

In <sup>radicals</sup>  
classmate  
Date \_\_\_\_\_  
Page \_\_\_\_\_

17

## Qualitative Analysis

↓  
Detection of Rad → Acidic Anionic  
Basis Cationic → Part is

Dry test

- Based on physical prop only
- Not confirmatory
- e.g.: Borsig Beil fest

Wet test

- Both physical and chem prop
- Confirmatory

### \* Acidic Radical:-

Group I =  $\text{CO}_3^{2-}$  /  $\text{HCO}_3^-$ ,  $\text{SO}_3^{2-}$  /  $\text{HSO}_3^-$ ,  $\text{S}_2\text{O}_3^{2-}$ ,  $\text{S}^{2-}$ ,  $\text{NO}_2^-$  SIGN HERE  
 $\text{CH}_3\text{COO}^-$

→ Dil HCl /  $\text{H}_2\text{SO}_4$ ,  
Reagent.

Group II:  $\text{Cl}^-$ ,  $\text{Br}^-$ ,  $\text{I}^-$ ,  $\text{NO}_3^-$ ,  $\text{C}_2\text{O}_4^{2-}$  → conc  $\text{H}_2\text{SO}_4$ ,  
CBII NE cutcha oxalate

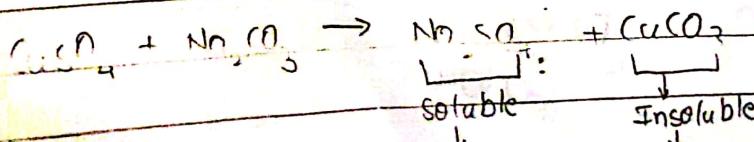
Group III:  $\text{BO}_3^{3-}$ ,  $\text{SO}_4^{2-}$ ,  $\text{PO}_4^{3-}$ ,  $\text{F}^-$

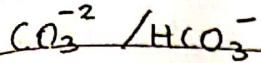
Interfering  
BSP

### \* Soda Extract formation:

Unknown salt +  $\text{Na}_2\text{CO}_3$  + dist. water

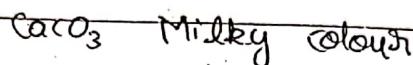
↓  
filter



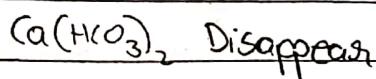
Group - I:

Salt + HCl  $\rightarrow$  colourless odourless gas ( $\text{CO}_2$ )  
dil

Lime water  $\rightarrow$  cheaper  
Benzoate  $\rightarrow$  better ppt.



$\downarrow$  ex. gas ( $\text{CO}_2$ )



$\rightarrow$  This is a confirmatory test for  $\text{CO}_2$ .

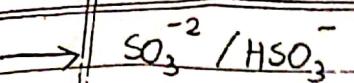
\* Source of  $\text{CO}_2$ :

Salt +  $\text{Cl}^-$  of  $\text{Ca}^{+2}/\text{Sr}^{+2}/\text{Ba}^{+2}$

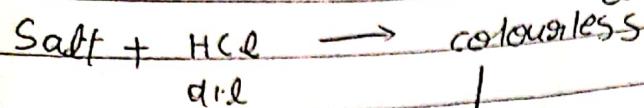
$\downarrow$   
white ppt                                  No ppt  
 $\text{CO}_3^{2-}$                                      $\text{HCO}_3^-$

$\text{PbCO}_3$  - Better  $\nexists$  HCl  $\rightarrow$  because  $\text{PbSO}_4$  passive.

$\text{BaCO}_3$  - None - because unstable salt.  
(won't decompose with dil acid)



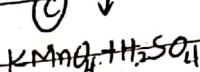
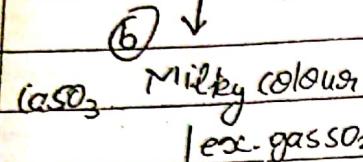
Pungent burning  
@ sulphur dioxide ( $\text{SO}_2$ )



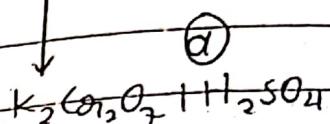
No connection



lime water  
Baigta water



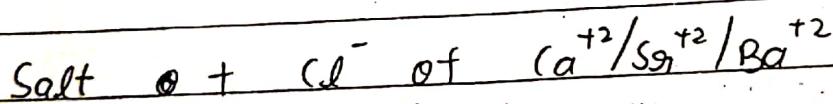
Purple colour  
discharge



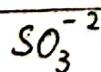
orange turns  
to green  
 $(\text{Cr}_2(\text{SO}_4)_3)$

→ Gives confirmation of  $\text{SO}_2$ .

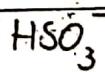
\* Source of  $\text{SO}_2$



white ppt



No ppt



→ soluble in  
mineral acid.

$S_2O_3^{2-}$ Salt + HCl  
dil $\rightarrow$  Burning sulphur like odour  
+ yellowish white turbidity. $(SO_2)$ 

(S)

(suspended)

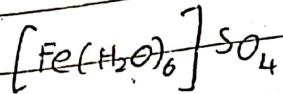
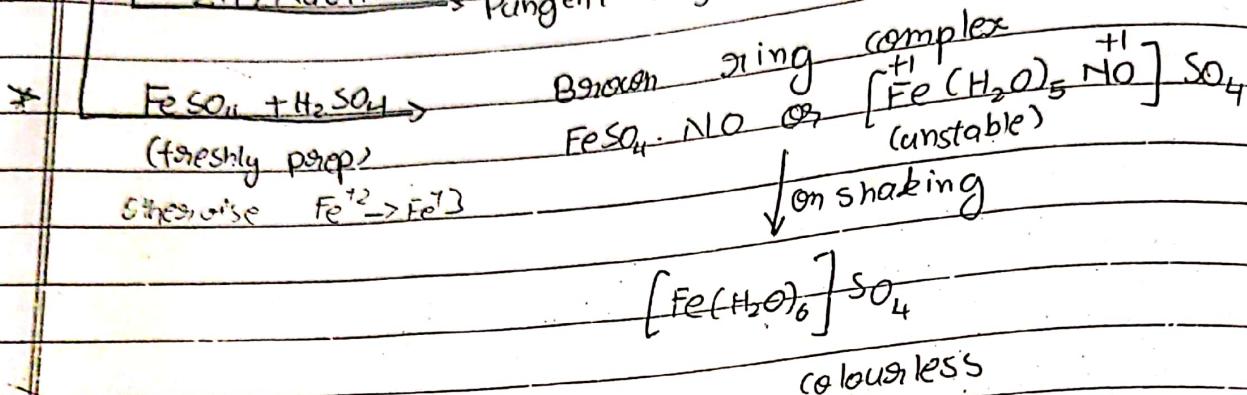
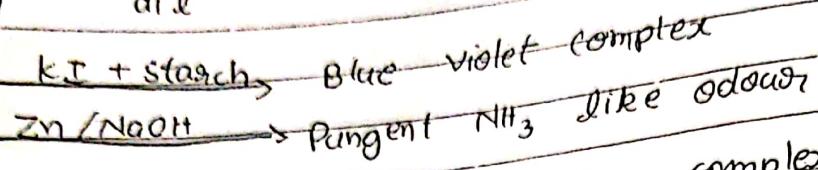
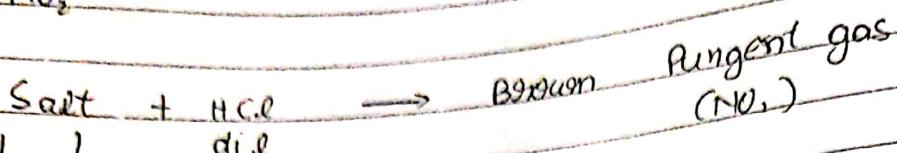
 $AgNO_3 \rightarrow$ white ppt  $Ag_2S_2O_3$  $\downarrow$  moistBlack ppt  $Ag_2S$  $S^{2-}$ Salt + HCl  
dil@ Pungent rotten egg  
like gas ( $H_2S$ )

