Organic Chemistry Summary by Functional Group

		Reactant	Reagents and Conditions	(Major) Product	Type of reaction	Observation, if any
ALKANES		CH ₃ CH ₃	Cl ₂ gas (or Br ₂) UV light	CH₃CH₂CI	Free Radical Substitution	Greenish yellow Cl ₂ decolourised White fumes of HCI formed
	CH3CH=CH2	H ₂ / Ni, heat (or H ₂ / Pt, r.t.p)	CH ₃ CH ₂ CH ₃	Reduction (Catalytic Hydrogenation)	NA	
			Br₂ in CCl₄ (Or Cl₂ in CCl₄)	CH₃CHBrCH₂Br	Electrophilic Addition	Red Brown Br2 decolourised
		CH ₃ CH=CH ₂	HBr (g), r.t.p	CH₃CHBrCH₃ (major)		NA
A L K			H ₂ O(g), 300°C, 60 atm, conc H ₃ PO ₄	CH ₃ CH(OH)CH ₃		NA
E N E			Cold dilute KMnO ₄	CH₃CH(OH)CH₂OH	Mild Oxidation	Purple KMnO₄ decolourised, brown ppt of MnO₂ formed (only in alkaline conditions).
S			Hot acidified KMnO ₄	CH ₃ COOH CO ₂ , H ₂ O	Oxidative Cleavage	Purple KMnO₄ decolourised
		In general, for read	tion with hot acidified KMn0	D ₄ , (where R is any alkyl group)		
		н		H HQ	R	R
		U	• CO ₂ , H ₂ O		-0 b 0- R	
			Conc HNO ₃ , Conc H ₂ SO ₄ , Reflux at 55 °C		Electrophilic Substitution	Yellow layer of nitrobenzene produced
•			Br ₂ , anhydrous FeBr ₃ , r.t.p (or Cl ₂ , anhydrous FeCl ₃)	Br		Red-brown Br2 decolourised
RENF	CH3		Conc HNO ₃ , Conc H ₂ SO ₄ , Refluxat 30 °C			NA
S			Br ₂ , anhydrous FeBr ₃ , r.t.p	Br Br CH ₃		Red-brown Br2 decolourised
			Cl ₂ , UV light or boil	CH ₂ CI	Free radical substitution	Yellow green Cl ₂ decolourised White fumes of HCI formed
			Acidified KMnO₄, heat under reflux	Соон	Oxidation of side chain	Purple KMnO₄ decolourised. White ppt of benzoic acid.
	CH₃CH₂Br		Alcoholic NaOH Heat under reflux	CH ₂ =CH ₂	Elimination	NA
H A L			Aqueous NaOH, Heat under reflux	CH₃CH₂OH	Nucleophilic Substitution	ΝΑ
OGENOA-			Excess alcoholic NH ₃ , heat in a sealed tube	CH ₃ CH ₂ NH ₂		NA
			Alcoholic NaCN, heat under reflux	CH₃CH₂CN		ΝΑ
K	1 2 CH ₃ CH ₂ CN	Dilute H ₂ SO ₄ , heat	CH ₃ CH ₂ COOH	Acid Hydrolysis	NA	
N E S		Dilute NaOH, heat	CH₃CH₂COO⁻	Base Hydrolysis	NA	
	3		LiAlH₄ in dry ether (or H₂ / Pd cat)	CH ₃ CH ₂ CH ₂ NH ₂	Reduction	NA

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-		PCl ₃ / PCl ₅ / SOCl ₂			Steamy fumes of HCI produced
		Conc HCl, anhydrous ZnCl ₂ , heat (only for 1° and 2° ROH)	CH ₃ CH ₂ Cl		NA
	CH3CH2OH	PBr ₃ (from Br ₂ and red phosphorus) HBr gas(from NaBr and conc H-SQ, beat)	CH ₃ CH ₂ Br	Substitution	NA
		Pl ₃ (from l ₂ and red phosphorus)	CH ₃ CH ₂ I		
	ОН	Any halogenating agent	No reaction	-	NA
	CH ₃ CH ₂ OH	Na metal	CH₃CH₂O ⁻ Na ⁺	Reduction	Effervescence of H ₂ gas evolved
