

King of Dumbs

Level: ♦ Intermediate

How much is 7×10^{27} ? Huge numbers without fear

Scientific notation, SI prefixes from kilo to quetta, orders of magnitude, log scales and Fermi estimates, explained with grains of sand, in three levels.

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Scan to open the interactive lesson

<https://kingofdumbs.com/en/lessons/huge-numbers>

What you'll learn

- Scientific notation
- SI prefixes, from quecto to quetta
- Orders of magnitude and log scales
- Billion versus the Spanish billón
- Fermi estimation

Symbols you'll meet

E_a subscript: the label underneath (♠) · Σ sum: add them all up (♠) · x_i index i: item number i (♠) · Π product: multiply them all (♠) · $\approx$ approximately equal (♦♦) · $\leq \geq$ less or equal / greater or equal (♠) · $\neq$ not equal to (♠) · $|x|$ absolute value: drop the sign (♠) · $\cdot$ dot: multiply (or dot product) (♠) · $\Rightarrow \Leftrightarrow$ implies / is equivalent to (♠) · 10^{-3} negative exponent: divide (♦♦) · $\log$ logarithm: how many times do I multiply? (♠) · $\lfloor x \rfloor$ floor: round down (♠) · μ mu: micro (a millionth) or mean (♦♦) · $\in$ belongs to (♠) · $\mathbb{R} \mathbb{Z}$ sets of numbers (♠)

Your body holds about **7×10^{27} atoms**. You read it “seven times ten to the twenty-seventh”, and it’s a 7 followed by 27 zeros. The dumb question of this lesson is: **how much is that?**

Don’t worry if the number means nothing to you: it means nothing to almost anyone. In an experiment with adults, nearly half put “a million” right in the middle between a thousand and a billion, as if those words were evenly spaced. They aren’t, not even close. This lesson gives you four tools to make huge numbers mean something again: count the zeros, give them names, compare them on the right scale, and estimate them without a calculator.

Pick your card: ♠ if you’re starting from scratch, ♦ if a simple formula doesn’t scare you, ♠ if you want the notation. You can switch at any time.



Counting zeros: scientific notation

$$7.000000 = 7 \times 10^6$$

the point jumps 6 places left: +6

$$0.0003 = 3 \times 10^{-4}$$

4 places right: -4

Writing 7 followed by 27 zeros is awkward and easy to get wrong. **Scientific notation** fixes it: a **number in front**, between 1 and 10, times 10 raised to an **exponent**. The exponent tells you **how many places the decimal point moves**.

- $7,000,000 = 7 \times 10^6$: the point jumps 6 places to the left.
- $0.0003 = 3 \times 10^{-4}$: a negative exponent means the point jumps the other way. It's a small number, not a negative one.

To calculate, **multiplying adds the exponents** and dividing subtracts them: $(2 \times 10^3) \times (4 \times 10^5) = 8 \times 10^8$.

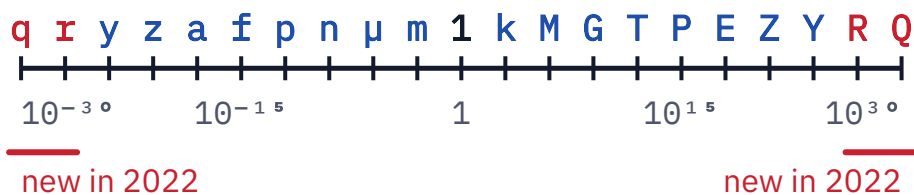
The decimals of the number in front tell you **how much you know**: 7×10^{27} means "about 7"; 7.0×10^{27} means "7, to a tenth".

Calculators and programs write the same thing **with an E**: $7e27$ is 7×10^{27} .



Giving them names: prefixes

each step: $\times 1,000$



h, da, d and c sit next to 1

A **prefix** is a word stuck in front of a unit that multiplies it by a power of ten. Each has a one-letter **symbol** (two for deca, *da*). The International System (SI) has 24.

