclature of Ketones



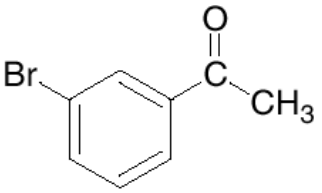
IUPAC name: **2-butanone**



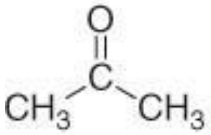
Common name: **ethyl methyl ketone**



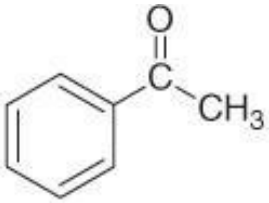
IUPAC name: 2-methyl-3-pentanone
Common name: ethyl isopropyl ketone



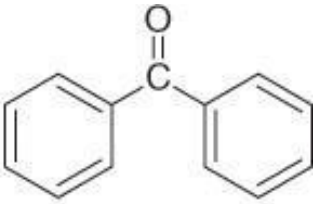
m-bromoacetophenone
or
3-bromoacetophenone



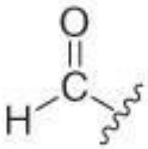
acetone



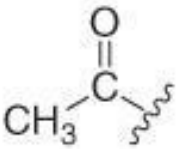
acetophenone



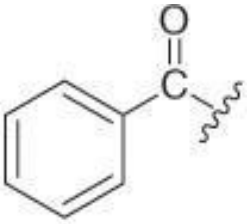
benzophenone



formyl group

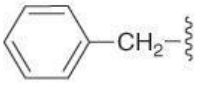


acetyl group



benzoyl group

Do not confuse a **benzyl** group with a **benzoyl** group.

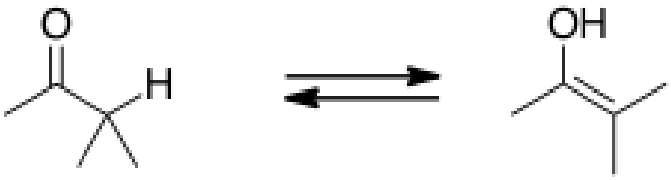


benzyl group

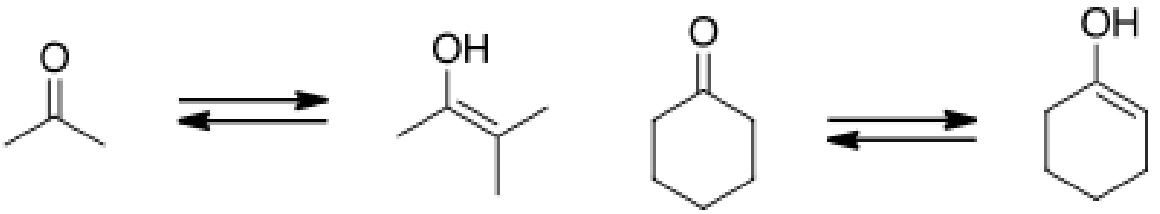
comparison table showing the physical properties of aldehydes and ketones:

Property	Aldehydes	Ketones
General Formula	R–CHO	R–CO–R′
Physical State	Lower members (like formaldehyde and acetaldehyde) are gases or liquids with sharp odors. Higher ones are liquids or solids.	Lower members (like acetone) are liquids with pleasant odor; higher ones are solids.
Boiling Point	Moderate; higher than hydrocarbons and ethers but lower than alcohols of similar molecular weight.	Slightly higher than corresponding aldehydes due to greater molecular mass and polarity.
Solubility in Water	Lower aldehydes are soluble due to hydrogen bonding with water; solubility decreases with size.	Lower ketones (like acetone) are soluble in water; solubility decreases with larger alkyl groups.
Solubility in Organic Solvents	Soluble in most organic solvents.	Soluble in most organic solvents.
Odor	Lower aldehydes have sharp, pungent odor; higher ones have pleasant smell.	Generally have sweet, pleasant odors.
Polarity	Polar due to the carbonyl group (C=O).	Also polar, often slightly more so due to two alkyl groups attached to C=O.
Density	Usually less dense than water.	Usually less dense than water.