colourless

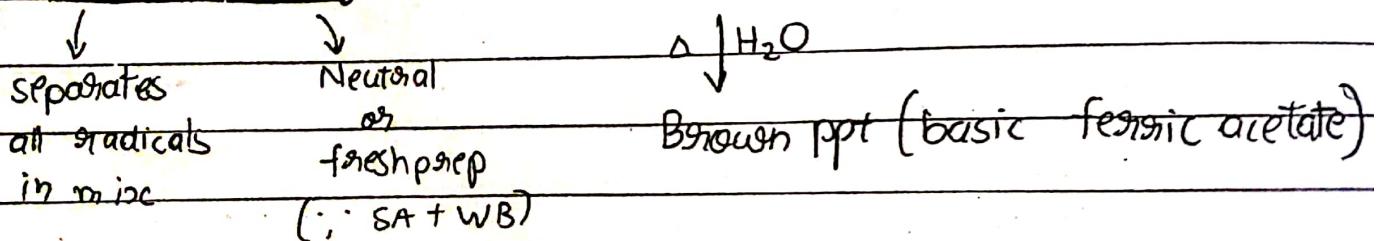
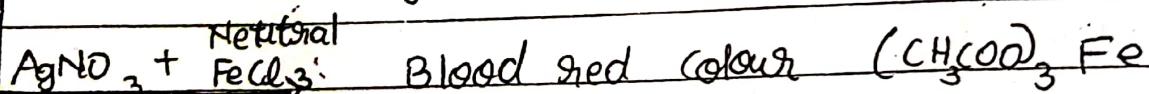
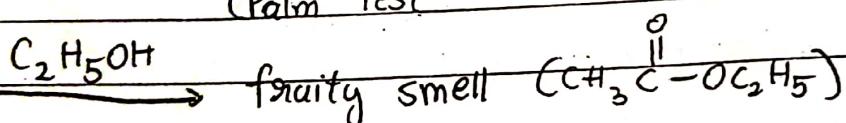
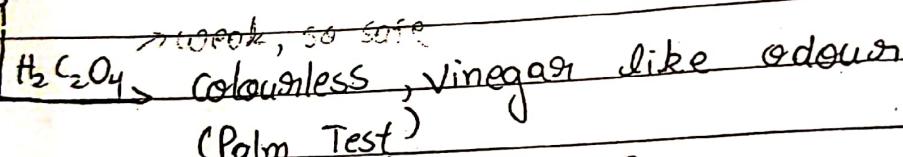
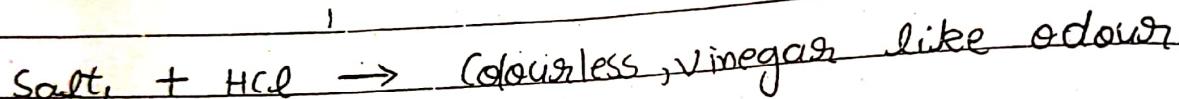
 $\downarrow (CH_3COO)_2Pb$ @ Black ppt  $PbS$  $KMnO_4 + H_2SO_4$ 

Purple colour discharge

 $H_2S$  $K_2Cr_2O_7 + H_2SO_4$ Orange turns to green  $(Cr_2(SO_4)_3$

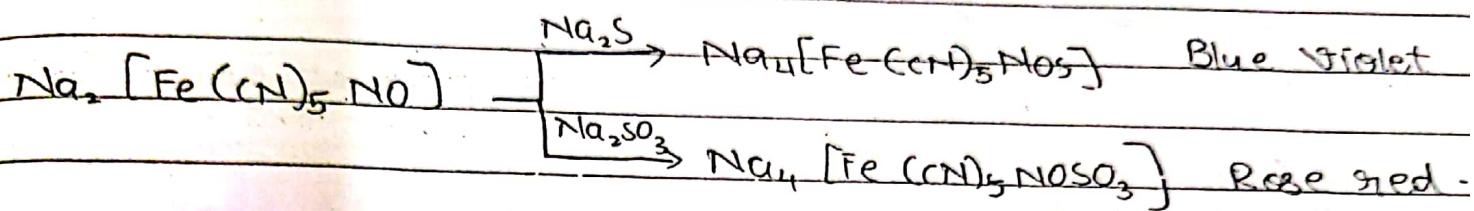
$\rightarrow \text{NO}_3^-$ 

colourless

 $\rightarrow \text{CH}_3\text{COO}^-$ 



### Nitroprusside test



which can be used to distinguish?

)  $\text{BaCl}_2 \rightarrow$  only with  $\text{SO}_3^{2-}$

)  $(\text{CH}_3\text{COO})_2\text{Pb} \rightarrow$  only with  $\text{S}^{2-}$

)  $\text{Na}_2[\text{Fe}(\text{CN})_5\text{NO}] \rightarrow$  reacts with both.

)  $\text{KMnO}_4 / \text{H}_2\text{SO}_4 \rightarrow$  discharges in both.

