Organic Salts :

Lassigne's Method: Put Na metal + sample in fusion tube, heat till Red hot, crush in a mortar pestel with water

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Used for S, N, X :

$Na + C + N \longrightarrow NaCN$

$2Na + S \longrightarrow Na_2S$

$Na + X \longrightarrow NaX$

For Nitrogen (N) :

filtrate + $FeSO_4$ (boiled → cooled) + H_2SO_4

$Fe^{2+} + 6CN^- \longrightarrow [Fe(CN)_6]^{4-}$

$Fe^{2+} + H^+ \longrightarrow Fe^{3+} + e^-$

$[Fe(CN)_6]^{4-} + 4Fe^{3+} \longrightarrow Fe_4[Fe(CN)_6] \cdot H_2O$

*(Prussian Blue).

For Sulphur (S) :

1. filtrate + $Na[Fe(CN)_5NO]$ (sodium Nitroprusside) $\longrightarrow Na_4[Fe(CN)_5(NOS)]$ *(Violet)

↓

Na_2S or S^{2-}

2. $Na_2S + Pb(CH_3COO)_2 \longrightarrow PbS\downarrow + 2CH_3COO^-Na^+$ (Lead Acetate) *(Black ppt)

For Halogen (X) :

Acidified with HNO_3

$AgNO_3 + NaX \longrightarrow AgX\downarrow + NaNO_3$

white ppt + NH_4OH = Cl^- ; yellow ppt + NH_4OH ≈ Br^- ; yellow ppt + NH_4OH ≠ I^-

Functional Groups : (-PhOH, -COOH, $\overset{O}{\overset{\|}{C}}-$, $-\overset{O}{\overset{\|}{C}}-H$)

→ Litmus Test for OH groups i.e, : -PhOH, -COOH.

For -COOH ::

$$R\text{-}COOH + NaHCO_3 \longrightarrow R\text{-}COONa + H_2O + CO_2\uparrow$$

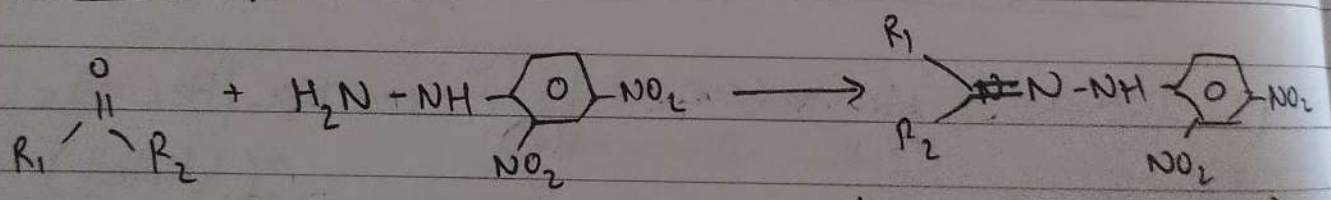
(Sodium Bicarbonate) (Vigorous effervescence)

For -PhOH ::

$$6\,PhOH + FeCl_3 \longrightarrow [Fe(OPh)_6]^{3-} + 3H^+ + 3HCl$$

(Violet / Bluish green ppt)

For $-\overset{O}{\overset{\|}{C}}-$ / DNP Test :



(Yellow / Orange ppt)

For $-\overset{O}{\overset{\|}{C}}-H$: (Silver mirror :3)

$$AgNO_3 + NaOH \longrightarrow Ag(OH)\downarrow + NaNO_2$$
$$Ag(OH) + 2NH_3 \longrightarrow Ag(NH_3)_2OH \text{ (soluble)}$$

$$2Ag(NH_3)_2OH + R\text{-}CHO \longrightarrow R\text{-}COONH_4 + 2Ag\downarrow + H_2O + 3NH_3$$

(silver mirror)

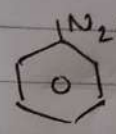
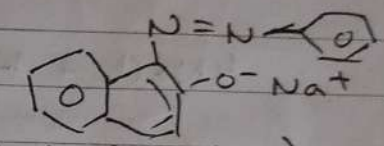
Nitrogen Containing : (NH_2, NO_2, $CONH_2$, $CONHAr$)

Amide : ($(R-C=O)-NR_1R_2$)

$RCONH_2 + NaOH \xrightarrow{boil} RCOONa + NH_3\uparrow$

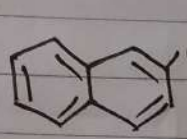
Aniline : ($R-C-N-Ar$; Ar : )