Keto-Enol Tautomerism



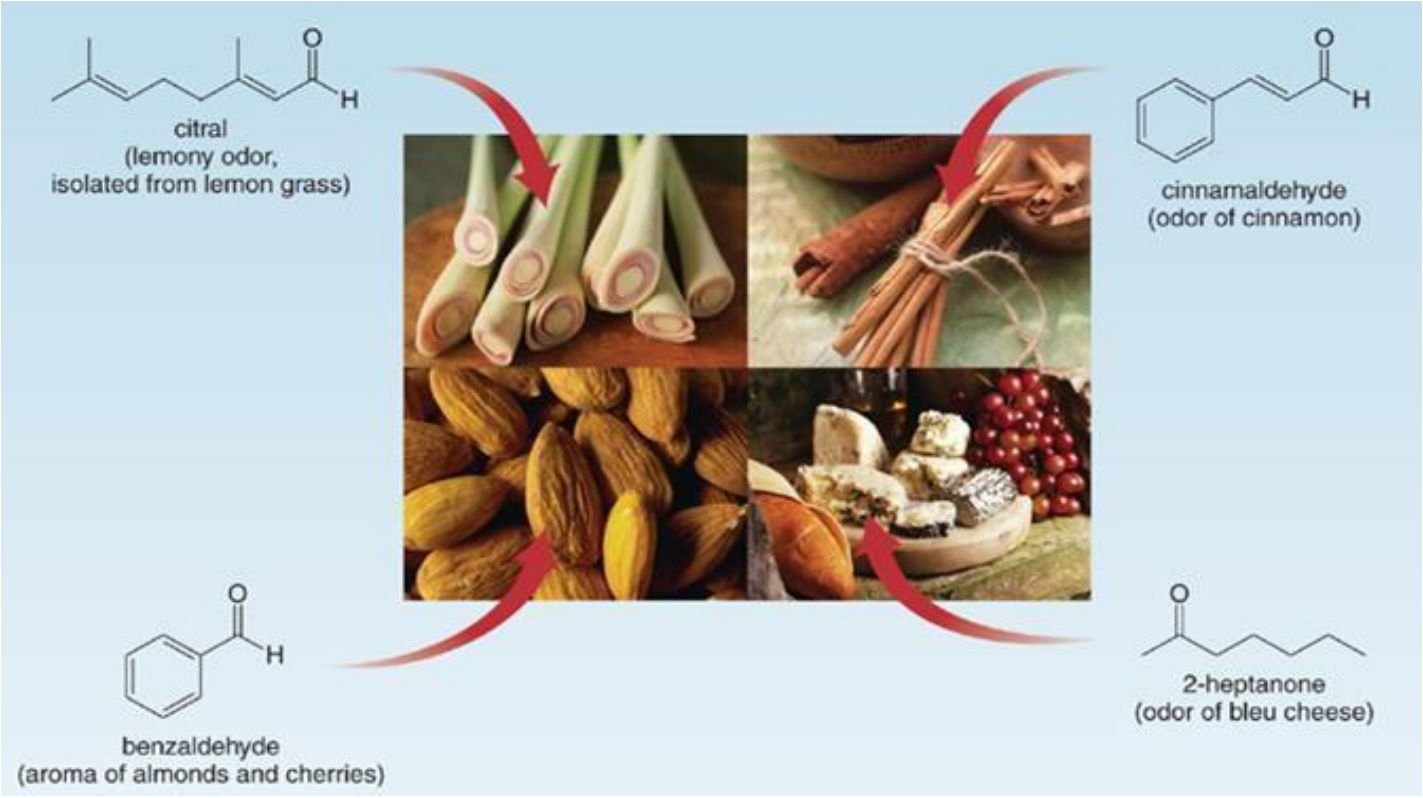
Keto tautomer Enol tautomer



99,9999999% 0,0000001% 99,9999% 0,0001%

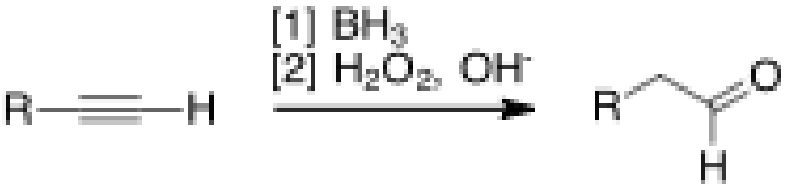
Interesting Aldehydes and Ketones

Many aldehydes and ketones with characteristic odors occur in nature.



