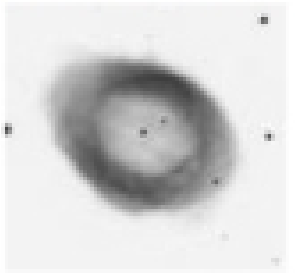
Appendix A: Math Review for Astronomy 101

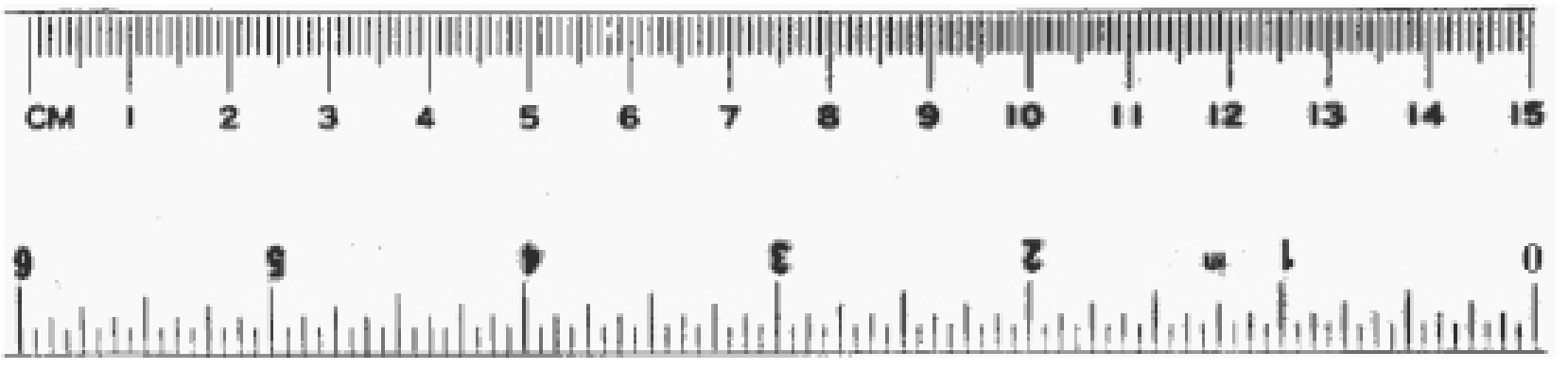
1. Measuring

We use the metric system (meter, kilogram, second) in astronomy. This system is so much easier than the inches, pounds, hours we use everyday that we're fairly sure that you'll wish we all used it all of the time!

Here's a good example of how convenient it is to measure in millimeters (mm) and centimeters (cm) versus inches.



At the left is an image of the Ring Nebula (a negative of what is left of a sun-like star). Measure the size of the full nebula both in the "longest" direction and then in the "shortest" direction. Ratio these two numbers to see how they compare. Now, measure the width of just one part of the "ring" part of the nebula (just the torus) and the white dwarf (what used to be the core of a sun-like star). How do these sizes compare? Isn't taking the ratio of 6 mm and 2 mm easier than taking the ratio of 5/32 and 1/16?



The standard is 1 meter:
1 kilometer = 1000 meters = 100 centimeters = 1000 meters = 1,000,000 micrometers = 1,000,000,000 nanometers
1 m = 0.001 km
1 cm = 0.01 m
1 mm = 0.001 m = 0.01 cm
1 μm = 0.000001 m
1 nm = 0.000000001 m; (10^{-9} m)

Here are some practice math problems. If you can do these problems, then you should not have any difficulties with the math in this class. If you do have some difficulties working through this exercise, then work with your classmates and your TA to refresh your math skills.

2. Scientific Notation

Convert these numbers between scientific and regular notation. Don't forget the units.

300,000 m/s
0.000325 m
5.08×10^{-7} kg
3.1536×10^{7} sec

2. Practice canceling units. Units cancel just as you would expect numbers to cancel.

Example: Simplify $\frac{m^3}{m} \cdot \frac{m^3}{m} = \frac{m \times m \times m}{m} = m \times m = m^2$

Simplify $\frac{m^5 \times kg}{kg^3 \times \sec}$

Simplify $\frac{m^2}{m^2/\text{sec}^2}$; remember $\frac{1}{1/\text{sec}} = \text{sec}$

Now for the long (but not hard) one:

Simplify $\frac{kg^4 \times m \times \text{sec}}{kg \times (m/\text{sec}) \times \text{sec}^2}$

3. Multiplying and Dividing using Scientific Notation

When multiplying using scientific notation, you need only multiply the numbers "out front" and then add the exponents.

Example: multiply $(3\times10^3)\times(2\times10^6) = 6\times10^{3+6} = 6\times10^{14}$

Your turn:

Multiply the following numbers, putting the product in correct scientific notation if necessary.

$(6\times10^2)\times(6\times10^5) =$ $(2.3\times10^4)\times(1.5\times10^2) =$

When dividing using scientific notation, you divide the numbers out front and subtract the exponent in the divisor from the exponent in the dividend.

Examples: divide $\frac{4\times10^8}{2\times10^6} = 2\times10^{8-6} = 2\times10^2$; harder one: $\frac{4\times10^8}{2\times10^{-3}} = 2\times10^{8-(-3)} = 2\times10^{11}$

Your turn:

$\frac{3.6\times10^6}{1.8\times10^6} =$ $\frac{3\times10^9}{2\times10^{-3}} =$ $1{,}000{,}000 \div 1{,}000 =$

4. More Practice

The distance between the Earth and the Sun is called the Astronomical Unit. It is approximately 150,000,000 km. The speed of light is approximately 300,000 km/sec. How many seconds does it take for the light from the Sun to reach Earth?

During the first 6 years of its operation, the Hubble Space Telescope circled the Earth 37,000 times, for a total of 1,280,000,000 km. Use scientific notation to find the number of kilometers in one orbit.

It takes the Hubble Space Telescope about 90 minutes to make one complete orbit. How fast is it traveling?

5. Just for Mathematical Enjoyment

____ 1. How many centimeters are there in one kilometer?
a. 100
b. 1000
c. 10,000
d. 100,000

____ 2. The average distance from Earth to the sun is called
a. 1 ly
b. 1 million km
c. 1 billion km
d. 1 Astronomical Unit

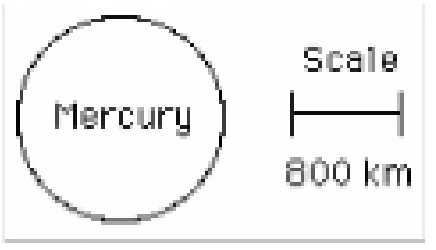
____ 3. The sun is
a. a star
b. 1 AU from Earth.
c. more than 100 times the diameter of Earth.
d. all of the above

____ 4. The radius of the moon's orbit is about 385,000 km. This is about ____ times larger than the radius of Earth.
a. 0.6
b. 6
c. 60
d. 600

____ 5. 2.9×10^7 is the same as
a. 29 thousand
b. 290 thousand
c. 2.9 million
d. 29 million

____ 6. 64,200,000,000 is equal to
a. 6.42×10^7
b. 6.42×10^{-7}
c. 6.42×10^{10}
d. 6.42×10^{-10}

____ 7. In this diagram, what is the diameter of Mercury?
a. about 160 km
b. about 1600 km
c. about 16,000 km
d. about 160,000 km



____ 8. 3.0×10^5 times 1.5×10^9 is equal to
a. 4.5×10^{-14}
b. 4.5×10^{14}
c. 2.0×10^4
d. 2.0×10^{-4}