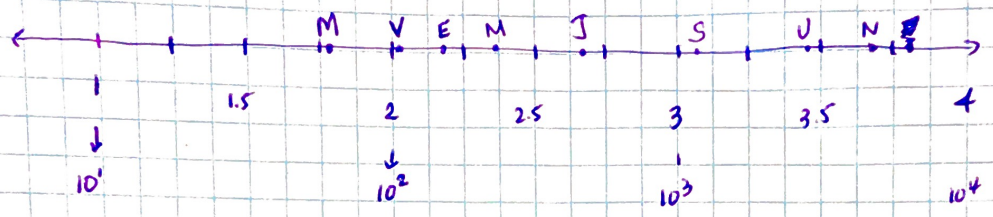
For quantities that vary greatly in magnitude, a standard scale of measurement is not always effective.

For example, our solar system

	Dis in mil km	
Mercury	58	1.76
Venus	108	2.03
Earth	150	2.18
Mars	228	2.36
Jupiter	779	2.89
Saturn	1430	3.16
Uranus	2880	3.46
Neptune	4500	3.65



Orders of Magnitude

When one quanity is roughly ten times larger than another, we say it is one order of magnitude larger.

Given two values A and B, to determine how many orders of magnitude A is greater than B

$$\text{Difference in orders of magnitude} = \log\left(\frac{A}{B}\right)$$

Moment Magnitude Scale

For an earthquake with seismic moment S, a measuement of earth movement, the mms value or magnitude of earthquake, is

$$M = \frac{2}{3}\log\left(\frac{S}{S_0}\right) \quad \text{where } S_0 = 10^{16}, \text{ baseline for seismic moment}$$

Ex1

If one earthquake has a mms magnitude of 6.0 and another has a magnitude of 8.0 How much more powerful is the second earthquake.

Earthquake 1

$6.0 = \frac{2}{3}\log\left(\frac{S}{S_0}\right)$

multiply by 3/2

$9 = \log\left(\frac{S}{S_0}\right)$

$10^9 = \frac{S}{S_0}$

$10^9 S_0 = S$

Earthquake 2

$8.0 = \frac{2}{3}\log\left(\frac{S}{S_0}\right)$

$12 = \log\left(\frac{S}{S_0}\right)$

$10^{12} = \frac{S}{S_0}$

$10^{12} S_0 = S$

$\frac{10^{12} S_0}{10^9 S_0} = 10^3 = 1000$ times more powerful!!