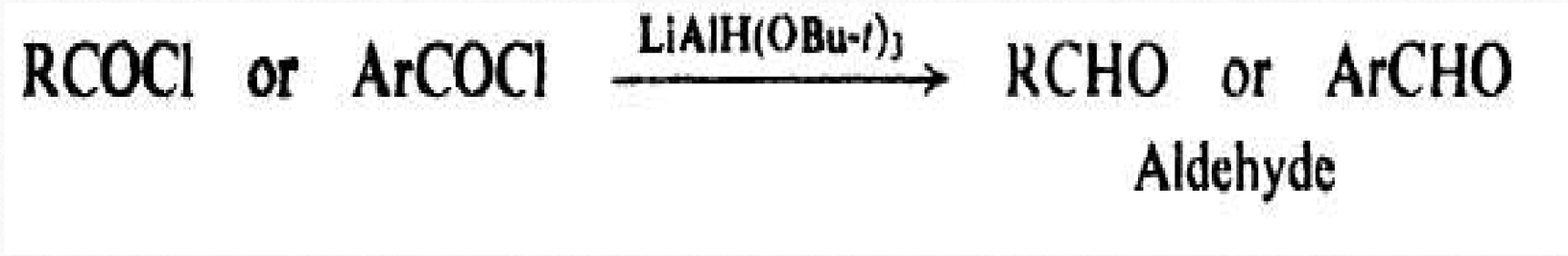
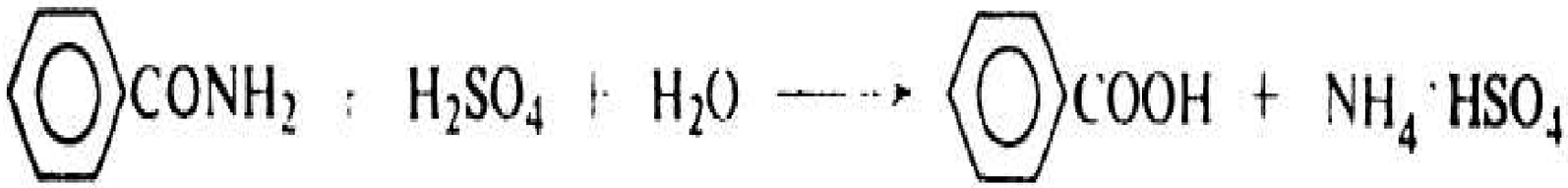
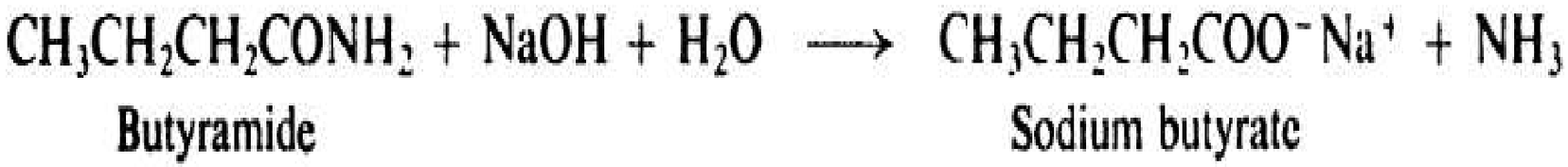
3-Formation of aldehydes by reduction.



