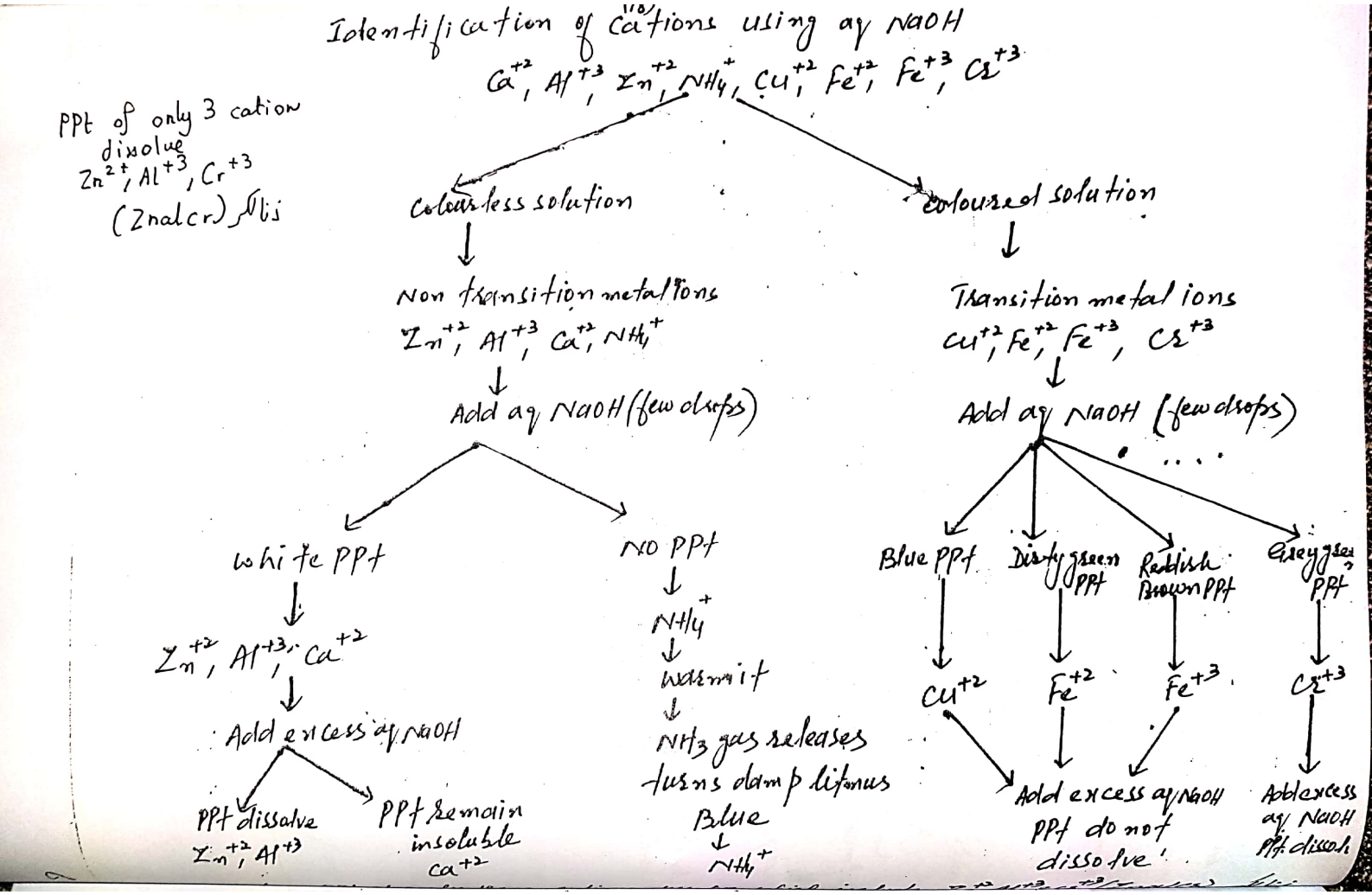
1.3 Identification of ions and gases

(a) describe the use of aqueous sodium hydroxide and aqueous ammonia to identify the following aqueous cations: aluminium, ammonium, calcium, chromium(III), copper(II), iron(II), iron(III) and zinc (formulae of complex ions are **not** required)

(b) describe tests to identify the following anions: carbonate (by the addition of dilute acid and subsequent use of limewater); chloride (by reaction of an aqueous solution with nitric acid and aqueous silver nitrate); iodide (by reaction of an aqueous solution with nitric acid and aqueous silver nitrate); nitrate (by reduction with aluminium and aqueous sodium hydroxide to ammonia and subsequent use of litmus paper), sulfate (by reaction of an aqueous solution with nitric acid and aqueous barium nitrate), and sulfite (by warming with dilute acid)

