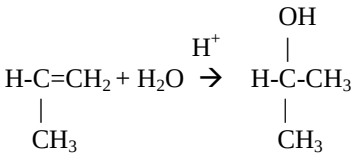
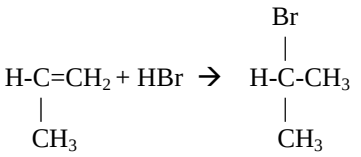
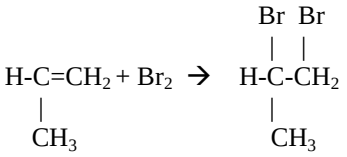
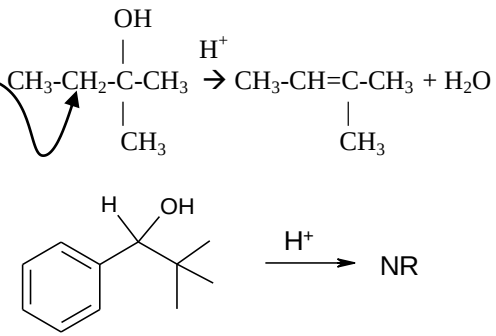
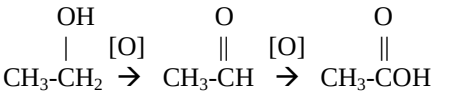
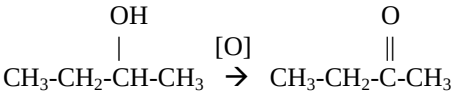
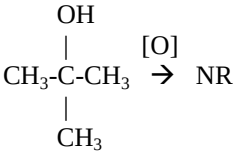
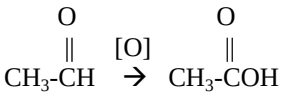
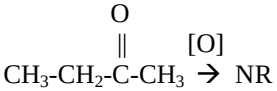
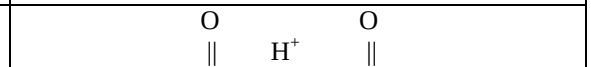
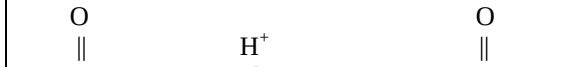
SUMMARY OF ORGANIC CHEMISTRY REACTIONS

Rxn #	FUNCTIONAL GROUP NAME and STRUCTURE	REACTION TYPE	CONDITIONS	PRODUCT(S)	COMMENTS	EXAMPLE
1 2 3 4 5	All that contain C, H, O Hydrocarbons, RCH_2CH_3 Alcohols, RCH_2OH aldehydes, ketones, $R_1C(O)R_2$ esters, carboxylic acids $R_1\ CO_2R_2$	Combustion	Oxygen (O_2) is always a reactant. Initiated by heat = Δ (including this symbol is optional)	$CO_2 + H_2O$	Must balance these equations. Use molecular formula in equation. Aldehydes/ketones are constitutional isomers Carboxylic acids/ esters are constitutional isomers	$2C_2H_6 + 7O_2 \xrightarrow{\Delta} 4CO_2 + 6H_2O$ $C_2H_4 + 3O_2 \rightarrow 2CO_2 + 2H_2O$ $2CH_3OH + 3O_2 \rightarrow 2CO_2 + 4H_2O$ $C_3H_6O + 4O_2 \rightarrow 3CO_2 + 3H_2O$ $2C_3H_6O_2 + 7O_2 \rightarrow 6CO_2 + 6H_2O$
6	Alkenes $RCH=CH_2$	Addition	H_2O in acid (H^+)	1^o, 2^o or 3^o alcohol	Hydration reaction follows Markovnikoff's Rule – rich get richer Reverse of dehydration of alcohol reaction (Rxn # 10)	
7			H_2	alkane	Hydrogenation reaction	$CH_2=CH_2 \rightarrow CH_3CH_3$
8			HCl , HBr, HI	Alkyl halide	Hydrohalogenation reaction follows Markovnikoff's Rule	
9			Cl_2 , Br_2 , I_2	Alkyl di-halide	Halogenation reaction	

SUMMARY OF ORGANIC CHEMISTRY REACTIONS (continued)