Preparation of Aldehydes

Hydration of an alkyne (hydroboration-oxidation)

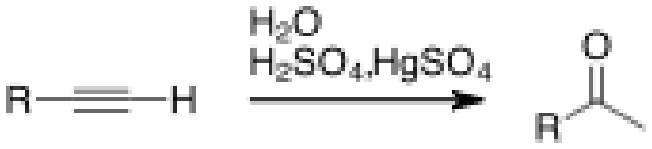


Oxidation of 1ry alcohols

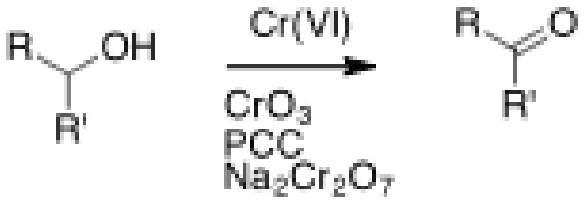
Reduction of esters and acyl chlorides

Preparation of Ketones

Hydration of alkynes



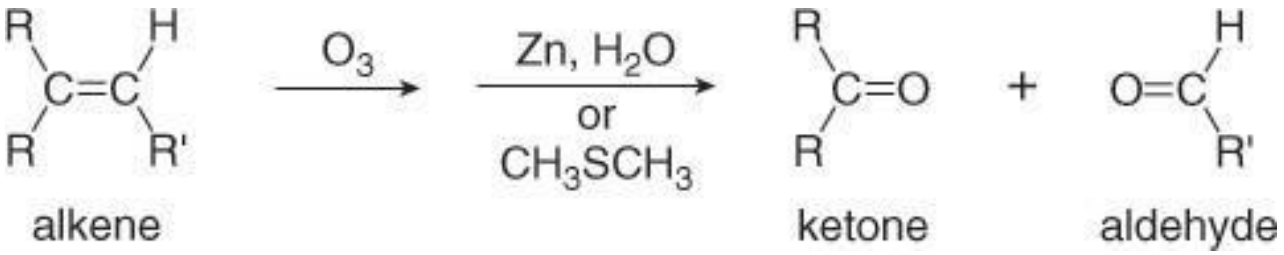
Oxidation of 2ry alcohols



Friedel-Crafts acylation

Acylation of organocuprates

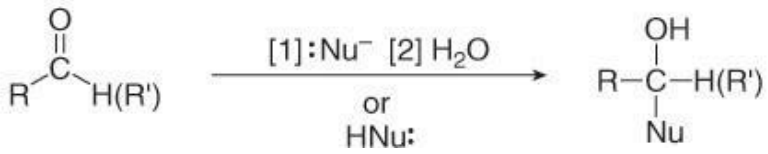
Aldehydes and ketones are also both obtained as products of the oxidative cleavage of alkenes