$RCONHAr \xrightarrow{dil.\ HCl} RCOOH + ArNH_2$

Diazo Test : $ArNH_2 \xrightarrow{HNO_2}$  $\xrightarrow{\beta\text{-Nap}}$ 

~~also~~ done for "NH_2"

(Red - Rose dye)

(β-Naphthol or Naphthalen-2-ol → )

Muliken Baker's Test : (For NO_2)

$ArNO_2 \xrightarrow[aq.\ NH_4Cl]{Zn\ dust} ArNHOH \xrightarrow[reagent]{Tollen's} ArNO + Ag\downarrow$ (Grey ppt)

$ArNO_2 \xrightarrow[Sn\ Metal]{conc.\ HCl} ArNH_2 \xrightarrow[Test.]{Diazo} $

Inorganic Salts :

1. For Halogens (Silver Nitrate Test)

$AgCl \mid AgBr \mid AgI + NH_4OH \longrightarrow [Ag(NH_3)_2]^+$

white ppt + NH_4OH = Cl
Yellow ppt + NH_4OH ≈ Br
Yellow ppt + NH_4OH ≠ I

⇒ For Chlorine : (Chromyl Chloride)

$4NaCl + K_2Cr_2O_7 + 3H_2SO_4 \longrightarrow K_2SO_4 + 2Na_2SO_4 + 3H_2O + 2CrO_2Cl_2$
(Chromyl Chloride)

$CrO_2Cl_2 + 4OH^- \longrightarrow CrO_4^{2-} + 2Cl^- + 2H_2O$

$CrO_4^{2-} + Pb^{2+} \longrightarrow PbCrO_4 \downarrow$
(Yellow ppt)

2. For CH_3COO^-

$Fe^{3+} + 3CH_3COO^- \longrightarrow Fe(CH_3COO)_3 \xrightarrow{\Delta} Fe(OH)_2CH_3COO$
(Red Colouration) (Red ppt)

$Fe(CH_3COO)_3 + H_2O$

3. **Brown Ring Test : (NO_3^-) Nitrate**

$$3Fe^{2+} + NO_3^- + 4H^+ \longrightarrow 3Fe^{3+} + NO + 2H_2O$$
($FeSO_4$) (H_2SO_4)

$$Fe^{2+} + NO + 5H_2O \longrightarrow [Fe(NO)(H_2O)_5]^{2+}$$

4. **Ferrous starch something : (NO_2^-) Nitrite**

$$NO_2^- + H_2SO_4 \longrightarrow HNO_2 + HSO_4^-$$

$$3HNO_2 \longrightarrow HNO_3 + 2NO + H_2O$$

- $FeSO_4 + NO \longrightarrow FeSO_4 \cdot NO$
  (Brown dark / Black)
- $NO + O_2 \longrightarrow NO_2$
  (Brown fumes)

5. **Sulphide : (S^{2-})**

- $Na_2S + H_2SO_4 \longrightarrow H_2S\uparrow + Na_2SO_4$
  (Rotten egg smell)

- $Na_2S + Pb(CH_3COO)_2 \longrightarrow PbS + 2CH_3COO^-Na^+$
  (Lead Acetate) (Brown ppt)

9. Sulphite : (SO_3^{2-})

- $Na_2SO_3 + H_2SO_4 \longrightarrow Na_2SO_4 + H_2SO_3$

$H_2SO_3 \longrightarrow H_2O + SO_2$
(Pungent Smell)

- $Cr_2O_7^{2-} + 2H^+ + 3SO_3^{2-} \longrightarrow 2Cr^{3+} + 3SO_4^{2-} + H_2O$
(Solution turns green)

10. Sulphate (SO_4^{2-})

$CaCl_2 + Na_2SO_4 \longrightarrow CaSO_4 + 2NaCl$
(white ppt)

$Na_2SO_4 + Pb(CH_3COO)_2 \longrightarrow PbSO_4 + 2Na(CH_3COO)$
(white ppt)

11. ThioSulphate : $(S_2O_3^{2-})$

$S_2O_3^{2-} + Pb^{2+} \longrightarrow PbS_2O_3 \downarrow$
$(Pb(CH_3COO)_2)$
Lead Acetate
(white ppt)

$PbS_2O_3 + H_2O \xrightarrow{boil} PbS \downarrow + 2H^+ + SO_4^{2-}$
(Black ppt)