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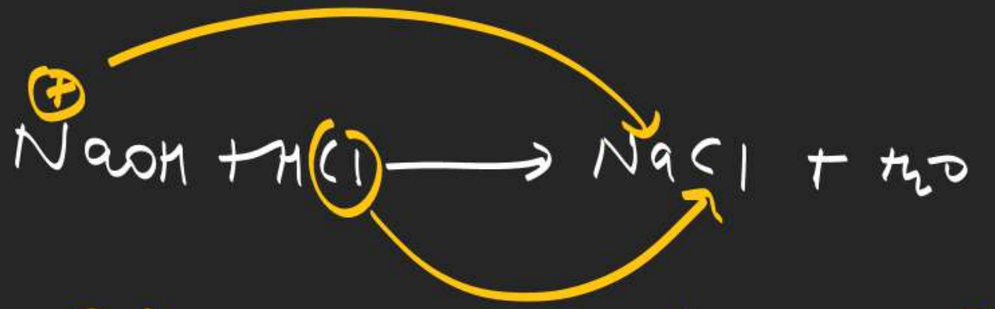
Given mixture → mixture of two and more than two salts



Cation comes from base — so it is called basic radical

anion comes from acid — acidic radical

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$F^{\ominus}$ SO_4^{-2} BO_3^{-3} PO_4^{-3} AsO_4^{-3} SiO_4^{-4}

Interfering radicals

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Volatile product with acid → Class A

Class - B
do not form volatile product with acid

dil HCl / dil H_2SO_4 → Subgroup - I

- $CO_3^{-2} \xrightarrow{H^+} CO_2$
- $HCO_3^- \longrightarrow CO_2$
- $SO_3^{-2} \longrightarrow SO_2$
- $HSO_3^- \longrightarrow SO_2$
- $S^{-2} \longrightarrow H_2S$
- $S_2O_3^{-2} \longrightarrow S + SO_2$
- $CH_3COO^- \longrightarrow CH_3COOH$
- $NO_2^- \longrightarrow NO_2$

Conc. H_2SO_4 → Subgroup - II

- $Cl^- \xrightarrow{H^+} HCl$
- $Br^- \longrightarrow Br_2$
- $I^- \longrightarrow I_2$
- $F^- \longrightarrow HF$
- $C_2O_4^{-2} \longrightarrow CO + CO_2$
- $BO_3^{-3} \longrightarrow H_3BO_3$
- $NO_3^- \longrightarrow NO_2$

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SALT ANALYSIS

JEE MAIN

CATION

1. How do we differentiate between Fe^{3+} and Cr^{3+} in qualitative analyses gp. III :-

[AIEEE - 2002]

(A) By taking excess of NH_4OH

(B) By increasing NH_4^+ ion ion concentration

(C) By decreasing OH^- ion concentration

(D) Both (B) and (C)

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SALT ANALYSIS

2. Which statement is correct :- [AIEEE-2003]

(A) Fe^{3+} ions give deep green precipitate with $K_2[Fe(CN)_6]$

(B) On heating K^+, Ca^{2+} and $HCOHOC_3^-$ ions, we get a precipitate of $K_2[Ca(CO_3)_2]$

(C) Manganese salts give a violet borax bead test in reducing flame

(D) From a mixed precipitate of AgCl and AgI ammonia solution dissolves only AgCl

AgCl AgI NH_3

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SALT ANALYSIS

3. Which of the following compounds is not colored yellow ? [JEE(Main) 2015]

(A) $Zn_2[Fe(CN)_6]$

(B) $K_3[Co(NO_2)_6]$ (fisher salt) (yellow ppt)

(C) $(NH_4)_3[As(Mo_3O_{10})_4]$

(D) $BaCrO_4$ } yellow
$PbCrO_4$ }

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SALT ANALYSIS

5. The cation that will not be precipitated by H_2S in the presence of dil HCl is:

[JEE(Main) 2017]

(A) Pb^{2+} (B) As^{3+} (C) Co^{2+} (D) Cu^{2+}

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SALT ANALYSIS

6. An aqueous solution of a salt X turns blood red on treatment with SCN^- and blue on treatment with $K_4[Fe(CN)_6]$. [JEE(Main) 2017]

X also gives a positive chromyl chloride test. The salt X is :

(A) $CuCl_2$ (B) $Cu(NO_3)_2$ (C) $FeCl_3$ (D) $Fe(NO_3)_3$

$Fe^{+3}Cl_3 + K_4[Fe(CN)_6] \longrightarrow Fe_4[Fe(CN)_6]_3$

$Cl^{\ominus}$ — Chromyl chloride

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SALT ANALYSIS

11. To an aqueous solution containing ions such as Al^{3+}, Zn^{2+}, Ca^{2+}, Fe^{3+}, Ni^{2+}, Ba^{2+} and Cu^{2+} was added conc. HCl, followed by H_2S. The total number of cations precipitated during this reaction is/are : [Main July 27, 2021 (II)]

(a) 1 (b) 3 (c) 4 (d) 2

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Salt

(1) given mixture — Mixture of two or more than two salts

Cation comes from base and anion comes from acid so they are also called Basic and acidic radical Respectively

analysis of anions first followed by cation because if any interfering radical [F^- $C_2O_4^{-2}$ BO_3^{-3} PO_4^{-3} AsO_4^{-3} SiO_4^{-4}] present in mixture then they will interfere test of III groups cation or downwards.

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Analysis of anion is not sys. as that of Cation However their volatile product formation tendency they are classified in two Class

→ class A

— Class B

Apni Kaksha

Chemical theory

— Salt

11th sheet discussion only Sat →

7.30 – 9 pm

Chemical bonding ex – 1

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Conc. H_2SO_4 → good O.A

anion

Cl^- is W.R.A so it will not give Redox Reaction with

Class (volatile product with acid)

dil HCl / dil H_2SO_4

↓

Subgroup-I

$CO_3^{-2} \xrightarrow{H^+} CO_2$

$HCO_3^- \xrightarrow{H^+} CO_2$

$SO_3^{-2} \xrightarrow{H^+} SO_2 \uparrow$

$HSO_3^- \xrightarrow{H^+} SO_2$

$S^{-2} \xrightarrow{H^+} H_2S$

$S_2O_3^{-2} \xrightarrow{H^+} S + SO_2$

(nitrite) $NO_2^- \xrightarrow{H^+} NO_2$

$CH_3COO^- \xrightarrow{H^+} CH_3COOH$

Reducing Power

$I^- > Br^- > Cl^- > F^-$

(Conc. H_2SO_4)

Subgroup-II

$Cl^- \xrightarrow{H^+} HCl$

$Br^- \xrightarrow{H^+} Br_2$

$I^- \xrightarrow{H^+} I_2$

$F^- \xrightarrow{H^+} HF$

$BO_3^{-3} \xrightarrow{H^+} H_3BO_3$

$C_2O_4^{-2} \xrightarrow{H^+} CO + CO_2$

NO_3^- (nitrate) $\xrightarrow{H^+} NO_2$

Class B

donot volatile product with acid they identify with their reactions in aq. solution.

Subgroup-I

SO_4^{-2}

PO_4^{-3}

AsO_3^{-3}

AsO_4^{-3}

CrO_4^{-2}

Subgroup-II

MnO_4^-

MnO_4^{-2}

CrO_4^{-2}

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CO_2 = brisk effervescence

SO_2 = suffocating smell of burning sulphur / pungent smell / irritating smell

H_2S ⇒ Rotten egg smell

$S_2O_3^{-2} \xrightarrow{H^+}$ $S\downarrow + SO_2$ (white / yellow ppt.)

CH_3COOH ⇒ Vinegar smell

NO_2 = Brown fumes

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HCl = White fumes
gives white dense fumes
with NH_4OH

$NH_4OH + HCl \longrightarrow \underline{NH_4Cl}$

Br_2 = Reddish Brown fumes

I_2 = Violete fumes

H_3BO_3 = White fumes

$CO \rightarrow$ Colourless gas burn with blue flames.

$NO_2 \Rightarrow$ Brown fumes

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CO_3^{-2} →

all CO_3^{-2} are insoluble except

IA and $(NH_4)_2CO_3$

↓ soluble

Li_2CO_3 ⇒ S.S (sparingly soluble)

① Test with acid

$$CO_3^{-2} + H^+ \longrightarrow CO_2\uparrow$$

CO_2 pass in to lime water or Baryta water

$CO_2 + Ca(OH)_2 \longrightarrow CaCO_3$ } white turbidity [milky solution]

$CO_2 + Ba(OH)_2 \longrightarrow BaCO_3$

if excess of CO_2 is passed then white turbidity disappear

$CaCO_3 + CO_2 (\text{excess}) + H_2O \longrightarrow Ca(HCO_3)_2$ soluble

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$BaCO_3 + (CO_2 + H_2O \text{ (excess)}) \longrightarrow Ba(HCO_3)_2$
Soluble

Test based on ppt

① Test with $BaCl_2$ / $CaCl_2$

$CO_3^{-2} + BaCl_2 / CaCl_2 \longrightarrow CaCO_3 / BaCO_3$
White ppt

Soluble in dil HCl / dil HNO_3
$Mg(OH)_2$, Soda water

Nishant Jindal

Test with $Pb(NO_3)_2$

$$CO_3^{-2} + Pb(NO_3)_2 \longrightarrow PbCO_3$$

White ppt

Sol. in dil HNO_3 / CH_3COOH and excess NaOH

$$PbCO_3 + NaOH \longrightarrow \cancel{Pb(OH)_2}\ (\text{white ppt.})$$

$$\cancel{Pb(OH)_2} + NaOH \xrightarrow{(Excess)} [Pb(OH)_3]^{-2}$$

Soluble

$$PbCO_3 + NaOH \longrightarrow [Pb(OH)_3]^{-2}$$

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पं ना बे अली गाना सुनाओ +3 +4 कार में

Pb Zn Be Al Ga Sn Cr

all the oxides and hydroxides are Amphoteric in nature.

As_2O_3 Sb_2O_3 V_2O_5

Amphoteric

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Test with $AgNO_3$

$$CO_3^{-2} + AgNO_3 \longrightarrow Ag_2CO_3$$

yellowish – white ppt.

Soluble in dil HNO_3 | CN | excess NH_3

$$Ag_2CO_3 + NH_3 \overset{H^+}{\rightleftharpoons} [Ag(NH_3)_2]Cl$$

$$[Ag(NH_3)_2]^+Cl^- \longrightarrow Ag_3N \xrightarrow{\text{explosive}} Ag + N_2$$

fulminating silver

9929776481

Nishant Jindal

Test with $HgCl_2$

$$CO_3^{-2} + HgCl_2 + 3H_2O \longrightarrow 3HgO \cdot HgCO_3 + 6H^+$$

Reddish Brown ppt.

Hg_2Cl_2 — Calomel

$HgCl_2$ — Corrosive Sublimate.

Poisonous

pH drastically change and becomes acidic

excess amount of CO_3^{-2} it act as buffer

$$CO_3^{-2} + H^+ \longrightarrow CO_2\uparrow + H_2O$$

Nishant Jindal

HCO_3^- ⇒ all are soluble

except $NaHCO_3$ (S.S)

① Test with acid

$$HCO_3^- + H^+ \longrightarrow CO_2$$

Test with $BaCl_2$ / $CaCl_2$

$$HCO_3^- + BaCl_2/CaCl_2 \longrightarrow$$ no ppt. because all soluble

$$HCO_3^- \xrightarrow{\text{boil}} CO_3^{-2} + CO_2\uparrow + H_2O\uparrow$$

$$CO_3^{-2} + BaCl_2/CaCl_2 \longrightarrow BaCO_3/CaCO_3$$

Nishant Jindal

Test with NH_4OH followed by $MgCl_2$

($NH_3 + H_2O$)

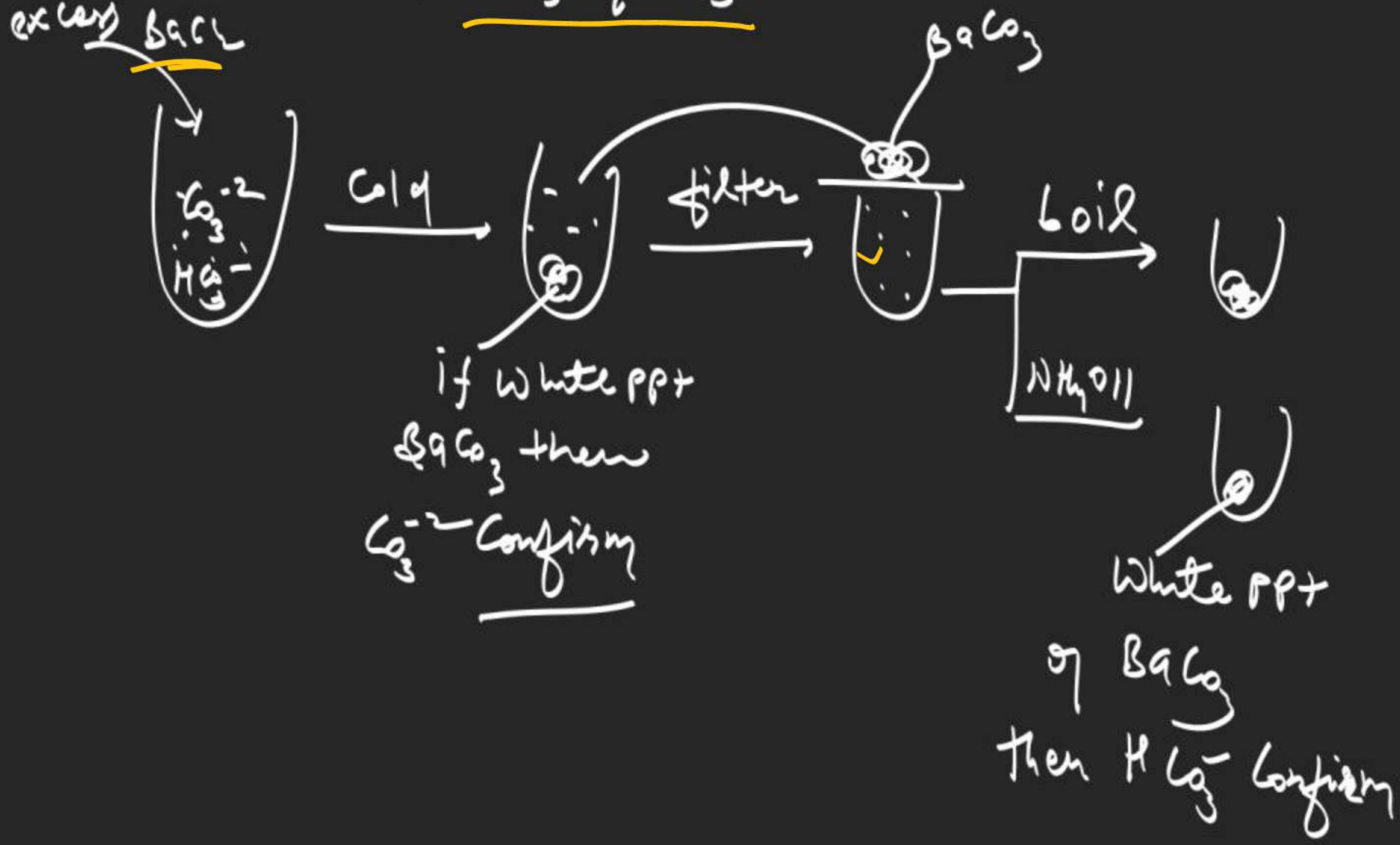
$$HCO_3^- + NH_4OH \longrightarrow CO_3^{-2} + H_2O + NH_4^+$$