Reactions of Aldehydes and Ketones—General

1. Nucleophilic addition

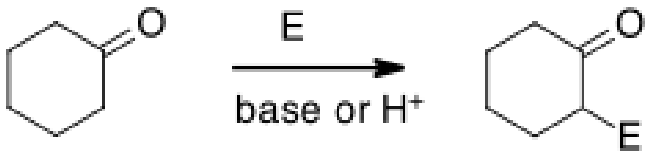
General reaction—Nucleophilic addition



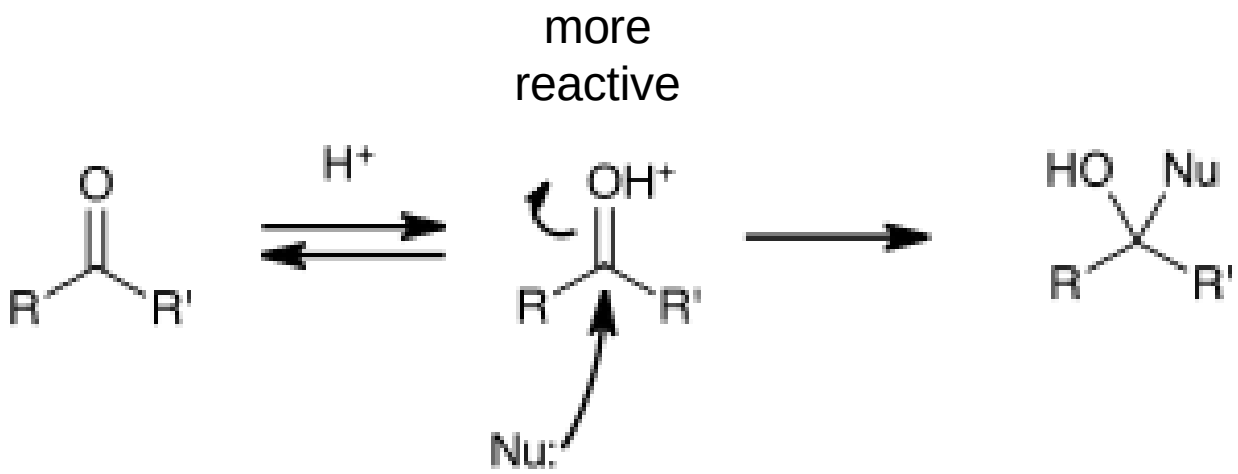
H and Nu are added.

