

ORGANIC CHEMISTRY

Part-1

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Topics Covered

1. Organic Reagents and It's Functions
2. Organic Named Reactions
3. Distinguish Chemical Tests

ORGANIC REAGENTS

S.No.	Reagent	Function
1	$\text{PCl}_3, \text{PBr}_3, \text{PI}_3$	Alcohols into Alkyl halides
2	$\text{SOCl}_2, \text{PCl}_5$	Alcohols into Alkyl chlorides & Carboxylic acids into Acid Chlorides
3	$\text{HCl}/\text{ZnCl}_2, \text{HBr}, \text{HI}$	Alcohols into alkyl halides
4	Cl_2/Fe or FeCl_3	Cl group substituting on Benzene
5	$\text{NaNO}_2 / \text{HCl}$ $0-5^\circ\text{C}$	Diazotisation
6	$\text{CuCl}, \text{CuBr}, \text{CuCN}, \text{KI}, \text{H}_2\text{O}, \text{H}_3\text{PO}_2$	Diazonium Chloride into Chlor Benzene, Bromo Benzene, Benzo nitrile, Iodo Benzene , Phenol, Benzene respectively
7	HBF_4 or NaBF_4	Diazonium Chloride into Fluoro Benzene
8	AgF or Hg_2F_2 or SbF_3 or CoF_2	Alkyl halides into alkyl fluorides
9	Na / dry ether	Alkyl halides into alkanes
10	NaOH $623/443/368\text{K}$	Chloro benzene to phenol
11	$\text{Br}_2 / \text{FeBr}_3$	Bromination of Benzene
12	$\text{Cl}_2 / \text{FeCl}_3$	Chlorination of Benzene
13	$\text{CH}_3\text{Cl} / \text{AlCl}_3$	alkylation of benzene and its derivatives
14	$\text{CH}_3\text{COCl} / \text{AlCl}_3$	Acylation on benzene
15	$\text{H}_2\text{SO}_4 / \text{HNO}_3$	Nitration of benzene
16	$(\text{CH}_3\text{CO})_2\text{O} / \text{AlCl}_3$	O \rightarrow Acylation of Phenol
17	H_2SO_4	Sulphonation on Benzene
18	$\text{H}_2\text{O} / \text{H}_2\text{SO}_4$	alkenes into alcohols
	Aq KOH	Alkyl halide into alcohol
19	$\text{BH}_3 / \text{H}_2\text{O}_2 / \text{OH}^-$	Alkenes into alcohols (Anti Markownikoff product)
20	$\text{NaBH}_4 / \text{LiAlH}_4 (\text{LAH})$	Aldehydes, ketones, acids into alcohols, Nitriles & Cyanides , Isocyanides into amines
21	H_2 / Ni or H_2 / Pd	reduction of aldehydes, ketones and cyanides
22	$\text{RMgX} / \text{H}_3\text{O}^+$	Aldehydes, ketones into alcohols
23	O_2 / H^+	Cumene to phenol
24	Na	Alcohol or phenol into Sodium alkoxide/Phenoxide
25	$(\text{CH}_3\text{CO})_2\text{O} / \text{CH}_3\text{COCl}$	O acylation on phenol or N acylation on Aniline or amine
26	Conc. $\text{H}_2\text{SO}_4 / 443\text{K}$	Conversion of primary alcohols into Alkenes
27	Conc. $\text{H}_2\text{SO}_4 / 410\text{K}$	Conversion of alcohols into Ethers
28	85% $\text{H}_3\text{PO}_4 / 440\text{K}$	Secondary alcohol into alkene
29	20% $\text{H}_3\text{PO}_4 / 358\text{K}$	Tertiary alcohol into alkene
	Alcoholic KOH	Alkyl halide into alkene

