

AST 105IN ANSWERS TO ASSIGNMENT 3

Chapter 3.4, “A Universe of Matter and Energy”

Does it Seem Reasonable?

26. Not reasonable. The planet “target” is sooo small as to be beyond insignificant. More like infinitesimal.
27. Not reasonable. There is just too many. At about one name per second, how long would 100 billion seconds be? I don’t know, but a *million years* might be in the ballpark!
28. Reasonable. We’re doing it all the time and can only get better at it.

Quick Quiz (Remember, no rationalizations needed for Quick Quiz responses.)

44. c

Quantitative Problems

57. The best place to start is with the speed of light, c , given as 300,000 in km/s and 186,000 in mi/s. So...
- a. 1 light-second is simply 300,000 km or 186,000 mi.
- b. 1 light-minute requires 60 light-seconds, so 60 times each distance in part a or 18,000,000 km or 11,160,000 mi.
- c. 1 light-hour is 60 times longer than 1 light-minute, so equals 1,080,000,000 km or 669,600,000 mi.
- d. 1 light-day is 24 light-hours, so equals 25,920,000,000 km or 16,070,400,000 mi.

FYI, missions to Mars, measured in light-distance units, are ten to twenty light-minutes. The distance to the outer planets of our solar system is several light-hours. These numbers tell you how long in minutes and hours radio signals (a form of light) need to travel between spacecrafts/astronauts and Earth.

- 58a. Closest distance is 56×10^6 km. This is a distance = rate times time problem. The time is the distance divided by the rate. So, dividing 56×10^6 km by 3×10^5 km/s yields 18.7×10^1 or 187 s. Seconds is not so relevant a unit here, so we should convert to minutes (or minutes and seconds). This conversion reduces our answer by a factor of 60, yielding 3.12 minutes. Even better, convert to minutes and seconds. The quick and easy way is to recognize that 60 goes into 187 3 times with a remainder of 7. So $187 \text{ s} = 3 \text{ m } 7 \text{ s}$. The grind it out way is to determine how many seconds are represented by the 0.12 minutes beyond 3. That would be 0.12 of the way to 60 s or 7 s.
- b. The process is identical here for 400 million km. Here, the time is $400 \times 10^6 \text{ km} \div 3 \times 10^5 \text{ km/s} = 133.3 \times 10^1 \text{ s}$ or 1333 s. Seconds are even more inappropriate here, so we divide by 60 to get 22.22 m or 22 m 13 s.