Q.54

\*

Group II

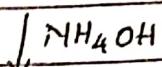
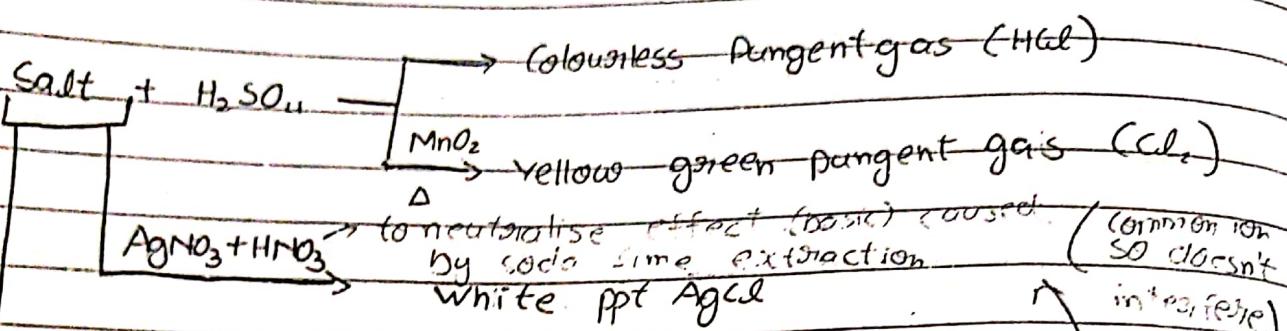
Q.55



.56

57

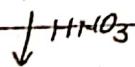
58



II Chromyl chloride test colourless

(not given by Ag, Hg, Pb, Sn)  $[Ag(NH_3)_2]^+$   $Cr_2O_7^{2-}$

( $\because$  stable salts etc.)



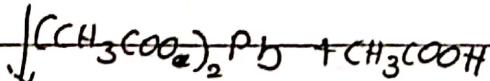
white ppt  $AgCl$



→ Orange red  $CrO_2Cl_2$

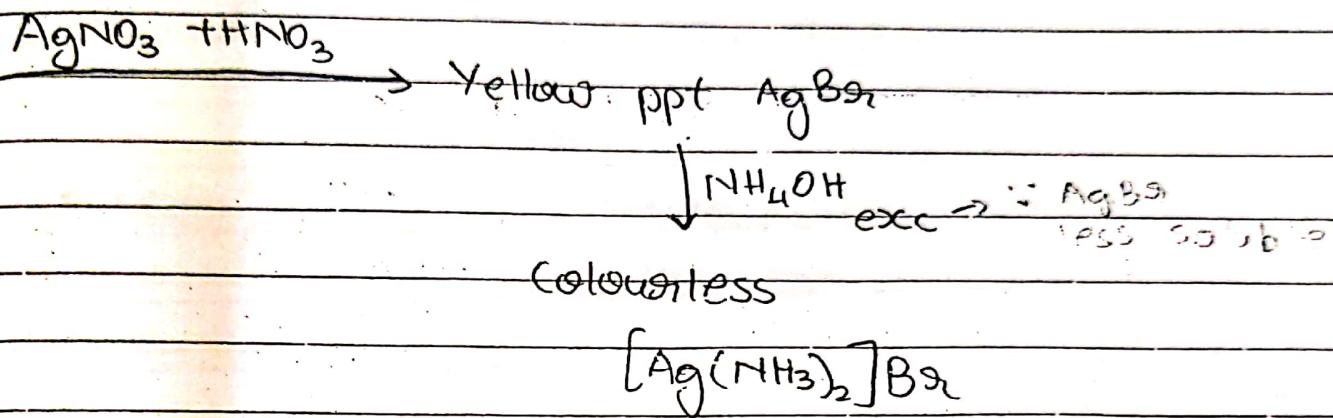
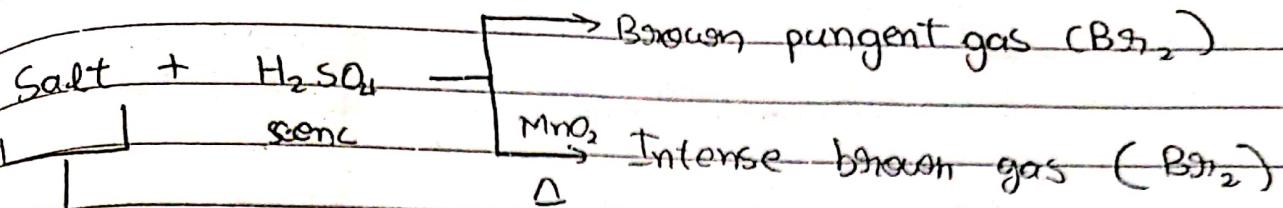


Yellow sol<sup>n</sup>  $Na_2CrO_4$

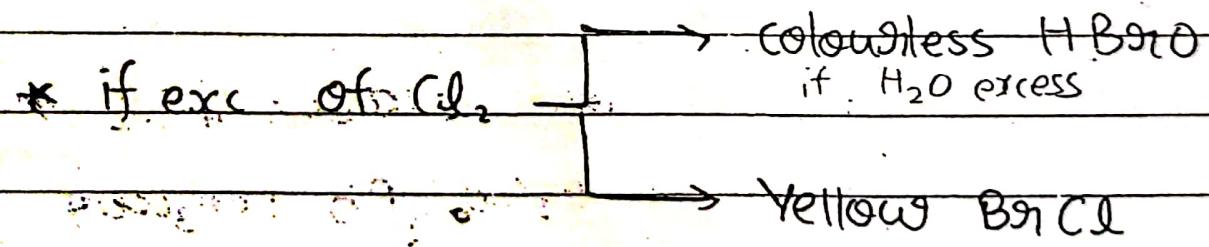
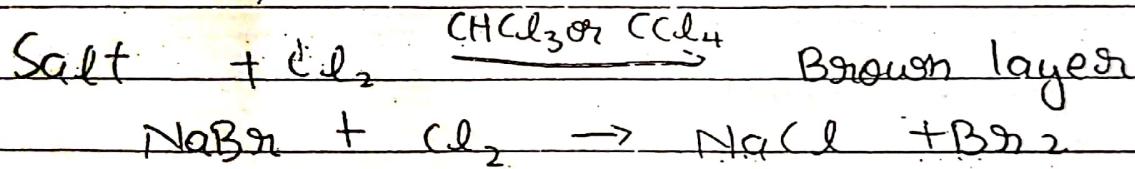


Yellow ppt  $PbCrO_4$

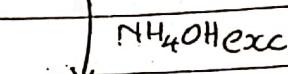
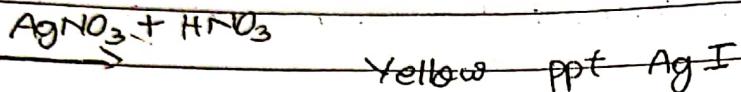
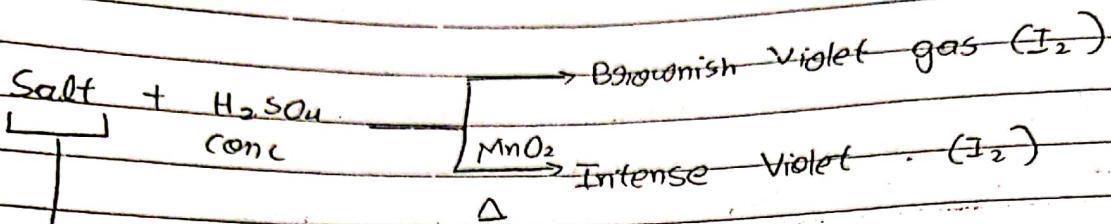
B91



