

CHEMISTRY SALT ANALYSIS CHEATSHEET

Version 2.0

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Only **important** stuff for CBSE Class 12th Chemistry practical syllabus has been included, **not everything**.

ANIONS

Test mentioned next to group is the preliminary test; the ones mentioned under an anion are confirmatory tests for it.

Group I (dilute H₂SO₄ group) – CO₃²⁻ (carbonate), SO₃²⁻ (sulphite), S²⁻ (sulphide), NO₂⁻ (nitrite): Salt + dil H₂SO₄

1. **No reaction:** Group I anion not present. Continue to group II.
2. **Carbonate:** Colourless and odourless gas (CO₂)
 1. WE ¹ + MgSO₄ = white ppt
3. **Sulphite:** Colourless gas with pungent smell
 1. WE + BaCl₂ (aq) = white ppt soluble in dil HCl

1 Water extract: Pinch of salt + water

2. WE + acidified K₂Cr₂O₇²⁻ = sol³ turns green
3. WE + acidified KMnO₄ = pink colour of KMnO₄ is discharged
4. **Sulphide:** Colourless gas with a smell of rotten eggs (H₂S); turns lead acetate paper black
 1. *Sodium nitroprusside test:* WE + sodium nitroprusside ⁴ = purple / violet colour
 2. *Lead acetate test:* WE + lead acetate ⁵ (aq) = black ppt
5. **Nitrite:** Pungent light brown gas
 1. *Starch-iodide test:* WE + dil H₂SO₄ (or dil acetic acid); boil, then add solid KI + fresh starch sol = deep blue colouration

Group II (conc H₂SO₄ group) – Cl⁻ (chloride), Br⁻ (bromide), I⁻ (iodide), NO₃⁻ (nitrate), CH₃COO⁻ (acetate), C₂O₄²⁻ (oxalate): Salt + conc H₂SO₄

1. **No reaction:** Group II anion not present. Continue to group III.
2. **Chloride:** Colourless white pungent fumes (HCl); intensify when glass rod dipped in NH₄OH is brought near mouth of test tube
 1. *Silver nitrate test:* WE + AgNO₃ = white ppt soluble in NH₄OH
 2. *Chromyl chloride test:* Salt + solid K₂Cr₂O₇ + 2-3 drops conc H₂SO₄ = orange / red fumes of chromyl chloride ⁶
 1. Vapours + NaOH (aq) = yellow solution
 2. Yellow solution + acetic acid + lead acetate sol = yellow ppt

-
- 2 Potassium dichromate
3 Solution
4 Na₂[Fe(CN)₅NO]
5 Pb(CH₃COO)₂
6 CrO₂Cl₂

3. **Bromide:** Reddish brown vapour

1. *Silver nitrate test:* WE + AgNO₃ (aq) = yellow ppt partially soluble in NH₄OH
2. *Organic layer test:* WE + CCl₄ + 1 drop conc HNO₃ = Upper layer aqueous; lower layer organic of orange / brown colour (bromine is soluble in non-polar solvent)

4. **Iodide:** Violet vapours

1. *Silver nitrate test:* WE + AgNO₃ (aq) = yellow ppt insoluble in NH₄OH
2. *Organic layer test:* WE + CCl₄ + 1 drop conc HNO₃ = Upper layer aqueous; lower layer organic of violet colour (iodine is soluble in non-polar solvent)

5. **Nitrate:** Brown fumes with pungent smell, which intensify on adding paper pellets (may need heating)

1. *Brown ring test:* WE + freshly prepared FeSO₄ sol + 1 drop conc HNO₃ added along side of test tube = brown ring formed at junction of sol and acid

6. **Acetate:** Pungent vapour with vinegar-like smell

1. *Ester test:* Salt + conc H₂SO₄ + ethanol = fruity smell of ester
2. *Ferric chloride test:* WE + FeCl₃ (aq) = brick red colour
 1. Add dil HCl = red colour disappears
 2. Add water and boil = reddish brown ppt

7. **Oxalate:** Colourless gas with effervescence (CO + CO₂)

1. *Calcium chloride test:* WE + acetic acid + CaCl₂ (aq) + boil

= white ppt; ppt dissolves when dil HNO₃ is added and warmed

2. *Potassium permanganate test:* Salt + dil H₂SO₄ + heat; then add 2-3 drops KMnO₄ sol = pink colour of KMnO₄ is discharged

Group III anions (special group) – SO₄²⁻ (*sulphate*), PO₄³⁻ (*phosphate*): No group reagent

1. **Sulphate:**

1. *Barium chloride test:* WE + BaCl₂ (aq) = white ppt insoluble in conc HCl
2. *Lead acetate test:* WE + lead acetate (aq) + acetic acid = white ppt soluble in CH₃COONH (ammonium acetate)

2. **Phosphate:**

1. *Ammonium molybdate test:* WE + dil HNO₃ + ammonium molybdate⁷ + boil = crystalline canary yellow ppt

CATIONS

- *Group reagent is mentioned next to group cations.*
- *Test mentioned next to cation is the preliminary; ones under it are confirmatory tests for it.*
- *When sulphate is detected, Ba²⁺, Ca²⁺, Pb²⁺, and Sr²⁺ are not present as sulphates of these radicals are insoluble.*
- *When phosphate is detected, cations of group III and later are absent.*

Group 0 – NH_4^+ (ammonium): No group reagent

1. *Sodium hydroxide test:* Salt + NaOH = pungent smelling gas; gives white fumes when a glass rod dipped in conc HCl is brought near mouth of test tube
2. *Nessler's reagent⁸ test:* OS⁹ + NaOH + Nessler's reagent = Brown / yellow ppt

