1.5: SI Prefixes

The SI base units are not always of convenient size for a particular measurement. For example, the meter would be too big for reporting the thickness of this page, but rather small for the distance from Chicago to Detroit. To overcome this obstacle the SI includes a series of prefixes, each of which represents a power of 10. These allow us to reduce or enlarge the SI base units to convenient sizes. The figures below show how these prefixes can be applied to the meter to cover almost the entire range of lengths we might wish to measure.

***Table 1.5.1**: Prefixes Used for Decimal Fractions and Multiples of SI Units.*

Prefix	Symbol for Prefix		Scientific Notation
exa	E	1 000 000 000 000 000 000	10^{18}
peta	P	1 000 000 000 000 000	10^{15}
tera	T	1 000 000 000 000	10^{12}
giga	G	1 000 000 000	10^{9}
mega	M	1 000 000	10^{6}
kilo	k	1 000	10^{3}
hecto	h	100	10^{2}
deka	da	10	10^{1}
----	--	1	10^{0}
deci	d	0.1	10^{-1}
centi	c	0.01	10^{-2}
milli	m	0.001	10^{-3}
micro	µ	0.000 001	10^{-6}
nano	n	0.000 000 001	10^{-9}
pico	p	0.000 000 000 001	10^{-12}
femto	f	0.000 000 000 000 001	10^{-15}
atto	a	0.000 000 000 000 000 001	10^{-18}

One non-SI unit of length, the angstrom (Å), is convenient for chemists and will continue to be used for a limited time. Since 1Å = 10^{-10} m, the angstrom corresponds roughly to the diameters of atoms and small molecules. Such dimensions are also conveniently expressed in picometers, 1 pm = 10^{-12} m = 0.01Å, but the angstrom is widely used and very familiar. Therefore we will usually write atomic and molecular dimensions in both angstroms and picometers.

The SI base unit of mass, the kilogram, is unusual because it already contains a prefix. The standard kilogram is a cylinder of corrosion-resistant platinum-iridium alloy which is kept at the International Bureau of Weights and Measures near Paris. The kilogram was chosen instead of a gram because the latter would have made an inconveniently small piece of platinum-iridium and would have been difficult to handle. Also, units of force, pressure, energy, and power have been derived using the kilogram instead of the gram.

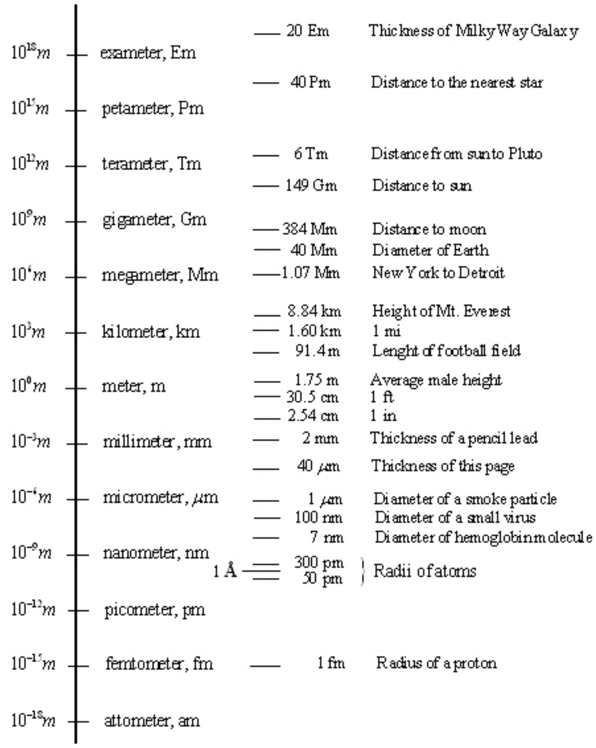

Figure 1.5.1: The magnitudes of some distances and lengths in the range 10^{18} through 10^{-18} m, expressed in SI units.

Despite the fact that the kilogram is the SI unit of mass, the standard prefixes are applied to the *gram* when larger or smaller mass units are needed. For example, the quantity 10^6 kg (1 million kilograms) can be written as 1 Gg (gigagram) but *not* as 1 Mkg (megakilogram). The operative rule here is that one and only one prefix should be attached to the name for a unit. Figure 1.6 illustrates the use of this rule in expressing the wide range of masses available in the universe. Note that the masses of atoms and molecules are usually so small that scientific notation must be used instead of prefixes.

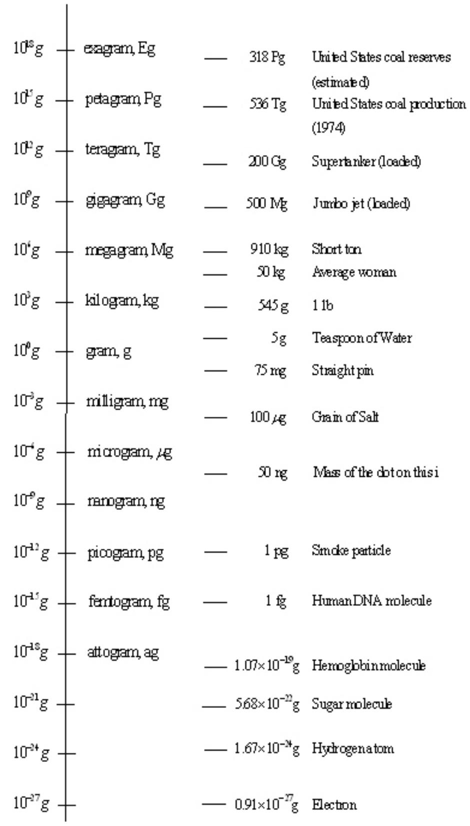

Figure 1.5.2: The masses of some objects in the range 10^{18} through 10^{-27} g, expressed in SI units.