	ОН		O [¯] Na ⁺		which gave a pop sound with lighted splint
	CH ₃ CH ₂ OH	NaOH(aq), rtp	No reaction	-	No visible observation
-	ОН		O'Na ⁺	Acid-base	Phenol layer dissolves into aqueous NaOH layer
	CH₃CH₂OH	Hot acidified K ₂ Cr ₂ O ₇ or KMnO ₄	CH₃COOH		Orange K₂Cr₂O₂ turned green / Purple KMnO₄ decolourised
	1° ROH	Hot acidified K ₂ Cr ₂ O ₇ distillation	CH₃CHO	Oxidation	
	CH ₃ CH(OH)CH ₃ 2° ROH	Hot acidified K ₂ Cr ₂ O ₇ or KMnO ₄	CH ₃ COCH ₃		Orange K₂Cr₂O7 turned green / Purple KMnO₄ decolourised
	(CH ₃) ₃ COH 3° ROH	Hot acidified $K_2Cr_2O_7$ or $KMnO_4$	Not oxidised	-	Orange K ₂ Cr ₂ O ₇ remains / Purple KMnO ₄ remains
H Y	CH₃CH₂OH	Excess, conc H ₂ SO ₄ ,170 °C	$CH_2=CH_2$	Elimination	NA
D R		Al ₂ O ₃ , 350 °C			
O X Y	н СН ₃ С	l₂, NaOH, heat	RCO₂⁻Na⁺ CHI₃	Mild oxidation	Yellow ppt of CHI₃ formed
	CH ₃ CH ₂ OH	CH₃CO₂H, conc H₂SO₄, heat	CH3CO2CH2CH3	Condensation (or nucleophilic acyl substitution)	Sweet smell of ester
		CH₃COCI, <mark>rtp</mark>			Sweet smell of ester White fumes of HCI formed
		CH₃CO₂H, conc H₂SO₄, heat	No reaction		
	ОН	CH₃COCI, pyridine, rtp			
-		NaOH, rtp			
	Дорон	Br₂(aq)	Br Br Br	Electrophilic substitution	Reddish brown Br₂ decolourised, White ppt formed White fumes of HBr formed
		Dilute HNO ₃			Yellow layer formed
		Conc HNO₃			Yellow ppt formed
		Neutral FeCl ₃ (aq)	-	Complex formation	Purple colouration

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C A R B O N Y L S	CH₃CH₂CHO Aldehyde	Hot acidified K2Cr2O7 or KMnO4	CH₃COOH	Oxidation	Orange K ₂ Cr ₂ O ₇ turned green / Purple KMnO ₄ decolourised
	CH₃COCH₃ Ketone		Not oxidised	-	No colour change
	CH₃CH₂CHO Aldehyde	NaBH₄(aq) or LiAlH₄ in dry ether or H₂ gas, Pt	CH₃CH₂CH₂OH 1º ROH	Reduction	NA
	CH₃COCH₃ Ketone		CH₃CH(OH)CH₃ <mark>2° ROH</mark>		
	R C=O R	HCN(g), trace NaOH (or trace NaCN), 10 – 20 °C	R CN C OH	Nucleophilic Addition	NA
	C=0	2,4-DNPH, warm	$R \xrightarrow{O_2N} NO_2$	Condensation	Orange ppt formed
	C=O CH ₃	l₂, NaOH, heat	RCO₂ [−] CHI₃	Oxidation	Yellow ppt formed
	CH ₃ CH ₂ CHO Aldehyde (except benzaldehyde)	Fehling's solution (Cu ²⁺	CH₃CH₂CO₂ [−] Cu₂O	Oxidation	Brick red ppt formed
	CH₃COCH₃ Ketone	and NaOH), warm	Not oxidised	-	No ppt formed
	CH ₃ CH ₂ CHO Aldehyde	Tollen's reagent (Ag ₂ O	CH₃CH₂CO₂ [−] Ag	Oxidation	Silver mirror formed
	CH ₃ COCH ₃ Ketone	in NH₃), warm	Not oxidised	-	No silver mirror
	CH₃CO₂H	Na metal	CH_3CO_2 -Na ⁺ + H ₂	Reduction	Effervescence of H ₂ gas evolved which gave a pop sound with lighted splint
