

mate the mass of a cell that has a diameter of $1.0 \mu\text{m}$, a human kidney, and a fly. Assume that a kidney is roughly a sphere with a radius of 4.0 cm and that a fly is roughly a cylinder 4.0 mm long and 2.0 mm in diameter.

69. The distance from the Sun to the nearest star is $4 \times 10^{16} \text{ m}$. The Milky Way galaxy is roughly a disk of diameter $\sim 10^{21} \text{ m}$ and thickness $\sim 10^{19} \text{ m}$. Find the order of magnitude of the number of stars in the Milky Way. Assume the $4 \times 10^{16}\text{-m}$ distance between the Sun and the nearest star is typical.
70. The data in the following table represent measurements of the masses and dimensions of solid cylinders of alu-

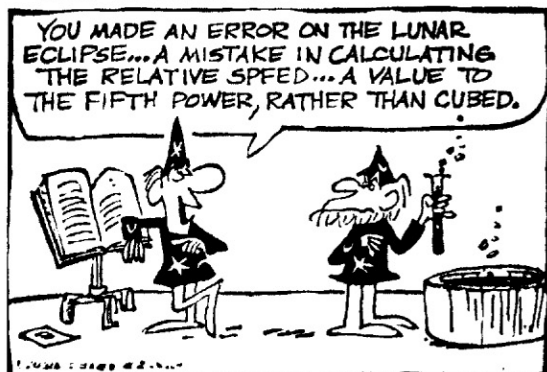
minum, copper, brass, tin, and iron. Use these data to calculate the densities of these substances. Compare your results for aluminum, copper, and iron with those given in Table 1.5.

Substance	Mass (g)	Diameter (cm)	Length (cm)
Aluminum	51.5	2.52	3.75
Copper	56.3	1.23	5.06
Brass	94.4	1.54	5.69
Tin	69.1	1.75	3.74
Iron	216.1	1.89	9.77

ANSWERS TO QUICK QUIZZES

- 1.1 False. Dimensional analysis gives the units of the proportionality constant but provides no information about its numerical value. For example, experiments show that doubling the radius of a solid sphere increases its mass 8-fold, and tripling the radius increases the mass 27-fold. Therefore, its mass is proportional to the cube of its radius. Because $m \propto r^3$ we can write $m = kr^3$. Dimensional analysis shows that the proportionality constant k must have units kg/m^3 , but to determine its numerical value requires either experimental data or geometrical reasoning.
- 1.2 Reporting all these digits implies you have determined the location of the center of the chair's seat to the nearest $\pm 0.000\,000\,000\,1 \text{ m}$. This roughly corresponds to being able to count the atoms in your meter stick because each of them is about that size! It would probably be better to record the measurement as 1.044 m : this indicates that you know the position to the nearest millimeter, assuming the meter stick has millimeter markings on its scale.

THE WIZARD OF ID



By Parker and Hart



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