Rxn #	FUNCTIONAL GROUP NAME and STRUCTURE	REACTION TYPE	CONDITIONS	PRODUCT(S)	COMMENTS	EXAMPLE
10	Alcohols – hydroxy 1° RCH_2OH 2° $RCHOHCH_3$ 3° $RC(CH_3)_2OH$	Elimination , dehydration – loss of H_2O	Acid catalyzed (H^+) with heat. There must be a H on an adjacent C otherwise NoReaction	Most substituted alkene	Saytseff's rule – poor get poorer	
11		Oxidation	[O] conditions. Some oxidizing agents = CrO_3 , H_2CrO_4 , $K_2Cr_2O_7$	1° give aldehydes first, then carboxylic acids	Reverse of reduction of aldehyde or ketone reaction (Rx # 15)	
12				2° give ketones		
13				3° No Reaction		
14	Aldehyde R-C=O | H	Oxidation	[O] conditions. Some oxidizing agents = CrO_3 , H_2CrO_4 , $K_2Cr_2O_7$ Tollens (Ag^+) NAD^+ (biological)	Aldehydes give carboxylic acids	Only aldehydes are oxidized	
15	Ketone R_1-C=O | R_2			Ketones → No reaction		

Rxn #	FUNCTIONAL GROUP NAME and STRUCTURE	REACTION TYPE	CONDITIONS	PRODUCT(S)	COMMENTS	EXAMPLE
16	Carboxylic acid R-C=O | OH	Neutralization	Reaction with any base. Usually OH^- or any amine (1^o, 2^o, 3^o)	Carboxylic acid + inorganic base gives carboxylate ion Carboxylic acid + amine gives carboxylate ion + ammonium ion	Same as amine neutralization reaction above (Rxn #18)	 
17		Combination - esterification	Reaction of any carboxylic acid with any alcohol , catalyzed by acid and heated	ester	Catalyzed by acid. Anhydride + alcohol gives ester product without acid catalysis	  ester
18		Combination – amide product	Acid + amine + heat.	Reaction with 1^o gives a 2^o amide. Reaction with 2^o amine gives 3^o amide Reaction with 3^o amine does not give amide, only neutralization product.	Same reaction as amide formation reaction already described in amines (Rxn # 21-24, below)	  not an amide$^+$
19	Ester R_1-C=O | OR_2	Hydrolysis	Ester + acid or base + heat Reverse of esterification reaction	Acid catalysis→carboxylic acid + alcohol Base catalysis→ carboxylate ion + alcohol	Reverse of ester forming reaction (Rxn # 17, above)	 

Rxn #	FUNCTIONAL GROUP NAME and STRUCTURE	REACTION TYPE	CONDITIONS	PRODUCT(S)	COMMENTS	EXAMPLE
20	Amines RNH_2 1^o amine R_2NH 2^o amine R_3N 3^o amine	Neutralization.	Reaction with any acid: inorganic or organic	Ammonium ion + anion (carboxylate if acid is carboxylic acid)	Rxn with inorganic acid Rxn with organic acid	$CH_3NH_2 + HCl \rightarrow CH_3NH_3^+ + Cl^-$ $CH_3NH_2 + CH_3\text{-}\overset{\overset{O}{\|}}{C}OH \rightarrow CH_3NH_3^+ + CH_3\text{-}\overset{\overset{O}{\|}}{C}O^-$
21 22 23 24		Combination – amide formation (Like Rxn # 18 above)	Reaction with carboxylic acid <u>Requires heat.</u> Otherwise only neutralization occurs	Ammonia + carboxylic acid gives primary amide Reaction with 1^o amine gives a 2^o amide. Reaction with 2^o amine gives 3^o amide (rxn not shown) Reaction with 3^o amine does not give amide, only neutralization products.	→ → →	$NH_3 + CH_3\text{-}\overset{\overset{O}{\|}}{C}OH \xrightarrow{\Delta} CH_3\text{-}\overset{\overset{O}{\|}}{C}NH_2 + H_2O$ $CH_3NH_2 + CH_3\text{-}\overset{\overset{O}{\|}}{C}OH \xrightarrow{\Delta} CH_3\text{-}\overset{\overset{O}{\|}}{C}NHCH_3 + H_2O$ $(CH_3)_3N + CH_3\text{-}\overset{\overset{O}{\|}}{C}OH \xrightarrow{\Delta} CH_3\text{-}\overset{\overset{O}{\|}}{C}O^- + (CH_3)_3NH^+$ not an amide$^+$
25	Amides $R\text{-}\overset{\overset{O}{\|}}{\underset{\underset{NH_2}{\|}}{C}}$	Hydrolysis	Acid or base catalzyed	Acid catalysis→ carboxylic acid + ammonium ion Base catalysis→ carboxylate ion + amine	Reverse of amide forming reaction (Rxn # 18 and 21-24 above)	$CH_3\text{-}\overset{\overset{O}{\|}}{C}NHCH_3 \xrightarrow{H^+} CH_3\text{-}\overset{\overset{O}{\|}}{C}OH + CH_3NH_4^+$ $CH_3\text{-}\overset{\overset{O}{\|}}{C}NHCH_3 \xrightarrow{OH^-} CH_3\text{-}\overset{\overset{O}{\|}}{C}O^- + CH_3NH_2$