1.1: Units

There is international agreement that the units used for physical quantities in science and technology should be those of the International System of Units, or SI (standing for the French **Système International d'Unités**). The Physical Chemistry Division of the International Union of Pure and Applied Chemistry, or IUPAC, produces a manual of recommended symbols and terminology for physical quantities and units based on the SI. The manual has become known as the Green Book (from the color of its cover) and is referred to here as the IUPAC Green Book. This e-book will, with a few exceptions, use symbols recommended in the third edition (2007) of the IUPAC Green Book (E. Richard Cohen et al, *Quantities, Units and Symbols in Physical Chemistry*, 3rd edition. RSC Publishing, Cambridge, 2007). These symbols are listed for convenient reference in Appendices C and D.

Any of the symbols for units listed in Tables 1.1–1.3, except kg and $^{\circ}\mathrm{C}$, may be preceded by one of the prefix symbols of Table 1.4 to construct a decimal fraction or multiple of the unit. (The symbol g may be preceded by a prefix symbol to construct a fraction or multiple of the gram.) The combination of prefix symbol and unit symbol is taken as a new symbol that can be raised to a power without using parentheses, as in the following examples:

- The physical quantity formally called **amount of substance** is a counting quantity for particles, such as atoms or molecules, or for other chemical entities. The counting unit is invariably the **mole**, defined as the amount of substance containing as many particles as the number of atoms in exactly 12 grams of pure carbon-12 nuclide, $^{12}\mathrm{C}$. See Appendix A for the wording of the official IUPAC definition. This definition is such that one mole of H_2O molecules, for example, has a mass of 18.0153 grams (where 18.0153 is the relative molecular mass of H_2O) and contains 6.02214×10^{23} molecules (where $6.02214 \times 10^{23}\ \mathrm{mol}^{-1}$ is the *Avogadro constant* to six significant digits). The same statement can be made for any other substance if 18.0153 is replaced by the appropriate atomic mass or molecular mass value.

  The symbol for amount of substance is n. It is admittedly awkward to refer to $n(H_2O)$ as "the amount of substance of water." This e-book simply shortens "amount of substance" to **amount**. An alternative name suggested for n is "chemical amount." Thus, "the amount of water in the system" refers not to the mass or volume of water, but to the *number* of H_2O molecules in the system expressed in a counting unit such as the mole.