

Quantitative Inorganic analysis

Experiment	Observation	Inference
I Preliminary tests 1. Physical state 2. Colour	Crystalline & Amorphous (a) White (b) Blue & bluish green (c) Pale green (d) Pale pink (e) Greenish (f) Pink	absence of $\text{Cu}^{2+}, \text{Mn}^{2+}, \text{Fe}^{2+}, \text{Ni}^{2+}, \text{Co}^{2+}$ Cu^{2+} salts Fe^{2+} salts Ni salts Ni salts Co salts
3. Action of heat - salt in test tube & strongly heated.	(a) H_2O droplets formed on inner wall (b) NH_4^+ salts - sublimation white fumes (c) Yellow (hot) & white (cold) (d) Orange red (hot) & yellow (cold) (e) Reddish Brown vapours (f) Pink (cold), blue (hot) (g) Blue (cold), white (hot)	May be hydrated salts May be NH_4^+ salts May be Zn^{2+} salts May be Pb salts May be NO_3^- salts May be Co salts May be Cu salts
4. Flame test - On a watch glass 2-3 drops of (salt) conc. HCl , make small paste, dip in Pt loop & put it on non-luminous flame.	(a) Blue & bluish green (b) Crimson red (c) Apple green (d) Beek red (e) Green flashes	Cu^{2+} Sr^{2+} Ba^{2+} Ca^{2+} Zn^{2+}
II Identification of anion I: Action of dil. HCl - small amount of salt is taken in test tube & few drops HCl added	(a) Colourless & odourless (CO_2 gas with brisk effervescence is evolved. $\text{CaO} + \text{CO}_2 \rightarrow \text{CaCO}_3 \downarrow \text{white}$) (b) Colourless vapours with smell of vinegar. Blue to red litmus	May be carbonate (CO_3^{2-}). May be acetate ion (CH_3COO^-)

<p>② <u>Action of con. H_2SO_4 (cold)</u> Salt + con. H_2SO_4 in T.T</p>	<p>① colourless, pungent odour evolved. Red dipped in NH_4OH introduced gives white fumes</p> <p>* ② colourless & reddish brown vapours (pungent smell)</p>	<p>May be chloride (Cl^-).</p> <p>Maybe Bromide (Br^-)</p>
<p>③ <u>action of con. H_2SO_4 (hot)</u> Salt + con. H_2SO_4 in T.T & heated strongly.</p>	<p>*** Reddish Brown vapours are evolved.</p>	<p>May be nitrate (NO_3^-).</p>
<p>④ for sulphate - $BaCl_2$ is added to salt soln.</p>	<p>White ppt formed. insoluble in con. HCl.</p>	<p>May be sulphate (SO_4^{2-}).</p>
<p>III. <u>Confirmation tests for anions.</u></p> <p>① Action of $BaCl_2$ soln.</p> <p>① Esterification: salt + C_2H_5OH & few drops of con. H_2SO_4 is added & heated.</p> <p>② with neutral $FeCl_3$ salt + neutral $FeCl_3$</p>	<p>A white ppt formed, soluble in dil. HCl</p> <p>Fruity odour evolved</p> <p>Red colouration formed on boiling changes to Brown red ppt.</p>	<p>Carbonate (CO_3^{2-}).</p> <p>acetate ion is confirmed</p> <p>acetate ion</p>
<p>③ Action of MnO_2 + con. H_2SO_4</p>	<p>① Greenish yellow gas with pungent odour</p> <p>② Reddish brown vapour with pungent smell.</p>	<p>Cl^- is obtained</p> <p>Br^- is obtained</p>
<p>④ con. H_2SO_4 + Cu turning</p>	<p>Reddish brown vapours with pungent smell & soln. becomes blue</p>	<p>NO_3^- is confirmed.</p>

Experiment	Observation	Inference
① Confirmed by tests Neutral Na_2CO_3 extract with dil. HNO_3 & AgNO_3 soln. (Cl^-)	AgCl - curdy white ppt formed ppt soluble in NH_4OH .	Cl^- ion is confirmed.
② Na_2CO_3 + dil HNO_3 & AgNO_3 soln. (Br^-)	AgBr - pale yellow ppt sparingly soluble in NH_4OH	Br^- ion is confirmed.
③ (NO_3^-) <u>Brown ring test:</u> Na_2CO_3 + dil. H_2SO_4 & freshly prepared FeSO_4 soln. + H_2SO_4 (inclined)	Brown ring is formed $[\text{Fe}(\text{H}_2\text{O})_5\text{NO}]^{+2}$	NO_3^- is confirmed.
④ (SO_4^{2-}) Neutral Na_2CO_3 + dil. HCl & BaCl_2 soln. is added.	BaSO_4 white ppt & insoluble in con. HCl .	Sulphate (SO_4^{2-}) confirmed

Identification of cation

① for NH_4^+ - salt + NaOH

Colourless gas with NH_3 smell evolved which gives dense white fumes when a rod dipped in con. HCl is exposed.

