(VERY) BIG NUMBERS

The Thirsty Archeologist Exercise

An archeologist was digging in a Paleozoic mudflat when she came across an imprint of a raindrop that fell 300 million years ago. She took a drink from her canteen. How many molecules of the original raindrop did she drink?

Some information:

water on Earth: 326 million cubic miles
1.36 x 10^9 cubic kilometers
1.36 x 10^24 cc

98 % of this water is in the Oceans
.001 % is in the atmosphere

1 cc water = 1 gram
1 drink = 100 grams
1 raindrop = 1 x 10^-1 grams

molecules in 1 gram of water: 6/18 x 10^23
3 x 10^22

Avogadro's number: 6 x 10^23

molecules of water on Earth = 4 x 10^46
molecules of water in drink = 3 x 10^24
molecules of water in drop = 3 x 10^21

size of random sample with one molecule from drop
= molecules on Earth / molecules in drop
= 1 x 10^25 molecules

So 1 molecule every 3 drinks.

Population of People on Earth: 6.5 billion

National debt of the USA: $9.5 x 10^12

Number of bytes sent over the Internet (per second): ?

Stars in our galaxy:	300 billion (3 x 10^11)
Galaxies in the Universe:	>100 billion
Weight of average star:	2 x 10^33 grams
Hydrogen molecules per average star:	1 x 10^57
Hydrogen molecules per average galaxy:	3 x 10^68
Visible matter in the Universe:	
All matter in the Universe:	20 x visible matter
Atoms in the Universe:	4-8 x 10^79 atoms of H
Age of the Universe:	14 billion years
Diameter of the Universe:	156 billion light years (Baez error) 92 billion light-years (Wiki)
Volume of the Universe:	3 x 10^80 cubic meters 3 x 10^86 cc
Diameter of H atom proton:	10^-15 meters 10^-13 centimeters
Protons packed in a cc:	10^39
Protons to fill entire Universe:	3 x 10^125

Ways to arrange protons packed into the Universe: (3 x 10^125)!

Sterling approximation: N! = (N/e)^N*sqrt[2PiN]

N/e = 10^125
2PiN = 2 x 10^126
sqrt[2PiN] = 10^63
N*sqrt[2PiN] = 3 x 10^188

(10^125)^(3 x 10^188) = 10^(3 x 10^(125x188))
10^(3 x 10^23500)

(10^23500) is 10 followed by 23500 zeros
10^(10^23500) is 10 followed by that many zeros.