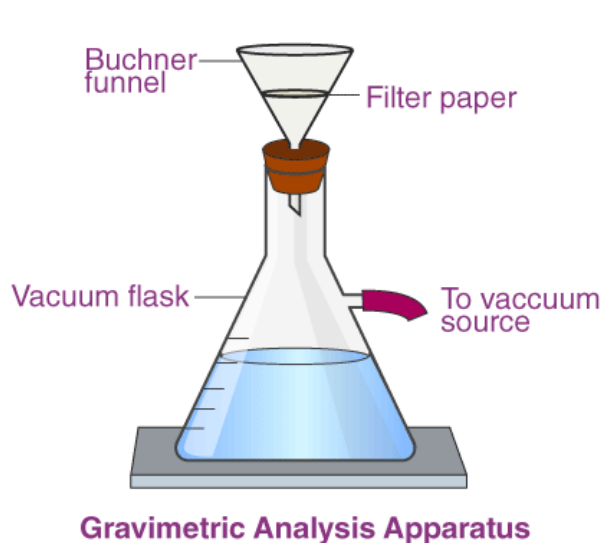


# What is Gravimetric Analysis?

Gravimetric analysis is a method in [analytical chemistry](#) to determine the quantity of an analyte based on the mass of a solid. Example: Measuring the solids suspended in the water sample – Once a known volume of water is filtered, the collected solids are weighed.

## The principle of Gravimetric Analysis:

The principle behind the gravimetric analysis is that the mass of an ion in a pure compound and can be determined. Later, used to find the mass percent of the same ion in a known quantity of an impure compound.



Gravimetric Analysis Apparatus

## Steps followed in the Gravimetric Analysis

1. Preparation of a solution containing a known weight of the sample.
2. Separation of the desired constituent.
3. Weighing the isolated constituent.
4. Computation of the amount of the particular constituent in the sample from the observed weight of the isolated substance.

## Types of Gravimetric Analysis

There are 4 fundamental types of gravimetric analysis. Of which, there are 2 common types involving changes in the phase of the analyte to separate it from the rest of a mixture, resulting in a change in mass.

### Volatilisation gravimetry

- Volatilisation Gravimetry involves separating components of our mixture by heating or chemically decomposing the sample.

### **Precipitation gravimetry.**

- Precipitation Gravimetry uses a precipitation reaction to separate one or more parts of a solution by incorporating it into a solid.

### **Electrogravimetry.**

- Electrogravimetry is a method used to separate and quantify ions of a substance, usually a metal.

### **Thermogravimetry.**

- Thermogravimetry is a method of thermal analysis in which changes in physical and chemical properties of materials are measured as a function of increasing temperature or as a function of time.

## **Advantages of Gravimetric Analysis**

If the methods are followed carefully, it provides exceedingly precise analysis. It is used to determine the atomic masses of many elements to six-figure accuracy. It provides little room for instrumental error and does not require a series of standards for calculation of an unknown.

## **Disadvantages of Gravimetric Analysis**

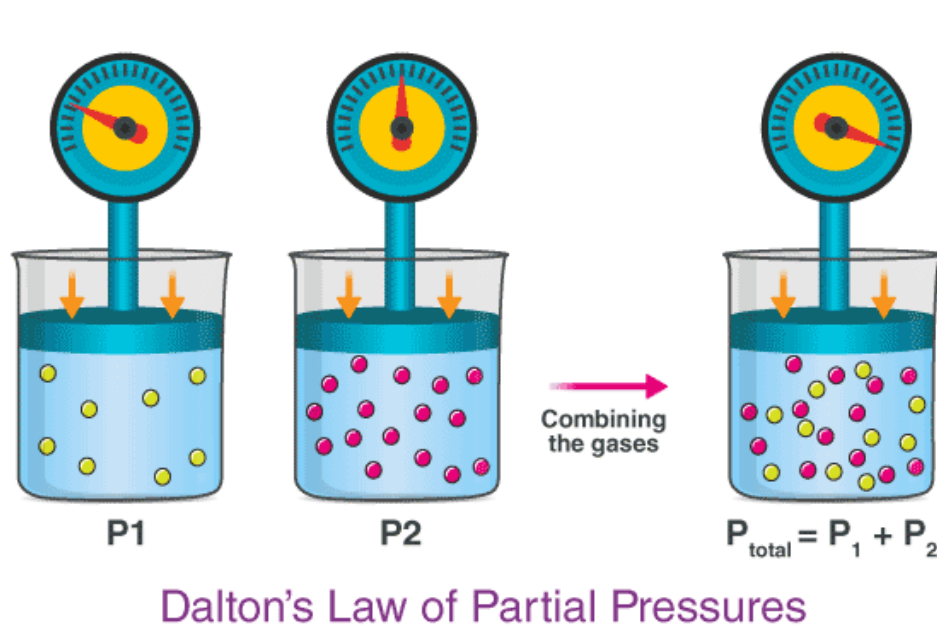
It usually provides only for the analysis of a single element, or a limited group of elements, at a time. Comparing modern dynamic flash combustion coupled with gas chromatography with traditional combustion analysis.