2.Oxidation

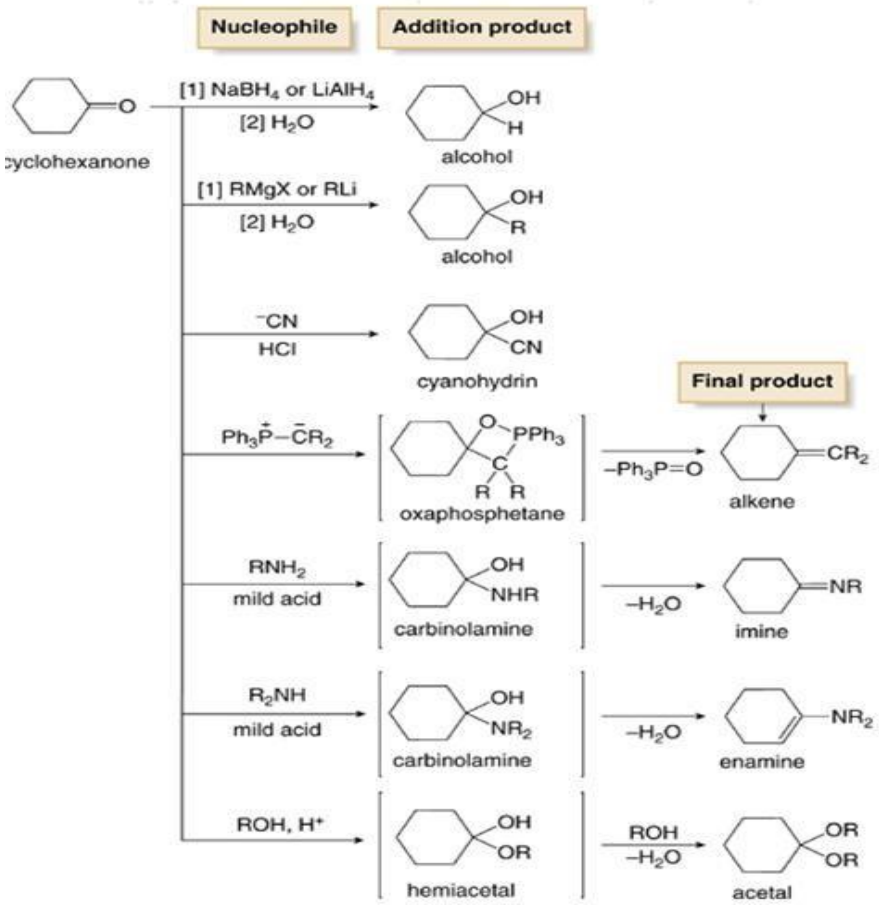
3. Reaction at the α carbon



Acid Catalysis

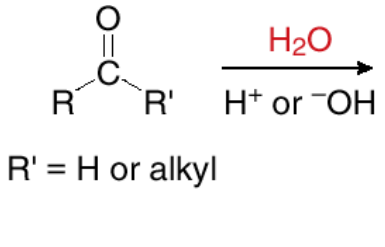


Nucleophilic Addition



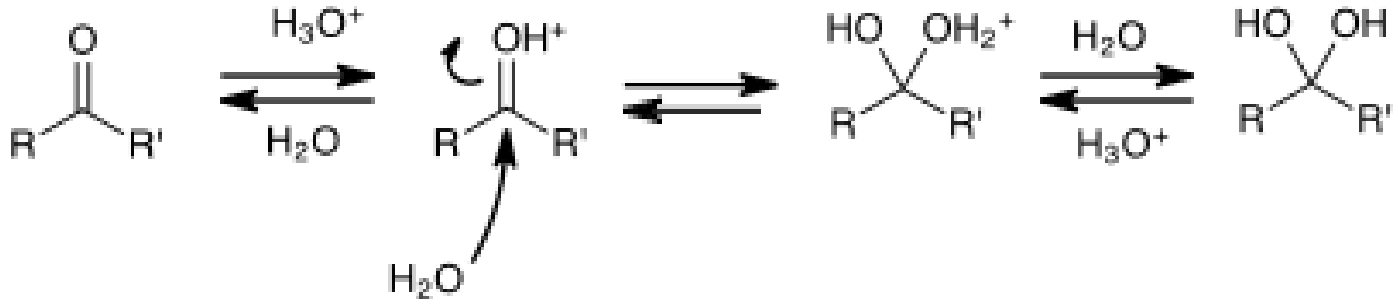
Addition of H_2O—Hydration

Nucleophilic addition of H_2O



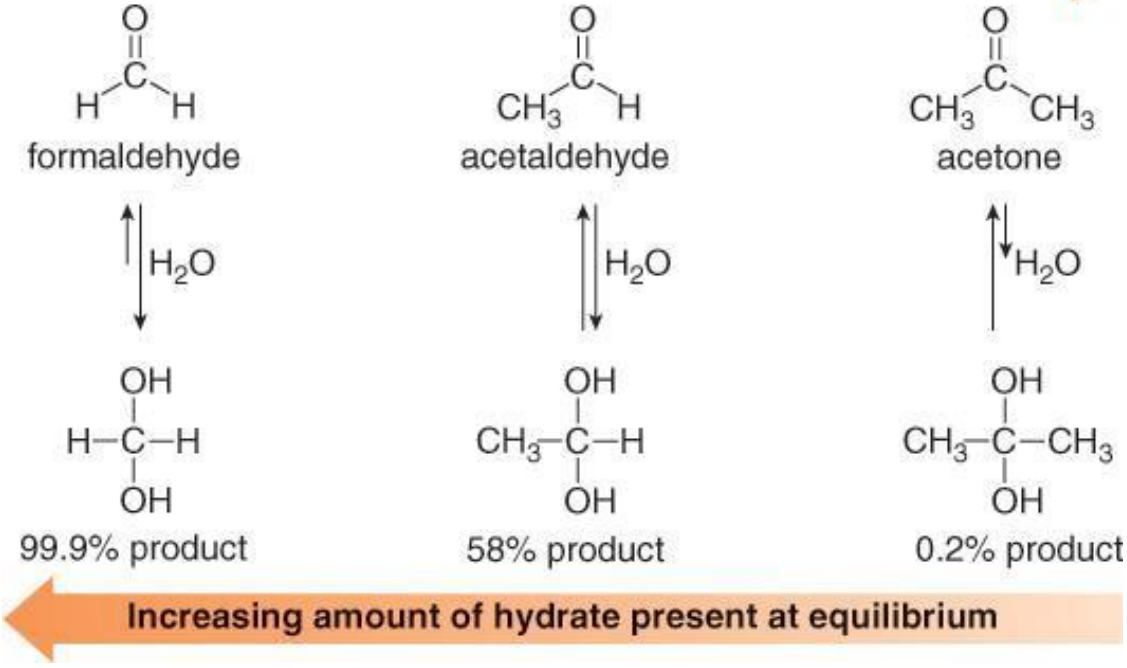
R' = H or alkyl

gem-diol
(hydrate)



Increasing number of R groups

Increasing stability of the carbonyl compound



Increasing amount of hydrate present at equilibrium