

**Ran Vijay Smarak Mahavidyalaya, Sector – 12/D, Bokaro**

**SEMESTR-VI**

**CHEMISTRY (Core – XIII)**

**INORGANIC CHEMISTRY – IV**

THEORETICAL PRINCIPLES IN QUALITATIVE ANALYSIS (H<sub>2</sub>S SCHEME)

**Qualitative Analysis**

It is mainly focused on detecting ions in an aqueous solution. The solution is treated with various reagents to test for reactions characteristic of certain ions, which may cause color change, solid forming, and other visible changes.

Finding out the nature of substance and identity of its constituents is also analysis and is known as qualitative analysis. Qualitative analysis of inorganic salts means the identification of cations and anions present in the salt or a mixture of salts. Inorganic salts may be obtained by complete or partial neutralisation of acid with base. In the formation of a salt, the part contributed by the acid is called anion and the part contributed by the base is called cation.

For example, in the salts CuSO<sub>4</sub> and NaCl,  
Cu<sup>2+</sup> and Na<sup>+</sup> ions are cations  
and SO<sub>4</sub><sup>2-</sup> and Cl<sup>-</sup> ions are anions.

Qualitative analysis is carried out through the reactions which are easily perceptible to our senses such as sight and smell. Such reactions involve:

- (a) Formation of a precipitate
- (b) Change in colour
- (c) Evolution of gas etc.

Systematic analysis of an inorganic salt involves the following steps:

- (i) Preliminary examination of solid salt and its solution.
- (ii) Determination of anions by reactions carried out in solution (wet tests) and confirmatory tests.
- (iii) Determination of cations by reactions carried out in solution (wet tests) and confirmatory tests.

Preliminary examination of a salt often furnishes important information, which simplifies further course of analysis. Although these tests are not conclusive but sometimes they give quite important clues for the presence of certain anions or cations. These tests can be performed within 10-15 minutes. These involve noting the general appearance and physical properties, such as colour, smell, solubility etc. of the salt. These are named as dry tests. Heating of dry salt, blow pipe test, flame tests, borax bead test, sodium carbonate bead test, charcoal cavity test etc. come under dry tests.

To detect one cation and one anion in the given salt from the following ions:

Cations -  $Pb^{2+}$ ,  $Cu^{2+}$ ,  $As^{3+}$ ,  $Al^{3+}$ ,  $Fe^{3+}$ ,  $Mn^{2+}$ ,  $Ni^{2+}$ ,  $Zn^{2+}$ ,  $Co^{2+}$ ,  $Ca^{2+}$ ,  $Sr^{2+}$ ,  $Ba^{2+}$ ,  $Mg^{2+}$ ,  $4NH$

Anions -  $2-3CO$ ,  $S^{2-}$ ,  $2-3SO$ ,  $2-4SO$ ,  $2-NO$ ,  $3-NO$ ,  $Cl^-$ ,  $Br^-$ ,  $I^-$ ,  $3-4PO$ ,  $2-2\ 4C\ O$ ,  $CH_3COO^-$   
(Insoluble salts to be excluded)

**Theory Two basic principles of great use in the analysis are:**

1. The Solubility product; and
2. The Common ion effect.

When ionic product of a salt exceeds its solubility product, precipitation takes place. Ionic product of salt is controlled by making use of common ion effect.

**SYSTEMATIC ANALYSIS OF CATIONS:-**

1. Colour Test Observe the colour of the salt carefully, which may provide useful information about the cations. Table gives the characteristic colours of the salts of some cations.

<u>Colour</u>	<u>Cations</u>
Light green, yellow, Brown	$Fe^{2+}$ , $Fe^{3+}$
Blue	$Cu^{2+}$
Bright green	$Ni^{2+}$
Blue, Red, Violet, Pink	$Co^{2+}$
Light Pink	$Mn^{2+}$