Layer test:

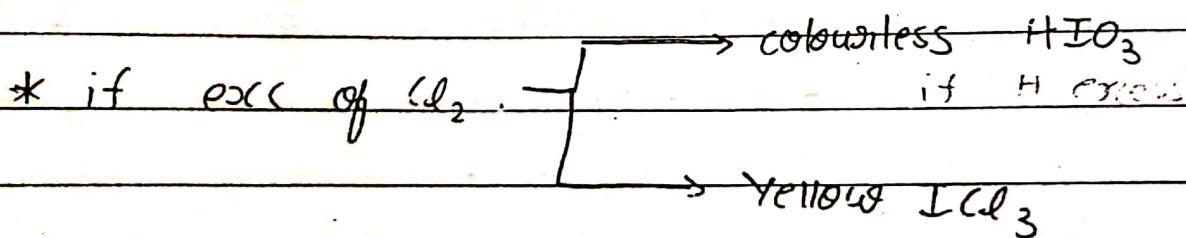
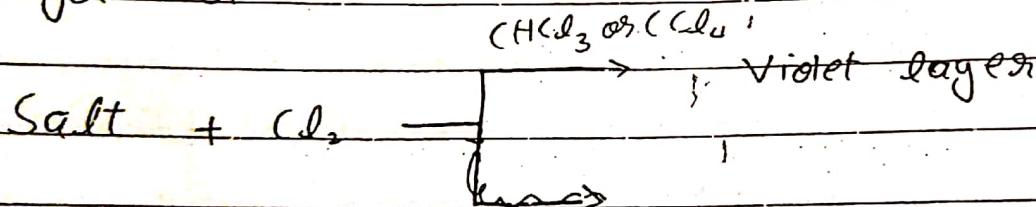


$\rightarrow \text{I}^-$



No room  
(+ve insoluble)

\* Layer test



- H - R - OH

L R

✓ J

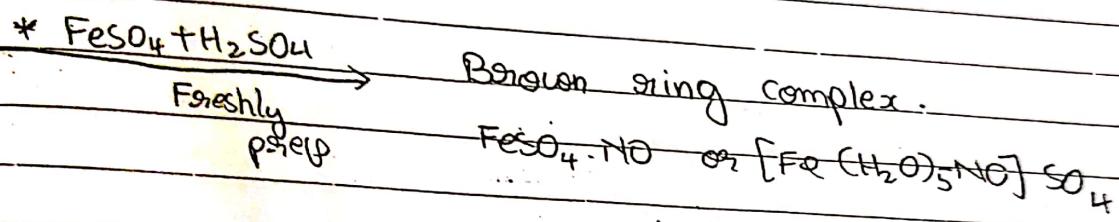
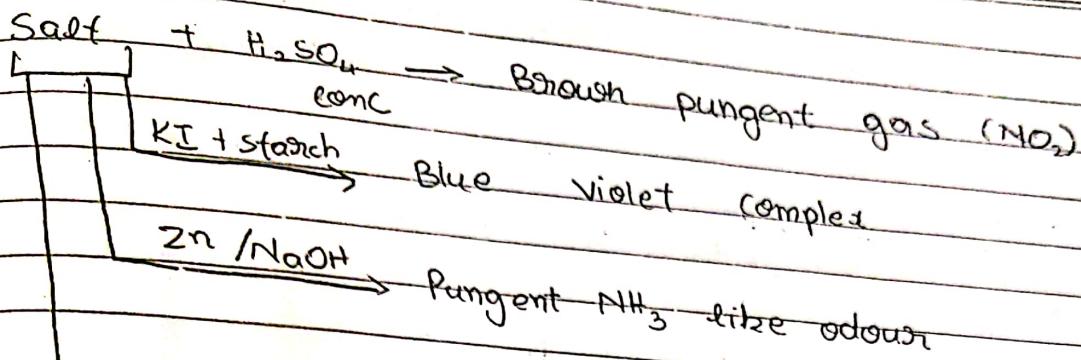
A

- OR

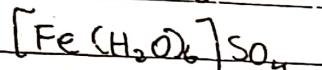
2 O

↓

CLASSMATE  
Date \_\_\_\_\_  
Page \_\_\_\_\_



↓ on shaking

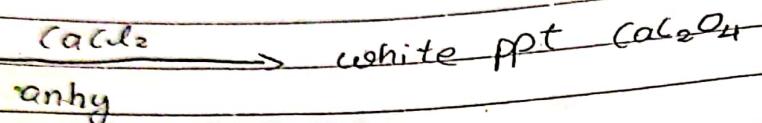


colourless

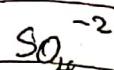
→ Not confirmatory in presence of  $\text{NO}_3^-$ ,  $\text{Br}^-$  and  $\text{I}^-$ .

→  $(\text{Ca}(\text{NO}_3)_2, \text{Ba}(\text{NO}_3)_2, \text{Pb}(\text{NO}_3)_2)$  do not respond to the test due to precipitation of their metal sulphates.

Q. 5 Date \_\_\_\_\_  
Page \_\_\_\_\_  
 $\rightarrow \text{CaCO}_3 \rightarrow$  only compound which gives both  $\text{CO}_2$  &  $\text{CO}$   
 $\text{Salt} + \text{H}_2\text{SO}_4$  (conc)  $\rightarrow$  colourless odourless gas ( $\text{CO}_2$ )  
+ Burns with blue flame ( $\text{CO}$ )