Prefix	Symbol	Value
quetta	Q	10^{30}
ronna	R	10^{27}
yotta	Y	10^{24}
tera	T	10^{12}
giga	G	10^9
mega	M	10^6
kilo	k	10^3
milli	m	10^{-3}
micro	μ	10^{-6}
nano	n	10^{-9}

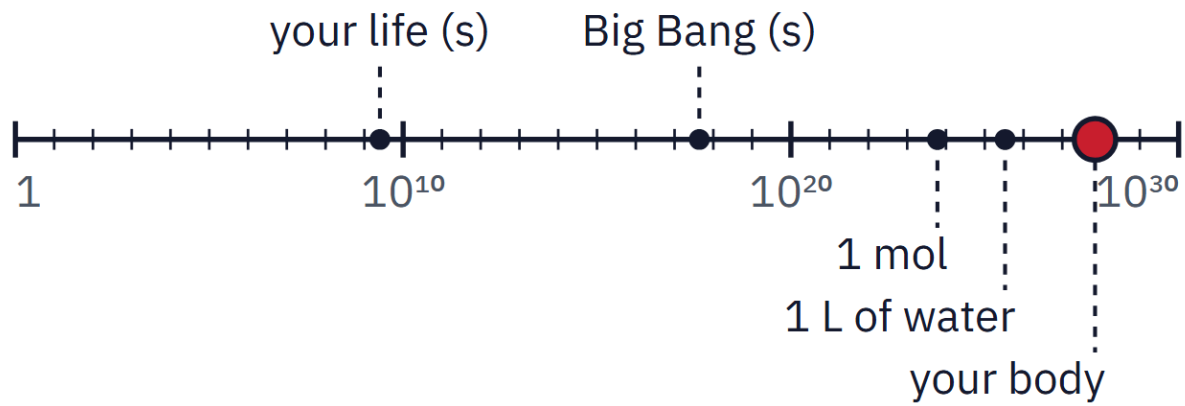
The four at the ends, ronna, quetta, ronto and quecto, were added in 2022, because the world's data will soon go past 10^{24} .

Two details matter:

- **Lower case and upper case** are not the same: m is milli (a thousandth) and M is mega (a million). Between 1 mm and 1 Mm there's a factor of a billion.
- **Kilo is always 1,000**. Computing sometimes uses "kilo" for 1,024, but there's a separate prefix for that, **kibi** (Ki). A **gibibyte versus a gigabyte** is 7.4% bigger.

The King of Dumbs says:

If a translated story says "un billón de dólares", count the zeros before panicking. It's a trillion, not a billion.



Number in front



Exponent (how many places the decimal point moves)



Seconds in 80 years

Seconds since the Big Bang

One mole (Avogadro constant)

Molecules in 1 litre of water

Atoms in your body

Written out 7,000,000,000,000,000,000,000,000,000

In scientific notation 7×10^{27}

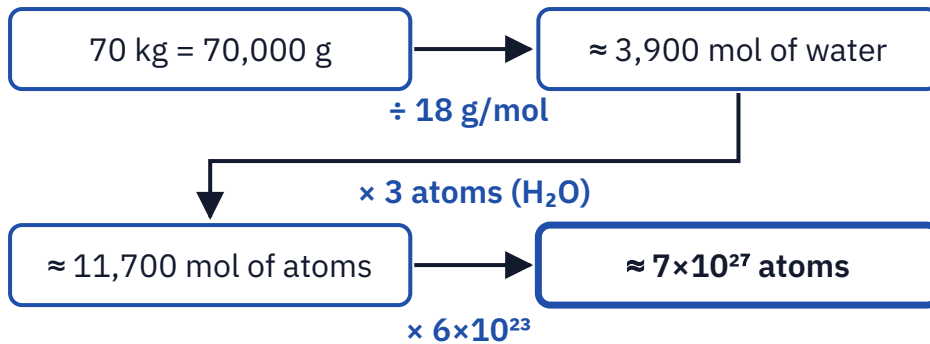
In words 7 octillion

Almost the same as the atoms in your body.



