

# CHEMISTRY SALT ANALYSIS CHEATSHEET

Version 2.0

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Only **important** stuff for CBSE Class 12<sup>th</sup> 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 H<sub>2</sub>SO<sub>4</sub> group) – CO<sub>3</sub><sup>2-</sup> (carbonate), SO<sub>3</sub><sup>2-</sup> (sulphite), S<sup>2-</sup> (sulphide), NO<sub>2</sub><sup>-</sup> (nitrite):** Salt + dil H<sub>2</sub>SO<sub>4</sub>

1. **No reaction:** Group I anion not present. Continue to group II.
2. **Carbonate:** Colourless and odourless gas (CO<sub>2</sub>)
  1. WE <sup>1</sup> + MgSO<sub>4</sub> = white ppt
3. **Sulphite:** Colourless gas with pungent smell
  1. WE + BaCl<sub>2</sub> (aq) = white ppt soluble in dil HCl

1 Water extract: Pinch of salt + water

2. WE + acidified K<sub>2</sub>Cr<sub>2</sub>O<sub>7</sub><sup>2-</sup> = sol<sup>3</sup> turns green
3. WE + acidified KMnO<sub>4</sub> = pink colour of KMnO<sub>4</sub> is discharged
4. **Sulphide:** Colourless gas with a smell of rotten eggs (H<sub>2</sub>S); turns lead acetate paper black
  1. *Sodium nitroprusside test:* WE + sodium nitroprusside <sup>4</sup> = purple / violet colour
  2. *Lead acetate test:* WE + lead acetate <sup>5</sup> (aq) = black ppt
5. **Nitrite:** Pungent light brown gas
  1. *Starch-iodide test:* WE + dil H<sub>2</sub>SO<sub>4</sub> (or dil acetic acid); boil, then add solid KI + fresh starch sol = deep blue colouration

**Group II (conc H<sub>2</sub>SO<sub>4</sub> group) – Cl<sup>-</sup> (chloride), Br<sup>-</sup> (bromide), I<sup>-</sup> (iodide), NO<sub>3</sub><sup>-</sup> (nitrate), CH<sub>3</sub>COO<sup>-</sup> (acetate), C<sub>2</sub>O<sub>4</sub><sup>2-</sup> (oxalate):** Salt + conc H<sub>2</sub>SO<sub>4</sub>

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 NH<sub>4</sub>OH is brought near mouth of test tube
  1. *Silver nitrate test:* WE + AgNO<sub>3</sub> = white ppt soluble in NH<sub>4</sub>OH
  2. *Chromyl chloride test:* Salt + solid K<sub>2</sub>Cr<sub>2</sub>O<sub>7</sub> + 2-3 drops conc H<sub>2</sub>SO<sub>4</sub> = orange / red fumes of chromyl chloride <sup>6</sup>
    1. Vapours + NaOH (aq) = yellow solution
    2. Yellow solution + acetic acid + lead acetate sol = yellow ppt

- 2 Potassium dichromate
- 3 Solution
- 4 Na<sub>2</sub>[Fe(CN)<sub>5</sub>NO]
- 5 Pb(CH<sub>3</sub>COO)<sub>2</sub>
- 6 CrO<sub>2</sub>Cl<sub>2</sub>

3. **Bromide:** Reddish brown vapour

1. *Silver nitrate test:* WE + AgNO<sub>3</sub> (aq) = yellow ppt partially soluble in NH<sub>4</sub>OH
2. *Organic layer test:* WE + CCl<sub>4</sub> + 1 drop conc HNO<sub>3</sub> = 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 + AgNO<sub>3</sub> (aq) = yellow ppt insoluble in NH<sub>4</sub>OH
2. *Organic layer test:* WE + CCl<sub>4</sub> + 1 drop conc HNO<sub>3</sub> = 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 FeSO<sub>4</sub> sol + 1 drop conc HNO<sub>3</sub> 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 H<sub>2</sub>SO<sub>4</sub> + ethanol = fruity smell of ester
2. *Ferric chloride test:* WE + FeCl<sub>3</sub> (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 + CO<sub>2</sub>)

1. *Calcium chloride test:* WE + acetic acid + CaCl<sub>2</sub> (aq) + boil

= white ppt; ppt dissolves when dil HNO<sub>3</sub> is added and warmed

2. *Potassium permanganate test:* Salt + dil H<sub>2</sub>SO<sub>4</sub> + heat; then add 2-3 drops KMnO<sub>4</sub> sol = pink colour of KMnO<sub>4</sub> is discharged

**Group III anions (special group) –** SO<sub>4</sub><sup>2-</sup> (*sulphate*), PO<sub>4</sub><sup>3-</sup> (*phosphate*): No group reagent

