

7	(a) To the solution add ammonium sulphide solution or H_2S (b) To the solution add potassium hexacyanoferrate(II) solution	Dirty white precipitate White precipitate	Zn^{2+} present Zn^{2+} present
8	Warm solution gently with slightly excess of $NaOH(aq)$	Gas evolved turned red litmus blue	NH_4^+ present

Tests for Anions

Test	Observation	Inference
1. (a) To the solution add silver trioxonitrate(V) solution + dilute trioxonitrate(V) acid solution in drops and in excess + $NH_4OH(aq)$ in excess or (b) Salt solution + $HNO_3(aq)$ + $AgNO_3(aq)$. To the mixture in (a) above + $NH_4OH(aq)$ in excess (c) To a salt sample add MnO_2 and conc H_2SO_4 and warm gently	White ppt White ppt White ppt dissolves White ppt insoluble in $HNO_3(aq)$, the white ppt dissolves Greenish yellow gas with suffocating odour and turns damp blue litmus paper red and finally bleaches it	Cl^- present Cl^- confirmed Cl^- present Cl^- present Cl^- present The gas is $Cl_2(g)$
2 To the salt solution add dilute $HCl(aq)$ or conc H_2SO_4	There is liberation of a gas, colourless gas which turns damp blue litmus paper red and turns lime water milky	The gas is CO_2 , CO_3^{2-} or HCO_3^- present
3. To the salt solution add barium chloride solution and then add few drops of hydrogen chloride solution or Salt solution + $Ba(NO_3)_2(aq)$ + dil HNO_3 Salt solution + acidified dil. $K_2Cr_2O_7$ To about 2 cm^3 of the clear solution add about 3 cm^3 of freshly prepared $FeSO_4(aq)$, then add about 3 cm^3 of conc H_2SO_4 slowly down the side of the test tube held in a slanting position or Salt solution + conc H_2SO_4	White precipitate which does not dissolve in presence of hydrogen chloride acid White ppt soluble in excess dil HCl White ppt insoluble in dilute HNO_3 White precipitate soluble in dil HNO_3 The orange colour of $K_2Cr_2O_7$ turns green A brown ring is formed at the junction of the two layers Reddish brown fumes evolved	SO_4^{2-} present SO_3^{2-} present SO_4^{2-} present SO_3^{2-} SO_3^{2-} confirmed NO_3^- confirmed, the brown ring is due to the formation of $FeSO_4 \cdot NO$ NO_3^- Present

Appearance	Probable salt/compound
Green	Iron II salts, iron II salts are usually pale green
Yellow/brown	Lead (II) oxide, iron (III) salt solution, cadmium sulphide-yellow,
Black or red	CuO, Pbs, CuS, Ag ₂ S, HgS
White colourless	Ca ²⁺ , Pb ²⁺ , NH ₄ ⁺ , Na ⁺ , Al ³⁺ , Zn ²⁺ , salts and ZnS, MnS
Smell of ammonia	Ammonium salt
Smell of sulphur	Trioxosulphate (IV) salts
Smell of hydrogen sulphide	Sulphides

Flame	Colour from	Cations
	Brick red	Ca ²⁺
	Deep green	Pb ²⁺
	Blue	Na ⁺
	Persistent golden yellow	K ⁺
	Persistent lilac	Ba ²⁺
	Persistent light green	

Gas	Inference
NO ₂	NO ₃ ⁻ present
CO ₂	CO ₃ ²⁻ or HCO ₃ ⁻ present
O ₂	NO ₃ ⁻ present
SO ₂	SO ₃ ²⁻ present
NH ₃	NH ₄ ⁺ present

Deliquescent	Chloride or trioxonitrates(V)
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Action of heat on specimen

Observation	Inference
White when cold and yellow when hot	Zn ²⁺ (ZnO) present
Yellow when cold and reddish brown when hot	Pb ²⁺ (PbO)
Reddish brown	Fe ³⁺ (Fe ₂ O ₃)
Water vapour which condenses at the upper part of the tube	Hydrated salts HCO ₃ ⁻ or OH ⁻ present
White sublimate	Ammonium salt

Test For Gases

Gas	Colour/smell	Test	Result if Positive
Cl ₂	Greenish-yellow, pungent	(a) Moist blue litmus paper (b) Bubble through bromine solution	Turns red then bleaches it (acidic) Bromine is liberated and solution turns yellow or orange
NO ₂	Reddish brown, pungent	(a) Moist blue litmus paper (b) Bubble through fresh FeSO ₄ solution	Turns red (acidic) Solution turns blue
NH ₃	Colourless pungent smell like that of urine	(a) Moist red litmus paper (b) Bring in contact with drop of conc HCl on a glass rod	Turns blue (alkaline gas) White dense fumes due to the presence of NH ₄ Cl
H ₂ S	Colourless, rotten egg smell	Moist lead (II) ethanoate paper	Turns black

Zn ²⁺	No ppt	No ppt	White gelatinous ppt soluble in excess reagent	White gelatinous ppt soluble in excess reagent	No ppt	No ppt	No ppt
Ca ²⁺	No ppt	No ppt (may have slight turbidity)	White powdery ppt insoluble in excess NaOH(aq)	No ppt, turbidity due to CO ₃ in reagent	No ppt	No ppt	No ppt
Fe ²⁺	No ppt	No ppt	Dirty green gelatinous ppt insoluble in excess reagent	Dirty green gelatinous ppt insoluble in excess	Dirty green gelatinous ppt	Slight ppt or non	No ppt
Fe ³⁺	No ppt	No ppt	Reddish brown gelatinous ppt insoluble in excess reagent	Reddish brown gelatinous ppt insoluble in excess NH ₃ (aq)	Reddish brown gelatinous ppt	Yellow to pale-green with yellow deposit Fe ³⁺ → Fe ²⁺	Yellow ppt to pale-green ppt
Cu ²⁺	No ppt	No ppt	Light blue gelatinous ppt in excess reagent	Light blue gelatinous ppt soluble in excess giving deep blue solution	Light blue ppt which dissolves in excess giving a deep blue solution	Black ppt	Black ppt