Interactive widget. Try it on the web: <https://kingofdumbs.com/en/lessons/huge-numbers>

Estimating without a calculator: the Fermi method



The Fermi method has four rules:

1. **Break the problem into factors** you can pin down.
2. If you don't know a factor, **bound it between a minimum and a maximum** that make sense and take a value in between.
3. Use **a single figure**: you're after the zeros, not the decimals.
4. **Check against something you know** at the end.

It works better than it looks because **errors partly cancel out**: if you overshoot on one factor and undershoot on another, the product gets closer.

Now, the question from the start: **where does 7×10²⁷ come from?** To count atoms you need the **mole**: a bundle of 6×10²³ things, the way a dozen is a bundle of 12. A mole of water weighs about **18 g**, and each water molecule has 3 atoms (two hydrogen and one oxygen).

Pretend a 70 kg person is all water: 70,000 g ÷ 18 g ≈ 3,900 moles of water, × 3 ≈ 11,700 moles of atoms, × 6×10²³ ≈ **7×10²⁷ atoms**. It matches the published estimate for the human body. With the real composition (more oxygen and carbon by mass, which are heavier) you get 6.7×10²⁷: the same number of zeros.



Final challenge

1. How many zeros does 10^6 have when written out?

- a. 10
- b. 6: it's a million
- c. 60

2. A Spanish news story says «3 billones de dólares». In English, that's...

- a. 3 billion dollars
- b. 3 trillion dollars
- c. 3 million dollars

3. On an ordinary ruler from 0 to a billion, where does a million land?

- a. Around the middle
- b. Stuck to zero: a thousandth of the way
- c. Near the end



In three sentences

1. Each zero is $\times 10$, and scientific notation counts them: 7×10^{27} is a 7 with 27 zeros, about seven octillion atoms, the ones in your body.
2. Prefixes name the zeros in threes (kilo, mega, giga... up to quetta), and in Spanish a *billón* is a million millions, not a billion.
3. To compare or estimate, count zeros: use a log scale when ratios matter, break the problem into factors and check you've got the order of magnitude right.



Sources

- SI prefixes: [NIST, metric prefixes](#) and [BIPM, CGPM 2022, Resolution 3](#) (ronna, quetta, ronto and quecto). Usage rules (inseparable symbol, no compound prefixes, kilogram, powers of 2): [BIPM, SI Brochure](#), section 3. Binary prefixes: [NIST](#).
- Billion, octillion and nonillion in US English: [Merriam-Webster](#). The Spanish billón: [DLE](#) and [Diccionario panhispánico de dudas](#).
- Order of magnitude and reference orders: [OpenStax, University Physics vol. 1, 1.1](#). Fermi estimates: [OpenStax, 1.5](#).
- How adults place large numbers: Landy, Silbert and Goldin, *Cognitive Science* 37, 775 (2013), [doi:10.1111/cogs.12028](#).
- Atoms in the human body: Freitas, [Nanomedicine I, 3.1](#), checked against our own calculation from the composition in [WebElements \(U. of Sheffield\)](#) and [CIAAW](#) atomic weights.
- Avogadro constant, exact: [NIST CODATA](#). Limits of a double: [MDN, Number.MAX_VALUE](#).
- Age of the universe (for the widget): Planck 2018, [arXiv:1807.06209](#), 13.787 ± 0.020 billion years, checked against [WMAP \(NASA\)](#), 13.77.

How this lesson was made: researched and written with help from Claude, from the sources above, checked and cross-checked against a second source on 13 October 2026. Numbers without their own link are calculations from them. The drawings are our own.

Answers

1. **b)** 6: it's a million. That's it: the exponent counts the zeros. 1,000,000.
2. **b)** 3 trillion dollars. Right. The Spanish billón is a million millions: your trillion.
3. **b)** Stuck to zero: a thousandth of the way. Exactly. A million is a thousandth of a billion. On a log scale, though, it does land in the middle.

A King of Dumbs lesson, kingofdumbs.com. Offline version; the original, with widgets you can play with, is at: <https://kingofdumbs.com/en/lessons/huge-numbers>

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