Astronomy (Schroeder) Name _____

Exercise 6

Due Tuesday, February 24, 5:00 pm

1. Half-life. Radon-222 is a radioactive gas with a half-life of 3.8 days. It is a natural by-product of the decay of uranium, so it is present in trace quantities in many rocks and soils. Unfortunately, it can sometimes seep into buildings (especially basements) and pose a hazard to the occupants. In fact, it is the second-leading cause of lung cancer, after smoking. Suppose, then, that your basement contains 200,000 atoms of radon-222, but you then seal it off so no more radon can get in. About how long must you wait before there are less than 1000 radon atoms left? (To answer this question, compute the number of remaining radon atoms after 3.8 days, then 7.6 days, etc., until the number is below 1000. Be sure to show your work.)

2. Speed of light. Calculate the time required for light to travel to you from each of the following. Show your work clearly in each case, and round your answers to two significant figures.

(a) a friend's flashlight, one block (about 200 meters) away

(b) a mountaintop, 20 kilometers away

(c) the planet Mars at its closest, 56 million kilometers away.

3. Types of energy. Imagine the Space Shuttle blasting off and heading into orbit. During this process, the shuttle converts energy from one type into several other types.

(a) In what principal form is the energy stored before blast-off?

(b) Into what forms is the energy converted during the launch process?

(c) What happens to the energy when the shuttle re-enters the atmosphere and returns to earth?

4. Units of energy. Compute the approximate retail cost of one jelly donut (JD) of energy, if it is in each of the following forms. Show your work clearly in each case, rounding off all numbers to one or two significant digits. Refer to the assigned reading ("chapter1.pdf") for data and examples (but feel free to update the prices based on your own experience).

(a) gasoline

(b) natural gas

(c) electricity

(d) an actual jelly donut (no calculation necessary!)