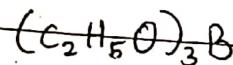
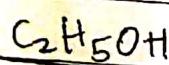
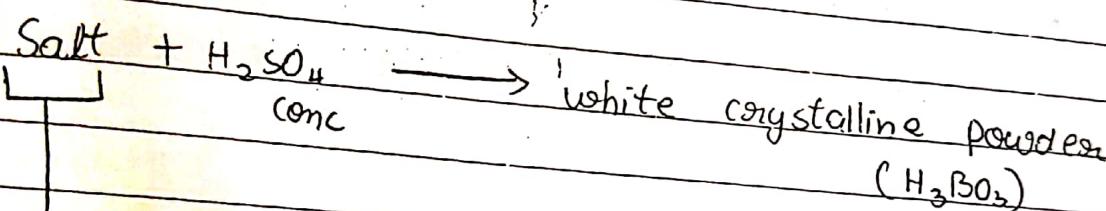
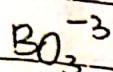
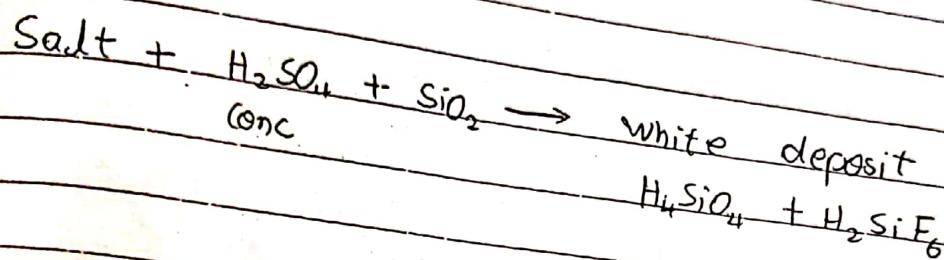
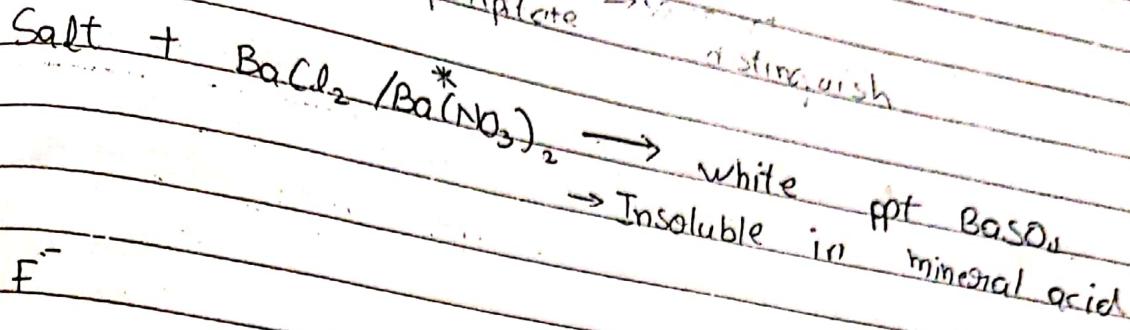


→ Ques 3:

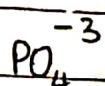

 $\text{AgNO}_3 \rightarrow \text{gives white}$ 

precipitate

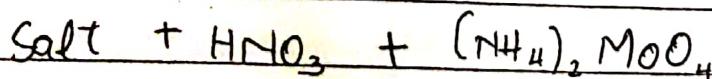
of stirring



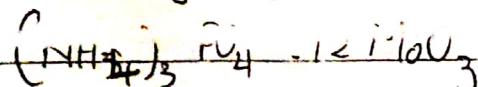
Burn with green edge flame



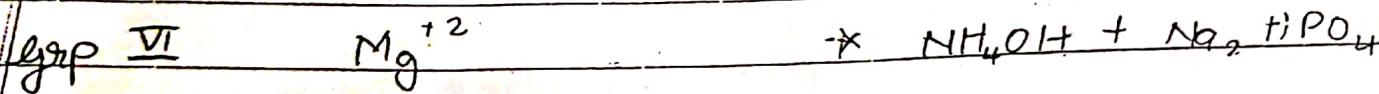
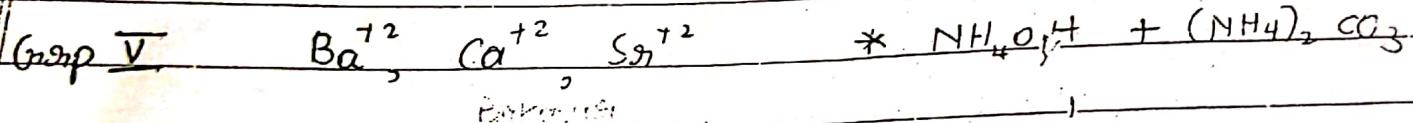
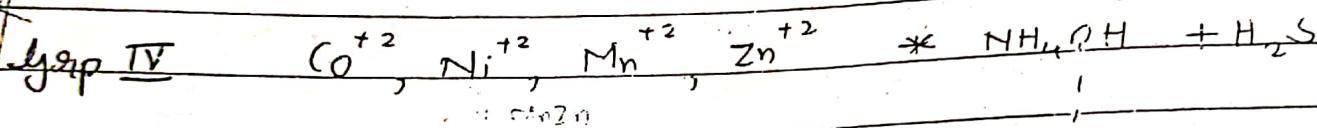
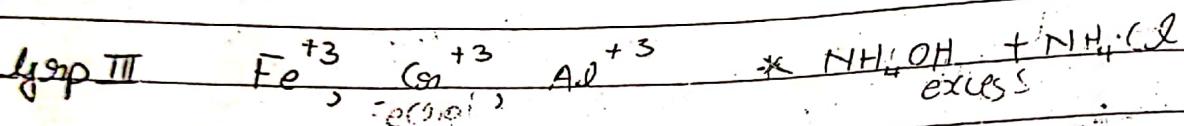
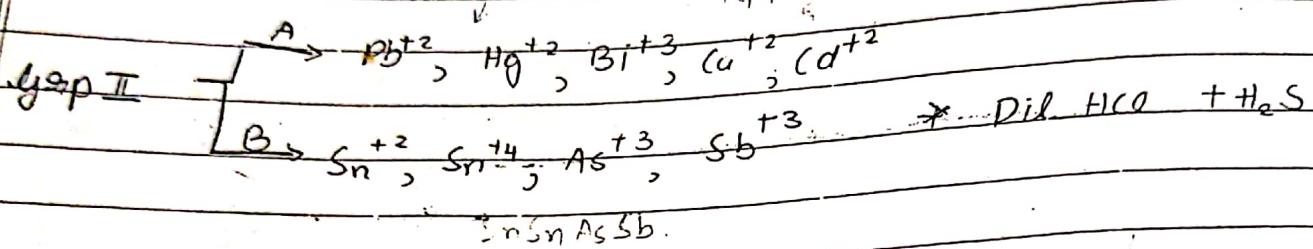
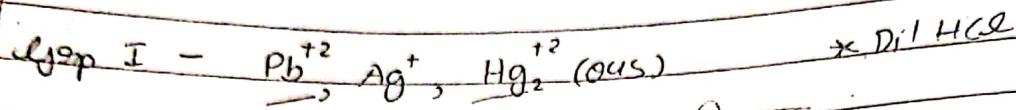
Ammonium molybdate