May be NH_4^+ .

ORIGINAL SOLUTION - (Sol)

Salt + solvent (excess)

Group

① Sol + dil. HCl

white ppt

May be Pb^{2+} .

② H_2S passed through I

black ppt

May be Cu^{2+}

③ Sol + NH_4Cl + NH_4OH

i) Gelatinous ppt
ii) dirty green ppt

May be Al^{3+}

May be Fe^{2+}

④ H_2S passed through III

i) white ppt
ii) Flesh coloured ppt.
iii) Black ppt

May be Zn^{2+}

May be Mn^{2+}

Maybe Ni^{2+} or Co^{2+} .

<p>(V) sol + little $\text{NH}_4\text{Cl}_{(g)}$ + NH_4OH soln. followed by $(\text{NH}_4)_2\text{CO}_3$ soln.</p>	<p>white ppt formed</p>	<p>May be Ba^{2+} (or) Ca^{2+} (or) Sr^{2+}</p>
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<p>(VI) Salt + $\text{NH}_4\text{Cl}_{(g)}$ + $\text{NH}_4\text{OH}_{(aq)}$ followed by disodium hydrogen phosphate $(\text{Na}_2\text{HPO}_4)$ soln.</p>	<p>white crystalline ppt.</p>	<p>Maybe Mg^{2+}</p>
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* In Pubs. & Clubs, All ^{G-I, II} Fellows are Zincates & Mangled with ^{G-IV} Ni & ^{G-V} Co & Ba (a) ^{G-VI} with Mg with NH_4^+ .

Confirmatory tests

① Group - I (Pb^{2+})

① salt + H_2CrO_4

② salt + KI

Yellow ppt formed which is soluble in dil. HNO_3 & insoluble in acetic acid.

Pb ion is confirmed

Yellow ppt formed which is soluble in hot H_2O . Golden spangles are formed on cooling.

Pb ion is confirmed.

② Group - II (Cu^{2+})

① Salt + NH_4OH soln.

② salt + $\text{K}_4[\text{Fe}(\text{CN})_6]$

Pale blue ppt soluble in excess of NH_4OH .

chocolate colour ppt

Cu^{2+} ion

$\text{Cu}^{+1/2+}$ ion

③ Group - III

(Al^{3+})

① salt + NH_4OH

② salt + NaOH

(Fe^{3+})

① salt + NH_4OH

② salt + $\text{K}_4[\text{Fe}(\text{CN})_6]$

Gelatinous ppt formed

Gelatinous white ppt formed soluble in excess NaOH

dirty green ppt

pale blue ppt

Al^{3+} ion

Al^{3+} ion

Fe^{2+} ion

Fe^{2+} ion

④ Group - IV

(Zn^{2+} & Mn^{2+})

① salt + NH_4OH soln.

A gelatinous white ppt formed which is soluble in NH_4OH (excess)

Zn^{2+} ion.

white ppt formed turns to ~~brown on exposure to air~~. ppt is ~~soluble~~ in excess of NH_4OH

Mn^{2+} ion.

② salt + $NaOH$ soln.

white ppt is formed which is soluble in excess of $NaOH$

Zn^{2+} ion

white ppt formed turns to brown on exposure to air. ppt is insoluble in excess of NH_4OH

Mn^{2+} ion

(Ni^{2+} & Co^{2+})

(salt + dimethyl glyoxime)

Bright red ppt

Ni^{2+} ion

⑤ Group - V

(Ba^{2+} & Ca^{2+})

① salt + K_2CrO_4 soln.

Yellow ppt formed, soluble in conc. HCl

Ba^{2+} ion

Yellow coloured soln. but not ppt.

Ca^{2+} ion

② salt + $(NH_4)_2C_2O_4$

White ppt. formed soluble in acetic acid

Ba^{2+} ion

for Sr^{2+} - salt + H_2CO_3 + $(NH_4)_2SO_4$

White ppt formed which is insoluble in acetic acid
white ppt

Ca^{2+} ion.

Sr^{2+} ion

⑥ Group - VI

(Mg^{2+} & NH_4^+)

① salt + $NaOH$ soln.

white ppt formed, soluble in NH_4Cl soln

Mg^{2+} ion

boiled

colourless & odourless white fumes with NH_4Cl

NH_4^+ ion

② $(NH_4)_2CO_3$ + salt

white ppt formed

Mg^{2+} ion

③ Nessler reagent (K_2HgI_4)

Yellow to reddish brown ppt

NH_4^+ ion