THU 5 SEP 2013

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

(1) Beer → Hogg claimed

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

Where did he get that?

~~Density of water~~

Hogg invoked → Density of water → $\approx 1 g/mL$

$\approx 1 g/cm^3$

ASIDE: ∴ $1 mL = 1 cm^3$

What did Hogg do (cont'd) .....

Step 1: $\dfrac{1\,g}{mL} \overset{?}{=} \dfrac{1\,Kg}{1\,L} \left(\text{i.e.} \dfrac{1000\,g}{1000\,mL} \right)$

$\times 1000$ $\times 1000$

- Yes 497
- No 0 4

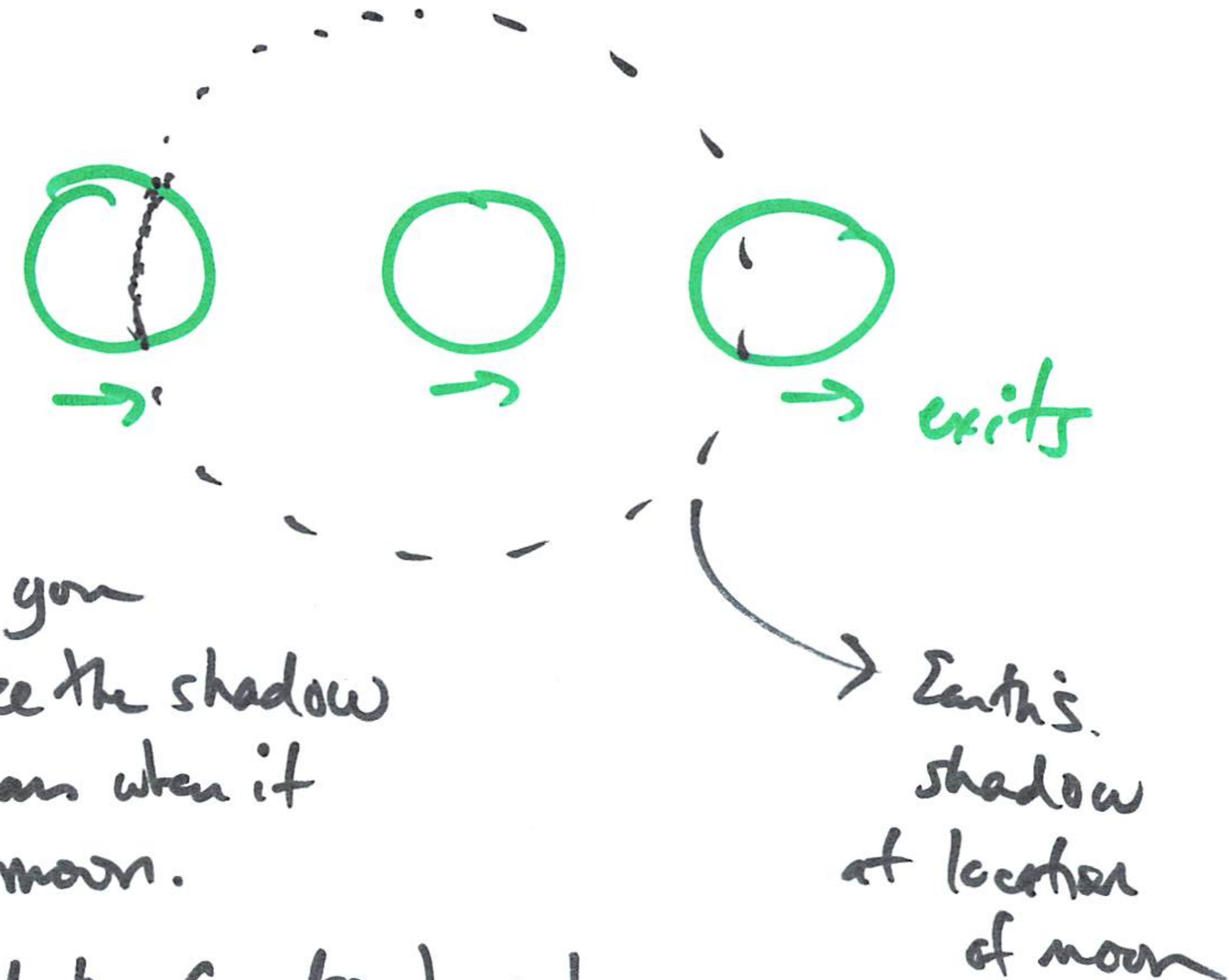
milli $= 10^{-3}$
kilo $= 10^{3}$

Step 2: 2 pints $\simeq$ 1 L

How did he know this?

Ideas:
- Beer in Europe served by 333cL or 500cL
- He knows what a ½L bottle of evian or polandspring or whatever is in volume & he compared.

