Astronomy 110

HOMEWORK #2 – Spring Semester

Use a calculator whenever necessary.

For full credit, always show your work and explain how you got your answer.

Be careful about units!

Please CIRCLE or put a box around your final answer if it is numerical.

If you wish, you may discuss the questions with friends, but please turn in your own handwritten solutions, with questions answered in your own way.

Note: All of the stuff on the homework sets is important to know; the questions will give you valuable practice. Some of these questions may also appear on the exams. (However, computational questions on exams will not require the use of a calculator.) This homework set is being assigned early in order to give you a chance to brush up on the metric system, scientific (exponential) notation, and ratios – in case you’re rusty.

Common prefixes: kilo = 1000 = 10^3, mega = 1,000,000 = 10^6, milli = 1/1000 = 0.001 = 10^-3 = 1/10^3, centi = 1/100 = 0.01 = 10^-2 = 1/10^2. We will frequently use mega and occasionally micro = 10^-6 and nano = 10^-9.

Numbers such as 210,000 are written as 2.1 x 10^5 in scientific notation, because you need to move five spaces to the right of the decimal point in 2.1 to get 210,000. The number 0.00015, on the other hand, is written as 1.5 x 10^-4, because you need to move four spaces to the left of the decimal point in 1.5 to get 0.00015. Generally, you want to express quantities as a number between 1 and 10, multiplied by 10 raised to some integer (power).

Rules for manipulating numbers expressed with scientific notation: (1) To add or subtract numbers you first have to make sure the exponents are the same; (2) to multiply numbers you add the exponents; (3) to divide numbers you subtract exponents; and (4) to exponentiate numbers you multiply exponents. Remember that multiplications and divisions are done before additions and subtractions. Some Examples:

\[4 \times 10^4 + 6 \times 10^2 = (4 \times 10^4) + (6 \times 10^2) = (4 \times 10^4) + (0.06 \times 10^4) = 4.06 \times 10^4.\]

\[51000 \times 400 = (5.1 \times 10^4) \times (4 \times 10^2) = (5.1 \times 4) \times (10^4 \times 10^2) = 20.4 \times 10^{4+2} = 20.4 \times 10^6 = 2.04 \times 10^7.\]

\[(1.4 \times 10^8) / 200 = (1.4 \times 10^8) / (2 \times 10^2) = (1.4 / 2) \times (10^{8-2}) = 0.7 \times 10^6 = 7 \times 10^5.\]

\[(2 \times 10^3)^5 = 2^5 \times (10^3)^5 = 32 \times 10^{2 \times 5} = 32 \times 10^{10} = 3.2 \times 10^{11}.\]

Finally, it is useful to be familiar with the following symbols: ~ means “roughly” or “around”; ≈ means “approximately equal to” (like ~); ≥ means “greater than or equal to”; ≤ means “less than or equal to”; » means “much greater than”; « means “much less than”; ⊥ means “perpendicular to”; || means “parallel to”; and ∝ means “proportional to.”
Questions

1) Let’s practice using scientific notation.
   
   a) Write 845.78 in scientific notation, with only one digit to the left of the decimal point.

   b) Write $8.03 \times 10^{-6}$ as an ordinary string of digits (i.e. not scientific notation).

   c) A light year (ly) = $9.5 \times 10^{12}$ km. If the Andromeda galaxy is 2.2 million light years away, how many kilometers is this?

2) Suppose you wish to construct a scale drawing of the Universe. The Sun has an actual diameter of about $1.5 \times 10^6$ km, and you represent it by a dot the size of a period (0.5 mm in diameter). The average distance between stars in our region of the Milky Way Galaxy is about 5 light years. (Recall that 1 light year = $9.5 \times 10^{12}$ km.)

   a) What is the average distance between stars on the scale of your drawing? (Hint: use ratios, and keep track of units!)

   b) The Galaxy is about $10^5$ light years in diameter. How large is this on your scale?

   c) On this same scale, what is the distance to the Andromeda galaxy, about 2.2 million light years away? (This is the nearest large galaxy).
3) Geologists study different strata to determine conditions on Earth long in the past. For example, dinosaur bones are found in strata dating from 250 million to 65 million years ago. How is it that astronomers are able to study parts of the Universe as they were in the past?

4) Identify the following asterisms and any numbered stars or special objects:

a) asterism ____________________________

b) asterism ____________________________

Star 1 ____________________________

Star 2 ____________________________

Messier no. ____________________________

Messier name ____________________________

c) asterism ____________________________

Deep-sky object ____________________________
d) 

S_1

S_2

asterism

Star 1

Star 2

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e) 

asterism

Messier no.

Messier name

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f) 

asterism

Star 1

Messier no.

Messier name

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