# APPENDIX C
# Systems and Techniques of Pharmaceutical Measurement

Knowledge and application of the systems of pharmaceutical measurement are essential to the practice of pharmacy. Whether applied to the compounding and dispensing of prescriptions in the community pharmacy, the filling of medication orders in the institutional pharmacy, or the large-scale industrial manufacture of pharmaceuticals, quantitative accuracy is essential in the preparation of safe and effective medications.

Pharmaceuticals prepared industrially undergo rigid in-process controls and final product assays to ensure conformance with the applicable standards for drug content. Prescriptions and medication orders filled extemporaneously in the community and institutional pharmacy often lack the advantage of control by assay, and thus the pharmacist must be absolutely certain of the accuracy of all calculations and measurements employed. Calculations should be double-checked by the pharmacist and, whenever possible, by a colleague. The importance of accurate calculations and measurements cannot be overstated. For example, an error in the placement of a decimal point represents a *minimum* error of a factor of 10, and if it is applicable to the active ingredient, a critical drug underdosage or overdosage results.

The pharmacy student must have a working knowledge of the systems of pharmaceutical measurement, their application in pharmaceutical calculations, the factors used for conversion between the systems, and the proper techniques of weighing and measuring.

## SYSTEMS OF PHARMACEUTICAL MEASUREMENT

Although pharmacy has moved toward the exclusive use of the metric system, two other systems of measurement, namely, the *apothecary system* and the *avoirdupois system*, occasionally may be encountered. The metric system includes units of weight, volume, and linear measure; the apothecary system includes units of weight and volume; and the avoirdupois system includes only units of weight. The metric system has replaced the apothecary system in virtually all pharmaceutical measurements and calculations, although some use remains, such as common reference to the dose of thyroid in *grains*, an apothecary system unit. The avoirdupois system is the *common* commercial system of weight used in the United States. It too is being replaced by the metric system, but at a much slower pace. The avoirdupois system is encountered by the pharmacist in the purchase of bulk chemicals and other items packaged and sold by the ounce or pound.

### The Metric System

The metric system is the most widely used system in pharmacy. It is the system used in the *United States Pharmacopeia* (USP) and *National Formulary (NF)*, by the federal Food and Drug Administration, in manufacturers' labeling of pharmaceutical products, and in most physicians' writing of prescriptions and medication orders.

In the metric system, the *gram* is the main unit of weight, the *liter* the main unit of volume, and the *meter* the main unit of length. Subunits and multiples of these basic units are indicated by the prefix notations and symbols shown in Table C.1.

In pharmacy, these are the most commonly used metric units:

*Weight* is expressed in terms of the kilogram (kg), gram (g), milligram (mg), or microgram (µg).
*Liquid measure* is expressed in terms of the liter (L) or milliliter (mL).