5.4: Units as an Error-Checking Technique

Checking units can be used as an important error-checking technique called *dimensional analysis*. If you derive an equation and find that the units don't work out properly, then you can be certain you made a mistake somewhere. If the units are correct, it doesn't necessarily mean your derivation is correct (since you could be off by a factor of 2, for example), but it does give you some confidence that you at least haven't made a units error. So checking units doesn't tell you for certain whether or not you've made a mistake, but it does help.

Here are some basic principles to keep in mind when working with units:

1. Units on both sides of an equation must match.
2. When adding or subtracting two quantities, they must have the same units.
3. Quantities that appear in exponents must be dimensionless.
4. The argument for functions like sin, cos, tan, $\sin^{-1}$, $\cos^{-1}$, $\tan^{-1}$, log, and exp must be dimensionless.
5. When checking units, radians and steradians can be considered dimensionless.
6. When checking complicated units, it may be useful to break down all derived units into base units (e.g. replace newtons with kg m s^{-2}).

Sometimes it's not clear whether or not the units match on both sides of the equation, for example when both sides involve derived SI units. In that case, it may be useful to break all the derived units down in terms of base SI units (m, kg, s, A, K, mol, cd). Table 2 in Appendix 63.8 shows each of the derived SI units broken down in terms of base SI units.