AST101: Our Corner of the Universe
Lab 6: Mass of the Earth prelab

Name:

Student number (SUID):

Lab section:

---

1 Introduction

For the most part in this class, we avoid relying heavily on mathematics, so that the concepts are what matter most. But math is the language in which most of science is written, and cannot be avoided entirely. In the lab we will do this week, you will calculate the mass of the Earth using a simple pendulum, but doing so will require a bit of mathematics. To help prepare you for the lab, this prelab will serve purely as a review of mathematics.

Materials

Something to write with and a calculator!

Objective

To refresh you on the math needed for this week's lab.

2 Scientific Notation

Often in science, the numbers we measure are quite large. We can create convenient units to describe them (like a light year), but sometimes there's just no avoiding very huge or very small numbers in your equations. To handle this, we've created a notation, called *Scientific Notation*. The notation works by writing a number as a multiple of a power of 10; for example, the number 1000 can be written as 1×10^3.

To write a number bigger than 1 in scientific notation, then you need to count the number of digits before the decimal point, move the decimal point to just after the first digit, and multiply by 10 raised to the number of digits. Maybe an example will help:

$$61238.12 = 6.123812 \times 10^4$$

Here, we found there were four digits before the decimal point (1, 2, 3, and 8). Then, we put the decimal point right after the first digit (6) to get 6.123812, then multiply 10 raised to the number of digits, so 10^4. As another example, $12345678.9 = 1.23456789 \times 10^7$.

Additionally, in science we often only know quantities to three or four digits of precision, and either don't know about or don't care about any of the less-significant digits. In this lab, you won't need to worry about more than three digits in any of your figures, and can thus keep only the digit before the decimal and the two digits after it, rounding the last digit. So, if you have the number 98765432.1, it is good enough for our purposes to write it as 9.88×10^7.

2.1 Practice with the Notation

Practice by writing the following numbers in scientific notation, rounding to three digits if appropriate:

1.)8675309

2.)1234

3.)604779386

4.)1068306.495

5.)1.0425

6.)55

2.2 Numbers Smaller Than 1

Scientific notation can also be used for very small numbers, i.e. numbers much smaller than 1. The rules are slightly different. You need to count the number of digits after the decimal point up to and including the first non-zero number, put the decimal point after that number, and multiply this by 10 raised to the negative of the digits you counted. For example

$$0.00008585438 = 8.585438 \times 10^{-5} \approx 8.59 \times 10^{-5}$$

Here, we counted to 5 digits (four 0s and the first non-zero digit of 8), put the decimal in front of the 8 to get 8.585438, and multiply by 10 raised to -5, because we counted 5! Likewise, $0.0055543 = 5.5543 \times 10^{-3}$.

2.3 Practice with Small Numbers

Practice by writing the following small numbers in scientific notation, rounding to three digits if appropriate:

7.)0.1

8.)0.022

9.)0.0004764

10.)0.000000001

11.)0.00008585438

12.)0.0055543

2.4 Math With Scientific Notation

Scientific notation not only makes numbers easier to write, it makes them easier to do multiplication or division with. To multiply a number in scientific notation, multiply the two numbers in front together, and multiply the result by 10 raised to the sum of the two previous powers of 10.

$$(5.543 \times 10^{6})(\times 4.44 \times 10^{-1}) = (5.543 \times 4.44) \times 10^{6+-1} = 24.61092 \times 10^{5} \approx 24.6 \times 10^{5}$$

Division works similarly; you divide the two numbers before the power of 10, then subtract the powers of 10.

$$\frac{9.752 \times 10^{-2}}{1.111 \times 10^{25}} = \frac{9.752}{1.111} \times 10^{-2-25} = 8.778 \times 10^{-27} \approx 8.78 \times 10^{-27}$$

2.5 Practice Calculations

Finish by calculating the following.

13.) $(4 \times 10^0) \times (5 \times 10^0)$

14.) $(1.2 \times 10^{-1}) \times (0.8 \times 10^1)$

15.) $(1.2 \times 10^1) \times (0.8 \times 10^{-1})$

16.) $\frac{7.55 \times 10^{1000}}{1.2 \times 10^{999}}$

17.) $\frac{(4.2 \times 10^2) \times (0.5 \times 10^1)}{0.7 \times 10^2}$

18.) $\frac{(1 \times 10^1) \times (2 \times 10^2)}{(3 \times 10^3) \times (4 \times 10^4)}$