Chapter 1 Self Test

I would expect that everyone reading this book has learned about the metric system, basic geometry, scientific notation, and unit conversions. It is my experience, however, that a disturbingly large fraction of Columbia students have not internalized these skills to the point where they can use them effortlessly in solving problems of the type they will encounter both in *Frontiers of Science* and later in life. I provide the following set of problems so that you may determine whether or not your skill-set is rusty and needs some polishing. Many of you need only glance through these problems to assure yourself you are ready. If you are out of practice, however, I suggest you take this self-test in order to identify what old textbooks you might want to spend a few hours with before September; the answers can be found below.

1. The Central Park Reservoir is surrounded by a well-worn jogging path about 1 km in length and is about 20 meters deep. How many cubic meters of water does it contain?

2. The metric system is designed so that water links its units of length, mass, and volume: 1 cm^3 = 1 ml = 1 gm. What is the total mass of the water in the Reservoir (in kg)?

3. If the Hydrogen in the H_2O has a mass of one unit and the Oxygen a mass of 16 units, and one (atomic mass) unit $= 1.67 \times 10^{-27}$ kg, how many Hydrogen atoms are there in the reservoir?

4. If we could recreate the conditions at the center of the Sun on Earth, we could use these hydrogen atoms to make energy by sticking four of them together to make helium (with the added benefit of cheaper helium balloons). For each helium atom produced, we would get 2.5×10^{-12} Joules of energy (it takes 100 Joules of energy each second to power a 100-Watt light bulb). How much energy would be produced if I converted all the hydrogen in the Reservoir to Helium?

5. Total energy use in the US is now roughly 4.4×10^{20} J/yr. How long would the Reservoir meet our energy supply (Now you see why engineers are anxious to make controlled fusion reactors work).

Answers

1. 1.6×10^6 m^3

2. 1.6×10^9 kg

3. 1.1×10^{35} atoms

4. 6.6×10^{22} Joules

5. roughly 150 years