2-Reaction of amide

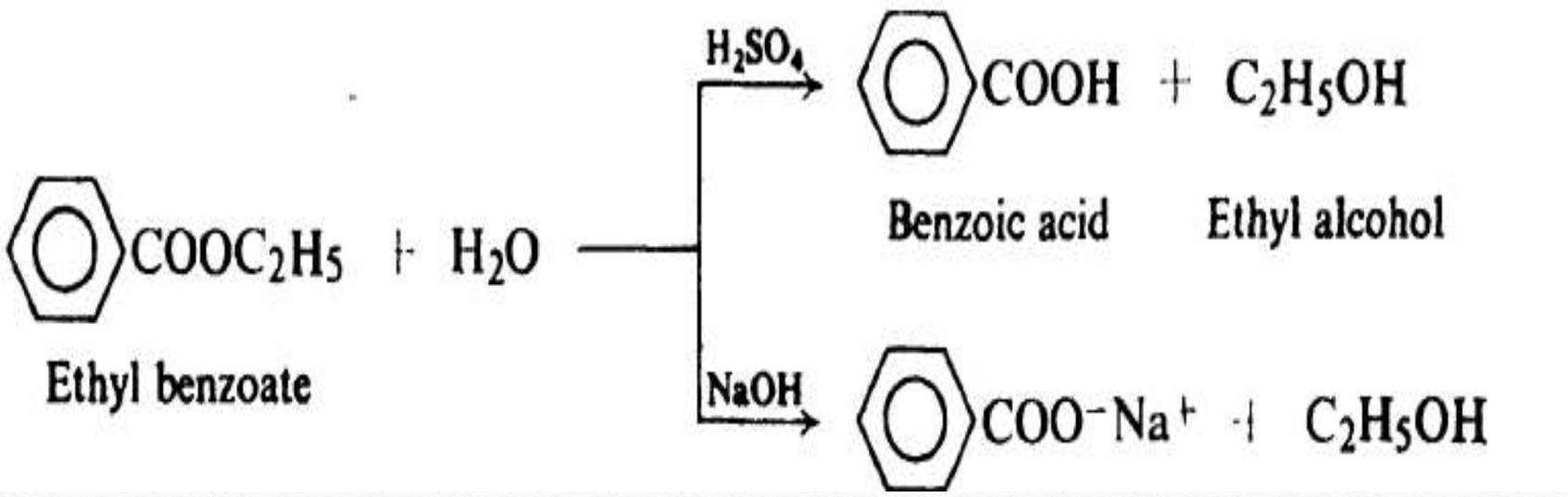
1. Hydrolysis





2-Reacation of ester

(a) Conversion into acids. Hydrolysis

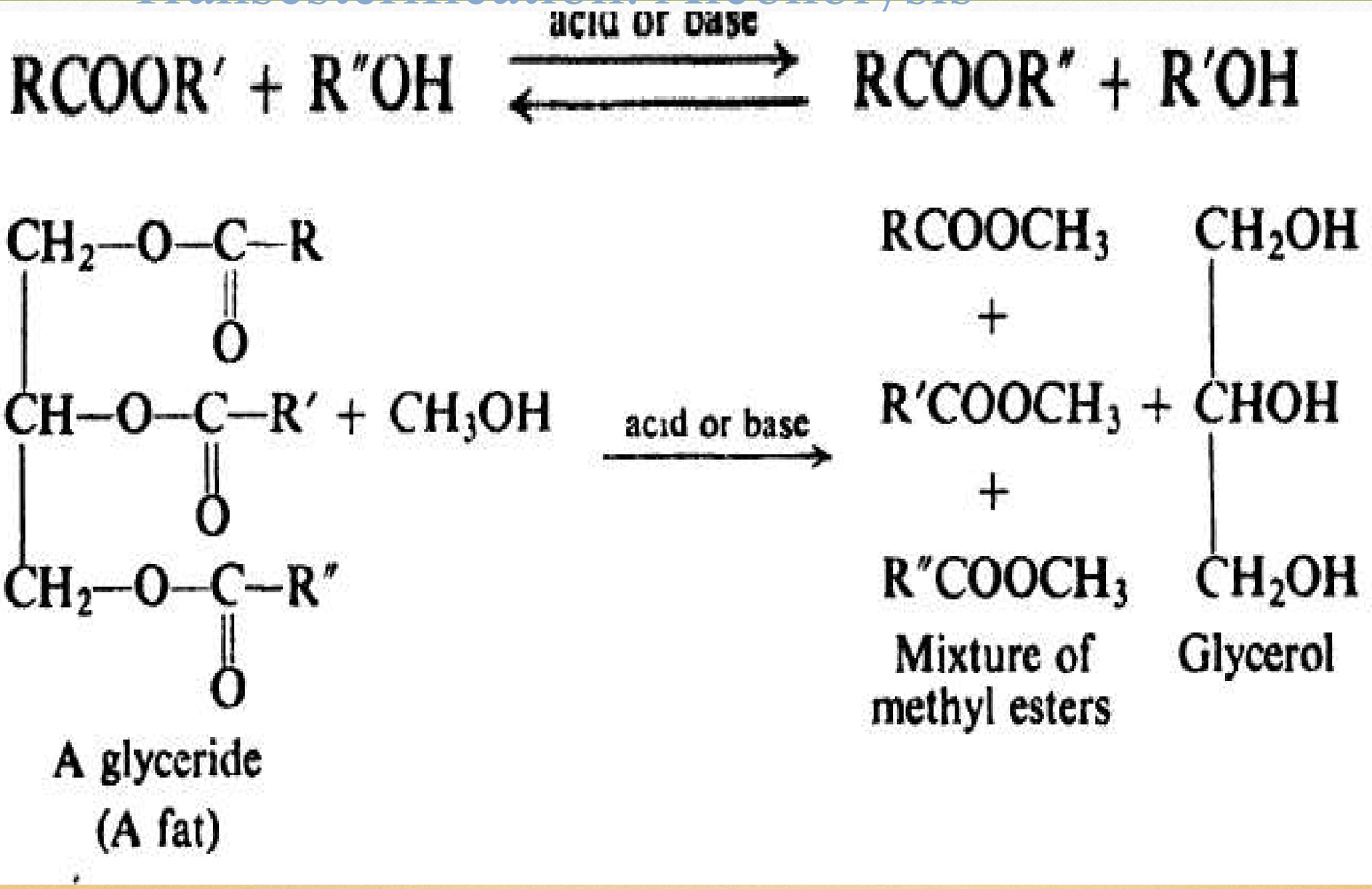


(b) Conversion into amides. Ammonolysis

$$CH_3COOC_2H_5 + NH_3 \longrightarrow CH_3CONH_2 + C_2H_5OH$$