ORGANIC REAGENTS

30	$\text{CrO}_3/\text{KMnO}_4$ or $\text{K}_2\text{Cr}_2\text{O}_7$ in acidic medium	oxidation of alcohols into acids
31	$\text{Cu} / 573\text{k}$	dehydrogenation of alcohols gives 1° alcohols into aldehydes and 2° alcohols into ketones & 3° alcohols into alkenes
32	Dil. HNO_3	Mono nitration of Phenol
33	Conc. HNO_3	tri nitration of phenol
34	$\text{Br}_2/\text{H}_2\text{O}$	tri bromination of phenol
35	Br_2/CS_2	mono bromination of phenol
36	NaOH/CO_2	Phenol to salicylic acid
37	$\text{CHCl}_3/\text{NaOH}$	Phenol to salicylaldehyde
38	Zn dust	Phenol to Benzene
39	$\text{Na}_2\text{Cr}_2\text{O}_7/\text{H}_2\text{SO}_4$ or air	Phenol to Benzo quinone
40	$\text{Zn}/\text{Cr}_2\text{O}_3$ 200 to 300 atm 573 to 673K	CO & H into methanol
41	Invertase	Sucrose into Glucose or Fructose
42	Zymase	Glucose or Fructose into ethanol
43	HI	Ether into alcohol & alkyl halide
44	PCC	alcohol to aldehyde
45	$\text{Pd}/\text{BaSO}_4, \text{H}_2$	acid chloride into aldehyde
46	$\text{SnCl}_2/\text{HCl}/\text{H}_3\text{O}^+$	Cyanides into aldehydes
47	$\text{AlH}(\text{i-Bu})_2/\text{H}_2\text{O}$	Cyanides into aldehydes
48	DIBAL-H/ H_2O	Esters into aldehydes
49	$\text{CrO}_2\text{Cl}_2/\text{H}_2\text{O}$	Toluene to aldehyde
50	$\text{CrO}_3/(\text{CH}_3\text{CO})_2\text{O}$	Toluene into Benzaldehyde
51	$\text{Cl}_2/h\nu$	Chlorination on alkyl group of Benzene or alkane
52	CO, HCl anhydrous AlCl_3	Benzene to Benzaldehyde
53	$(\text{CH}_3)_2\text{Cd}$	acid chloride into ketones
54	$\text{RMgX}/\text{H}_3\text{O}^+$	Cyanides into ketones
55	HCN	Carbonyl compound into cyanohydrin
56	NaHSO_3	addition to aldehyde and ketone
57	H_2NOH	carbonyl compound into oxime
58	$\text{H}_2\text{N}-\text{NH}_2$	carbonyl compound into hydrazone
59	$\text{H}_2\text{N}-\text{NH}-\text{Ph}$	carbonyl compound into Phenyl hydrazone
60	2,4DNP	carbonyl compound into 2,4 dinitro phenyl hydrazone
61	$\text{H}_2\text{N}-\text{NH}-\text{CO}-\text{CH}_3$	carbonyl compound into semi carbazide
62	ROH/HCl	Aldehydes & ketones into hemiacetal and acetal
63	$\text{HO}-\text{CH}_2-\text{CH}_2-\text{OH}/\text{HCl}$	Aldehyde or ketone into ethylene glycol


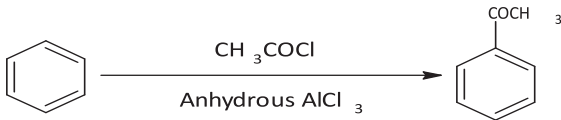
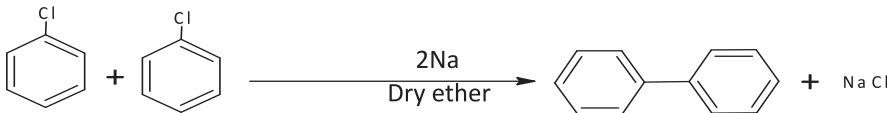
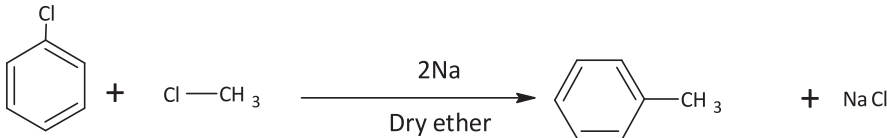
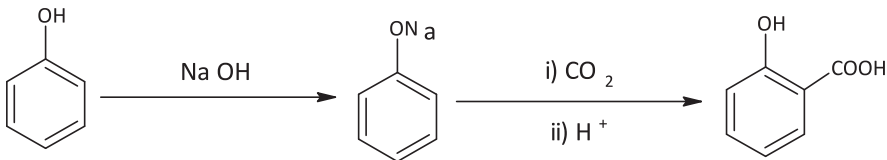
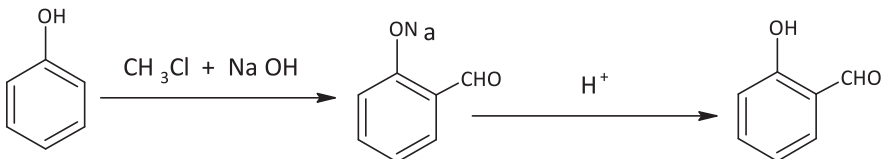
ORGANIC REAGENTS