1. **Sulphate:**

1. *Barium chloride test:* WE + BaCl<sub>2</sub> (aq) = white ppt insoluble in conc HCl
2. *Lead acetate test:* WE + lead acetate (aq) + acetic acid = white ppt soluble in CH<sub>3</sub>COONH (ammonium acetate)

2. **Phosphate:**

1. *Ammonium molybdate test:* WE + dil HNO<sub>3</sub> + ammonium molybdate<sup>7</sup> + boil = crystalline canary yellow ppt

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## 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, Ba<sup>2+</sup>, Ca<sup>2+</sup>, Pb<sup>2+</sup>, and Sr<sup>2+</sup> are not present as sulphates of these radicals are insoluble.*
- *When phosphate is detected, cations of group III and later are absent.*

**Group 0 –  $\text{NH}_4^+$  (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 reagent<sup>8</sup> test:* OS<sup>9</sup> + NaOH + Nessler's reagent = Brown / yellow ppt

**Group I –  $\text{Pb}^{2+}$  (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 +  $\text{K}_2\text{CrO}_4$  = yellow ppt

**Group II –  $\text{Cu}^{2+}$  (copper):**

OS + dil HCl +  $\text{H}_2\text{S}$  = black ppt

1. Throw off extra sol, retain ppt, and dissolve in a few drops of conc  $\text{HNO}_3$  = bluish green sol, ppt dissolves; divide into two parts
  1. Part 1 + excess  $\text{NH}_4\text{OH}$  = 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 –  $\text{Fe}^{2+}$ ,  $\text{Fe}^{3+}$  (iron),  $\text{Al}^{3+}$  (aluminium):**

OS + solid  $\text{NH}_4\text{Cl}$  + excess  $\text{NH}_4\text{OH}$

1.  **$\text{Fe}^{2+}$  /  $\text{Fe}^{3+}$ :** 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  $\text{HNO}_3$  + 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.  **$\text{Al}^{3+}$ :** Gelatinous white ppt

1. *Blue lake test:* Retain ppt + dil HCl = clear sol
  1. Sol + blue litmus and  $\text{NH}_4\text{OH}$  (drop-by-drop) = blue colour layer ('lake') floats over colourless sol

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

OS + solid  $\text{NH}_4\text{Cl}$  + excess  $\text{NH}_4\text{OH}$  + pass  $\text{H}_2\text{S}$  gas

1.  **$\text{Co}^{2+}$  /  $\text{Ni}^{2+}$ :** Black ppt; dissolve ppt in aqua regia<sup>10</sup> and evaporate sol to dryness to get residue

1.  **$\text{Co}^{2+}$ :** Blue residue; turns pink / purple when dissolved in water; divide into two parts
  1. Part 1 + dil acetic acid +  $\text{KNO}_2$  + warm = yellow ppt
  2. Part 2 + ether (1 mL) + solid  $\text{NH}_4\text{CNS}$ <sup>11</sup> = blue colour in ether

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

8  $\text{K}_2\text{Hgl}_4$

9 Original solution: Salt + acid + water

10 Aqua regia: 3 parts conc HCl + 1 part conc  $\text{HNO}_3$

11 Ammonium sulphocyanide

1. *DMG*<sup>12</sup> test: Part 1 + excess  $\text{NH}_4\text{OH}$  + *DMG* = bright red ppt
2. Part 2 +  $\text{NaOH}$  + bromine water + boil = black ppt

2.  $\text{Mn}^{2+}$ : Buff / skin colour ppt; divide into two parts
  1. Part 1 + dil  $\text{HCl}$  + boil off  $\text{H}_2\text{S}$  +  $\text{NaOH}$  = white ppt; which turns black / brown on adding bromine water
  2. *Lead dioxide test*: Part 2 +  $\text{PbO}_2$  + conc  $\text{HNO}_3$  + boil = after cooling; pink colouration
3.  $\text{Zn}^{2+}$ : Greyish white ppt; divide into two parts
  1. Part 1 + excess  $\text{NaOH}$  = white ppt dissolves
  2. *Potassium ferrocyanide test*: Part 2 +  $\text{K}_4[\text{Fe}(\text{CN})_6]$  = white / bluish white ppt

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

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

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

12 Dimethyl glyoxime reagent  
13 Potassium chromate  
14 Ammonium oxalate

**Group VI** –  $\text{Mg}^{2+}$  (*magnesium*): No group reagent  
OS +  $\text{NH}_4\text{Cl}$  + excess  $\text{NH}_4\text{OH}$  + ammonium phosphate = white ppt

**Coloured salts**

Colour	Inference
Blue	Cupric salts
Green	Hydrated nickel salts
Rose red	Cobalt salts, $\text{HgI}_2$
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  $\text{Br}^-$ , most labs only have  $\text{NH}_4^+$ .
- With  $\text{Ca}^{2+}$ , most labs only have  $\text{Cl}^-$ .
- *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  $\text{HCl}$ , 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.