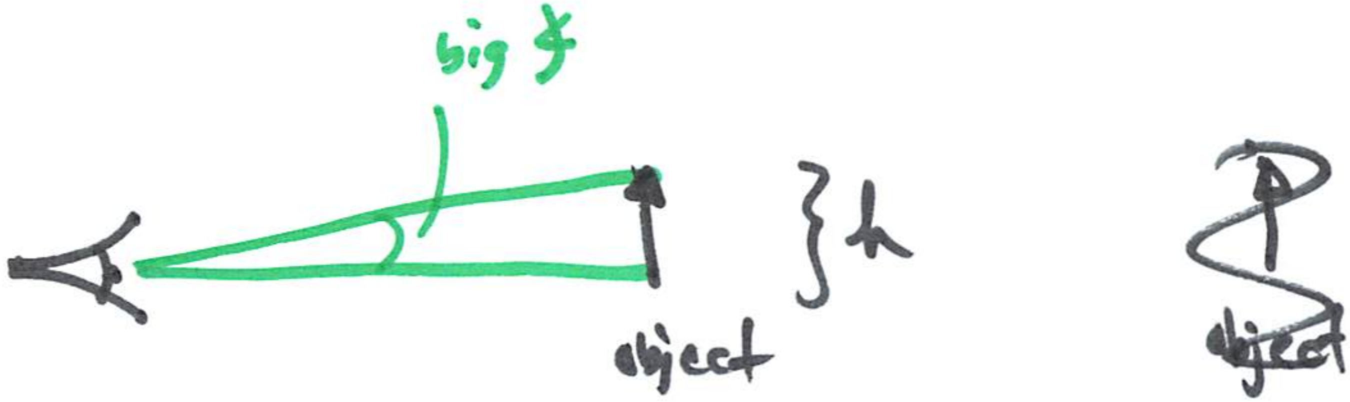
Lunar eclipse ASIDE..



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 ang. size of moon in sky?

Angular size...



Objects look smaller when they're further b/c they subtend a smaller angle in your field of view

<u>Moral of the story</u>:

Important to think about <u>HOW</u>
people know/measure stuff
b/c it gives you insight into
how to do that yourself
(& appreciation for what people
were able to figure out in centuries
past ...)

(2) time to impact when dropped from 3 stories up (no air)

(2nd thing from last time)

$h \approx 10\,m$

$g = 10\,m\,s^{-2}$ (i.e. $10\,m/s^2$)

$m = 10\,kg$ → 10 L bucket of H_2O

You seek a value whose units are seconds, i.e. t_{impact}

Not a lot of choice

$[S] = ?$ ← means "something w/ units of sec."

oops $\cancel{\left[\frac{g}{h}\right] = \frac{m \cdot s^{-2}}{m} = \frac{1}{s^2}}$

$$[s] \stackrel{?}{=} \left[\frac{h}{g}\right] = \frac{m}{\cancel{m}\cdot s^{-2}} = \frac{1}{s^{-2}} = s^2$$

$\neq$ Need a sqrt

$$[s] \stackrel{?}{=} \left[\sqrt{\frac{h}{g}}\right]$$

<u>Moral of this story</u> $\Rightarrow$ <u>Pay attention</u> <u>to units</u>!

Today's question:

What is the mass of the Earth? (≈ about)

X 0	A)	10^6 kg (1 million kg)
1% ~~5~~	B)	10^{12} kg
10%	C)	10^{18} kg
85%	D)	10^{24} kg
3%	E)	10^{30} kg

1% abstained

Earth ≈ H_2O

density $\frac{1\,kg}{1\,L}$

$\sim 1\,g/cm^3$

Need R_E → radius

$V = \frac{4}{3}\pi R^3$

Know ~ 3000 mi ⟶ 5000 km

⇒ NYC → LAX (plane)

3 hr time difference

× 8 b/c 24 hrs for "all the way around" Earth

Circumf ⇒ 5000 km × 8 (for 24 hrs) = 40000 km

⇒ Radius $\dfrac{40000}{2\pi \simeq 6} \simeq 6.5 \times 10^3$ km

$\simeq$ 6000 km

$$\frac{1\,kg}{1\,L} \times (6\,000\,km)^3$$

$1000\,cm^3$

$10^3\,cm^3$

$(10\,cm)^3$

$\left(\frac{1}{10}m\right)^3 \rightarrow \left(\frac{1}{10^4}km\right)^3$

$\frac{1}{1000}km$

$$\frac{10^{12}\,\cancel{kg}}{\cancel{km^3}} \times 6^3 \times 10^9\,\cancel{km^3}$$

$6^3 \times 10^{21}\,\cancel{kg}$

$\overset{\shortparallel}{200}$

$\boxed{2 \times 10^{23}\,kg}$

<u>Moral</u>: You can figure out a lot of things you don't know just from stuff in your experience. (MacGyver the problem)