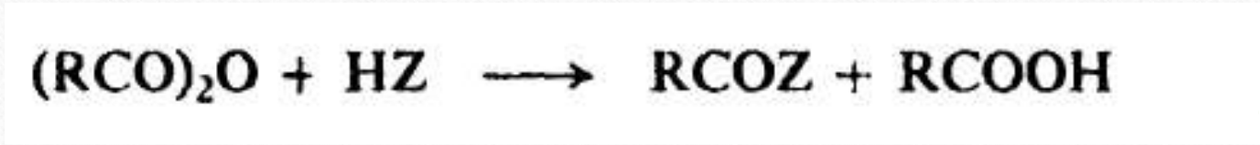
Ethyl acetate — Acetamide — Ethyl alcohol

(c) Conversion into esters: Transesterification. Alcoholysis

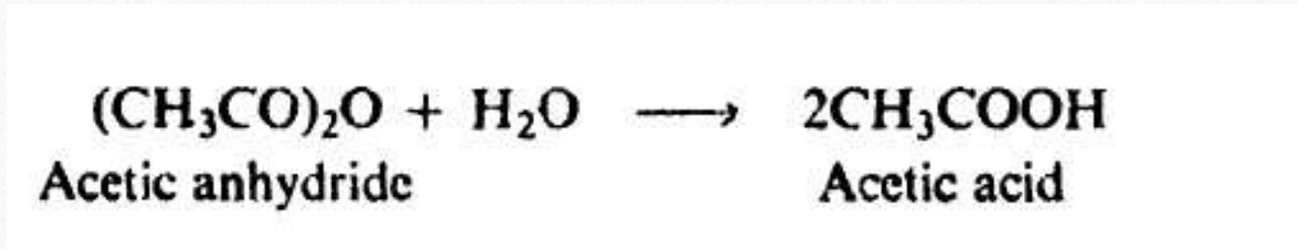


3-Reaction of acid anhydrides

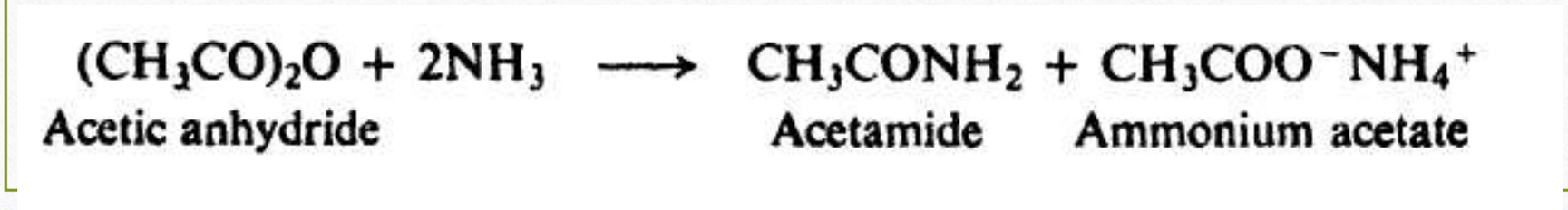
1. Conversion into acids and acid derivatives



