PHARM.D • YEAR 1

Pharmaceutical Inorganic Chemistry

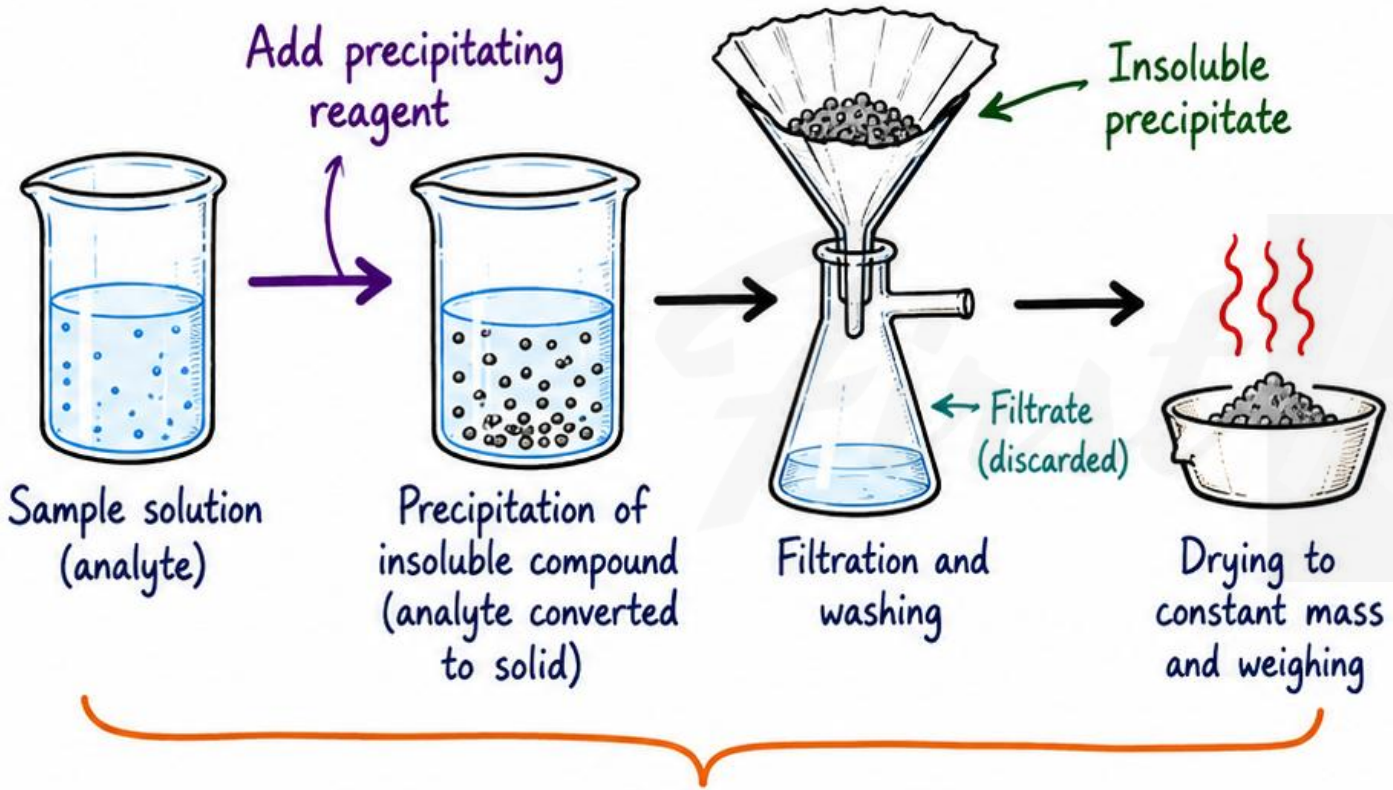
CHAPTER 9

# Gravimetry

PPT CHAPTER COVER



# Gravimetric Analysis: Core Principle




Mass of precipitate is proportional to amount of analyte in the sample

- Gravimetric analysis is a quantitative method that determines the amount of an analyte based on its mass.
- The analyte is converted into a pure, insoluble precipitate of known composition, isolated, dried to constant mass, and weighed.
- The mass of the precipitate is used to calculate the amount of analyte by stoichiometric relationship.

# Gravimetric Workflow: Precipitate Formation

## ① Precipitate Formation



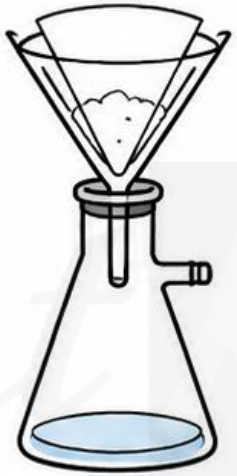
Add precipitating agent → insoluble precipitate forms.