$$CO_3^{-2} + MgCl_2 \longrightarrow MgCO_3$$

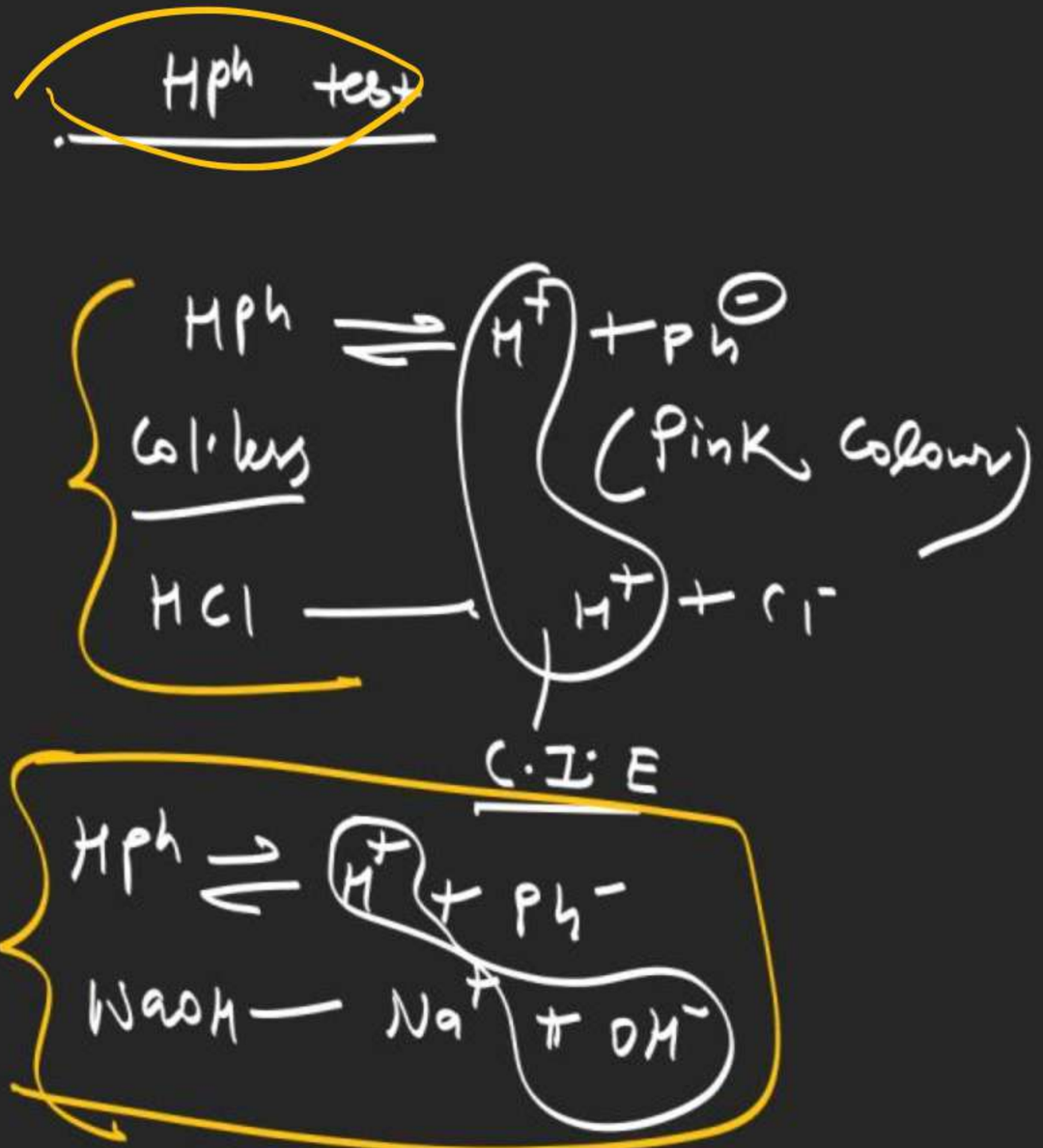
(White ppt.)

Nishant Jindal

Dist b/w CO_3^{-2} / HCO_3^-



Nishant Jindal



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Sol 'A' Mixture Contain x and y ion which give CO_2 gas with dil HCl

X does not give col. with Hph while Y gives pink col. of Hph then Identify X and Y

CO_3^{-2}

$MCO_3 \rightleftharpoons M^+ + CO_3^{-2}$

$X = MCO_3^-$

$Y = CO_3^{-2}$

Nishant Jindal

for Prince — Ad. ke liye — total 12 — 15

but as per discussion with students we are doing only for JEE mains syllabus. cation and anion

It take only 4 to 5 lect remaining left will we cover after JEE mains Jan.

Nishant Jindal

SO_3^{-2} : all are Insoluble
except IA / $(NH_4)_2SO_3$

① Test with acid

$$SO_3^{-2} + H^+ \longrightarrow SO_2 \uparrow$$

SO_2 is passed in lime water / Baryta water

$$SO_2 + Ca(OH)_2 \longrightarrow CaSO_3$$
$$SO_2 + Ba(OH)_2 \longrightarrow BaSO_3$$

} White turbidity (milky solution)

Excess of SO_2 pass

$$CaSO_3 + SO_2 + H_2O \longrightarrow Ca(HSO_3)_2$$
$$BaSO_3 + SO_2 + H_2O \longrightarrow Ba(HSO_3)_2$$

} Soluble

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Test based on ppt

(1) Test based on $BaCl_2$ / $CaCl_2$

$$SO_3^{-2} + BaCl_2 / CaCl_2 \longrightarrow \underset{\text{White ppt}}{BaSO_3 / CaSO_3}$$

$$\underset{\text{White ppt}}{\overset{+4}{BaSO_3}} \xrightarrow[\text{Standing}]{O_2 \text{ (slow)}} \overset{+6}{BaSO_4}\ \text{Heavy white ppt}$$

$$BaSO_3 \xrightarrow[\text{(fast)}]{H_2O_2 / HNO_3 / Br_2 \text{ water}} BaSO_4$$

(it is Insoluble in any acid or base at room temp.)
but sol. in Hot and conc. H_2SO_4 / HCl

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Test with $Pb(NO_3)_2$

Sulphite

$$SO_3^{-2} + Pb(NO_3)_2 \longrightarrow PbSO_3$$

White ppt

excess NaOH sol.

$$PbSO_3 \xrightarrow[O_2]{boil} PbSO_4$$

White → White

(thiosulphate)

$$PbS_2O_3 \xrightarrow{boil} PbS + H_2SO_4$$

White → (Black)

(Sulphide)

Nishant Jindal

Test with $AgNO_3$

$SO_3^{-2} + AgNO_3 \longrightarrow [Ag(SO_3)]^{\ominus}$ (Soluble)

$\xrightarrow{\text{excess of } AgNO_3}$ White Ag_2SO_3

$\xrightarrow{\text{excess } Na_2SO_3} [Ag_2(SO_3)]^{\ominus}$

Initially no visible action due to formation of Soluble complex

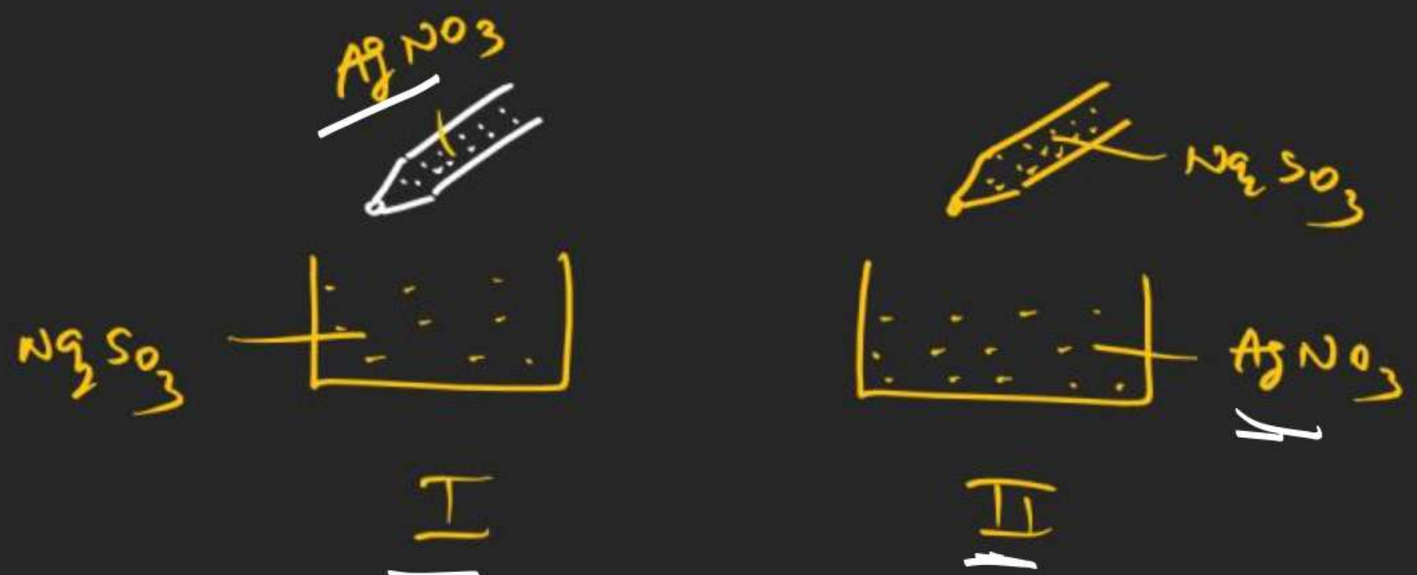
White Ag_2SO_3 — Sol. in dil HNO_3 and NH_3 — Δ → $Ag + SO_2 + 2H^+$

Metallic Black ppt

$[Ag_2(SO_3)]^{\ominus}$ — Δ → $Ag + SO_2 + SO_4^{-2}$

metallic Black

Nishant Jindal



ans

ppt first obt. in II diagram because in this $AgNO_3$ is in excess

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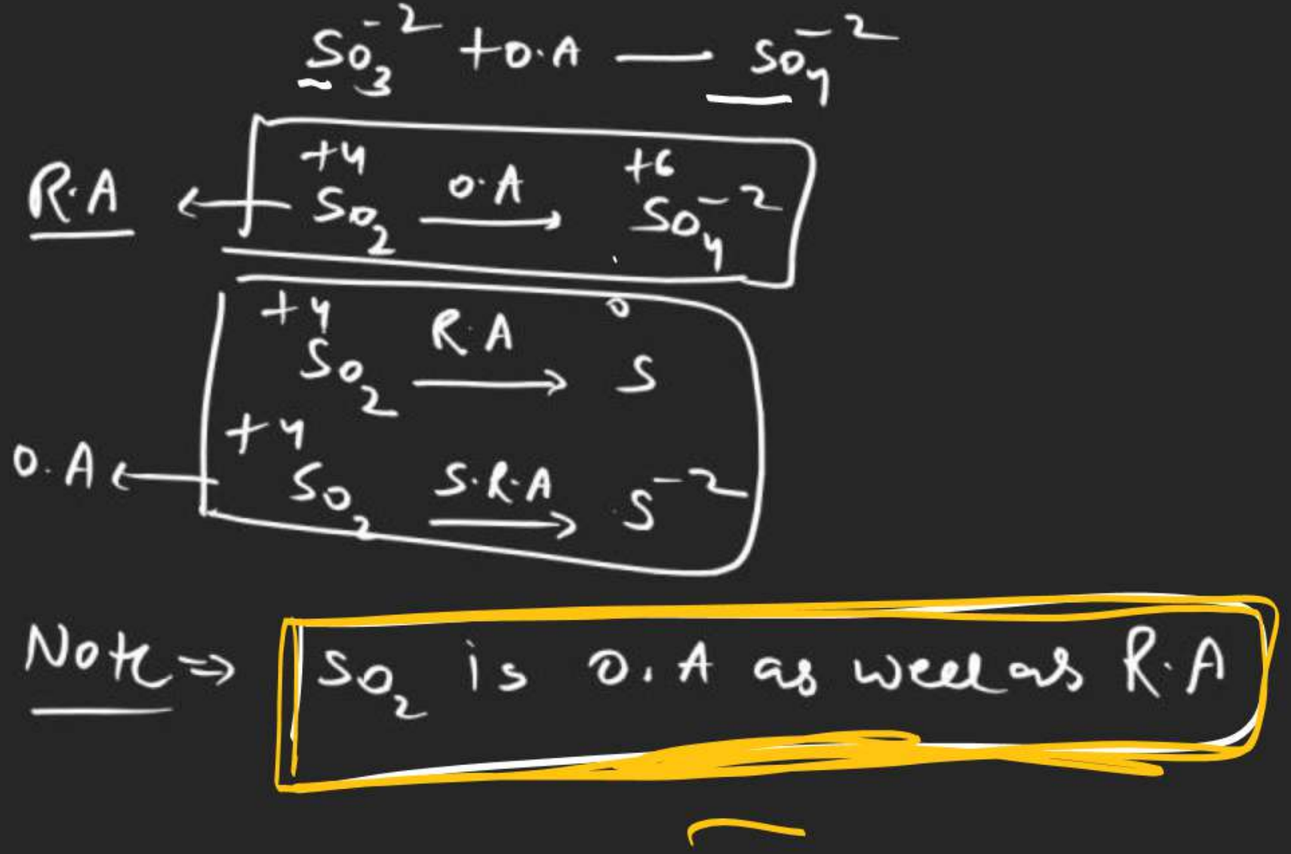
Test based on Redox



Note ⇒ SO_2 is O.A as well as R.A

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Test based on Reducing Prop.

MnO_4^- + SO_2 ⟶ Mn^{+2} + SO_4^{-2}

(Pink/Purple) — Col. less

$Cr_2O_7^{-2}$ + SO_2 ⟶ Cr^{+3} + SO_4^{-2}

orange — green

Br_2 + H_2O + SO_2 ⟶ Br^- + SO_4^{-2}

(Brown) — Col. less

Fe^{+3} + SO_2 ⟶ Fe^{+2} + SO_4^{-2}

yellow — green

IO_3^- + SO_2 ⟶ I_2 + SO_4^{-2}

Col. less — I_2 ↓ starch

Deep Blue

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Test based on Oxidising Prop.