(a) Conversion into acids. Hydrolysis

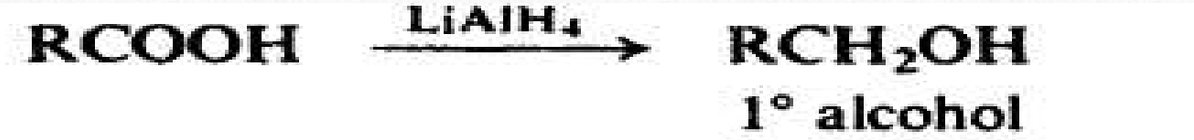


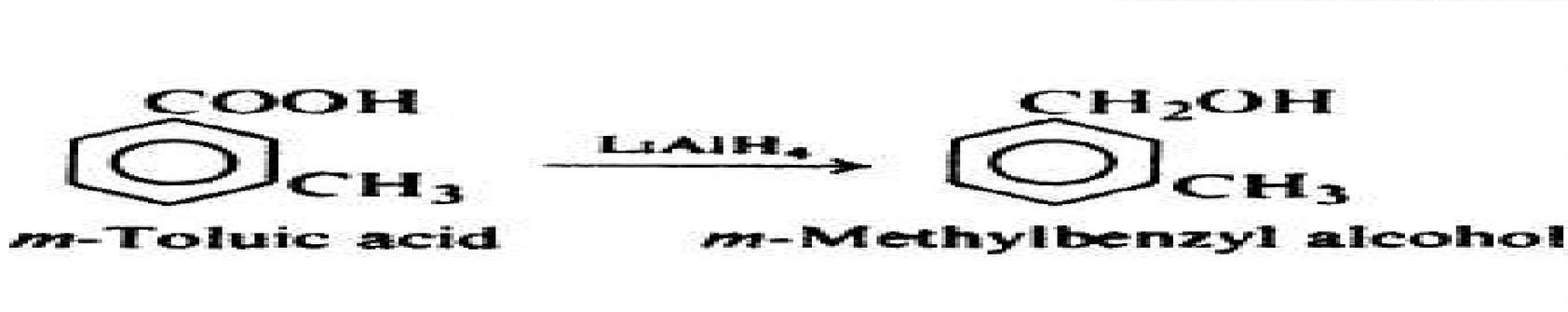
(b) Conversion into amides. Ammonolysis



3. Reduction

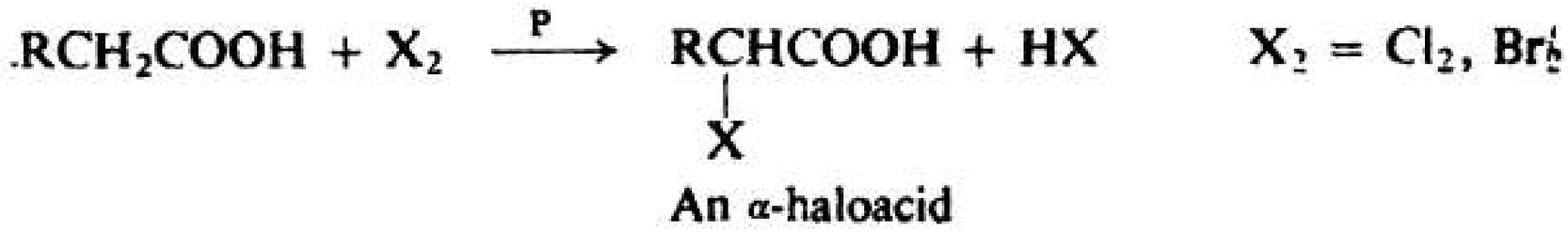
One of the few reducing agents capable of reducing an acid directly to an alcohol is lithium aluminum hydride, $LiAlH_4$

