Accuracy & Precision

The Quality of Measurements

Measured values like those listed in the Warm Up at the beginning of this section are determined using a variety of different measuring devices.

There are devices designed to measure all sorts of different quantities. The collection pictured in Figure 1.3.1 measures length, volume, and temperature. In addition, there are a variety of exactnesses associated with different devices.

The micrometer (also called a caliper) is more precise than the ruler while the burette and pipette are more precise than the graduated cylinder.

Despite the fact that some measuring devices are more precise than others, it is impossible to design a measuring device that gives perfectly exact measurements. All measuring devices have some degree of uncertainty associated with them.

Figure 1.3.2. This kilogram mass was made in the 1880s and accepted as the international prototype of the kilogram in 1889. (© BIPM — Reproduced with permission.)

The 1-kg mass kept in a helium-filled bell jar at the BIPM in Sèvres, France, is the only exact mass on the planet. (Figure 1.3.2.) All other masses are measured relative to this and therefore have some degree of associated uncertainty.

Accuracy refers to the agreement of a particular value with the true value. The term precision can actually have two different meanings.

Precision refers to the reproducibility of a measurement (or the agreement among several measurements of the same quantity).

Precision refers to the exactness of a measurement.

This relates to uncertainty; the lower the uncertainty of a measurement, the higher the precision.