

Quantities every Physicist should know

Just as to understand the size and nature of numbers one needs to be fluent with multiplication tables, so to understand the size and nature of effects around us, one needs to know a few facts about the world. We list here a few that all Physicists should be familiar with. If you feel there are some missing from the list that you have found useful at times, please suggest them.

Physical Quantities

quantity	magnitude	unit	comment
Seconds per year	$\pi \times 10^7$	-	(Earth goes in circle)
Distance to Sun	8.3	light minutes	150 million km
Distance to Moon	1	light second	-
Radius of Earth	6.4×10^3	km	-
Mass Earth	6×10^{24}	kg	(optional to remember?)
Density water	10^3	kg/m ³	-
Density air	1.3	kg/m ³	STP
Avogadro's number	6.03×10^{23}	-	-
Boltzmann's constant	1.38×10^{-23}	J/K	(Gas constant too?)
Speed of light	3×10^8	m/sec	-
Speed of sound	3.3×10^2	m/sec	RTP
Planck's constant / 2π	1.05×10^{-34}	J.sec	(or without $/(2\pi)$)
Charge on electron	1.6×10^{-19}	Coulomb	-
Mass of proton	1.67×10^{-27}	kg	-
Wavelength of visible light	700 – 400	nm	(roughly; red laser 630nm)
Distance to closest star	4.2	light years	Alpha Centauri
Temperature of surface of Sun	6000	K	-
Solar flux incident on Earth	1.4	Kw/m ²	mid summer in tropics, no clouds
Acceleration due to gravity	9.81	m/sec ²	on surface of Earth
RTP	293, 10^5	K, Pa	Pa = 1 N/m ²
Specific heat water	4.12	J/(gm K)	\equiv 1 cal/(gm C) - high value

Estimation

No calculators or tables of constants allowed. Pencil & paper encouraged.

Answers are to be given either (i) in the form 10^x , where x is integer or half integer, that is give $\log_{10}(\text{answer})$, rounded to nearest half integer. This therefore accommodates answers like 1×10^5 or 3×10^{15} , since $3 \sim 10^{0.5}$, and so you are in effect rounding the prefactor to the powers of 10 to be 1, 3 or 10. Answering in this form encourages concentration on the big issues, and minimises distraction by spurious accuracy that is not illuminating; or (ii) if you feel more comfortable answers are to be given equivalently as e.g. 3×10^{15} or 1×10^9 etc.

The Master of estimation is Dr Sanjoy Mahajan, former fellow of Corpus and now a staff member at MIT, Cambridge, Mass. He has supplied many of our questions in the past and our questions are much in his style.

Some numbers are also very useful to remember, especially to be able to attack some seemingly impossible questions from Dr Mahajan:

number	magnitude
e	2.7
ln(10)	2.3
ln(2)	.69

Also useful can be:

$$\ln(x) = \ln(10) \times \log_{10}(x) \Rightarrow \log_{10}(x) = \ln(x)/\ln(10).$$