

Scientific Notation

Recall that

$$\begin{aligned}
 10^0 &= 1 \\
 10^1 &= 10 \\
 10^2 &= 10 \times 10 = 100 \\
 10^3 &= 10 \times 10 \times 10 = 1000 \\
 10^4 &= 10 \times 10 \times 10 \times 10 = 10,000 \\
 &\textit{etc.}
 \end{aligned}$$

Also

$$\begin{aligned}
 10^6 &= 1 \text{ million} \\
 10^9 &= 1 \text{ billion} \\
 10^{12} &= 1 \text{ trillion}
 \end{aligned}$$

and

$$10^{-n} = \frac{1}{10^n}$$

so, for example,

$$\begin{aligned}
 10^{-2} &= 1/100 = 0.01 \\
 10^{-3} &= 1/1000 = 0.001
 \end{aligned}$$

Scientific notation allows us to write big or small numbers more compactly, e.g., $1,250,000 = 1.25 \times 10^6$, $0.0000253 = 2.53 \times 10^{-5}$. In astronomy we deal with a lot of big numbers, so scientific notation is very useful.

Here are some examples that you should try out on your calculator to check that you can correctly compute things with scientific notation.

1. $10^6 \times 10^{17} = 10^{23}$
2. $(1.42 \times 10^6) \times (3.08 \times 10^{17}) = 4.37 \times 10^{23}$
3. $(4 \times 10^{-6}) \times (7.3 \times 10^{23}) = 2.9 \times 10^{18}$
4. $(4 \times 10^{-6}) / (7.3 \times 10^{23}) = 5.5 \times 10^{-30}$
5. $(7.3 \times 10^{23}) / (4 \times 10^{-6}) = 1.8 \times 10^{29}$
6. $(1.42 \times 10^6) / [(3.08 \times 10^{17}) \times (4 \times 10^{-6})] = 1.15 \times 10^{-6}$