Test with Zn + dil H_2SO_4

$Zn + dil\,H_2SO_4 \longrightarrow ZnSO_4 + 2H$ (S.R.A)

$SO_3^{-2} \xrightarrow{Zn + dil\,H_2SO_4} S^{-2}$

$SO_2 \xrightarrow{Zn + dil\,H_2SO_4} H_2S^{-2}$

Test with Devarda alloy with alkaline solution (Cu/Zn/Al)

$Zn + NaOH \longrightarrow Na_2ZnO_2 + H$

$Al + NaOH \longrightarrow NaAlO_2 + H$

$SO_2 \xrightarrow{(Zn + NaOH)} H_2S^{-2}$

Test with

NO_2^- $\xrightarrow{(Zn + NaOH)}$ NH_3

NO_3^- $\xrightarrow{Zn + NaOH}$ NH_3

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Test with shiff | magneta | fuchion Reagent

SO_2 decol. Pink col. of shiff Reagent

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HSO_3^- = all are soluble

Test with acid

$$HSO_3^- + H^+ \longrightarrow SO_2$$

Test with H_2O_2

$$HSO_3^- + H_2O_2 \longrightarrow SO_4^{-2} + H_2O + H^+$$

(acidic)

$$SO_3^{-2} + H_2O_2 \longrightarrow SO_4^{-2} + H_2O$$

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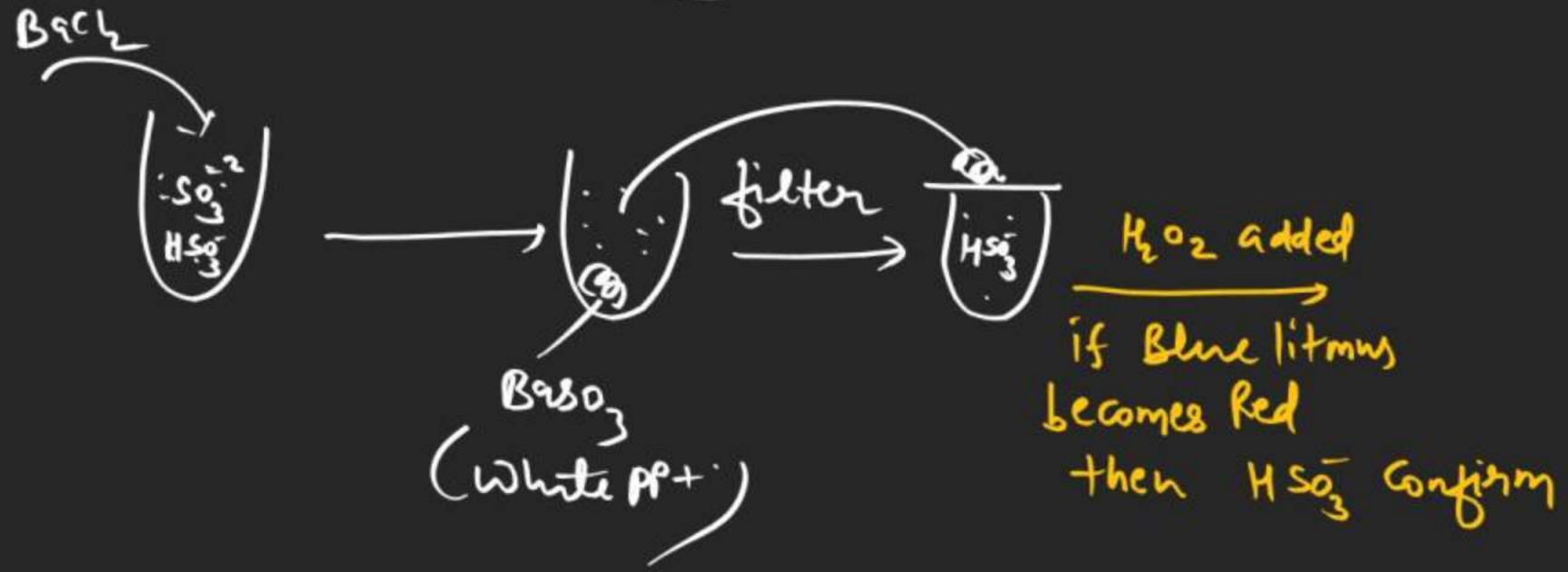
Dist b/w SO_3^{-2} / HSO_3^-



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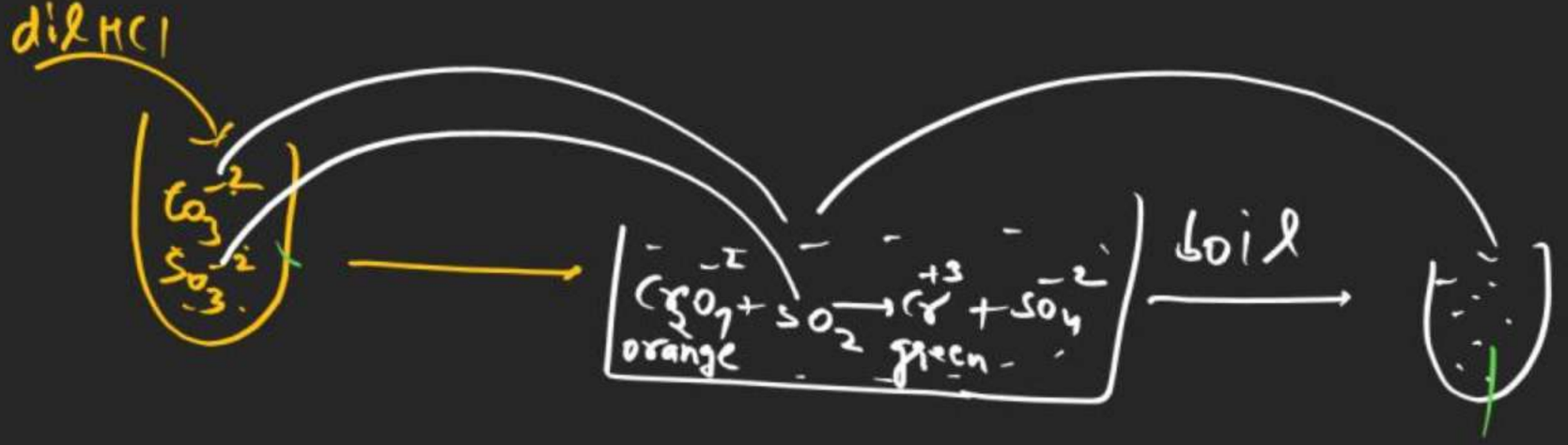
CO_3^{-2} | SO_3^{-2}



if lime water turns milky then CO_3^{-2} confirm

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S^{-2}

all are insoluble

except IA|IIA $(NH_4)_2S$

① Test with acid

$S^{-2} + H^+ \longrightarrow H_2S \uparrow$

Rotten egg smell

$Pb(CH_3COO)_2$ Paper $\longrightarrow$ PbS (Black ppt.)

$Cd(CH_3COO)_2$ Paper $\longrightarrow$ CdS (yellow ppt.)

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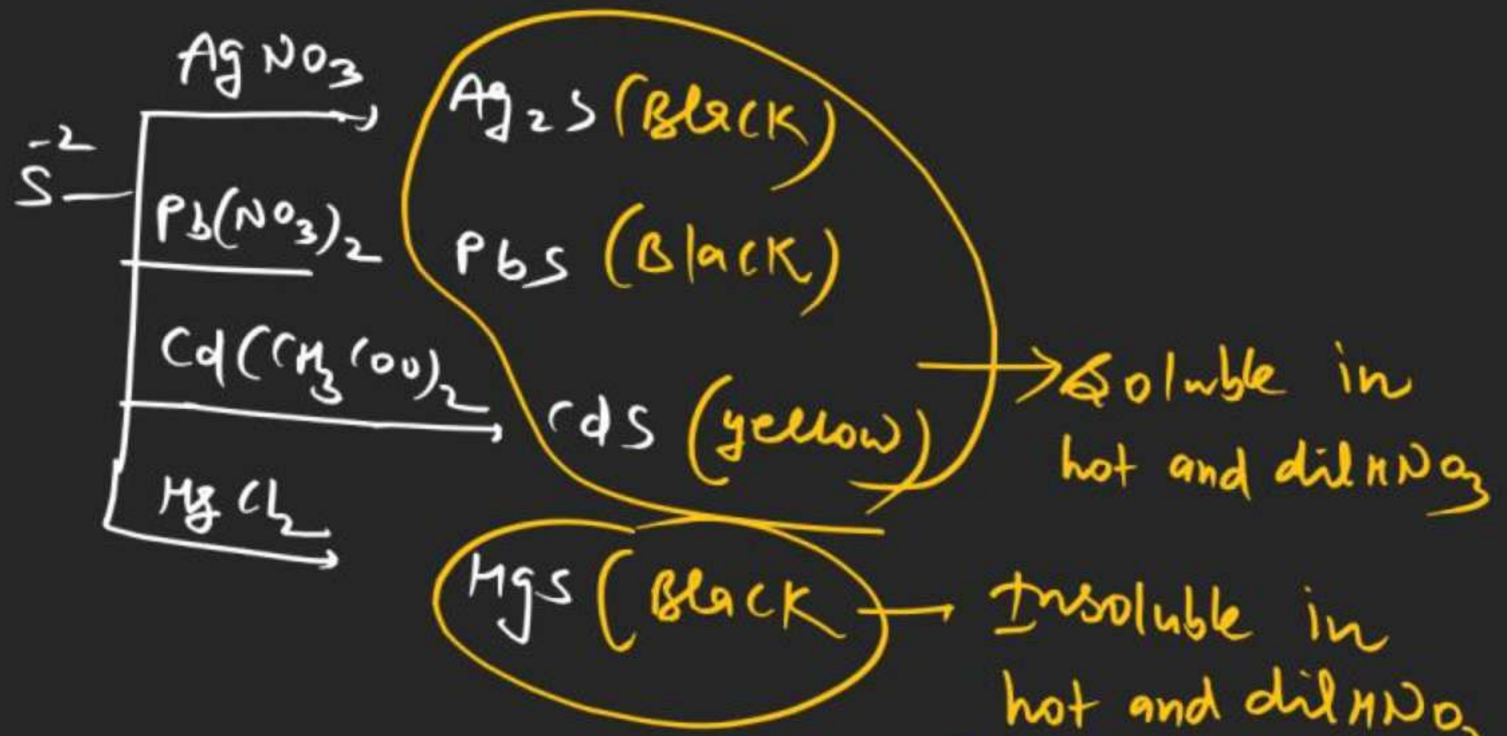
Test based on ppt.



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$H_2S^{-2} \longrightarrow S$

(R.A)

Test based on Reducing Prop.

$MnO_4^- + H_2S \longrightarrow Mn^{+2} + S$

$Cr_2O_7^{-2} + H_2S \longrightarrow Cr^{+3} + S$

$Br_2 + H_2O + H_2S \longrightarrow Br^- + S$

$Fe^{+3} + H_2S \longrightarrow Fe^{+2} + S$

$IO_3^- + H_2S \longrightarrow I_2 + S$

I_2 + Starch → Deep Blue

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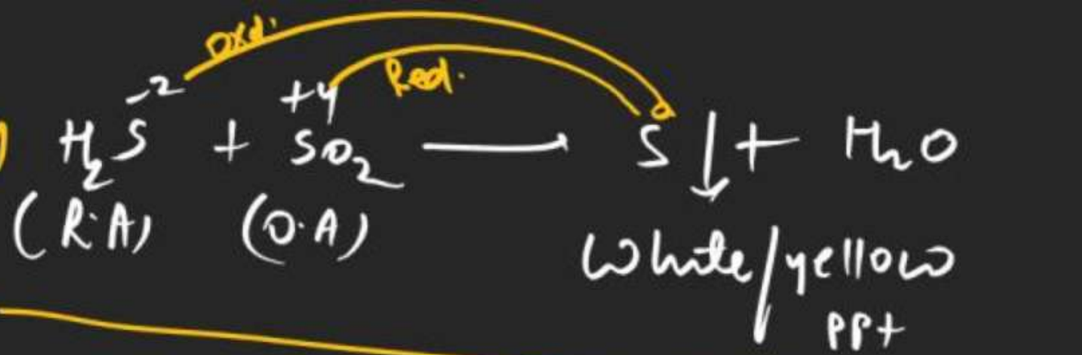
Comproportionation



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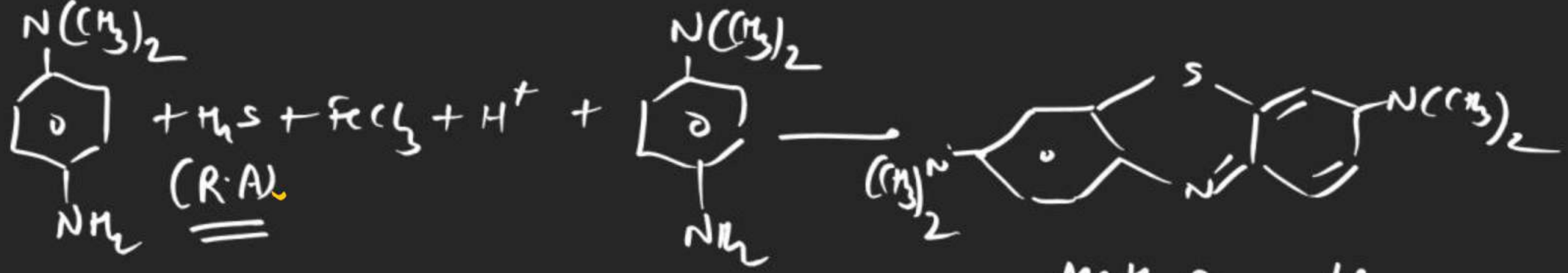
Test with N,N dimethyl phenylene diamine



Methylene blue

(Blue colour dye)

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NO_2^- ⇒ all are soluble except $AgNO_2$

test with acid →

$$NO_2^- + H^+ \longrightarrow HNO_2$$
(Unstable)

$$HNO_2 \longrightarrow NO + HNO_3$$

$$NO + \tfrac{1}{2}O_2 \longrightarrow NO_2$$ (Brown fumes)

CO_3^{-2}
S^{-2}
SO_3^{-2}
NO_2^-
NO_3^-

NO_2^- — (Cl^- Br^- I^-)

$$HNO_2 \longrightarrow N_2O_3 + H_2O$$

$$N_2O_3 \longrightarrow NO + NO_2\uparrow$$

$$NO + \tfrac{1}{2}O_2 \longrightarrow NO_2\uparrow$$ (Brown fumes)

Nishant Jindal

Test based on ppt

Test with $AgNO_3$

$AgNO_3 + NO_2^- \longrightarrow AgNO_2 + NO_3^-$

(White ppt.)

Soluble in dil HNO_3 and NH_3 sol.

Redox

$NO_2^- \xrightarrow{O.A} NO_3^-$

$NO_2^- \xrightarrow{R.A} NO$

$NO_2^- \xrightarrow[H]{S.R.A} NH_3$

Redox based on oxidising prop.

$NO_2^- + I^{\ominus} \longrightarrow NO\uparrow + I_2$

Deverda alloy with alkaline sol.

$NO_2^- \xrightarrow{Zn + NaOH} NH_3$

Redox Reaction (based on Reducing agent)

$MnO_4^- + NO_2^- \xrightarrow{H^+} Mn^{+2} + NO_3^-$

$Cr_2O_7^{-2} + NO_2^- \xrightarrow{H^+} Cr^{+3} + NO_3^-$

$Br_2 + H_2O + NO_2^- \xrightarrow{H^+} Br^- + NO_3^-$

Nishant Jindal

NO_3^- ⇒ all are soluble

Test with acid

$$NO_3^- + Conc.H_2SO_4 \longrightarrow HNO_3$$

$$HNO_3 \xrightarrow{\Delta} NO_2\uparrow + H_2O + (O)$$

or

Cu turnings

$$Cu + HNO_3 \longrightarrow Cu(NO_3)_2 + NO_2\uparrow$$

(Brown)

Nishant Jindal

Brown Ring test

$NO_3^- + Conc.H_2SO_4 \longrightarrow HNO_3 + HSO_4^-$

$HNO_3 + FeSO_4 \longrightarrow Fe_2(SO_4)_3 + NO$

($FeSO_4$: Freshly Prep.)