## ② Digestion



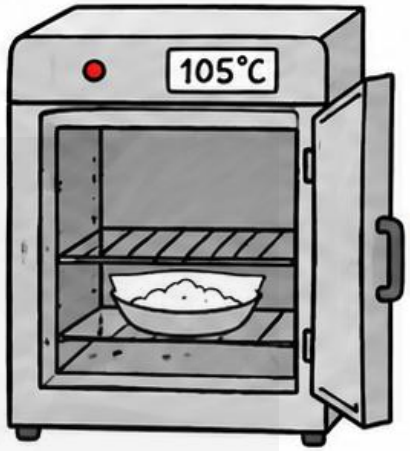
Heat or allow to stand to improve purity and particle size.

## ③ Filtration



Filter the precipitate using appropriate filter paper.

## ④ Drying




Wash to remove impurities, then dry in an oven or desiccator to remove moisture.

## ⑤ Weighing



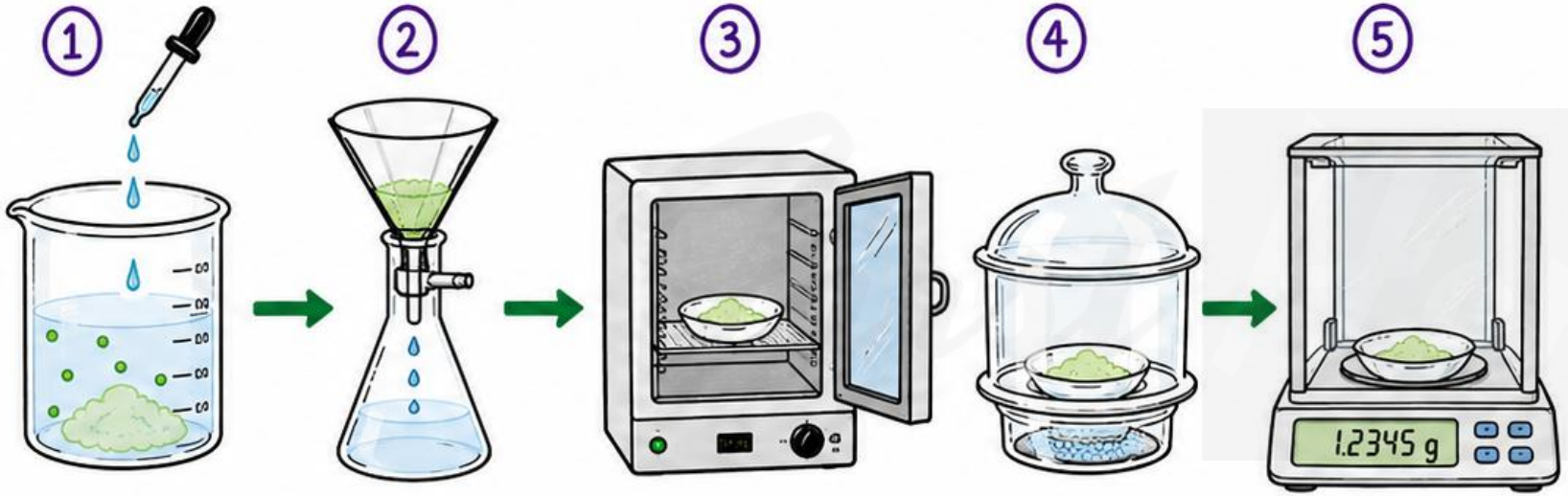

Weigh the dried precipitate using an analytical balance.

- **Principle**: The amount of analyte is determined by the mass of a pure, dry precipitate.
- **Mechanism**: A precipitating agent reacts selectively with the analyte to form an insoluble precipitate.
- **Endpoint**: Constant mass of the dried precipitate is obtained.

$$\underset{\text{Analyte}}{M^{n+}_{(aq)}} + \underset{\text{Precipitating agent}}{X^{-}_{(aq)}} \longrightarrow \underset{\text{Insoluble precipitate}}{MX_{(s)}\downarrow}$$

# Gravimetric Workflow: Isolation to Constant Mass

## ① Workflow: Isolation to Constant Mass




**Precipitation**
Add reagent to form insoluble precipitate.

**Filtration**
Collect precipitate on a filter and wash to remove impurities.

**Drying**
Dry precipitate to remove moisture.

**Cooling in Desiccator**
Cool to room temperature in desiccator.

**Weigh to Constant Mass**
Weigh; dry (if needed), cool and reweigh until mass is constant.

## ② Principle & Calculation

- Principle: Quantify analyte based on the mass of a purified precipitate.
- Calculation: Use the mass of the precipitate and the reaction stoichiometry to determine the analyte's concentration.