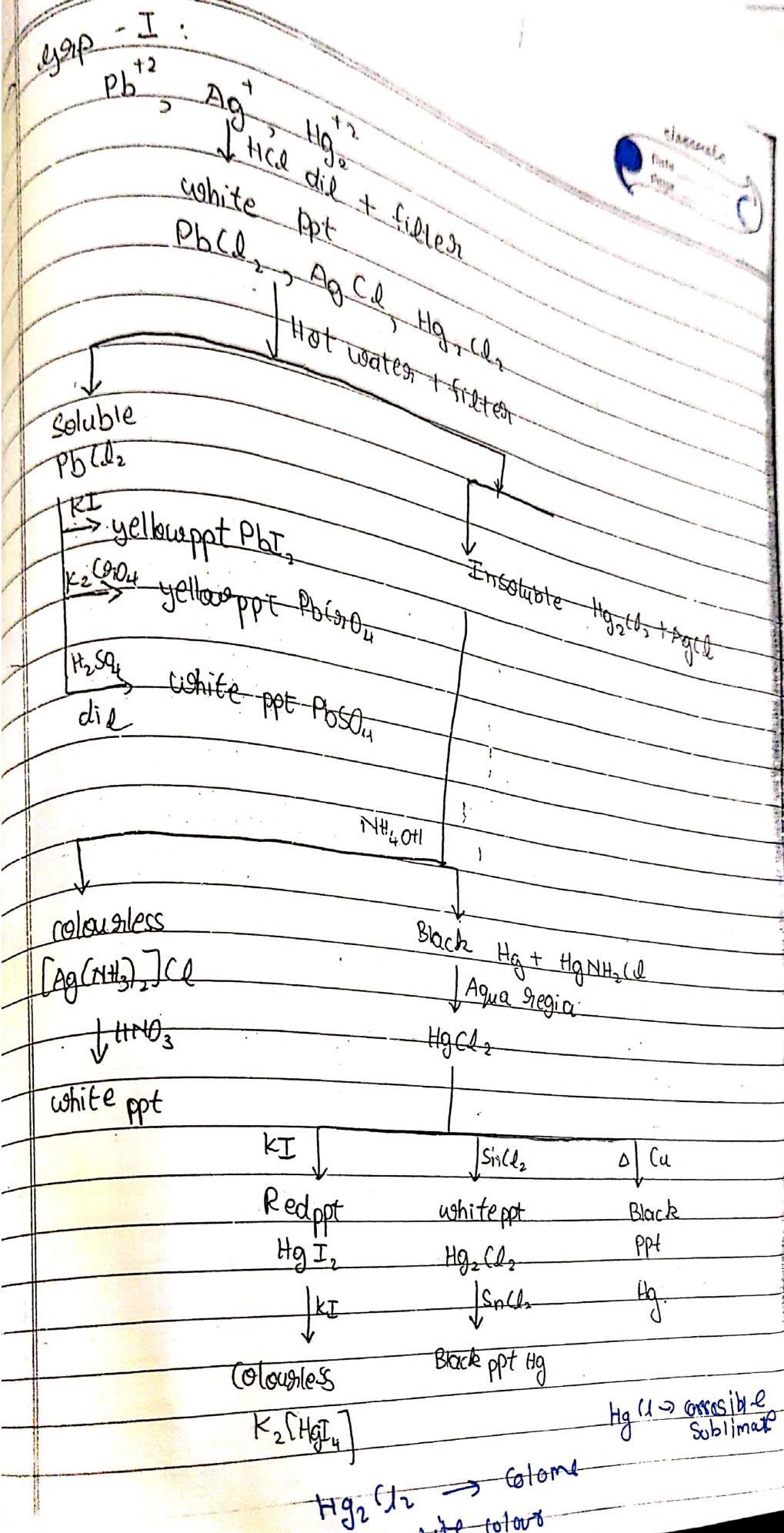


Canary Yellow



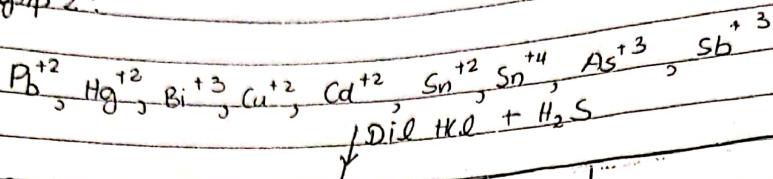
## # Basic Radical:-



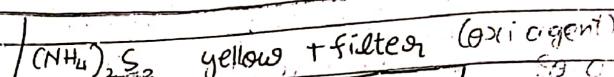


→ Usually sulphides blacks in colour except

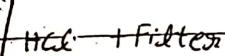
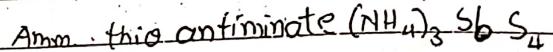
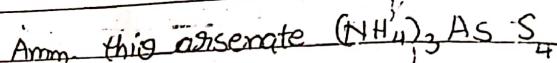
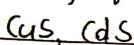
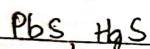
Group 2:



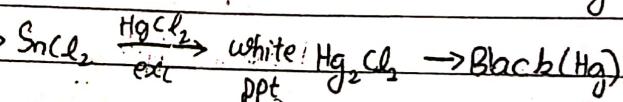
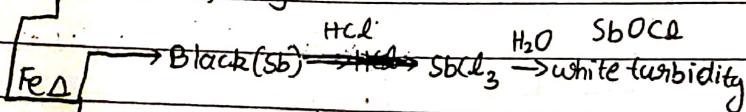
Black ppt	yellow ppt	orange $\text{Sb}_2\text{S}_3$	Brown $\text{SnS}$
$\text{PbS}, \text{HgS}$	$\text{CdS}, \text{As}_2\text{S}_3$	only orange	$\text{Bi}_2\text{S}_3^*$ (blackish)
$\text{CuS}$	$\text{SnS}_2$	sulphide	
the only yellow sulphides			



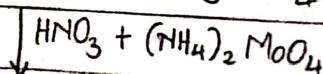
IIa Insoluble



Soluble  $\text{SnCl}_4, \text{SbCl}_3$

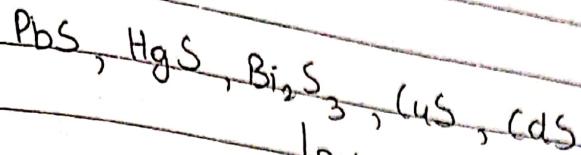


Insoluble  $(\text{NH}_4)_3\text{ASS}_4$



Crucible yellow  $(\text{NH}_4)_3\text{AsS}_4 + \text{MoO}_3$

Group - II A



$\downarrow$   $\text{Dil HNO}_3 + \text{filter}$  ( $\frac{1}{2} \text{ conc HNO}_3$ ,  
 $\text{20°C, 10 min}$ )

↓ Insoluble  $\text{HgS}$ 

↓ Aqua regia

 $\text{HgCl}_2$ 

$\xrightarrow{\text{KI}}$  Red ppt  $\text{HgI}_2 \xrightarrow{\text{KI}}$   $\text{K}_2[\text{HgI}_4]$   
colourless