$FeSO_4$ (remaing) $+ NO + H_2O \longrightarrow [Fe(H_2O)_5\overset{+1}{N}O\overset{+1}{}]SO_4$

Brown Ring complex

or $FeSO_4 \cdot NO$

Fe^+, NO = +1 oxidation state and it dec. by it's mag. mom. Cal. due to charge transfer

sp^3d^2 oct. Page 3.87, high spin

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Brown test also Performed by NO_2^- with dil H_2SO_4

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$Cl^- / Br^- / I^-$

Solubility :- all are soluble except

$Ag^+ \,|\, Cu_2^{+2} \,|\, Hg_2^{+2} \,|\, Pb^{+2}$

① Test with acid

$$Cl^{\ominus} + Conc.\ H_2SO_4 \longrightarrow HCl \xrightarrow[Conc.\ H_2SO_4]{Remaining} \times$$

$$Br^{\ominus} + Conc.\ H_2SO_4 \longrightarrow HBr \xrightarrow{-''-} Br_2$$

$$I^{\ominus} + Conc.\ H_2SO_4 \longrightarrow HI \xrightarrow{-''-} I_2$$

acid formation — Redox Reaction

Note ⇒ HCl does not give Redox Reaction because it is W.R.A

Nishant Jindal

Q. Why freshly Prep. $FeSO_4$ use.

because $FeSO_4$ is good absorben of NO

$FeSO_4$ Can Oxidised into $Fe_2(SO_4)_3$ by air.

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Conc. H_3PO_4 is not a oxidising agent

$$Cl^- + \text{Conc.}\ H_3PO_4 \longrightarrow HCl$$

$$Br^- + \text{Conc.}\ H_3PO_4 \longrightarrow HBr$$

$$I^- + \text{Conc.}\ H_3PO_4 \longrightarrow HI$$

Note ⇒ Pure HCl / HBr / HI can be obt. by Conc. H_3PO_4

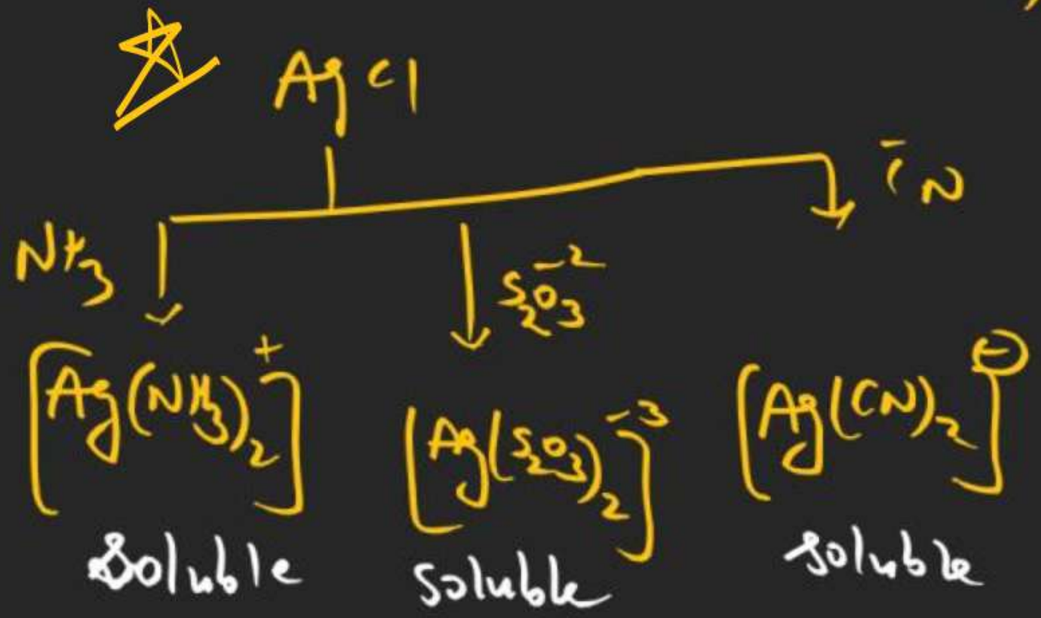
Test with MnO_2 + Conc. H_2SO_4

$$Cl^- + \text{Conc.}\ H_2SO_4 + MnO_2 \xrightarrow{(S.O.A)} Cl_2$$

Nishant Jindal

Test with $AgNO_3$

$Cl^- + AgNO_3 \longrightarrow AgCl$
(white ppt.)
Sol. in excess NH_3, $S_2O_3^{-2}$ CN^-



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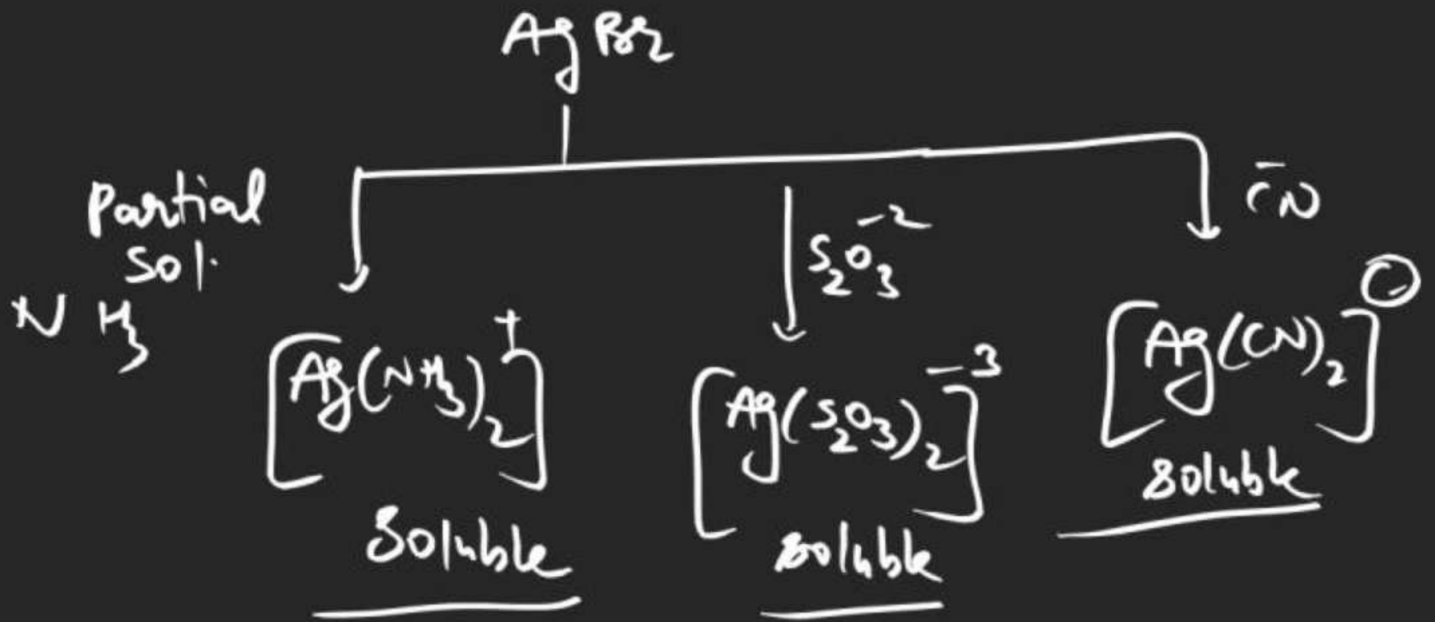
$Br^- + AgNO_3 \longrightarrow AgBr$

(Pale yellow ppt)

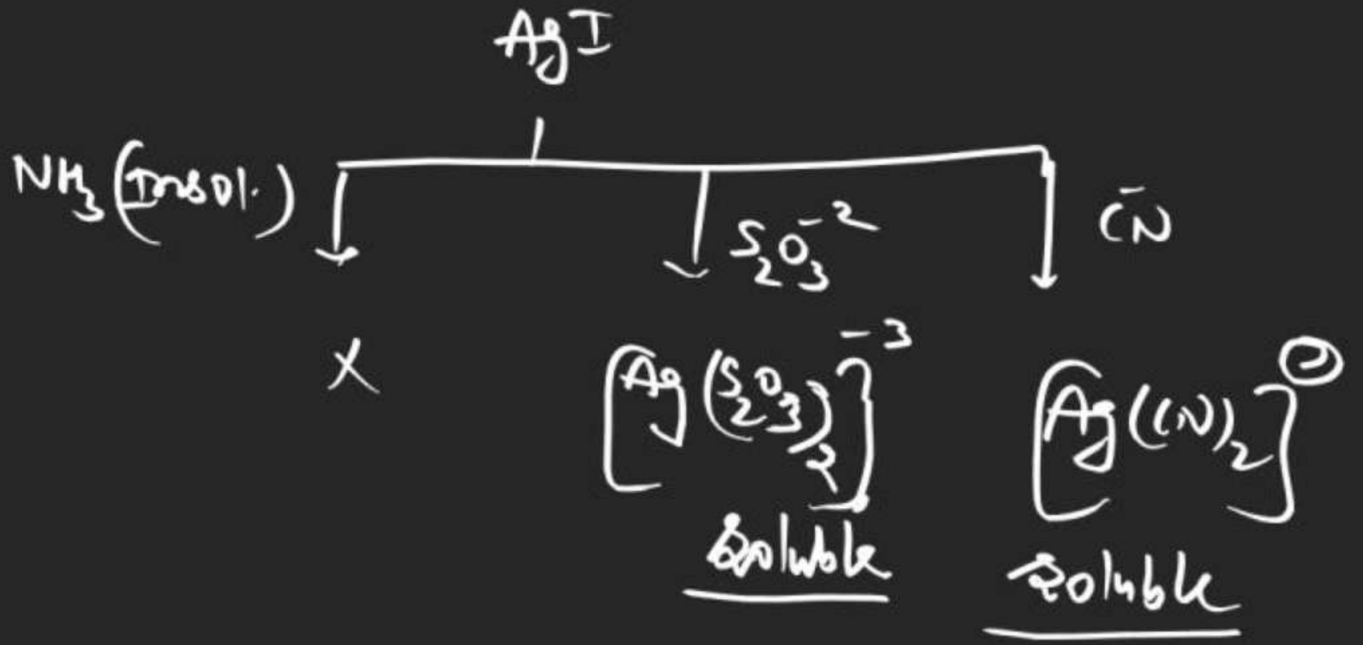
Sol. in NH_3 $S_2O_3^{-2}$ CN^-



Nishant Jindal

$I^{\ominus} + AgNO_3 \longrightarrow AgI$

yellow ppt.



Nishant Jindal

Test with $Pb(NO_3)_2$

$Cl^- + Pb(NO_3)_2 \longrightarrow PbCl_2$ White ppt — sparingly sol. in cold water but sol. in warm water

$Br^- + Pb(NO_3)_2 \longrightarrow PbBr_2$ White ppt — sol. in hot water

$I^- + Pb(NO_3)_2 \longrightarrow PbI_2$ yellow ppt — sol. in boil water

NH_3 Polar

$AgCl > AgBr > AgI$

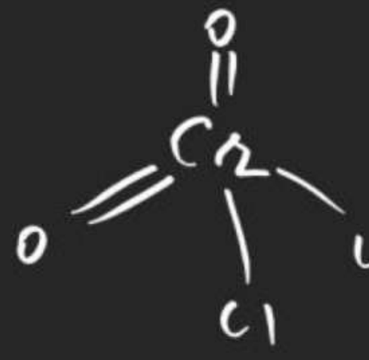
Thus (Polar)

$PbCl_2 > PbBr_2 > PbI_2$

Nishant Jindal

★ Chromyl Chloride test [specific test]

Solid mix + Conc. H_2SO_4 + Solid $K_2Cr_2O_7$ $\xrightarrow{\Delta}$ (Reddish Brown fumes) CrO_2Cl_2



dsp^2 [dxy dy²-d²x]

Charge transfer

CrO_2Cl_2 $\xrightarrow{NaOH}$ Na_2CrO_4 (yellow sol.)

Na_2CrO_4 $\xrightarrow[Pb(CH_3COO)_2]{CH_3COOH}$ $PbCrO_4$ (yellow ppt.)

Na_2CrO_4 $\xrightarrow{H_2O_2 + \text{organic solvent}}$ CrO_5 (Blue sol.)

Nishant Jindal

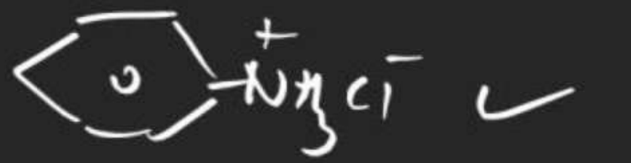
$NaCl + Conc.H_2SO_4 \rightarrow HCl$

$K_2Cr_2O_7 + Conc.H_2SO_4 \rightarrow CrO_3$

$CrO_3 + HCl \xrightarrow{\Delta} CrO_2Cl_2$

$CHCl_3$ CCl_4 X

NaCl NH_4Cl



Hg_2Cl_2 | $HgCl_2$

Ag | Pb | Sb | Bi | Au | Pt → X

$SnCl_2$

$SnCl_4$ X

Nishant Jindal

Layer test { specific test for Br^- }

$Br^- + Cl_2$ water (dropwise) $\longrightarrow$ Br_2 and impart orange Red colour due to Br_3^- formation $\xrightarrow[\text{Solvent}]{\text{organic}}$ Reddish Brown layer

Note ⇒ excess amount of Cl_2 water not use

$$Br_2 + Cl_2 + H_2O \longrightarrow \underbrace{\overset{+}{B}r_2\bar{C}l}_{\text{yellow solution}}$$
(excess)

Nishant Jindal

Layer test for I^- (Specific test)

$$I^- + Cl_2 \text{ water (dropwise)} \longrightarrow \underset{\text{(Brown Col. to the sol}^n\text{)}}{I_3^-} \xrightarrow[\text{solvent}]{\text{organic}} \text{violet layer}$$

excess amount of Cl_2 water not use

$$I_2 + Cl_2 + H_2O \longrightarrow \underset{\text{(Col. less)}}{HIO_3}$$
(excess)

Note ⇒ if $I^\ominus$ and Br^- present together then violet layer Comes First followed by Reddish Brown layer

if Reddish Brown layer Comes First then Br^- confirm but I^- absent

Nishant Jindal

SO_4^{-2}

all are soluble

except Ba | Pb | Sr | – Insoluble

Hg | Ag | → Insoluble

SO_4^{-2} —

- $BaCl_2$ → $BaSO_4$ (White)
- $Pb(NO_3)_2$ → $PbSO_4$ (White)
- $AgNO_3$ → Ag_2SO_4 (White)
- $Hg(NO_3)_2$ → $2HgO \cdot HgSO_4$ (Yellow)

Nishant Jindal

Test with ($Na_2SO_4 + BaS$) in MnO_4^- solution

$(Na_2SO_4 + BaS) \xrightarrow[\text{solution}]{MnO_4^-} BaSO_4$ (white ppt)

but it adsorbed some MnO_4^- ion so it becomes Pink/Purple ppt

$\xrightarrow{H_2O}$

decol. MnO_4^- ion in the solution

So Pink ppt of $BaSO_4$ clearly observed.