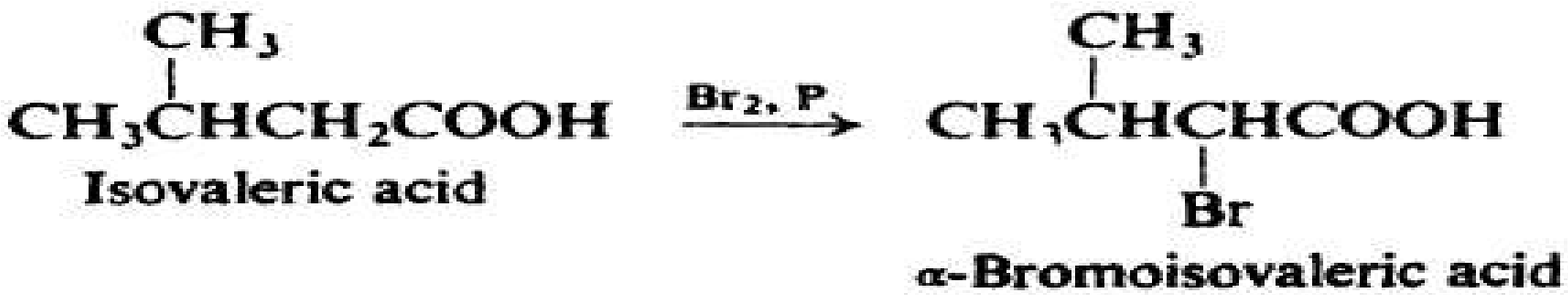




4. Substitution in alkyl or aryl group

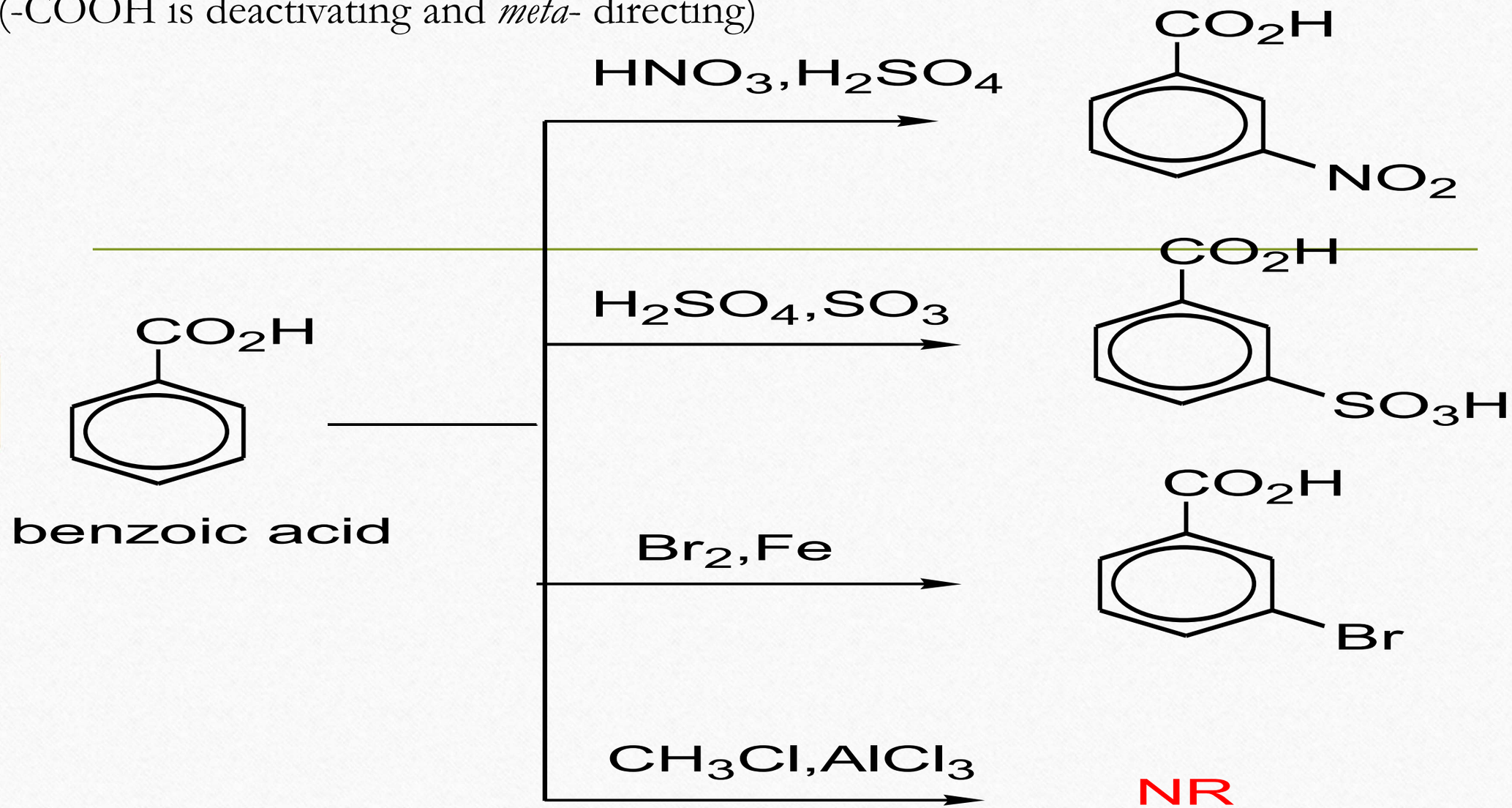
a- Alpha-halogenation of aliphatic acids. Hell-Volhard-Zelinsky reaction