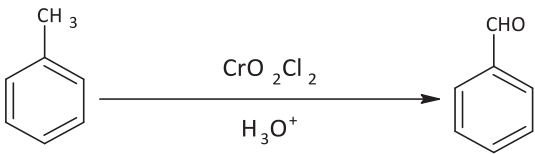
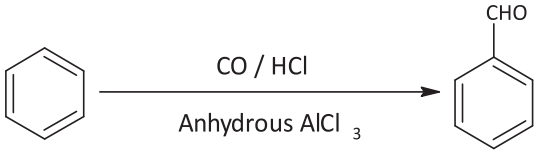
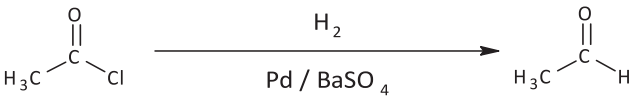
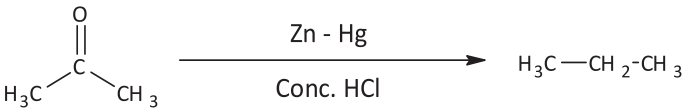
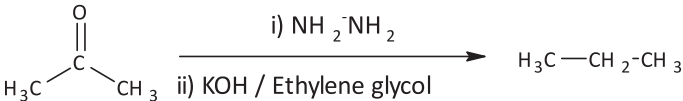
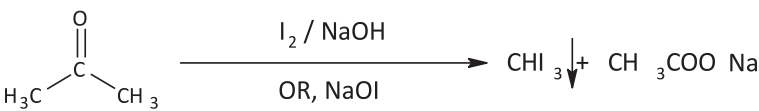
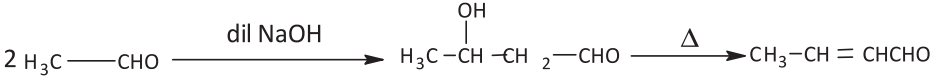
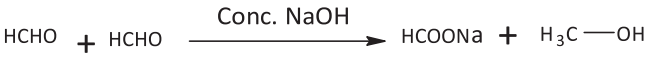
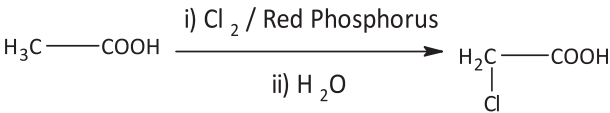
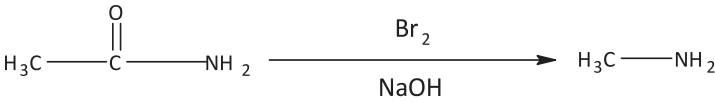
		ketone
64	Zn-Hg/HCl	carbonyl compound into alkane
65	H ₂ N-NH ₂ /KOH	carbonyl compound into alkane
66	KMnO ₄ /OH ⁻ / K ₂ Cr ₂ O ₇ /H ₂ SO ₄ or HNO ₃	Ketones into mixture of carboxylic acids on prolonged oxidation
67	(Ag(NH ₃) ₂)NO ₃ +NaOH	Tollen's test
68	Cu(OH) ₂	Fehling's test
69	NaOH+I ₂	Iodoform
70	NaOH or Ba(OH) ₂	aldol condensation
71	Conc KOH or NaOH	Cannizzaro's reaction
72	KMnO ₄ /KOH	Toluene/alkyl Benzene into Benzoic Acid
73	H ₂ O/H ⁺	Cyanides into carboxylic acids, amides into carboxylic acids, esters into carboxylic acids and alcohols, acid chlorides or anhydrides into carboxylic acids
74	NaOH	Saponification of ester, acid into salt of acid
75	Na ₂ CO ₃ or NaHCO ₃	Carboxylic acid test
76	P ₄ O ₁₀ or P ₂ O ₅	Dehydration of acids into anhydride, amides into nitriles
77	ROH/conc H ₂ SO ₄	Carboxylic acids into esters
78	PCl ₃ , SOCl ₂ , PCl ₅	Carboxylic acids into acid chlorides
79	NH ₃ heating	Carboxylic acids into amides
80	NaOH/CaO	Decarboxylation (acids into alkanes)
81	LiAlH ₄	Carboxylic acids into alcohols, amides into amines
82	Cl ₂ /red.P ₄	HVZ reaction
83	Sn/HCl or Fe/HCl, H ₂ /Pd	Reduction of nitro compounds into amines
84	NH ₃	Alkyl halides into amines
85	H ₂ /Ni or H ₂ /Pd LiAlH ₄	Amides into cyanides
86	KOH/R-X	Phthalamide into amine
87	NaOH/Br ₂	Hoffman bromamide, amide into amine with one C less
88	KOH,CHCl ₃	Amines into Carbyl amines
89	NaNO ₂ /HCl	1 ^o aliphatic amines into alcohols
90	NaNO ₂ /HCl 0 to 5°C	Aniline into diazonium chloride
91	C ₆ H ₅ SO ₂ Cl	Distinguishing 1 ^o , 2 ^o & 3 ^o amines
92	Br ₂ /H ₂ O	Aniline into tri bromo aniline
93	Br ₂ /CH ₃ -CO-Cl/(CHCO) ₂ O	Aniline into Bromo Aniline