Confirmatory tests for cations

Test	Observation	Inference
1. To the aqueous solution, add ammonium trioxocarbonate(IV) or ammonium oxalate	White precipitate	Ca ²⁺ confirmed
2. To an aqueous solution is added ammonia solution and ammonium chloride solution	White precipitate	Al ³⁺ confirmed
3. (a) To an aqueous solution add potassium tetraoxochromate(VI) solution (K ₂ CrO ₄) (b) Solution + potassium iodide solution (KI(aq))	(a) Yellow precipitate (b) Yellow precipitate	Pb ²⁺ present
4. (a) To the solution, add potassium hexacyanoferrate(II) solution K ₄ Fe(CN) ₆ (aq) (b) To the solution add potassium hexacyanoferrate(III) solution K ₃ Fe(CN) ₆ (aq)	(a) Light blue precipitate (b) Deep blue precipitate	Pb ²⁺ present Fe ²⁺ present
5. (a) To the specimen solution add potassium hexacyanoferrate(II) solution (b) To the specimen solution add potassium thiocyanate solution (KSCN(aq)) or ammonium thiocyanate solution	(a) Deep blue precipitate (b) Deep blood red colouration	Fe ²⁺ present Fe ³⁺ present
Specimen solution + potassium hexacyanoferrate(II) solution (K ₄ Fe(CN) ₆)	Brown ppt	Cu ²⁺ present

SO ₂	Colourless, pungent smell	(a) Damp blue litmus paper (b) Bubble through K ₂ Cr ₂ O ₇ acidified with dil. H ₂ SO ₄ (c) Bubble through KMnO ₄ solution acidified	Turns red (acidic) Turns from orange to green Turns from purple to colourless (reducing agent)
<i>NOTE: H₂S gives the same result with K₂Cr₂O₇ and KMnO₄ all acidified but there will be yellow deposit of sulphur</i>			
HCl(g)	Colourless	(a) Damp blue litmus paper (b) Blow across mouth of test tube (c) Bring in contact with drop of ammonia solution on a glass rod	Turns red (acidic) Copious fuming White dense fume of ammonium chloride
CO ₂	Colourless Odourless	(a) Damp blue litmus paper (b) Bubble through lime water in excess of it	Turns red (acidic) Turns milky (ppt of CaCO ₃) milky colour disappears due to formation of CaHCO ₃
O ₂	Colourless Odourless	(a) Damp blue and red litmus paper (b) Glowing splint	No change (neutral) Ignites or rekindles glowing splint
H ₂	Colourless Odourless	(a) Damp blue or red litmus paper (b) Lighted splint	No effect (neutral gas) Little explosion occurs giving pop sound; burns with blue flame, if mixed with air
H ₂ O(g)	Colourless Odourless	(a) Damp blue or red litmus paper (b) Anhydrous CuSO ₄ (white in colour)	No change (neutral gas) It turns to blue crystal of CuSO ₄ 5H ₂ O

Test For Cations

Cation	Reactions With						
	Dil. HCl	Dil. H ₂ SO ₄	Dil. NaOH	Dil. NH ₃	NH ₄ Cl + dil. NH ₃	H ₂ S	H ₂ S/dil. HCl
Pb ²⁺	White crystalline ppt dissolving when warmed, reappears on cooling	White powdery ppt	White powdery ppt soluble in excess	White powdery ppt insoluble in excess	White crystalline ppt on adding NH ₄ Cl	Black ppt	Black ppt
Al ³⁺	No precipitate	No ppt	White gelatinous ppt soluble in excess reagent	White gelatinous ppt insoluble in excess reagent	White gelatinous ppt	No ppt	No ppt

Test	Observation
i. $\text{ZnSO}_4(\text{aq}) + \text{BaCl}_2(\text{aq})$ and then + dilute HCl in excess	White precipitate Precipitate insoluble
ii. $\text{ZnSO}_4(\text{aq}) + \text{NaOH}(\text{aq})$ in drops and then in excess	White precipitate Precipitate dissolved/colourless solution formed
iii. $\text{ZnSO}_4(\text{aq}) + \text{NH}_3(\text{aq})$ in drops and then in excess	White precipitate Precipitate dissolved/colourless solution formed

Test	Observation	Inference
C + NaOH(aq)+ heat	Colourless gas with choking smell. Gas produced dense white fumes with concentrated HCl/gas turned red litmus paper blue	Gas is NH_3 from NH_4^+
C + $\text{BaCl}_2(\text{aq})$ + dil HCl in excess	White precipitate. Precipitate remained/precipitate insoluble in dilute HCl	SO_4^{2-} or CO_3^{2-} or SO_3^{2-} SO_4^{2-} present
i. D + litmus paper	Red litmus paper turned blue	D is alkaline
ii. D + NaOH(aq) in drops; then in excess	White precipitate insoluble in excess	Ca^{2+} present (accept Mg^{2+})
iii. D shaken with soap solution	No lather formation/scum was formed with D	Hardness in D due to presence of $\text{Ca}^{2+}/\text{Mg}^{2+}$
Distilled water shaken with the soap solution	Lather formed easily with distilled water	