6-Ring substitution in aromatic acids (Electrophilic aromatic substitution)

(-COOH is deactivating and *meta*- directing)



Dicarboxylic acids

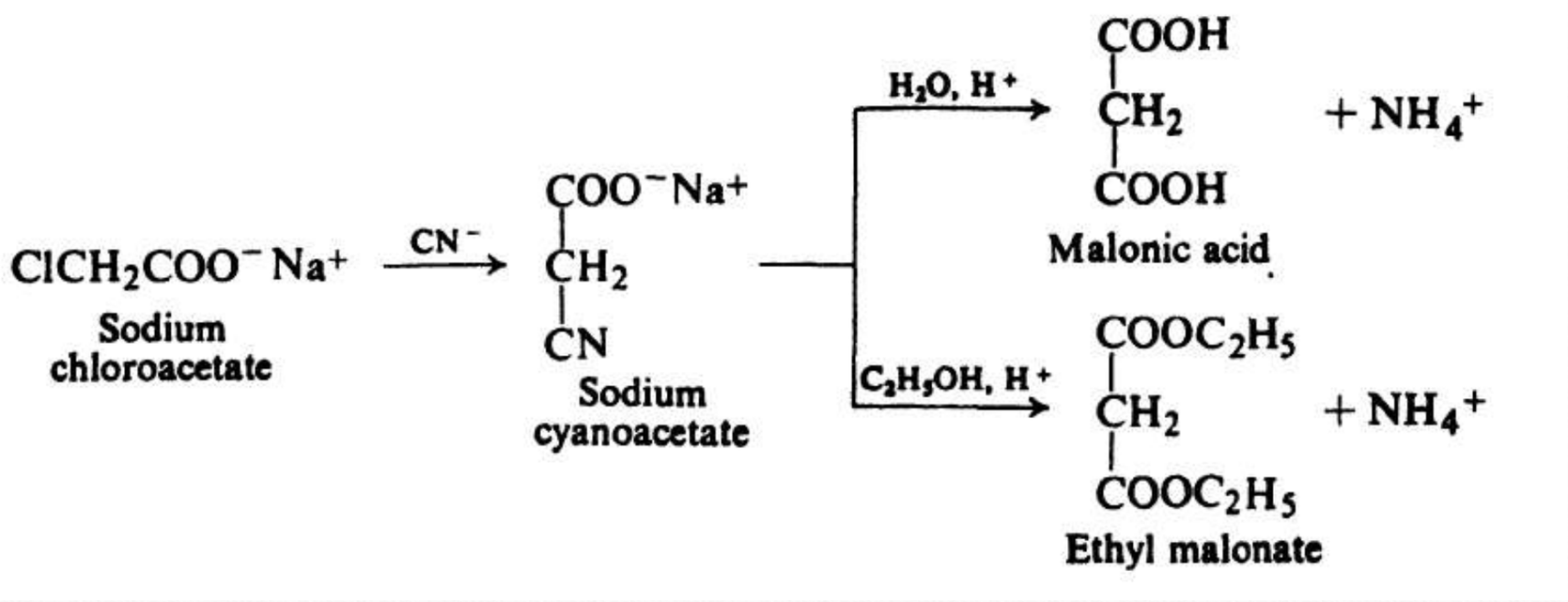
If the substituent is a second carboxyl group, we have a dicarboxylic acid. For example:

