

Homework #1 Solutions

Astronomy 10, Section 2

due: Wednesday, September 7, 2011

For the following problems, you must show your work in order to get credit.

- 1) The diameter of Earth is 7928 miles. What is this diameter in inches? In yards? If the diameter of Earth is expressed as 12756 km, what is its diameter in meters? In centimeters? Glve your answers in scientific notation.

Inches: (2 points)

$$D = 7928 \text{ miles} \times \frac{5280 \text{ ft}}{1 \text{ mi}} \times \frac{12 \text{ in}}{1 \text{ ft}} = 5.023 \times 10^8 \text{ in}$$

Yards: (2 points)

$$D = 7928 \text{ miles} \times \frac{5280 \text{ ft}}{1 \text{ mi}} \times \frac{1 \text{ yd}}{3 \text{ ft}} = 1.395 \times 10^7 \text{ yd}$$

Meters: (2 points)

$$D = 12756 \text{ km} \times \frac{1000 \text{ m}}{1 \text{ km}} = 1.2756 \times 10^7 \text{ m}$$

Centimeters: (2 points)

$$D = 12756 \text{ km} \times \frac{1000 \text{ m}}{1 \text{ km}} \times \frac{100 \text{ cm}}{1 \text{ m}} = 1.2756 \times 10^9 \text{ cm}$$

- 2) One astronomical unit is about 1.5×10^8 km. Explain why this is the same as 150×10^6 km.

To change 150×10^6 km to scientific notation, the leading number must be reduced to a number between 1 and 9.99999.... To do this, one must dDIVIDE by 100, yielding 1.50. In order to keep the entire quantity the same, one must then MULTIPLY the exponential part of the number of 100. This is equivalent to increasing the exponent from 6 to 8.

(2 points)

- 3) Light from the Sun takes 8 minutes to reach Earth. How long does it take to reach Mars?

The average distance between the Sun and Earth is 1 AU. The average distance between the Sun and Mars is 1.52 AU (see Table A-10). If light takes 8 minutes to reach the Earth, it will take 1.52 times that duration to reach Mars:

$$\frac{8 \text{ min}}{1 \text{ AU}} = \frac{t}{1.52 \text{ AU}}$$
$$t = \frac{8 \text{ min} \times 1.52 \text{ AU}}{1 \text{ AU}} = 12.2 \text{ min}$$

(2 points)

- 4) Use the fact that the speed of light is 3×10^5 km/s to determine how many kilometers are in a light-year. Use that number to then determine how many meters are in a light-year.

If light travels 3×10^5 km in one second, how far does it travel in one year? We can use the methods of unit conversion to answer this question, changing units of seconds to units of years:

$$\text{speed of light} = 3 \times 10^5 \frac{\text{km}}{\text{s}} \times \frac{60 \text{ s}}{1 \text{ min}} \times \frac{60 \text{ min}}{1 \text{ hr}} \times \frac{24 \text{ hr}}{1 \text{ day}} \times \frac{365 \text{ days}}{1 \text{ year}} = 9.4608 \times 10^{12} \frac{\text{km}}{\text{year}}$$

(2 points)

The definition of the light year is the distance light travels in one year which, as we can see from above, is 9.4608×10^{12} km.

Converting this to meters:

$$d = 9.4608 \times 10^{12} \text{ km} \times \frac{1000 \text{ m}}{1 \text{ km}} = 9.4608 \times 10^{15} \text{ m}$$

(2 points)

- 5) The nearest galaxy to our own is about 2 million light-years away. How many meters is that?

$$d = 2.0000 \times 10^6 \text{ light-years} \times \frac{9.4608 \times 10^{15} \text{ m}}{1 \text{ light-year}} = 1.8922 \times 10^{22} \text{ m}$$

(2 points)

6) The Summer Triangle: Use the sky charts in the back of your text to find the summer triangle. In doing so, make a sketch of what you see. Include, on your sketch, the answers to the following questions:

To get full credit for this problem, the stars in your sketch must be oriented correctly for the date, time, and direction specified. This will be different for different people.

Answers are checked against software that simulates the sky for the date/time/direction specified.

- a) What is the local time? (1 point)
- b) Approximately which direction were you facing when you made this sketch? (1 point)
- c) Sketch and label the stars comprising the summer triangle. Be sure to place them accurately with their relative separations well represented. (2 points)
- d) Measure the angular separation between each pair of stars using your hand (10 degrees) and thumb (2 degrees) for reference as described in class. Include these numbers in your sketch, making it clear which separation the number corresponds to. (2 points)
- e) Which of the three stars appears brightest to you? (1 point)