С		NaOH <mark>(aq)</mark>	$CH_3CO_2^-Na^+ + H_2O$	Acid-base	NA
A R B		Na_2CO_3 or $NaHCO_3$	CH_3CO_2 ⁻ Na ⁺ + CO_2 + H_2O	Acid-base	Effervescence of CO ₂ gas evolved which gave a white ppt with limewater
X Y		$PCl_3 / PCl_5 / SOCl_2$	CH₃COCI	(Nucleophilic) substitution	White fumes of HCI
- ゴ ひ ゑ ひ — ロ		CH₃CH₂OH Conc H₂SO₄, heat	CH ₃ CO ₂ CH ₂ CH ₃	Condensation (or nucleophilic acyl substitution)	Sweet smell of ester
		LiAlH₄ in dry ether	CH₃CH₂OH 1° ROH	Reduction	NA
S		Hot acidified KMnO4	Not oxidised	-	No colour change
	HCO ₂ H (COOH) ₂	Hot acidified KMnO4	CO ₂ , H ₂ O	Oxidation	Purple KMnO₄ decolourised, effervescence of CO₂ gas
	CH₃COCI	CH ₃ CH ₂ OH rtp	CH ₃ CO ₂ CH ₂ CH ₃	Condensation (or nucleophilic acyl substitution)	Sweet smell of ester White fumes of HCI
ACYL CHLOR-DES		OH Pyridine, rtp			
	Ср-сосі	он NaOH, rtp	-oco-		
	CH₃COCI	Excess conc NH ₃	CH₃CONH₂ 1° amide		White fumes of HCI
	CH₃COCI	Excess RNH ₂ 1° amine	CH₃CONHR 2° amide		White fumes of HCI
	CH₃COCI	Excess R ₂ NH 2º amine	CH ₃ CONR ₂ 3° amide		White fumes of HCI
	CH₃COCI	Excess R ₃ N 3° amine	No reaction		NA
	CH ₃ COCI	H ₂ O	CH ₃ CO ₂ H	Hydrolysis	White fumes of HCI

	Reactant	Reagents and Conditions	(Major) Product	Type of reaction	Observation, if any
E S	CH ₃ CO ₂ CH ₂ CH ₃	Dilute H ₂ SO ₄ , heat under reflux	CH ₃ CO ₂ H, CH ₃ CH ₂ OH	Acid hydrolysis	NA
E R		Dilute NaOH, heat under reflux	CH₃CO₂ [−] Na⁺, `CH₃CH₂OH	Base hydrolysis	NA
	NO ₂	Sn, conc HCI ,heat, followed by NaOH Or H ₂ ,Ni, heat	NH ₂	reduction	NA
	$CH_3CH_2NH_2$	Aq HCI	CH₃CH₂NH₃⁺CI⁻	Acid-base	White crystalline solid
N I T B	$CH_3CH_2NH_2$	CH₃COOH (aq)	[CH₃CH₂NH₃⁺][CH₃COO⁻]	Acid-base	White crystalline solid
O G E	$CH_3CH_2NH_2$	CH₃Cl, heat Or any other halogenoalkane	CH ₃ CH ₂ NHCH ₃	Nucleophilic substitution	NA
Ν	$CH_3CH_2NH_2$	CH₃COCI	CH ₃ CONHCH ₂ CH ₃	Condensation	White fumes of HCI
0 0 A C O A C O A C O A C O A C O A C O A C O A C O A C O A C O A C O A C O A C O A C O A C O A C O A C O A C O	₽H2	Aq Br ₂	Br Br Br	Electrophilic substitution	Reddish–brown bromine decolourises, white ppt of 2,4,6–tribromophenylamine formed and white fumes of HBr seen.
	CH₃CONH₂ 1° amide	Dilute H ₂ SO ₄ , heat under reflux	CH₃COOH NH₄⁺	Acid hydrolysis	NA
		Dilute NaOH, heat under reflux	CH₃COO⁻ NH₃	Base hydrolysis	Pungent NH ₃ gas evolved which turns red litmus blue
	CH₃CONHCH₂CH₃ 2° amide	Dilute H ₂ SO ₄ , heat under reflux	CH₃COOH CH₂CH₂NH₃⁺	Acid hydrolysis	NA
		Dilute NaOH, heat under reflux	CH_3COO^- $CH_2CH_2NH_2$	Base hydrolysis	NA