$\xrightarrow{\text{SnCl}_2}$  white ppt  $\text{Hg}_2\text{Cl}_2 \xrightarrow{\text{SnCl}_2}$  Black  $\text{Hg}$   
exc

soluble  
 $\text{Pb}(\text{NO}_3)_2$ ,  $(\text{Cu}(\text{NO}_3)_2)$ ,  
 $(\text{Cd}(\text{NO}_3)_2$ ,  $\text{Bi}(\text{NO}_3)_3$ )

 $\xrightarrow{\text{Dil H}_2\text{SO}_4}$ white ppt  $\text{PbSO}_4$  $\rightarrow$  soluble in  $\text{CH}_3\text{COONH}_4$ 

Insoluble

 $\text{Cu}(\text{NO}_3)_2$ ,  $\text{Cd}(\text{NO}_3)_2$ ,  $\text{Bi}(\text{NO}_3)_3$ 

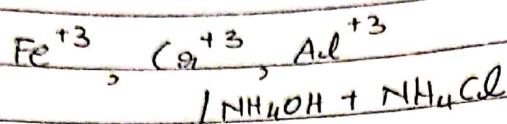
$\xrightarrow{\text{NH}_4\text{OH}}$   
exc

white ppt  $\text{Bi(OH)}_3$ Blue  $[\text{Cu}(\text{NH}_3)_4](\text{NO}_3)_2$  $\xrightarrow{\text{HCl}}$  $\text{BiCl}_3$  $\downarrow \text{H}_2\text{O}$ white turbidity  
 $\text{BiOCl}$ 

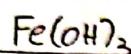
Brownish ppt.

 $[\text{Cu}_2[\text{Fe}(\text{CN})_6]]$ colourless  $[(\text{Cd}(\text{NH}_3)_4)(\text{NO}_3)_2]$  $\downarrow \text{H}_2\text{S}$ yellow ppt  $(\text{CdS})$

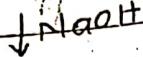
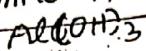
→ Group 3:



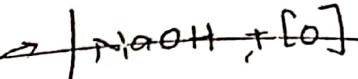
Red brown ppt



white ppt



green ppt

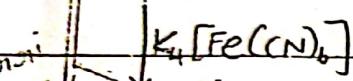
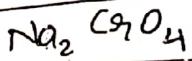


any Oxi

agent  
in

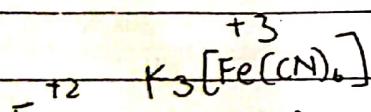
basic  
medium.

yellow soln

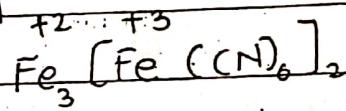


Blood  
red

Prussian  
blue



$\text{Fe}^{+2} \xrightarrow{\text{K}_3[\text{Fe}(\text{CN})_6]} \text{Fe}^{+3}$  (cyanide)

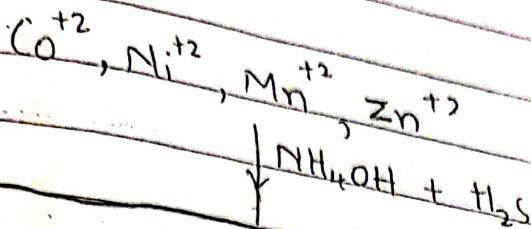


Turmal blue

a  
name  
of  
Scientist.

Group IV:

classmate

Date \_\_\_\_\_  
Page \_\_\_\_\_Black ppt  
 $\text{CoS}, \text{NiS}$ white ppt  
 $\text{ZnS}$ Buff (brownish green)  
 $\text{MnS}$ 

Insoluble

 $\text{CoS} + \text{NiS}$ 

Aqua regia

 $\text{CoCl}_2 \text{ & } \text{NiCl}_2 \xrightarrow{\text{green soln}}$ Soluble  $\text{ZnCl}_2 \text{ & } \text{MnCl}_2$  $\downarrow \text{NaOH}$ Pink ppt  
 $\text{Mn(OH)}_2$  $\downarrow \text{PbO}_2 \text{ & }$ 

Pink Soln

 $\downarrow \text{H MnO}_4$ acid of  
 $\text{Mn}$  $\downarrow \text{HgOH}$   
&  $\text{HgNO}_3$ 

Blood red

 $[\text{Ni}(\text{dmg})_3]$ 

yellow soln

 $\text{K}_3[\text{Co}(\text{NO}_2)_6]$  $\text{KNO}_3 + (\text{CH}_3\text{COO})_2$ 

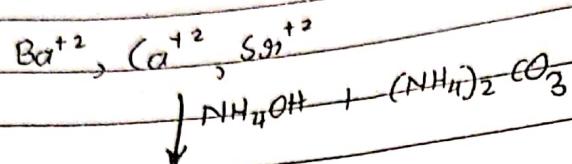
White ppt.

 $\text{Zn}(\text{OH})_2$  $\downarrow \text{NaOH}$ 

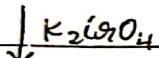
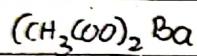
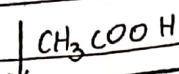
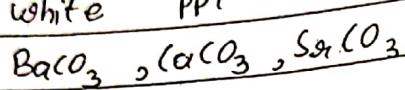
Colourless

 $\text{Na}_2\text{ZnO}_2$  $\downarrow$  $\downarrow$

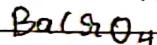
→ Syrup V :



white ppt

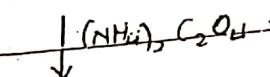
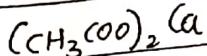


yellow ppt.



flame test

Apple green

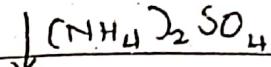
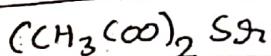


white ppt

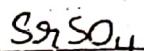


flame test

brick red



white ppt

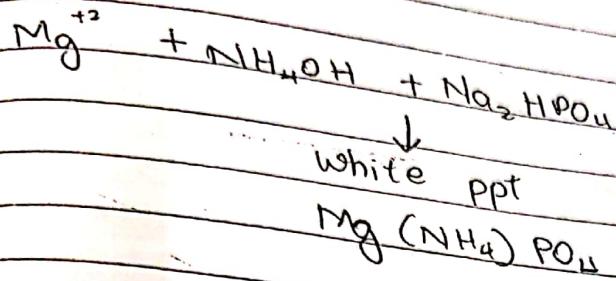
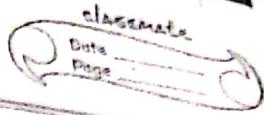