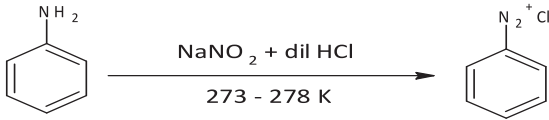


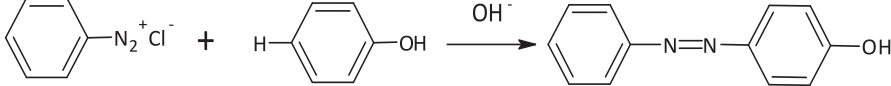
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94	$\text{HNO}_3 / \text{CH}_3\text{CO}-\text{Cl}$ $/(\text{CH}_3\text{CO})_2\text{O}$	Nitro aniline
95	H_2SO_4	Sulphonation on aniline
96	$\text{CuCl}, \text{CuBr}, \text{CuCN}, \text{KI}, \text{H}_2\text{O},$ H_3PO_2 or $\text{CH}_3-\text{CH}_2-\text{OH}$	Diazonium Chloride into Chlor Benzene, Bromo Benzene, Benzo nitrile, Iodo Benzene , Phenol, Benzene respectively

NAME REACTIONS

1.	Finkelstein	$\text{CH}_3\text{Br} + \text{NaI} \xrightarrow{\text{Acetone}} \text{CH}_3\text{I} + \text{NaBr}$
2.	Swarts	$\text{CH}_3\text{Br} + \text{AgF} \longrightarrow \text{CH}_3\text{F} + \text{AgBr}$
3.	Friedel-Crafts Alkylation	
4.	Friedel-Crafts Acylation	
5.	Wurtz	$\text{H}_3\text{C}-\text{Cl} + \text{Cl}-\text{CH}_3 \xrightarrow[\text{Dry ether}]{2\text{Na}} \text{H}_3\text{C}-\text{CH}_3 + \text{NaCl}$
6.	Fittig	
7.	Wurtz-Fittig	
8.	Kolbe	
9.	Reimer-Tiemann	
10.	Williamson	$\text{CH}_3-\text{Br} + \text{CH}_3-\text{ONa} \longrightarrow \text{CH}_3-\text{O}-\text{CH}_3 + \text{NaBr}$
11.	Stephen	$\text{H}_3\text{C}-\text{CN} + \text{SnCl}_2 + \text{HCl} \longrightarrow \text{H}_3\text{C}-\text{CH}=\text{NH} \xrightarrow{\text{H}_3\text{O}^+} \text{H}_3\text{C}-\text{CHO}$

12.	Etard	
13.	Gatterman – Koch	
14.	Rosenmund reduction	
15.	Clemmensen reduction	
16.	Wolff-Kishner reduction	
17.	Tollens' test	$\text{R-CHO} + 2 [\text{Ag}(\text{NH}_3)_2]^+ + 3 \text{OH}^- \longrightarrow \text{R-COO}^- + 2\text{Ag} \downarrow + 2\text{H}_2\text{O} + 4 \text{NH}_3$
18.	Fehling's test	$\text{R-CHO} + 2 \text{Cu}^{2+} + 5 \text{OH}^- \longrightarrow \text{R-COO}^- + \text{Cu}_2\text{O} \downarrow + 3\text{H}_2\text{O}$
19.	Iodoform	
20.	Aldol condensation	
21.	Cannizzaro	
22.	Hell-Volhard-Zelinsky (HVZ)	
23.	Hoffmann bromamide degradation	