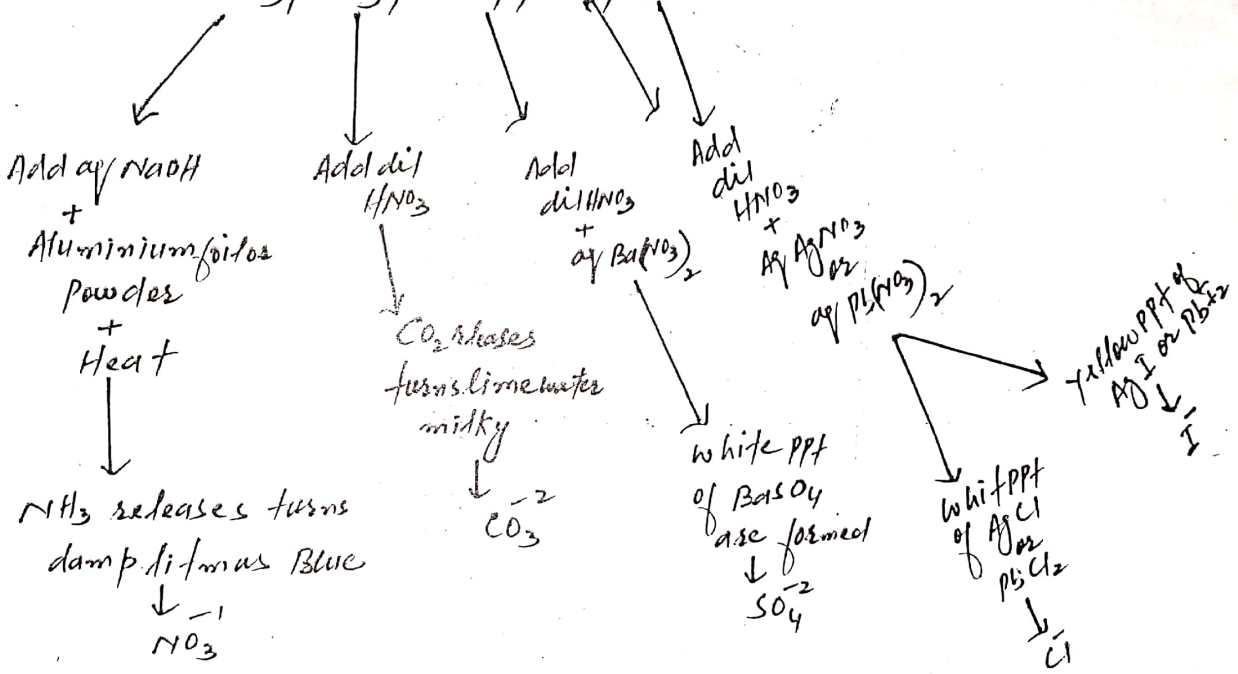
(c) describe tests to identify the following gases: ammonia (using damp red litmus paper); carbon dioxide (using limewater); chlorine (using damp litmus paper); hydrogen (using a burning splint); oxygen (using a glowing splint) and sulfur dioxide (using acidified potassium manganate(VII))

(d) describe a chemical test for water



Identification of Anions

NO_3^{-1}, CO_3^{-2}, SO_4^{-2}, Cl^-, I^-



Note :- In the identification of SO_4^{-2}, Cl^- and I^- dil HNO_3 is added to destroy any carbonate if present.

Only two cations ppt are insoluble (Zn^{+2} and Cu^{+2})
ZnCu (جنس)

Identification of cations using aq NH_3 (NH_4OH)

Zn^{+2}, Al^{+3}, Ca^{+2}, NH_4^+, Cu^{+2}, Fe^{+2}, Fe^{+3}, Cr^{+3}

↓

Add aq NH_3 few drops

- **No ppt**: Ca^{+2}, NH_4^+
- **White ppt**: Zn^{+2}, Al^{+3}
  - ↓ Excess aq NH_3
    - ppt dissolve: Zn^{+2}
    - ppt remain insoluble: Al^{+3}
- **Coloured ppt**
  - **Blue ppt**: Cu^{+2}
    - ↓ Excess aq NH_3
    - Blue ppt dissolve solution turns deep Blue: Cu^{+2}
  - **Dirty green ppt**: Fe^{+2}
  - **Reddish Brown ppt**: Fe^{+3}
  - **Grey Green ppt**: Cr^{+3}
    - ↓ Excess aq NH_3
    - ppt remain insoluble: Fe^{+2}, Fe^{+3}, Cr^{+3}

In [illegible]ing way to rem[illegible]es
O[illegible]o cations (ppt Zn^{+2} & Cu^{+2})

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(24)

Identification of Cations

Following cations are identified using reagents Zn^{+2} Al^{+3}, Ca^{+2}, NH_4^+, Fe^{+2}, Fe^{+3}, Cu^{+2}, Cr^{+3}.

Cations are identified either by using aq NaOH or aq NH_3 (NH_4OH).

Following ionic equations are obtained

$Zn^{+2}_{(aq)} + 2OH^-_{(aq)} \longrightarrow Zn(OH)_{2(s)}$ white ppt

$Al^{+3}_{(aq)} + 3OH^-_{(aq)} \longrightarrow Al(OH)_{3(s)}$ white ppt

$Ca^{+2}_{(aq)} + 2OH^-_{(aq)} \longrightarrow Ca(OH)_{2(s)}$ white ppt

$NH_4^+ + OH^- \longrightarrow$ No ppt

$Fe^{+2}_{(aq)} + 2OH^-_{(aq)} \longrightarrow Fe(OH)_{2(s)}$ Dirty green ppt

$Fe^{+3}_{(aq)} + 3OH^-_{(aq)} \longrightarrow Fe(OH)_{3(s)}$ Reddish brown ppt

$Cu^{+2}_{(aq)} + 2OH^-_{(aq)} \longrightarrow Cu(OH)_{2(s)}$ Blue ppt

$Cr^{+3}_{(aq)} + 3OH^-_{(aq)} \longrightarrow Cr(OH)_{3(s)}$ Grey Green ppt or Green ppt

Identification of gases