## **Examples of Gravimetric Analysis**

# Dalton's Law of Partial Pressure

## What is Dalton's Law?

Dalton's law of partial pressures is a gas law which states that the total pressure exerted by a mixture of gases is equal to the sum of the partial pressures exerted by each individual gas in the mixture. For example, the total pressure exerted by a mixture of two gases A and B is equal to the sum of the individual partial pressures exerted by gas A and gas B (as illustrated below).



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## Dalton's Law Formula

Dalton's law of partial pressures can be mathematically expressed as follows:

$$\text{(or) } P_{\text{total}} = P_1 + P_2 + P_3 + \dots + P_n$$

Where,

- $P_{\text{total}}$  is the total pressure exerted by the mixture of gases
- $P_1, P_2, \dots, P_n$  are the partial pressures of the gases 1, 2, ..., 'n' in the mixture of 'n' gases

## Expressing Partial Pressures in Terms of Mole Fraction

The mole fraction of a specific gas in a mixture of gases is equal to the ratio of the partial pressure of that gas to the total pressure exerted by the gaseous mixture. This mole fraction can also be used to calculate the total number of moles of a constituent gas when the total number of moles in the mixture is known. Furthermore, the volume occupied by a specific gas in a mixture can also be calculated with this mole fraction with the help of the equation provided below.

$$X_i = \frac{P_i}{P_{\text{total}}} = \frac{V_i}{V_{\text{total}}} = \frac{n_i}{n_{\text{total}}}$$

then slower as it tends to another constant value. It is  $35.5 \text{ J}\cdot\text{K}^{-1}\cdot\text{mol}^{-1}$  at  $1500 \text{ }^{\circ}\text{C}$ ,  $36.9$  at  $2500 \text{ }^{\circ}\text{C}$ , and  $37.5$  at  $3500 \text{ }^{\circ}\text{C}$ .<sup>21</sup> The last value corresponds almost exactly to the predicted value for 7 degrees of freedom per molecule.

## Derivations of heat capacity

### Relation between specific heat capacities

Starting from the [fundamental thermodynamic relation](#) one can show,

$$c_p - c_v = \frac{\alpha^2 T}{\rho \beta_T}$$

where,

- $\alpha$  is the [coefficient of thermal expansion](#),
- $\beta_T$  is the [isothermal compressibility](#), and
- $\rho$  is [density](#).

A derivation is discussed in the article [Relations between specific heats](#).

For an [ideal gas](#), if  $\rho$  is expressed as [molar](#) density in the above equation, this equation reduces simply to [Mayer's relation](#),

$$C_{p,m} - C_{v,m} = R$$

where  $C_{p,m}$  and  $C_{v,m}$  are [intensive property](#) heat capacities expressed on a per mole basis at constant pressure and constant volume, respectively.

### Specific heat capacity

The specific heat capacity of a material on a per mass basis is

$$c = \frac{\partial C}{\partial m},$$

which in the absence of phase transitions is equivalent to

$$c = E_m = \frac{C}{m} = \frac{C}{\rho V},$$

where

- $C$  is the heat capacity of a body made of the material in question,
- $m$  is the mass of the body,
- $V$  is the volume of the body, and

- $\rho = \frac{m}{V}$   
is the density of the material.

For gases, and also for other materials under high pressures, there is need to distinguish between different boundary conditions for the processes under consideration (since values differ significantly between different conditions). Typical processes for which a heat capacity may be defined include **isobaric** (constant pressure,  $dp = 0$ ) or **isochoric** (constant volume,  $dV = 0$ ) processes. The corresponding specific heat capacities are expressed as

$$c_p = \left( \frac{\partial C}{\partial m} \right)_p,$$

$$c_v = \left( \frac{\partial C}{\partial m} \right)_v.$$

A related parameter to  $c$  is  $CV^{-1}$ , the **volumetric heat capacity**. In engineering practice,  $c_v$  for solids or liquids often signifies a volumetric heat capacity, rather than a constant-volume one. In such cases, the mass-specific heat capacity is often explicitly written with the subscript  $m$ , as  $c_m$ . Of course, from the above relationships, for solids one writes

$$c_m = \frac{C}{m} = \frac{c_v}{\rho}.$$

For pure homogeneous **chemical compounds** with established **molecular or molar mass** or a **molar quantity** is established, heat capacity as an **intensive property** can be expressed on a per **mole** basis instead of a per mass basis by the following equations analogous to the per mass equations:

$$C_{p,m} = \left( \frac{\partial C}{\partial n} \right)_p = \text{molar heat capacity at constant pressure}$$

$$C_{v,m} = \left( \frac{\partial C}{\partial n} \right)_v = \text{molar heat capacity at constant volume}$$

where  $n$  = number of moles in the body or **thermodynamic system**. One may refer to such a *per mole* quantity as molar heat capacity to distinguish it from specific heat capacity on a per-mass basis.

## Polytropic heat capacity

The **polytropic** heat capacity is calculated at processes if all the thermodynamic properties (pressure, volume, temperature) change

$$C_{i,m} = \left( \frac{\partial C}{\partial n} \right) = \text{molar heat capacity at polytropic process}$$

The most important polytropic processes run between the adiabatic and the isotherm functions, the polytropic index is between 1 and the adiabatic exponent ( $\gamma$  or  $\kappa$ )

## Dimensionless heat capacity

The **dimensionless** heat capacity of a material is

$$C^* = \frac{C}{nR} = \frac{C}{Nk_B}$$