### General Precipitation Reaction

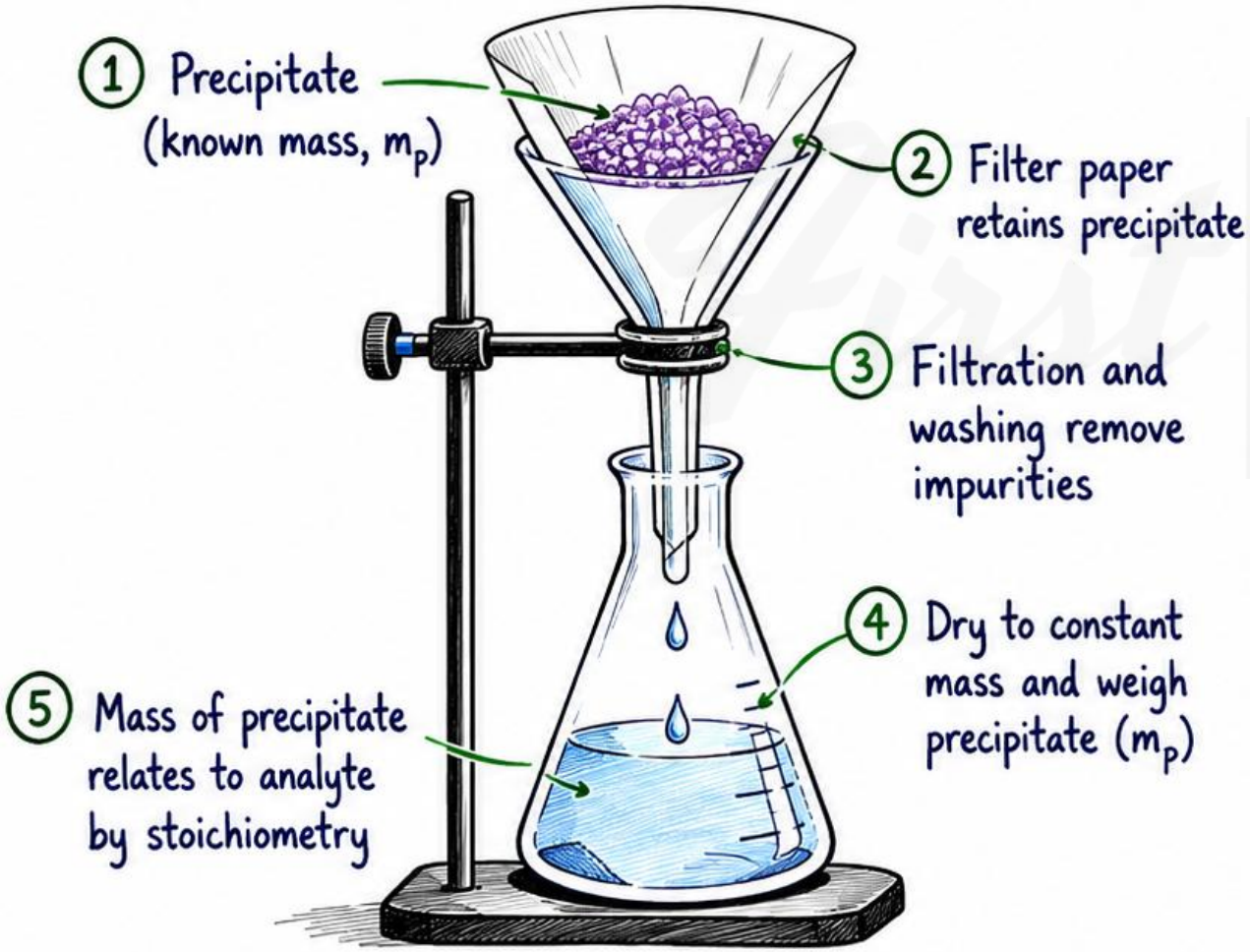
$$a\,A^{m+} + b\,B^{n-} \longrightarrow A_aB_b(s)$$

- $A^{m+}$: analyte ion
- $B^{n-}$: precipitating ion
- $A_aB_b(s)$: insoluble precipitate

**Mass of precipitate + Stoichiometry ⇒ Analyte concentration**

# Gravimetric Factor and Calculation

**PRINCIPLE** → Determine the amount of an analyte based on the mass of a precipitate.




**CALCULATION** → Use the mass of the precipitate and reaction stoichiometry.

General precipitation reaction:

$$a\,A + b\,B \longrightarrow p\,P_{(s)}$$

Gravimetric factor (GF):

$$GF = \frac{a \times M_A}{p \times M_P}$$

$M_A$ = molar mass of analyte A

$M_P$ = molar mass of precipitate P

Mass of analyte (A):

$$m_A = m_p \times GF$$

Amount (mol) of analyte:

$$n_A = \frac{m_A}{M_A}$$

**INTERPRETATION**

The heavier the precipitate (higher $m_p$) or the larger its molar mass ($M_p$), the greater the calculated amount of analyte.

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