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Let's clear up two things from last time...

(1) Beer $\rightarrow$ Hogg claimed

$1 \text{ pint of beer} \approx \frac{1}{2} \text{ kg}$

Where did he get that?

$\text{Aside:} \quad 1 \text{ mL} = 1 \text{ cm}^3$

$\text{Density of water} \rightarrow 1 \text{ g/mL} \approx 1 \text{ g/cm}^3$
What did Hogg do (cont'd)?

- Yes 497
- No 0...?

Step 1: 1 kg = 1 L

\[ \frac{1 \text{ kg}}{1 \text{ L}} \times \frac{1000 \text{ g}}{1 \text{ kg}} \times \frac{1 \text{ L}}{1000 \text{ mL}} \]

Step 2: 2 pints = 1 L

How did he know this?

Ideas: Beer in Europe served by 333 cl or 500 cl.

He knows what a 1/2 L bottle of Orion or Polocock or whatever is.
Lunar eclipse aside...

Let's say that you can't see the shadow other than when it hits the moon.

How could the Greeks have known that the angular size of Earth's shadow is \( \approx 2.5 \) times the angular size of moon in sky?
Angular size...

Objects that appear smaller when they're further back subtend a smaller angle in your field of view.
Moral of the story:

Important to think about how people knew/measured stuff.

Because it gives you insight into how to do that yourself.

(& appreciation for what people were able to figure out in centuries past...)

The time to impact when a bucket of \( \text{H}_2\text{O} \) (10 L) is dropped from 3 stories up (in air) is calculated as follows:

\[
h = 10 \text{ m} \quad \text{(2nd thing from last time)}
\]

\[
g = 10 \text{ m/s}^2 \quad \text{(i.e. 10 m/s}^2)\]

\[
m = 10 \text{ kg}
\]

You seek a value whose units are seconds, i.e., time of impact.

\[
[S] = \ ? \quad \left[ \frac{g}{h} \right] = \text{m/s}^2 \quad \frac{m}{\text{s}^2} = \frac{1}{\text{s}^2}
\]

Not a lot of choice.
\[ [S] = \left[ \frac{h}{g} \right] = \frac{m}{m \cdot s^2} = \frac{1}{s^2} = s^2 \]

Need a sqrt

\[ [S] = \left[ \sqrt{\frac{h}{g}} \right] \]

*Novel of this story* ⇒ *Pay attention to units!*
Today's question:

What is the mass of the Earth?

* (about) 1 million kg

- 10^6 kg
- 10^12 kg
- 10^9 kg
- 10^24 kg
- 10^30 kg

Earth = H2O

density 1 kg/1 L ~ 1 g/cm³

Need $R_E$ (radius)

$V = \frac{4}{3} \pi R^3$
Known ~ 3000 mi $\rightarrow$ 5000 km

$\Rightarrow$ NYC $\rightarrow$ LAX (plane)

3 hr time difference

Circum $\Rightarrow$ 5000 km $\times 8$ (for 24 hrs) $= 40000$ km

$\Rightarrow$ Radius $\frac{40000}{\frac{6}{2\pi}} \approx 6.5 \times 10^3$ km

$\approx 6000$ km
\[
\begin{align*}
\frac{1 \text{ kg}}{1 \text{ L}} \times (6000 \text{ km})^3 & = 10^{12} \text{ kg} \times 6 \times 10^9 \text{ km}^3 \\
\frac{1000 \text{ cm}^3}{10^3 \text{ cm}^3} & = \frac{(10 \text{ cm})^3}{\left(\frac{1}{10} \text{ m}\right)^3} \\
1 \text{ km} & = 10^4 \text{ km}
\end{align*}
\]
Moral: You can figure out a lot of things from stuff in your experience. (Macy Gray, "The Problem")