flame test

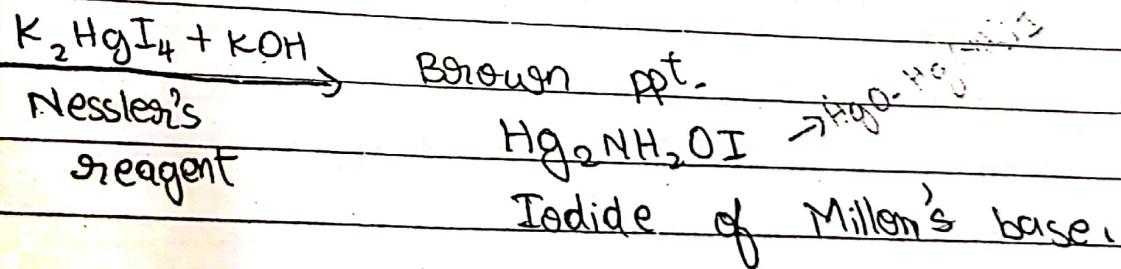
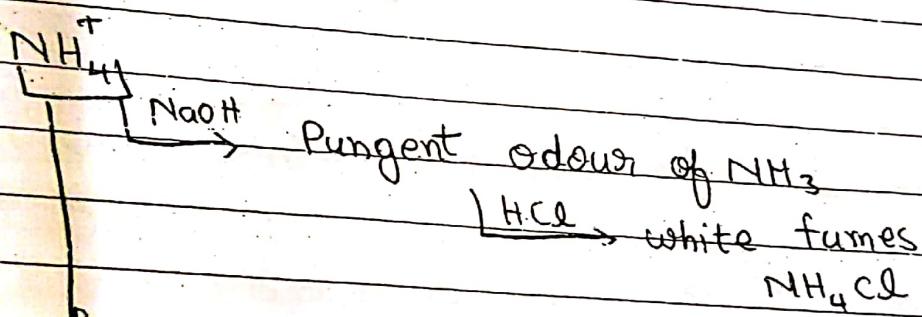
Crimson red.



Topic VI



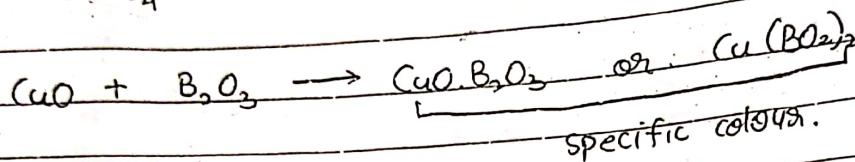
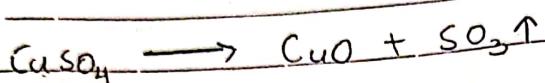
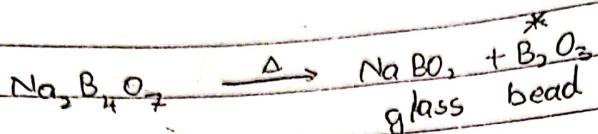
Topic VII



## # DRY TEST:

1) Borax - Bead test (for transition metals only).

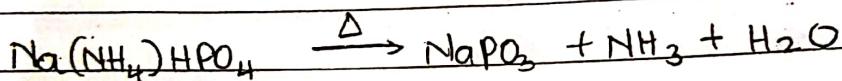
unknown Salt + Borax  $\xrightarrow{\Delta}$  Bead of specific colour



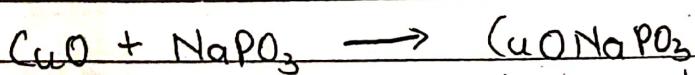
Pg 154  
155

2) Microscopic Bead test (for transition metals +  $\downarrow \text{SiO}_2$ )  
cloudy bead,

unknown Salt + Microscopic  $\xrightarrow{\Delta}$  Bead of specific colour

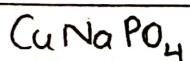


Pg 155  
list.



specific colour,

or



Ag<sub>2</sub>CO<sub>3</sub> - Red colour.

Solubility Rules and some common precipitate colors

- 1). All common salts of the nitrate ion ( $\text{NO}_3^-$ ) are soluble in water.
- 2). All common salts of the  $\text{Na}^+$ ,  $\text{K}^+$ , and  $\text{NH}_4^+$  cations are soluble in water.
- 3). Most common salts of the  $\text{Cl}^-$ ,  $\text{Br}^-$ , and  $\text{I}^-$  anions are soluble in water EXCEPT when the accompanying cation is  $\text{Ag}^+$ ,  $\text{Pb}^{2+}$ , and  $\text{Hg}_2^{2+}$ .
- 4). All common salts of the sulfate ion ( $\text{SO}_4^{2-}$ ) are soluble in water EXCEPT when the accompanying cation is  $\text{Ba}^{2+}$ ,  $\text{Sr}^{2+}$ , and  $\text{Pb}^{2+}$ .
- 5). Salts of the  $\text{S}^{2-}$  ion are insoluble in water EXCEPT when the accompanying cation is  $\text{Na}^+$ ,  $\text{K}^+$ ,  $\text{NH}_4^+$ ,  $\text{Ba}^{2+}$ , and  $\text{Ca}^{2+}$ .
- 6). Most of the transition metal cations ( $\text{Ag}^+$ ,  $\text{Cu}^{2+}$ ,  $\text{Ni}^{2+}$ , etc.) form complexes with aqueous ammonia. Sometimes, ammonia is used to "dissolve" otherwise insoluble precipitates of these metal cations.

Colors of Some Common Water-Insoluble MaterialsCarbonates,  $\text{CO}_3^{2-}$ 

$\text{Ag}_2\text{CO}_3$	=	yellow	$\text{CuCO}_3$	=	pale blue
$\text{BaCO}_3$	=	white	$\text{CaCO}_3$	=	white

Chlorides,  $\text{Cl}^-$ 

$\text{AgCl}$	=	white	$\text{Hg}_2\text{Cl}_2$	=	white
$\text{PbCl}_2$	=	white	$\text{CuCl}$	=	white

Hydroxides,  $\text{OH}^-$ 

$\text{AgOH}$	=	grey-brown	$\text{Cu}(\text{OH})_2$	=	pale blue
$\text{Fe}(\text{OH})_3$	=	rust red	$\text{Ni}(\text{OH})_2$	=	pale green
$\text{Pb}(\text{OH})_2$	=	white	$\text{Zn}(\text{OH})_2$	=	white

Iodides,  $\text{I}^-$ 

$\text{AgI}$	=	yellow	$\text{Hg}_2\text{I}_2$	=	yellow-orange
$\text{PbI}_2$	=	yellow	$\text{CuI}$	=	brown

Sulfides,  $\text{S}^{2-}$ 

$\text{Ag}_2\text{S}$	=	black	$\text{CuS}$	=	black
$\text{Fe}_2\text{S}_3$	=	black	$\text{HgS}$	=	black
$\text{NiS}$	=	black	$\text{PbS}$	=	black

Sulfates,  $\text{SO}_4^{2-}$ 

$\text{BaSO}_4$	=	white	$\text{PbSO}_4$	=	white
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