Nishant Jindal

Cation

Groups	Cation	Reagent
I	Pb^{+2} Hg_2^{+2} Ag^{+}	dil HCl
II A	Pb^{+2} Cu^{+2} Hg^{+2} Cd^{+2} Bi^{+3}	H_2S gas in acidic medium
II B	As^{+3} As^{+5} Sb^{+3} Sb^{+5} Sn^{+2} Sn^{+4}	H_2S gas in acidic medium
III	Al^{+3} Cr^{+3} Fe^{+3}	NH_4OH in presence of NH_4Cl
IV	Ni^{+2} Co^{+2} Mn^{+2} Zn^{+2}	H_2S gas in basic medium
V	Ba^{+2} Sr^{+2} Ca^{+2}	$(NH_4)_2CO_3$ in presence of NH_4Cl and NH_4OH
VI group	Na^{+} Mg^{+2} K^{+}	no Common Reagent

down the group K_{sp} ↑

Nishant Jindal

Pb^{+2}

P-block cation + KI (excess) ⟶ Soluble

D-Block + excess KI ⟶ Insoluble

except — HgI_2 it soluble

$HgI_2 + KI \rightarrow [HgI_4]^{-2}$

Soluble

Nishant Jindal

D-Block + excess $\overset{-}{C}N/NH_3$ ⟶ Soluble

except for NH_3

Fe^{+2} | Fe^{+3} | Mn^{+2} | Hg_2^{+2} | Mg^{+2} | Cr^{+3} [partial sol]

Insoluble

P-Block + excess $\overset{-}{C}N/NH_3$ ⟶ Insol.

Nishant Jindal

Hg_2^{+2} / Hg^{+2} / Ag^{+} [native metal / less Reactive]

NaOH

Hg_2O HgO Ag_2O

excess NaOH

Insoluble

Pb Zn Be Al Ga Sn $Cr^{+3/+4}$

all the oxides and hydroxides are Amphoteric

excess of NaOH

Soluble

Nishant Jindal

$Pb^{+2} + KI \longrightarrow \underset{\text{yellow ppt}}{PbI_2} \xrightarrow[KI]{\text{excess}} \underset{\text{Soluble}}{[PbI_4]^{-2}}$

$Pb^{+2} + \bar{C}N \longrightarrow Pb(CN)_2 \xrightarrow[KCN]{\text{excess}}$ Insol.

$Pb^{+2} + CrO_4^{-2} \longrightarrow \underset{\text{yellow ppt}}{PbCrO_4}$

$Pb^{+2} + NaOH \longrightarrow \underset{\text{White ppt}}{Pb(OH)_2} \xrightarrow[NaOH]{\text{excess}} \underset{\text{Soluble}}{[Pb(OH)_4]^{-2}}$

$Pb^{+2} + \underset{(NH_3 + H_2O)}{NH_4OH} \longrightarrow Pb(OH)_2 \xrightarrow[NH_4OH]{\text{excess}}$ X

$Pb^{+2} + H_2S \longrightarrow PbS$ (Black ppt.)

Nishant Jindal

Cu^{+2}

① $Cu^{+2} + I^{\ominus} \longrightarrow Cu^{+} + I_2$

(O.A) (R.A)

$Cu^{+} \xrightarrow{I^{\ominus}} Cu_2I_2$ (White PPt)

$I_2 \xrightarrow{I^{-}} I_3^{\ominus}$ (Brown Col.)

$Cu_2I_2 + I_3^{\ominus}$ → Brown

CuI_2 does not exist

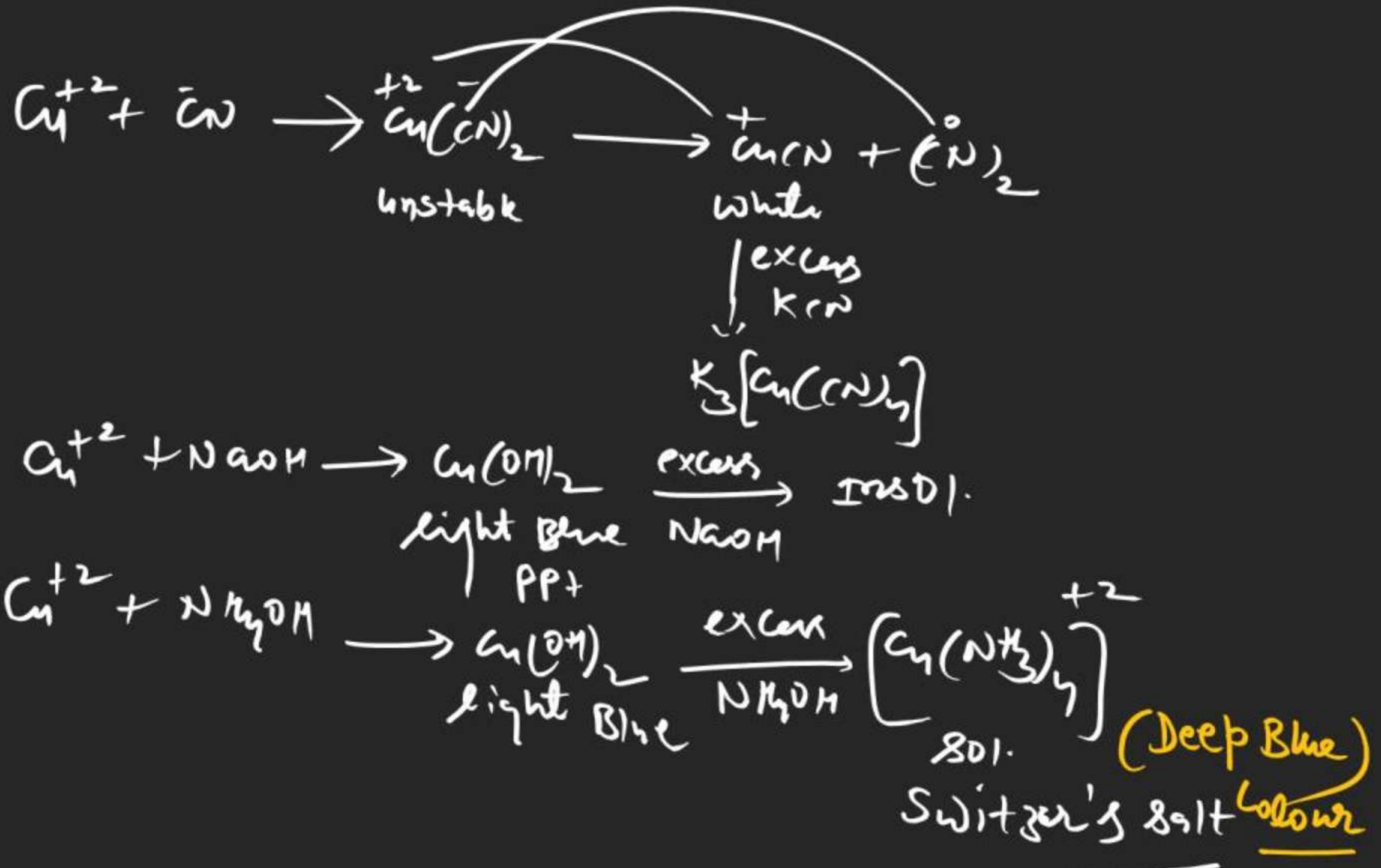
Iodometry test

$Cu_2I_2 + I_3^{\ominus} + S_2O_3^{-2} \longrightarrow I^{\ominus} + Cu_2I_2 + S_4O_6^{-2}$

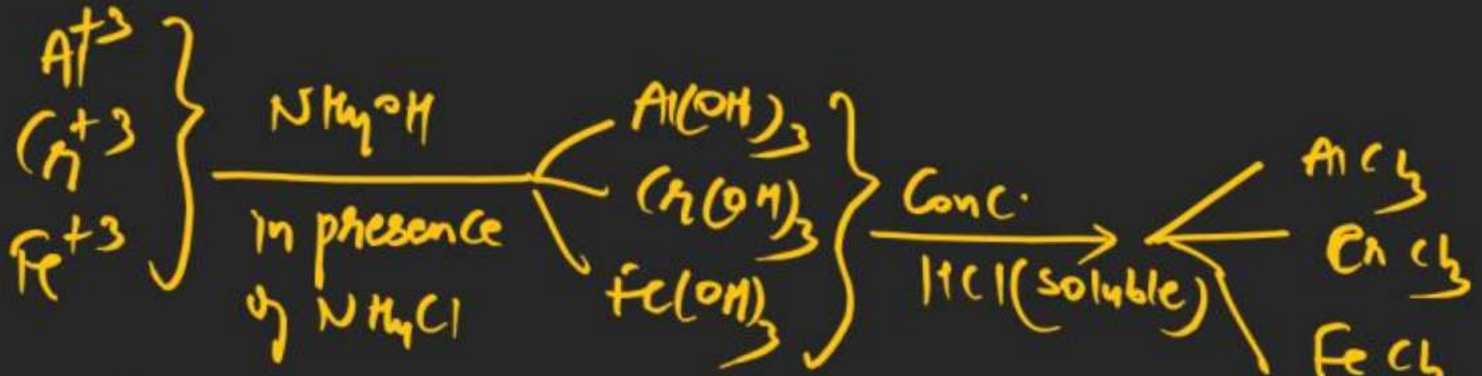
$Cu_2I_2 + I_3^{\ominus}$ → Brown colour

$I^{\ominus} + Cu_2I_2 + S_4O_6^{-2}$ (Col. less)

Nishant Jindal



Nishant Jindal



$$Al^{+3} + NaOH \longrightarrow Al(OH)_3$$

$$Al(OH)_3 + NaOH \text{ (excess)} \rightleftharpoons [Al(OH)_4]^{\ominus} \text{ (aluminate)}$$

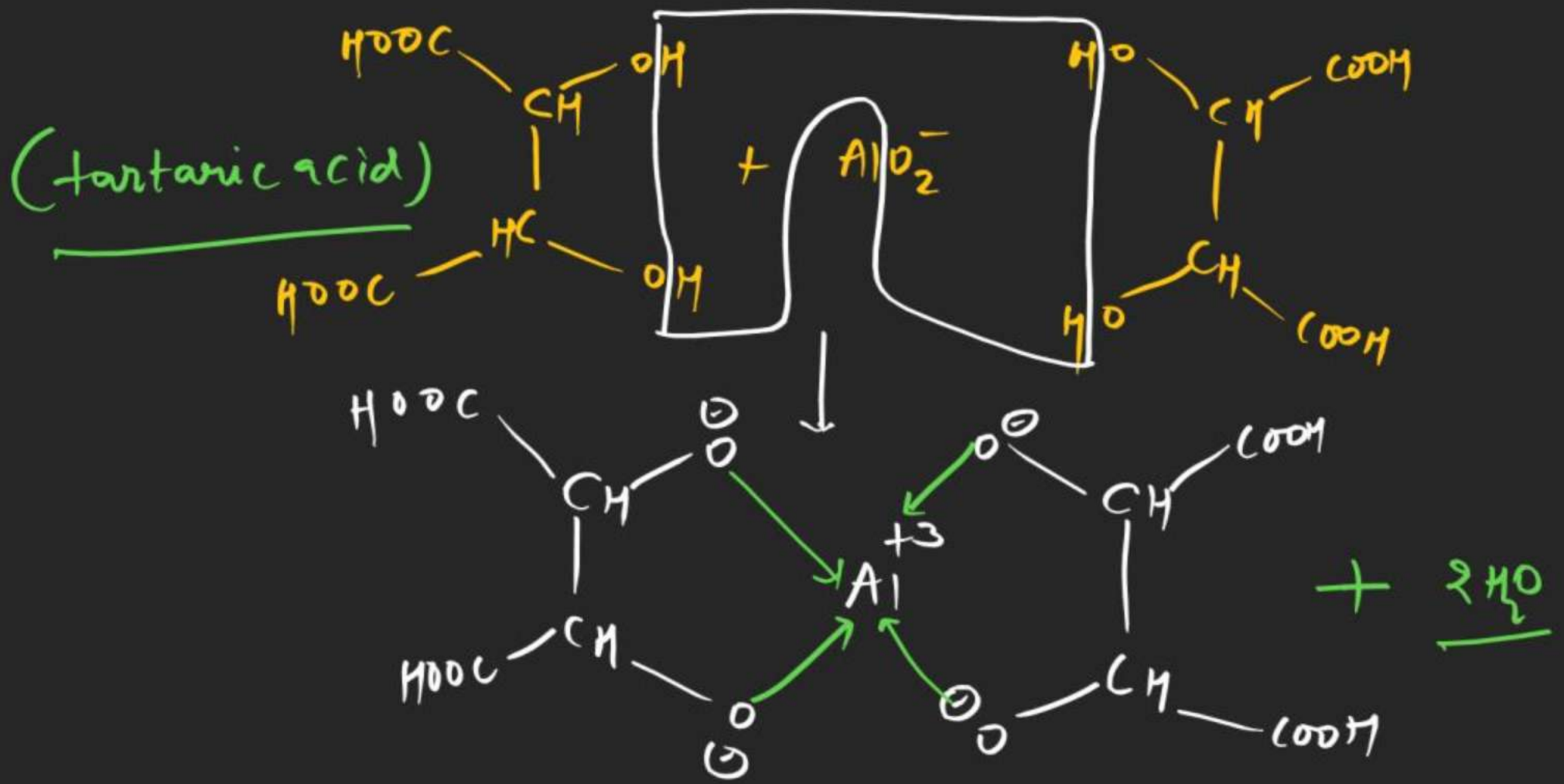
White ppt

sol. or $AlO_2^- + 2H_2O$ (metaaluminate)

On addition of acid White ppt reappear due to shifting of eq. in backward direction.

but On addition of polyHydroxy or gano acid White ppt disappear due to formation of complex compound.

