

Measurement of Mass

Introduction:

Chemistry as an art dates back to the days of the Egyptians and Babylonians. But chemistry as a science is less than two hundred years old. The introduction of the analytical balance to a large extent transformed the art into a science. By the end of the 18th century Antoine Lavoisier was making accurate weighing the basis of all his work and his practice established chemistry as a quantitative science. The results of the innumerable weight measurements made since Lavoisier's time are embodied in our chemical formulas and equations, in the quantitative laws of chemical combination that we use so freely, and in the atomic theory that guides so much of our thinking and experimenting.

Mass is a measure of the quantity of matter. The analytical balance measures mass by comparing the mass of an object with the mass of a set of "weights" which have been universally accepted for this purpose. The standard of mass in scientific work is the International Prototype Kilogram, a block of platinum alloy preserved in the Bureau of Archives near Paris.

Weight vs. Mass

Great care should be taken to distinguish between mass and weight. Weight is the force of the earth's attraction on an object. In terms of Newton's second law:

$$\text{Weight} = \text{mass} \times \text{acceleration of gravity}$$

The mass of a stone would be the same here or on the surface of any other planet. Its weight would be quite different. Mass is a scalar quantity whereas weight is a vector quantity.

Accuracy and Precision

The concept of accuracy concerns the deviation of a measured or calculated value from the "true" value. Unfortunately, the "true" value is not always readily obtainable. The only kind of physical quantity that can be measured with perfect accuracy is a count of discrete objects, for example the number of candies in a jar. In a measurement of the mass of the candies (or some other quantity capable of continuous variation) there is always some uncertainty because the measurement has a finite number of digits.

Often the "true" values used are actually "accepted" values, such as defined standards of length, weight and time accepted by international scientific committees or other quantities chosen by some competent group from available data.

Precision is a measure of the reproducibility of an experiment and can be quantitatively expressed as an average or standard deviation. Remember that a precise measurement is not necessarily an accurate one as many errors in the measuring technique can be constant.