

# CHEMISTRY SALT ANALYSIS CHEATSHEET

Copyright © 2007 by Ankur Banerjee. No part of this document may be modified and distributed by any means without the permission of the author.

*This cheatsheet has been made for the CBSE Class 12 Board chemistry practical exams. Only the common tests used in school have been mentioned, with certain portions outside school syllabus being omitted.*

---

## ANIONS

- Some anions have not been included.
- Test mentioned next to group (or anion, for group III) 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
  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

---

1 Water extract – Made by taking a pinch of salt in a test tube and shaking it with water.

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>

**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
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> <sup>7</sup> + 1 drop conc HNO<sub>3</sub> <sup>8</sup> = Upper layer aqueous; lower layer organic of orange / brown colour (bromine is soluble in non-polar solvent)
4. **Iodide:** Violet vapour
  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> <sup>9</sup> 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

---

6 CrO<sub>2</sub>Cl<sub>2</sub>

7 Carbon tetrachloride

8 HNO<sub>3</sub> is added to act as oxidising agent

9 Ferrous sulphate

**Group III anions (special group) –  $SO_4^{2-}$  (sulphate),  $PO_4^{3-}$  (phosphate):**  
No group reagent

1. **Sulphate:**

1. *Barium chloride test:* WE +  $BaCl_2$  (aq) = white ppt insoluble in conc HCl
2. *Lead acetate test:* WE + lead acetate (aq) + acetic acid = white ppt soluble in  $CH_3COONH$  (ammonium acetate)

2. **Phosphate:**

1. *Ammonium molybdate test:* WE + dil  $HNO_3$  + ammonium molybdate <sup>10</sup> + boil = crystalline canary yellow ppt

---

## CATIONS

- *All cations have not been mentioned.*
- *Group reagent is the one 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,  $Ba^{2+}$ ,  $Ca^{2+}$ ,  $Pb^{2+}$ , and  $Sr^{2+}$  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 reagent <sup>11</sup> test:* OS <sup>12</sup> + 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

---

<sup>10</sup>  $(NH_4)_2MoO_4$

<sup>11</sup>  $K_2Hgl_4$

<sup>12</sup> Original solution – Salt + acid + water

**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  $\text{HNO}_3$ <sup>13</sup> + 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>14</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 +  $\text{KNO}_2$ <sup>15</sup> + warm = yellow ppt
    2. Part 2 + ether (1 mL) + solid  $\text{NH}_4\text{CNS}$ <sup>16</sup> = blue colour in ether
  2.  **$\text{Ni}^{2+}$ :** Yellow residue; turns green when dissolved in water; divide into two parts
    1. *DMG*<sup>17</sup> test: Part 1 + excess  $\text{NH}_4\text{OH}$  + DMG = bright red ppt
    2. Part 2 + NaOH + bromine water + boil = black ppt
2.  **$\text{Mn}^{2+}$ :** Buff / skin colour ppt; divide into two parts
  1. Part 1 + dil HCl + boil off  $\text{H}_2\text{S}$  + NaOH = white ppt; which turns black / brown on adding bromine water

---

13 Used as oxidising agent

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

15 Potassium nitrite

16 Ammonium sulphocyanide

17 Dimethyl glyoxime reagent

2. *Lead dioxide test*: Part 2 + PbO<sub>2</sub> + conc HNO<sub>3</sub> + boil = after cooling; pink colouration
3. **Zn<sup>2+</sup>**: Greyish white ppt; divide into two parts
  1. Part 1 + excess NaOH = white ppt dissolves
  2. *Potassium ferrocyanide test*: Part 2 + K<sub>4</sub>[Fe(CN)<sub>6</sub>] = white / bluish white ppt

**Group V** – Ba<sup>2+</sup> (*barium*), Sr<sup>2+</sup> (*strontium*), Ca<sup>2+</sup> (*calcium*):

OS + (NH<sub>4</sub>)<sub>2</sub>CO<sub>3</sub><sup>18</sup> + NH<sub>4</sub>Cl + NH<sub>4</sub>OH = white ppt; add dil acetic acid, divide sol into three parts and test for following IN ORDER

1. **Ba<sup>2+</sup>**: Part 1 + excess K<sub>2</sub>CrO<sub>4</sub><sup>19</sup> (aq) = yellow ppt
2. **Sr<sup>2+</sup>**: Part 2 + (NH<sub>4</sub>)<sub>2</sub>SO<sub>4</sub><sup>20</sup> (aq) = white ppt
3. **Ca<sup>2+</sup>**: Part 3 + (NH<sub>4</sub>)<sub>2</sub>C<sub>2</sub>O<sub>4</sub><sup>21</sup> (aq) + NH<sub>4</sub>OH (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<sup>2+</sup>**: Green flame
  2. **Sr<sup>2+</sup>**: Crimson red flame
  3. **Ca<sup>2+</sup>**: Brick red flame

**Group VI** – Mg<sup>2+</sup> (*magnesium*): No group reagent

OS + NH<sub>4</sub>Cl + excess NH<sub>4</sub>OH + ammonium phosphate = white ppt

### Coloured salts

Colour	Inference
Blue	Cupric salts
Green	Hydrated nickel salts
Rose red	Cobalt salts, HgI <sub>2</sub>
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

18 Ammonium carbonate

19 Potassium chromate

20 Ammonium sulphate

21 Ammonium oxalate