Nishant Jindal



Nishant Jindal

$$Cu^{+2} + K_4[Fe(CN)_6] \longrightarrow Cu_2[Fe(CN)_6]$$

Chocolate Brown

$$Cu^{+2} + K_3[Fe(CN)_6] \longrightarrow Cu_3[Fe(CN)_6]_2$$

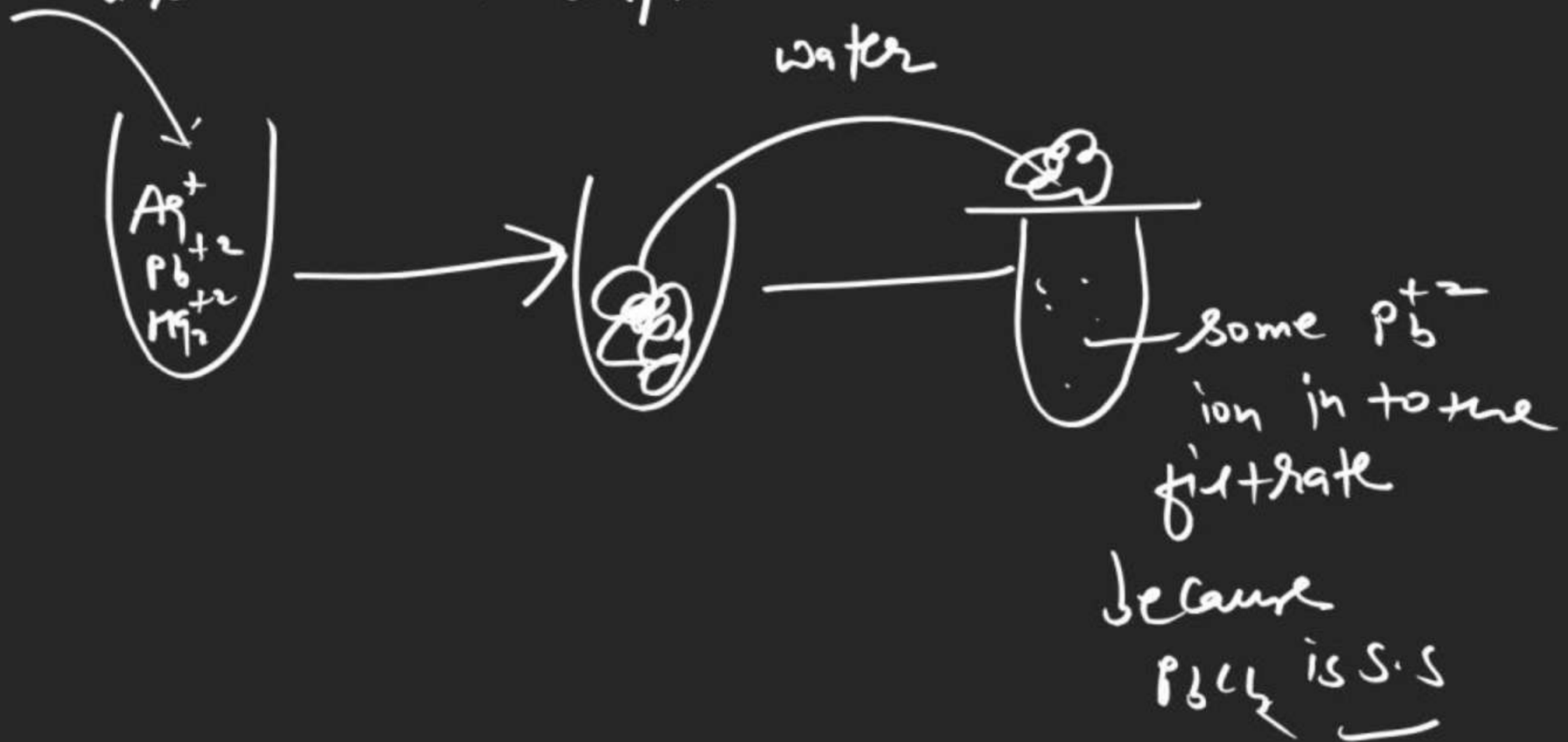
green ppt

$$Cu^{+2} + H_2S \longrightarrow CuS$$

(Black)

Nishant Jindal

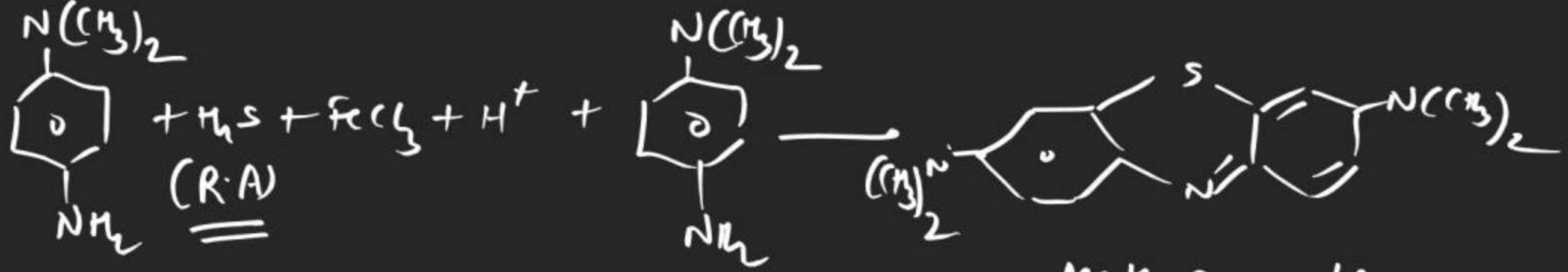
$PbCl_2$ → Sparingly soluble in cold water but Complete soluble in Hot water



Because $PbCl_2$ is S.S

Nishant Jindal

Test with N,N dimethyl phenylene diamine



Methylene blue

(Blue colour dye)

Nishant Jindal

NO_2^- ⇒ all are soluble except $AgNO_2$

test with acid →

$$NO_2^- + H^+ \longrightarrow HNO_2$$
(Unstable)

$$HNO_2 \longrightarrow NO + HNO_3$$

$$NO + \tfrac{1}{2}O_2 \longrightarrow NO_2$$ (Brown fumes)

CO_3^{-2}
S^{-2}
SO_3^{-2}
NO_2^-
NO_3^-

NO_2^- — (Cl^- Br^- I^-)

$$HNO_2 \longrightarrow N_2O_3 + H_2O$$

$$N_2O_3 \longrightarrow NO + NO_2\uparrow$$

$$NO + \tfrac{1}{2}O_2 \longrightarrow NO_2\uparrow$$ (Brown fumes)

Nishant Jindal

Test based on ppt

Test with $AgNO_3$

$$AgNO_3 + NO_2^- \longrightarrow AgNO_2 + NO_3^-$$

(White ppt.)

Soluble in dil HNO_3 and NH_3 sol.

Redox

Redox based on oxidising prop.

$$NO_2^- + I^{\ominus} \longrightarrow NO + I_2$$

Deverda alloy with alkaline sol.

$$NO_2^- \xrightarrow{Zn + NaOH} NH_3$$

$$NO_2^- \xrightarrow{O.A} NO_3^-$$

$$NO_2^- \xrightarrow{R.A} NO$$

$$NO_2^- \xrightarrow[H]{S.R.A} NH_3$$

Redox Reaction (based on Reducing agent)

$$MnO_4^- + NO_2^- \xrightarrow{H^+} Mn^{+2} + NO_3^-$$

$$Cr_2O_7^{-2} + NO_2^- \xrightarrow{H^+} Cr^{+3} + NO_3^-$$

$$Br_2 + H_2O + NO_2^- \xrightarrow{H^+} Br^- + NO_3^-$$

Nishant Jindal

NO_3^- ⇒ all are soluble

Test with acid

$$NO_3^- + Conc.H_2SO_4 \longrightarrow HNO_3$$

$$HNO_3 \xrightarrow{\Delta} NO_2\uparrow + H_2O + (O)$$

or

Cu turnings

$$Cu + HNO_3 \longrightarrow Cu(NO_3)_2 + NO_2\uparrow$$

(Brown)

Nishant Jindal

Brown Ring test

$NO_3^- + Conc.H_2SO_4 \longrightarrow HNO_3 + HSO_4^-$

$HNO_3 + FeSO_4 \longrightarrow Fe_2(SO_4)_3 + NO$

($FeSO_4$: Freshly Prep.)

$FeSO_4$ (remaing) $+ NO + H_2O \longrightarrow [Fe(H_2O)_5\overset{+1}{N}O\overset{+1}{}]SO_4$

Brown Ring complex

or $FeSO_4 \cdot NO$

Fe^+, NO = +1 oxidation state and it dec. by it's mag. mom. Cal. due to charge transfer

sp^3d^2 oct. Page 3.87, high spin

Nishant Jindal

Brown test also Performed by NO_2^- with dil H_2SO_4

Nishant Jindal

$Cl^- / Br^- / I^-$

Solubility :- all are soluble except

$Ag^+ \,|\, Cu_2^{+2} \,|\, Hg_2^{+2} \,|\, Pb^{+2}$

① Test with acid

$$Cl^{\ominus} + Conc.\ H_2SO_4 \longrightarrow HCl \xrightarrow[Conc.\ H_2SO_4]{Remaining} \times$$

$$Br^{\ominus} + Conc.\ H_2SO_4 \longrightarrow HBr \xrightarrow{-''-} Br_2$$

$$I^{\ominus} + Conc.\ H_2SO_4 \longrightarrow HI \xrightarrow{-''-} I_2$$

acid formation — Redox Reaction

Note ⇒ HCl does not give Redox Reaction because it is W.R.A

Nishant Jindal

Q. Why freshly Prep. $FeSO_4$ use.

because $FeSO_4$ is good absorben of NO

$FeSO_4$ Can Oxidised into $Fe_2(SO_4)_3$ by air.

Nishant Jindal

Conc. H_3PO_4 is not a oxidising agent

$Cl^- + Conc.H_3PO_4 \longrightarrow HCl$

$Br^- + Conc.H_3PO_4 \longrightarrow HBr$

$I^- + Conc.H_3PO_4 \longrightarrow HI$

Note ⇒ Pure HCl / HBr / HI can be obt. by Conc. H_3PO_4

Test with MnO_2 + Conc. H_2SO_4

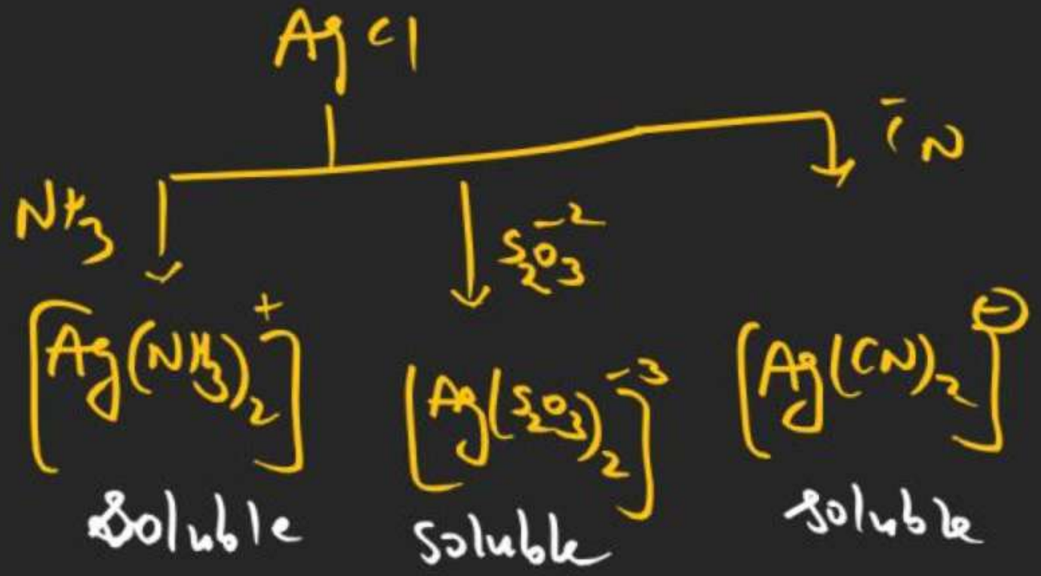
$Cl^- + Conc.H_2SO_4 + MnO_2 \longrightarrow Cl_2$

(S.O.A)

Nishant Jindal

Test with $AgNO_3$

$Cl^- + AgNO_3 \longrightarrow AgCl$
(white ppt.)
Sol. in excess NH_3, $S_2O_3^{-2}$ CN^-

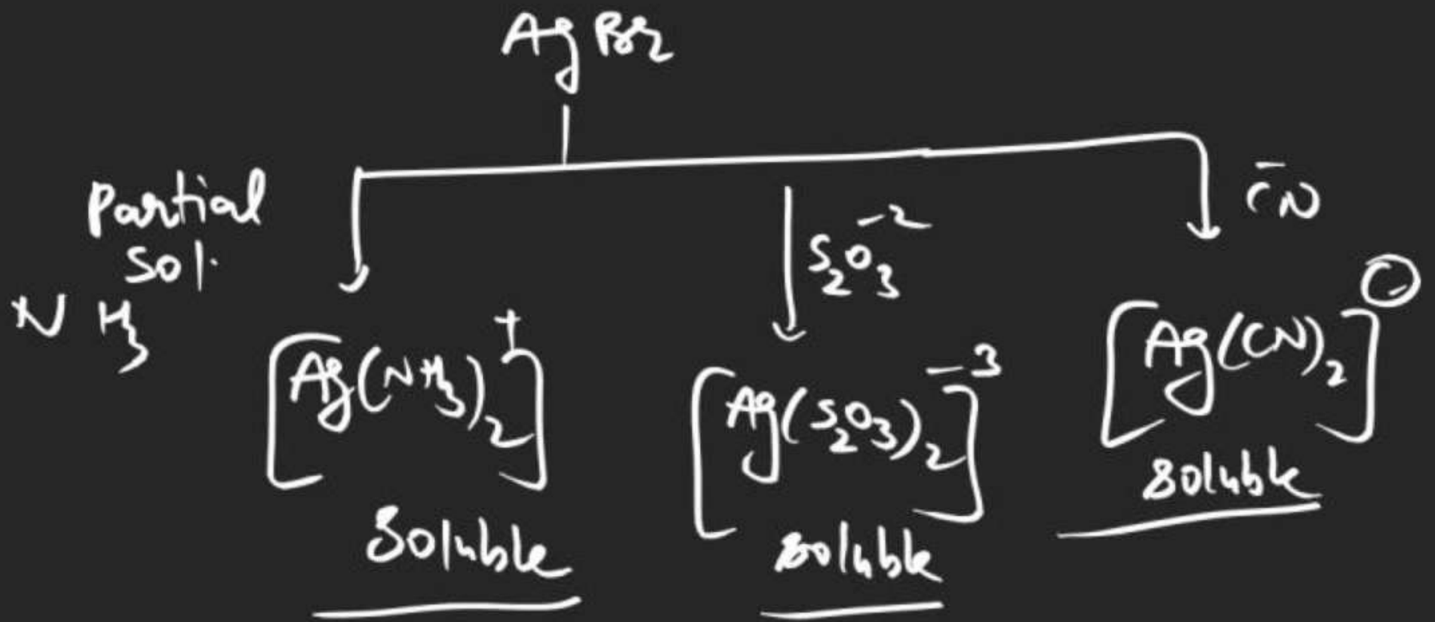


Nishant Jindal

$Br^- + AgNO_3 \longrightarrow AgBr$

(Pale yellow ppt)

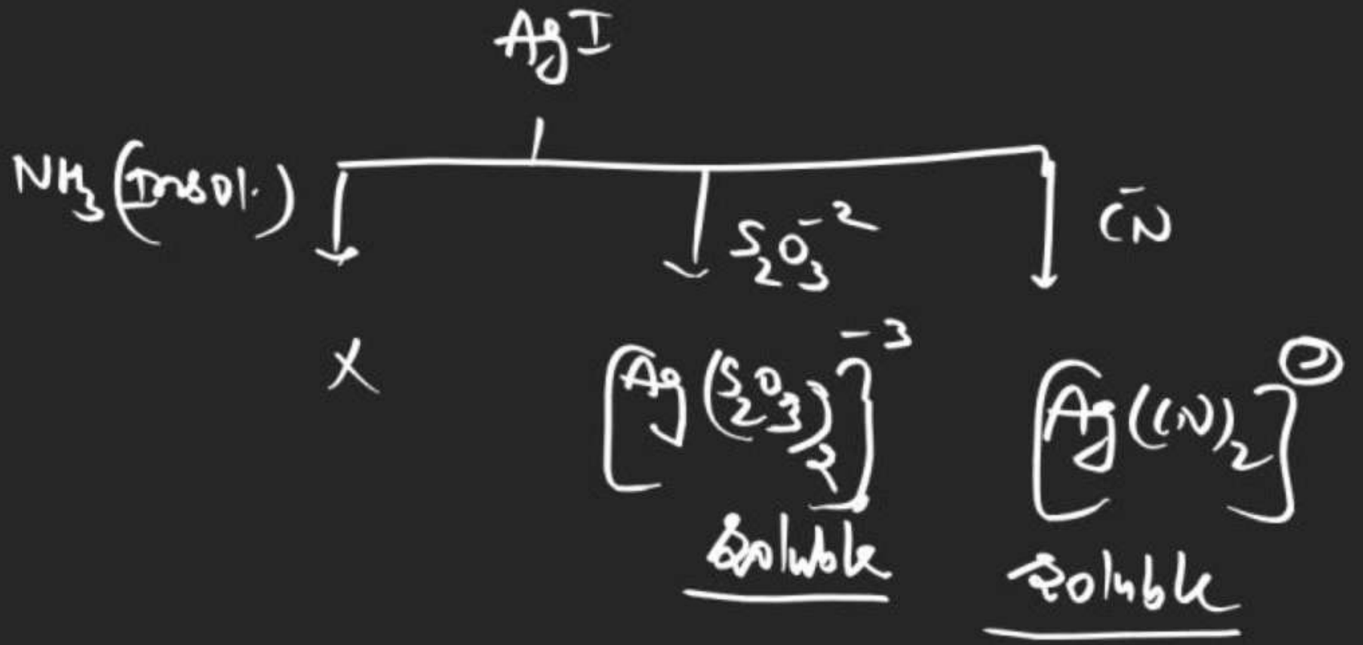
Sol. in NH_3 $S_2O_3^{-2}$ CN^-



Nishant Jindal

$I^{\ominus} + AgNO_3 \longrightarrow AgI$

yellow ppt.