Group I – Pb^{2+} (lead):

OS + dil HCl = white ppt; add water, boil, and divide into three parts

1. Leave OS undisturbed = white crystals formed on cooling
2. *Potassium iodide test:* OS + KI = yellow ppt
3. *Potassium chromate test:* OS + K_2CrO_4 = yellow ppt

Group II – Cu^{2+} (copper):

OS + dil HCl + H_2S = black ppt

1. Throw off extra sol, retain ppt, and dissolve in a few drops of conc HNO_3 = bluish green sol, ppt dissolves; divide into two parts
 1. Part 1 + excess NH_4OH = blue coloured sol
 2. *Potassium ferrocyanide test:* Part 2 + acetic acid + $\text{K}_4[\text{Fe}(\text{CN})_6]$ = reddish brown / chocolate coloured ppt (Note – this test is difficult to get)

Group III – Fe^{2+} , Fe^{3+} (iron), Al^{3+} (aluminium):

OS + solid NH_4Cl + excess NH_4OH

1. **Fe^{2+} / Fe^{3+} :** Note – ferrous salts are green in colour, ferric salts are brown in colour.

1. *If ferrous salt has been given, convert to ferric:* OS + conc HNO_3 + heat = brown ppt; then do reaction with group reagent
2. Brown ppt + HCl; then divide into two parts
 1. *Potassium ferrocyanide test:* Part 1 + $\text{K}_4[\text{Fe}(\text{CN})_6]$ = blue ppt / colour
 2. *Potassium thiocyanate test:* Part 2 + KCNS = blood red colour

2. **Al^{3+} :** Gelatinous white ppt

1. *Blue lake test:* Retain ppt + dil HCl = clear sol
 1. Sol + blue litmus and NH_4OH (drop-by-drop) = blue colour layer ('lake') floats over colourless sol

Group IV – Co^{2+} (cobalt), Ni^{2+} (nickel), Mn^{2+} (manganese), Zn^{2+} (zinc):

OS + solid NH_4Cl + excess NH_4OH + pass H_2S gas

1. **Co^{2+} / Ni^{2+} :** Black ppt; dissolve ppt in aqua regia¹⁰ and evaporate sol to dryness to get residue

1. **Co^{2+} :** Blue residue; turns pink / purple when dissolved in water; divide into two parts
 1. Part 1 + dil acetic acid + KNO_2 + warm = yellow ppt
 2. Part 2 + ether (1 mL) + solid NH_4CNS ¹¹ = blue colour in ether

2. **Ni^{2+} :** Yellow residue; turns green when dissolved in water; divide into two parts

8 K_2Hgl_4

9 Original solution: Salt + acid + water

10 Aqua regia: 3 parts conc HCl + 1 part conc HNO_3

11 Ammonium sulphocyanide

1. *DMG*¹² test: Part 1 + excess NH_4OH + DMG = bright red ppt
2. Part 2 + NaOH + bromine water + boil = black ppt

2. Mn^{2+} : Buff / skin colour ppt; divide into two parts
 1. Part 1 + dil HCl + boil off H_2S + NaOH = white ppt; which turns black / brown on adding bromine water
 2. *Lead dioxide test*: Part 2 + PbO_2 + conc HNO_3 + boil = after cooling; pink colouration
3. Zn^{2+} : Greyish white ppt; divide into two parts
 1. Part 1 + excess NaOH = white ppt dissolves
 2. *Potassium ferrocyanide test*: Part 2 + $\text{K}_4[\text{Fe}(\text{CN})_6]$ = white / bluish white ppt

Group V – Ba^{2+} (*barium*), Sr^{2+} (*strontium*), Ca^{2+} (*calcium*):

OS + $(\text{NH}_4)_2\text{CO}_3$ + NH_4Cl + NH_4OH = white ppt; add dil acetic acid, divide sol into three parts and test for following IN ORDER

1. Ba^{2+} : Part 1 + excess K_2CrO_4 ¹³ (aq) = yellow ppt
2. Sr^{2+} : Part 2 + $(\text{NH}_4)_2\text{SO}_4$ (aq) = white ppt
3. Ca^{2+} : Part 3 + $(\text{NH}_4)_2\text{C}_2\text{O}_4$ ¹⁴ (aq) + NH_4OH (only if nothing appears at first) = white ppt
4. **Flame test**: Take salt and make a paste by mixing with conc HCl . Take paste on tip of glass rod / platinum wire, and put in Bunsen burner flame
 1. Ba^{2+} : Green flame
 2. Sr^{2+} : Crimson red flame
 3. Ca^{2+} : Brick red flame

12 Dimethyl glyoxime reagent
13 Potassium chromate
14 Ammonium oxalate

Group VI – Mg^{2+} (*magnesium*): No group reagent
OS + NH_4Cl + excess NH_4OH + ammonium phosphate = white ppt

Coloured salts

Colour	Inference
Blue	Cupric salts
Green	Hydrated nickel salts
Rose red	Cobalt salts, HgI_2
Light green	Ferrous salts
Yellow / brown	Ferric salts
Green / blue	Hydrated copper salts
Deep blue	Anhydrous cobalt salts
Pale pink	Manganese salts
Dark green / purple	Chromic salts

MISCELLANEOUS NOTES

- With Br^- , most labs only have NH_4^+ .
- With Ca^{2+} , most labs only have Cl^- .
- *Easier way to do flame test*: Use test tube holder as tongs, and pick up a sizeable chunk of salt with it. Put one drop of conc HCl , and put in Bunsen burner flame.
- Do flame test first; if you're lucky you'll get your cation early. Most students spend up a lot of time doing cation test.