

## Exercise 9

Due Tuesday, November 11, 5:00 pm

This exercise is intended to help you appreciate the extreme differences between different types of matter found in the universe. You will do this through calculations of the **densities** of various objects. The density of an object is simply the ratio of its mass to its volume. The official scientific unit of mass is the kilogram, while the official unit of volume is the cubic meter, so the official unit of density is kilograms per cubic meter, abbreviated  $\text{kg}/\text{m}^3$ .

For this exercise you will need a calculator—preferably a scientific calculator that can handle scientific notation. If you don't have such a calculator, or if you do but you don't know how to use scientific notation on it, you can either handle all the powers of 10 by hand (which isn't so hard), or work with a classmate, or ask someone else (such as your instructor) for help. Please round off all your answers to about two significant figures.

1. As you may know, a liter of water has a mass of one kilogram. A liter is the volume of a cube that is 1/10 of a meter across, so there are 1000 liters in a cubic meter (10 by 10 by 10). Use this information to calculate the density of water, in  $\text{kg}/\text{m}^3$ . Be sure to show your work. (Hint: Density is mass/volume. Take the volume to be one cubic meter.)
2. For the rest of this exercise you'll need to know the mass of the sun in kilograms. Look up the number and write it here, using scientific notation (e.g.,  $3 \times 10^8$ ).
3. Now calculate the volume of the sun using the formula

$$\text{volume of a sphere} = \frac{4}{3}\pi r^3,$$

where  $r$  is the radius of the sun in meters (which you should look up). Be sure to show your work.