Nishant Jindal

Test with $Pb(NO_3)_2$

$Cl^- + Pb(NO_3)_2 \longrightarrow PbCl_2$ White — Sparingly sol. in cold water but sol. in warm water

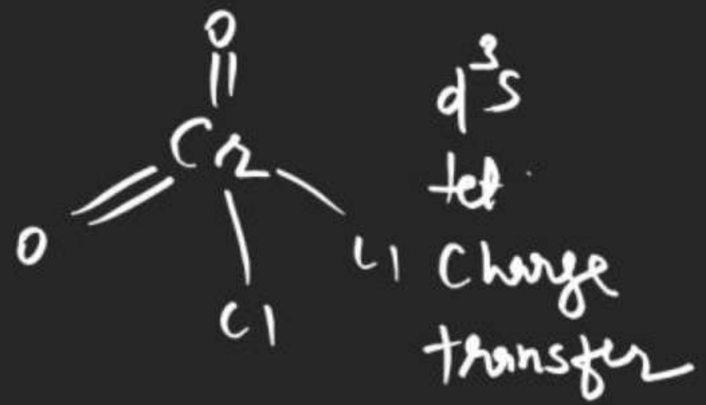
$Br^- + Pb(NO_3)_2 \longrightarrow PbBr_2$ White — sol. in hot water

$I^- + Pb(NO_3)_2 \longrightarrow PbI_2$ yellow ppt. — sol. in boil water

Nishant Jindal

★ Chromyl Chloride test [specific test]

Solid mix + Conc. H_2SO_4 + Solid $K_2Cr_2O_7$ $\xrightarrow{\Delta}$ CrO_2Cl_2 (Reddish Brown fumes)



d^2s tet

Charge transfer

CrO_2Cl_2 + NaOH → Na_2CrO_4 (yellow sol.)

Na_2CrO_4 + CH_3COOH + $Pb(CH_3COO)_2$ → $PbCrO_4$ (yellow ppt.)

Na_2CrO_4 + H_2O_2 + organic solvent → CrO_5 (Blue sol.)

Nishant Jindal

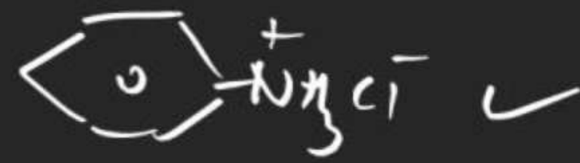
$NaCl + Conc.H_2SO_4 \longrightarrow HCl$

$K_2Cr_2O_7 + Conc.H_2SO_4 \longrightarrow CrO_3$

$CrO_3 + HCl \xrightarrow{\Delta} CrO_2Cl_2$

$CHCl_3$ CCl_4 X

NaCl NH_4Cl



Hg_2Cl_2 | $HgCl_2$

Ag | Pb | Sb | Bi | Au | Pt → X

$SnCl_2$

$SnCl_4$ X

Nishant Jindal

Layer test { specific test for Br^- }

$Br^- + Cl_2$ water (dropwise) $\longrightarrow$ Br_2 and impart orange Red colour due to Br_3^- formation $\xrightarrow[\text{Solvent}]{\text{organic}}$ Reddish Brown layer

Note ⇒ excess amount of Cl_2 water not use

$$Br_2 + Cl_2 + H_2O \longrightarrow \underbrace{\overset{+}{B}r_2\bar{C}l}_{\text{yellow solution}}$$
(excess)

Nishant Jindal

Layer test for I^- (Specific test)

$$I^- + Cl_2 \text{ water (dropwise)} \longrightarrow \underset{\text{(Brown Col. to the sol}^n\text{)}}{I_3^-} \xrightarrow[\text{solvent}]{\text{organic}} \text{violet layer}$$

excess amount of Cl_2 water not use

$$I_2 + Cl_2 + H_2O \longrightarrow \underset{\text{(Col. less)}}{HIO_3}$$
(excess)

Note ⇒ if $I^\ominus$ and Br^- present together then violet layer Comes First followed by Reddish Brown layer

if Reddish Brown layer Comes First then Br^- confirm but I^- absent

Nishant Jindal

SO_4^{-2}

all are soluble

except { Ba | Pb | Sr | – Insoluble
Hg | Ag | → Insoluble

SO_4^{-2} + $BaCl_2$ → $BaSO_4$ (White)

$Pb(NO_3)_2$ → $PbSO_4$ (White)

$AgNO_3$ → Ag_2SO_4 (White)

$Hg(NO_3)_2$ → $2HgO \cdot HgSO_4$ (Yellow)

Nishant Jindal

Test with ($Na_2SO_4 + BaS$) in MnO_4^- solution

($Na_2SO_4 + BaS$) $\xrightarrow[\text{solution}]{MnO_4^-}$ $BaSO_4$ (white ppt)

but it adsorbed some MnO_4^- ion so it becomes Pink/Purple ppt

$\xrightarrow{H_2O}$

decol. MnO_4^- ion in the solution

So Pink ppt of $BaSO_4$ clearly observed.

Nishant Jindal

Cation

Groups	Cation	Reagent
I	Pb^{+2} Hg_2^{+2} Ag^{+}	dil HCl
II A	Pb^{+2} Cu^{+2} Hg^{+2} Cd^{+2} Bi^{+3}	H_2S gas in acidic medium
II B	As^{+3} As^{+5} Sb^{+3} Sb^{+5} Sn^{+2} Sn^{+4}	H_2S gas in acidic medium
III	Al^{+3} Cr^{+3} Fe^{+3}	NH_4OH in presence of NH_4Cl
IV	Ni^{+2} Co^{+2} Mn^{+2} Zn^{+2}	H_2S gas in basic medium
V	Ba^{+2} Sr^{+2} Ca^{+2}	$(NH_4)_2CO_3$ in presence of NH_4Cl and NH_4OH
VI group	Na^{+} Mg^{+2} K^{+}	no Common Reagent

down the group K_{sp} ↑

Nishant Jindal

Pb^{+2}

P-block cation + KI (excess) ⟶ Soluble

D-Block + excess KI ⟶ Insoluble

except — HgI_2 it soluble

$HgI_2 + KI \rightarrow [HgI_4]^{-2}$

Soluble

Nishant Jindal

D-Block + excess $\overset{-}{C}N/NH_3$ ⟶ Soluble

except for NH_3

Fe^{+2} | Fe^{+3} | Mn^{+2} | Hg_2^{+2} | Mg^{+2} | Cr^{+3} [partial sol]

Insoluble

P-Block + excess $\overset{-}{C}N/NH_3$ ⟶ Insol.

Nishant Jindal

Hg_2^{+2} / Hg^{+2} / Ag^{+} [native metal / less Reactive]

NaOH

Hg_2O HgO Ag_2O

excess NaOH

Insoluble

Pb Zn Be Al Ga Sn $Cr^{+3/+4}$

all the oxides and hydroxides are Amphoteric

excess of NaOH

Soluble

Nishant Jindal

$Pb^{+2} + KI \longrightarrow \underset{\text{yellow ppt}}{PbI_2} \xrightarrow[KI]{\text{excess}} \underset{\text{Soluble}}{[PbI_4]^{-2}}$

$Pb^{+2} + CN^- \longrightarrow Pb(CN)_2 \xrightarrow[KCN]{\text{excess}} \text{Insol.}$

$Pb^{+2} + CrO_4^{-2} \longrightarrow \underset{\text{yellow ppt}}{PbCrO_4}$

$Pb^{+2} + NaOH \longrightarrow \underset{\text{White ppt}}{Pb(OH)_2} \xrightarrow[NaOH]{\text{excess}} \underset{\text{Soluble}}{[Pb(OH)_4]^{-2}}$

$Pb^{+2} + \underset{(NH_4 + H_2O)}{NH_4OH} \longrightarrow Pb(OH)_2 \xrightarrow[NH_4OH]{\text{excess}} \times$

$Pb^{+2} + H_2S \longrightarrow PbS\ (\text{Black ppt.})$

Nishant Jindal

Cu^{+2}

① $Cu^{+2} + I^{\ominus} \longrightarrow Cu^{+} + I_2$

(O.A) (R.A)

$Cu^{+} \xrightarrow{I^{\ominus}} Cu_2I_2$ (White PPt)

$I^{\ominus} \xrightarrow{I^-} I_3^{\ominus}$ (Brown Sol.)

$Cu_2I_2 + I_3^{\ominus}$ — Brown

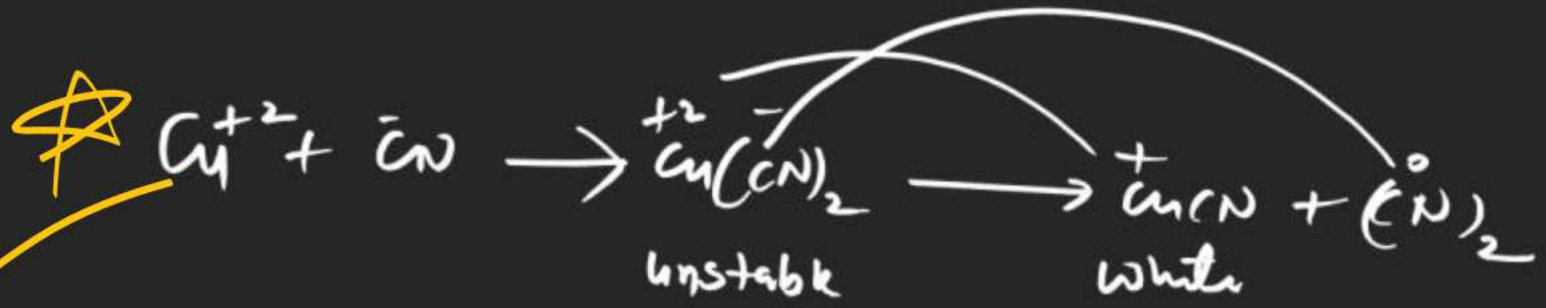
CuI_2 does not exist

Iodometry test

$Cu_2I_2 + I_3^{\ominus} + S_2O_3^{-2} \longrightarrow I^{\ominus} + Cu_2I_2 + S_4O_6^{-2}$

Brown colour — (Sol. less)

Nishant Jindal



$Cu^{+2} + K_3[Fe(CN)_6] \longrightarrow Cu_3[Fe(CN)_6]_2$
green ppt.

$Cu^{+2} + NaOH \longrightarrow Cu(OH)_2 \xrightarrow{excess\ NaOH}$ Insol.
light Blue ppt

$Cu^{+2} + NH_4OH \longrightarrow Cu(OH)_2 \xrightarrow{excess\ NH_4OH} [Cu(NH_3)_4]^{+2}$
light Blue — Sol. — (Deep Blue colour)

$Cu^{+2} + K_4[Fe(CN)_6] \longrightarrow Cu_2[Fe(CN)_6]$
Chocolate brown ppt

$Cu(CN)_2 \xrightarrow{excess\ KCN} K_3[Cu(CN)_4]$

Switzer's salt

Nishant Jindal

$Al^{+3} + NaOH \longrightarrow Al(OH)_3$

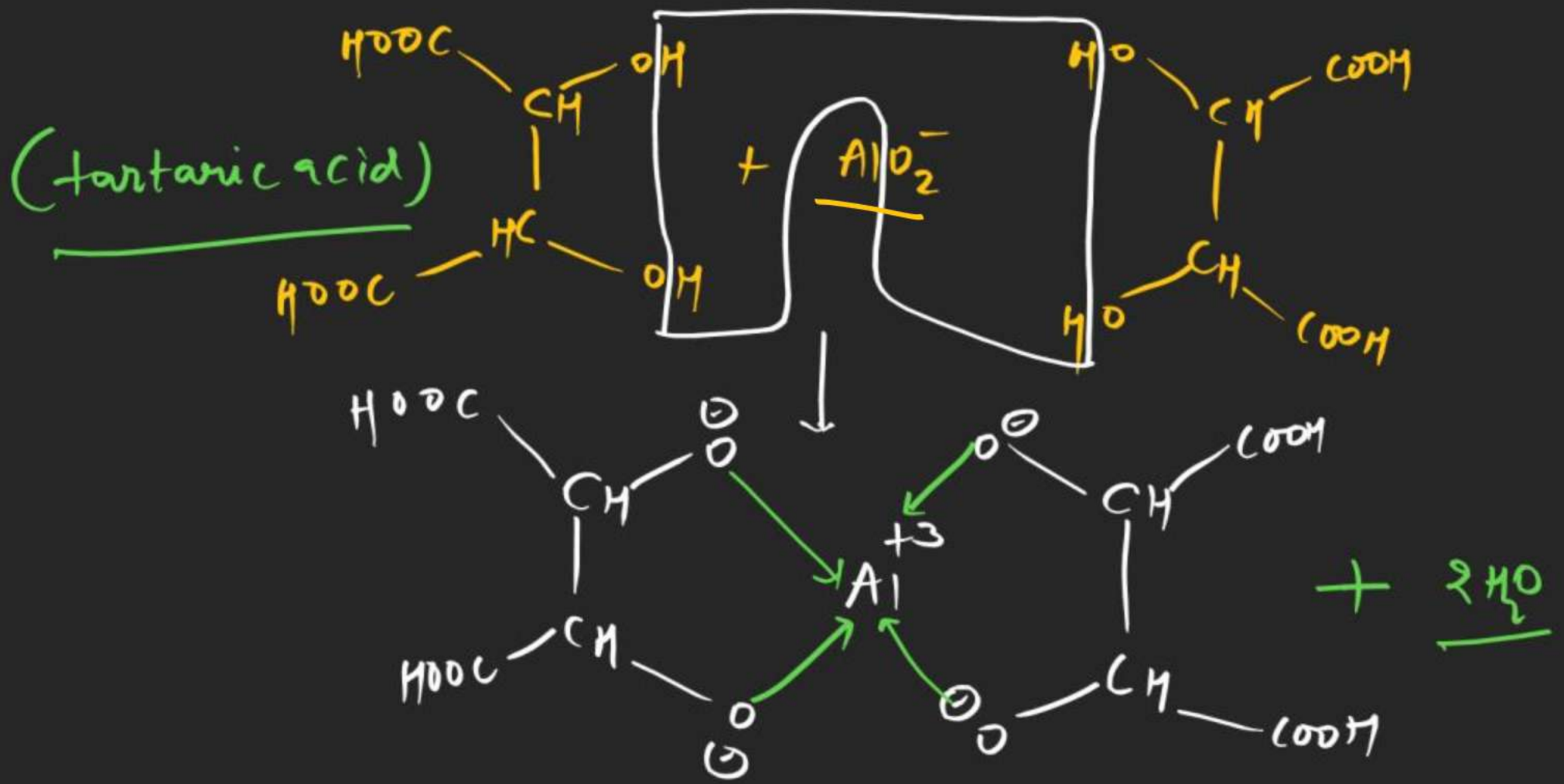
$Al(OH)_3$ (White ppt) + $NaOH$ (excess) $\rightleftharpoons [Al(OH)_4]^{\ominus}$ (aluminate)

sol. or $AlO_2^- + 2H_2O$ (metaaluminate)

On addition of acid White ppt reappear due to shifting of eq. in backward direction.