$HOOCCH_2COOH$	$HOOC(CH_2)_2COOH$,	$HOOC(CH_2)_4COOH$
Malonic acid	**Succinic acid**	**Adipic acid**
Propanedioic acid	**Butanedioic acid**	**Hexanedioic acid**

- **Table 2 Dicarboxylic acid**

Name	Formula
Oxalic	HOOC—COOH
Malonic	$HOOCCH_2COOH$
Succinic	$HOOC(CH_2)_2COOH$
Glutaric	$HOOC(CH_2)_3COOH$
Adipic	$HOOC(CH_2)_4COOH$
Maleic	*cis*-HOOCCH=CHCOOH
Fumaric	*trans*-HOOCCH=CHCOOH

Preparation of Dicarboxylic acid



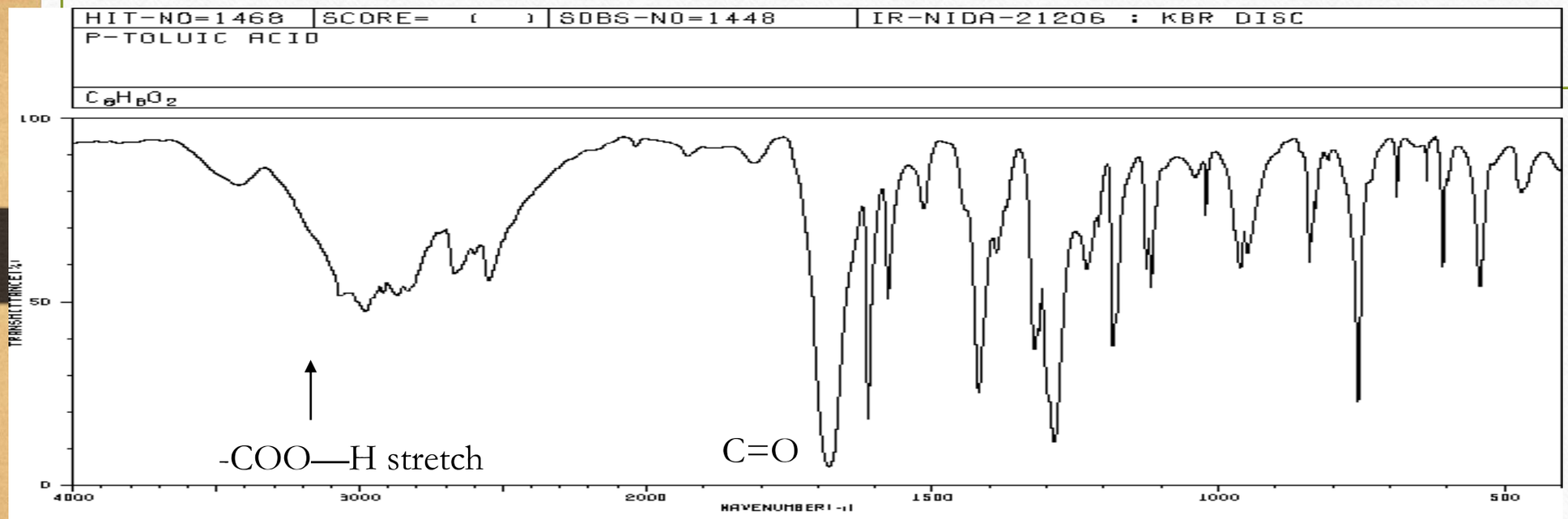
Spectroscopy

- IR: -COOH O—H stretch 2500 – 3000 cm^{-1} (b)

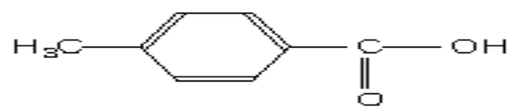
  C=O stretch 1680 – 1725 (s)

- nmr: -COOH 10.5 – 12 ppm

IR SPECTRUM of p-toluic acid



3420	79	2649	69	1322	36	1041	81	767	21
2978	46	1680	4	1287	11	1023	70	689	74
2919	50	1613	17	1231	57	962	57	636	79
2869	50	1577	49	1210	68	960	60	609	57
2833	50	1515	72	1185	36	841	58	601	79
2670	55	1420	24	1126	57	830	72	545	52
2598	60	1388	60	1118	62	808	84	472	77



NMR Spectrum of p-toluic acid