24.	Carbylamine	$\text{R-NH}_2 + \text{CHCl}_3 + 3 \text{KOH} \xrightarrow{\Delta} \text{R-NC} + 3 \text{KCl} + 3 \text{H}_2\text{O}$
25.	Diazo	
26.	Sandmeyer.	
27.	Gatterman	
28.	Coupling	

Distinguish By a Single Chemical Test

- All aldehydes (**R-CHO**) give **Tollens' Test** and produce silver mirror.

$$\text{RCHO} + 2 [\text{Ag}(\text{NH}_3)_2]^+ + 3 \text{OH}^- \rightarrow \text{RCOO}^- + 2 \text{Ag} \downarrow + 2 \text{H}_2\text{O} + 4 \text{NH}_3$$

Tollens' Reagent
silver ppt

Note: HCOOH(methanoic acid) also gives this test, ketones (RCOR) do not give this test
- All aldehydes (**R-CHO**) and ketones (**RCOR**) give **2,4-DNP test**

$$\text{RCOR} + 2,4\text{-DNP} \rightarrow \text{Orange ppt}$$

$$\text{R-CHO} + 2,4\text{-DNP} \rightarrow \text{Orange ppt}$$
- Aldehydes and ketones having **CH₃CO-** (keto methyl) group give Iodoform Test. Alcohols having **CH₃CH- OH** group also give **Iodoform Test**.

$$\text{CH}_3\text{CHO} + 3\text{I}_2 + 4 \text{NaOH} \rightarrow \text{CHI}_3 \downarrow + \text{HCOONa} + 3 \text{NaI} + 3 \text{H}_2\text{O}$$

Yellow ppt
- The following compounds give Iodoform Test: ethanol (C₂H₅OH), propan-2-ol (CH₃CH(OH)CH₃), ethanal(CH₃CHO), propanone(CH₃COCH₃), butanone (CH₃COCH₂CH₃), pentan-2-one (CH₃COCH₂CH₂CH₃), acetophenone (PhCOCH₃)
- All carboxylic acids (**R-COOH**) give **Bicarbonate Test**

$$\text{RCOOH} + \text{NaHCO}_3 \rightarrow \text{RCOONa} + \text{CO}_2 \uparrow + \text{H}_2\text{O}$$

effervescence
- Phenol** gives **FeCl₃ Test**

$$\text{C}_6\text{H}_5\text{OH} + \text{FeCl}_3 \rightarrow (\text{C}_6\text{H}_5\text{O})_3\text{Fe} + 3 \text{HCl}$$

(neutral)
(violet color)

7. All primary amines (R/Ar -NH₂) give **Carbyl Amine Test**
 $\text{R-NH}_2 + \text{CHCl}_3 + \text{KOH(alc)} \rightarrow \text{R-NC} + \text{KCl} + \text{H}_2\text{O}$
offensive smell
8. Aniline gives Azo Dye Test (Only for aromatic amines)
 $\text{C}_6\text{H}_5\text{NH}_2 + \text{NaNO}_2 + \text{HCl} \rightarrow \text{C}_6\text{H}_5\text{N}_2^+\text{Cl}^-$; then add β -naphthol orange dye
9. All alcohols (ROH) give **Na-metal test**
 $\text{R-OH} + \text{Na} \rightarrow \text{R-ONa} + \text{H}_2$
bubbles
10. For esters (RCOOR) : Hydrolyses first. Then see the products (acid & alcohol) and give a test to identify them.
11. All alkenes (C=C) and alkynes (C \equiv C) decolorizes Br₂ – water from red to colourless
12. **Lucas Test to distinguish primary, secondary and tertiary alcohols**
Lucas reagent: ZnCl₂/HCl
3^o-alcohol + Lucas reagent \rightarrow immediate turbidity
2^o-alcohol + Lucas reagent \rightarrow turbidity after sometime
1^o-alcohol + Lucas reagent \rightarrow no turbidity