But on addition of polyhydroxy or gano acid white ppt disappear due to formation of complex compound.

Nishant Jindal



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$$Cu^{+2} + K_4[Fe(CN)_6] \longrightarrow Cu_2[Fe(CN)_6]$$

Chocolate Brown

$$Cu^{+2} + K_3[Fe(CN)_6] \longrightarrow Cu_3[Fe(CN)_6]_2$$

green ppt

$$Cu^{+2} + H_2S \longrightarrow CuS$$

(Black)

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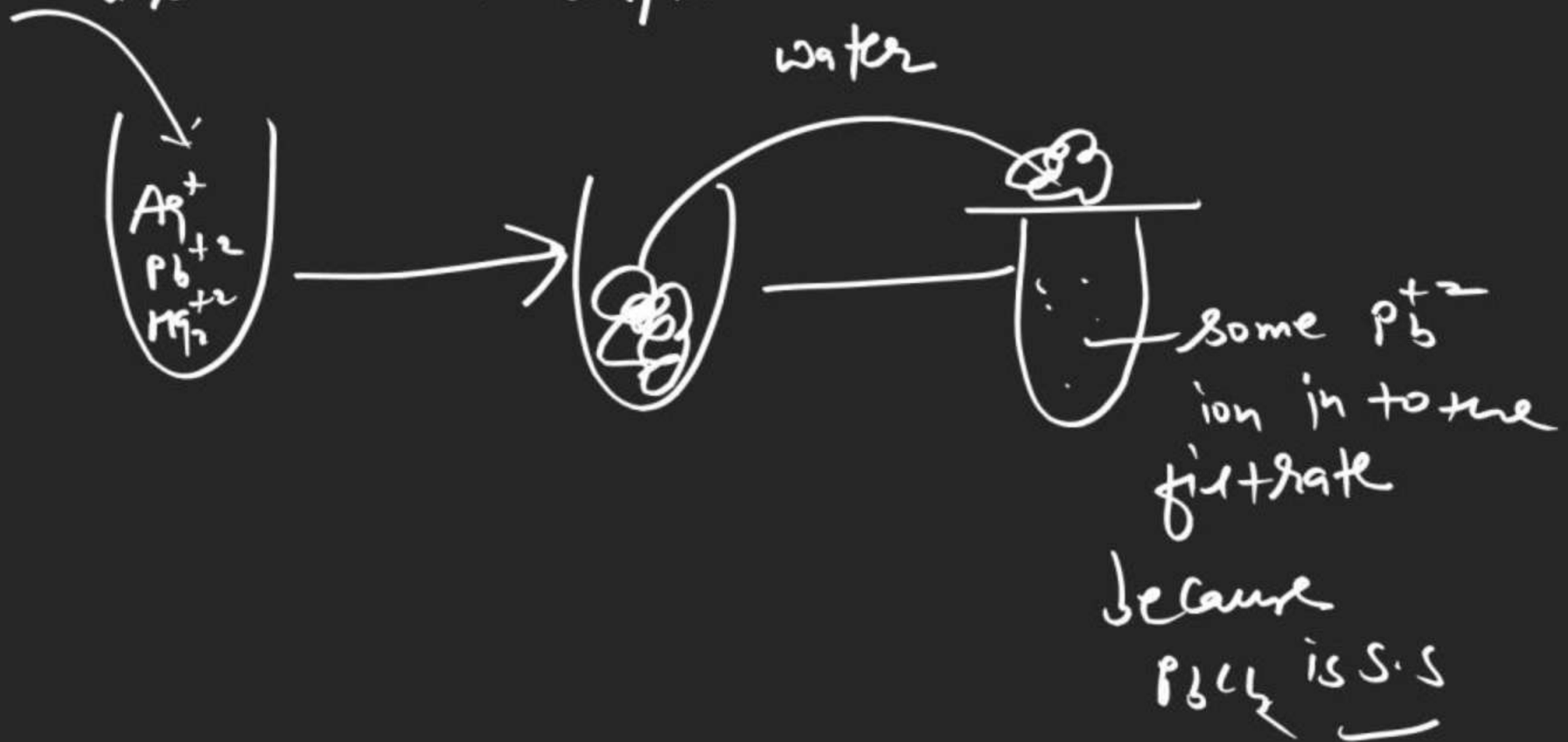
$PbCl_2$ → Sparingly soluble in cold water but Complete soluble in Hot water



Because $PbCl_2$ is S.S

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→ Sulphides salt of Al^{+3} Cr^{+3} and Mg^{+2} donot exist in their aq. solution because they readily hydrolysed in their Corresponding hydroxides

$Al^{+3} + H_2S \xrightarrow{\text{basic}} Al(OH)_3 S_3 H \xrightarrow{H\text{-}OH} Al(OH)_3 + H_2S$

→ Carbonate salts of Fe^{+3} Cr^{+3} Al^{+3} donot exist in their solution because they readily hydrolysed in to their ~~Hydroxide~~

→ Some basic acetates of Fe^{+3} Cr^{+3} Al^{+3} are insoluble

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$Al^{+3} + NH_4OH \longrightarrow Al(OH)_3$ (white) $\xrightarrow{excess\ NH_4OH}$ Insol.
$(NH_3 + H_2O)$

$Al^{+3} + H_2S \longrightarrow \times$

$Al^{+3} + H_2S \xrightarrow{basic} Al_2S_3 \xrightarrow{Hydrolysis} Al(OH)_3 + H_2S$

$Al^{+3} + (NH_4)_2S \longrightarrow Al_2S_3 \xrightarrow{Hydrolysis} Al(OH)_3 + H_2S$

$Al^{+3} + Na_2CO_3 \longrightarrow Al(OH)_3$

$Al^{+3} + CH_3COO^- + H_2O \longrightarrow Al(OH)_2CH_3COO$
white ppt

Al | Zn
all ppt white

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Lake test

NH_4OH is added in to the solution of Al^{+3}, so Al^{+3} react and form $Al(OH)_3$ after this blue litmus solution added in to this solution, $Al(OH)_3$ adsorb blue litmus and make Blue/Red mass which is called Lake.

$$Al^{+3} + PO_4^{-3} \longrightarrow AlPO_4 \text{ (White)}$$

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$Fe^{+3} + I^{\ominus} \longrightarrow Fe^{+2} + I_2$

(O.A) (R.A)

[FeI_3 does not exist
CuI_2 does not exist]

$Fe^{+3} + \bar{C}N \longrightarrow \underset{\text{Brown}}{Fe(CN)_3} \xrightarrow[KCN]{\text{excess}} K_3[Fe(CN)_6]$

yellow sol.

$Fe^{+2} + \bar{C}N \longrightarrow \underset{\text{dirty green}}{Fe(CN)_2} \xrightarrow[KCN]{\text{excess}} K_4[Fe(CN)_6]$

Pale yellow sol.

$Fe^{+2} \,|\, Fe^{+3} + NH_4OH \longrightarrow \underset{\text{Reddish Brown}}{Fe(OH)_3} \,|\, \underset{\text{dirty green}}{Fe(OH)_2} \xrightarrow[NH_4OH]{\text{excess}} \text{Insoluble}$

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$Fe^{+3} + Na_2CO_3 \longrightarrow Fe(OH)_3$

✡ $Fe^{+3} + \bar{S}CN \longrightarrow Fe(SCN)_3$

$\left[Fe^{+3}(H_2O)_5 SCN\right]^{+2}$ sp^3d^2

ferric thiocyanate

Blood Red Colour

$Fe^{+2} + SCN \longrightarrow \underline{x}$

Dist between Fe^{+2} | Fe^{+3}

$\bar{O}X$ — $[Fe(ox)_3]^{-3}$ — Colourless

Hg → $Hg(SCN)_2$ — Colourless

F^- — $[FeF_6]^{-3}$ — Colourless

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$Fe^{+3} + K_4[Fe(CN)_6] \longrightarrow Fe_4[Fe(CN)_6]_3$

Prussian Blue

Blue ppt ppt.

if excess η reagent then soluble prussian Blue is formed $KFe[Fe(CN)_6]$

$Fe^{+3} + K_3[Fe(CN)_6] \longrightarrow Fe[Fe(CN)_6]$

Brown solution

$Fe^{+2} + K_4[Fe(CN)_6] \longrightarrow K_2Fe_2[Fe(CN)_6]$

White ppt

$Fe^{+2} + K_3[Fe(CN)_6] \longrightarrow Fe_3[Fe(CN)_6]_2$ Turn bull's Blue

Nishant Jindal

Note ⇒ Turn bull's Blue and Prussian Blue both are identical Hence they cannot distinguish with moss bauear

Hence they represented as

$$Fe^{II}[Fe^{III}(CN)_6]^{\ominus}$$

Charge transfer metal to metal

C.T.M.M

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Zn^{+2}

$Zn^{+2} + NaOH \longrightarrow Zn(OH)_2 \xrightarrow[NaOH]{excess} [Zn(OH)_4]^{-2}$

Soluble

$\downarrow H_2S$

ZnS (white ppt.)

$Zn^{+2} + NH_4OH \longrightarrow Zn(OH)_2 \xrightarrow[NH_4OH]{excess} [Zn(NH_3)_4]^{+2}$

$\downarrow H_2S$

ZnS [White

$Zn^{+2} + H_2S \longrightarrow ZnS$ (partial ppt)

$Zn^{+2} + H_2S \xrightarrow{Basic} ZnS$

$Zn^{+2} + (NH_4)_2S \longrightarrow ZnS$

Nishant Jindal

$Zn^{+2} + Na_2CO_3 \longrightarrow$ White ppt $2ZnCO_3 \cdot Zn(OH)_2$

$\downarrow \Delta$

$ZnO + CO_2 + H_2O$

(Purest form) [Phillospher's Wool]

$ZnO \underset{\text{Cold}}{\overset{\text{Hot}}{\rightleftharpoons}} ZnO$

White — Yellow

ZnS ⇒ Black Jack's

$Zn^{+2} + HPO_4^{-2}$ —

- presence of NH_4Cl → $Zn(NH_4)PO_4$
- absence of NH_4Cl → $Zn_3(PO_4)_2$

Nishant Jindal

$Zn^{+2} + K_4[Fe(CN)_6] \longrightarrow Zn_2[Fe(CN)_6]$

or

$K_2Zn_3[Fe(CN)_6]_2$

White ppt.

Ni^{+2}

Ni^{+2} + dmg $\xrightarrow[\text{solution}]{\text{ammonical}}$ $[Ni(dmg)_2]$

Rosy Red ppt.

Ni sheet + dmg — ×

Nishant Jindal

V group

B^{+2} Ca^{+2} Sr^{+2}

Ba^{+2}, Ca^{+2}, Sr^{+2} $\xrightarrow{(NH_4)_2CO_3}$ (in presence of NH_4Cl and NH_4OH) $\rightarrow$ $BaCO_3$, $SrCO_3$, $CaCO_3$ } White ppt.

~ Soluble in CH_3COOH

	Ba^{+2}	Sr^{+2}	Ca^{+2}
$(NH_4)_2CrO_4$	$BaCrO_4$ (Yellow ppt)	×	×
$(NH_4)_2SO_4$ (excess)	$BaSO_4$ White ppt.	$SrSO_4$ White ppt.	×
$(NH_4)_2C_2O_4$	BaC_2O_4 White	SrC_2O_4 White ppt	CaC_2O_4 White ppt

Nishant Jindal

$Ca^{+2} + K_4[Fe(CN)_6] \longrightarrow K_2Ca[Fe(CN)_6]$ White ppt.

NH_4^+ = Zero group

$NH_4^+ + NaOH \longrightarrow NH_3\uparrow$ (Basic)

$K_2[HgI_4]$ (Nessler's reagent) $K_2HgI_4|OH$

- ($CuSO_4$) → $[Cu(NH_3)_4]SO_4$ Deep Blue (Switzer's salt)
- ($NiCl_2$) → $[Ni(NH_3)_6]^{+2}$ (Deep Blue)
- (HCl) → NH_4Cl White dense fumes
- (Brown ppt) → $\left[Hg\begin{matrix}O\\NH_2\end{matrix}Hg\right]I$ Oxydimercuryamino iodide (Iodide of million's base)

Nishant Jindal

Canary yellow ppt

$(NH_4)_3PO_4 \cdot 12MoO_3$

$(NH_4)_3P(Mo_3O_{10})_4$

$(NH_4)_3AsO_4 \cdot 12MoO_3$

$(NH_4)_3AsO_4(Mo_3O_{10})_4$

Nishant Jindal

$Mg^{+2} + NaOH \longrightarrow Mg(OH)_2$

$NH_4OH \rightleftharpoons NH_4^+ + OH^-$

$NH_4Cl \longrightarrow NH_4^+ + Cl^-$

$Mg^{+2} + NH_4OH + NH_4Cl + HPO_4^{-2} \longrightarrow$ White ppt $Mg(NH_4)PO_4$

(magnesia mixture)

$\xrightarrow{\Delta}$

$Mg_2P_2O_7 + NH_3 + H_2O\uparrow$

White Residue

above ppt can not form in the absence of NH_4Cl

$Mg^{+2} + Na_2CO_3 \longrightarrow MgCO_3 \cdot Mg(OH)_2$ White

$Li^+ + CO_3^{-2} \longrightarrow Li_2CO_3$

White ppt.