1. Recently in this course we’ve discussed three distinct types of “nebulae” or gas clouds that are found among the stars. List these three types, name an example of each, explain how astronomers can tell the three types apart, and describe their roles in the life histories of stars.

2. Consider a main-sequence star that is 10 times as massive as our sun. As discussed in class, such a star is approximately 3000 times as luminous as the sun. Given that the sun’s main-sequence lifetime is about 10 billion years, estimate the main-sequence lifetime of this massive star. (Hint: First estimate how long it would last if it burned its fuel at the same rate as the sun. Then take into account its much greater rate of fuel consumption.)
3. The average density of our sun is only slightly greater than the density of water—about one gram per cubic centimeter. What will be its average density after it expands to become a red giant, roughly 100 times larger in diameter? What will be its average density after it has collapsed to become a white dwarf, roughly 100 times smaller in diameter than at present? (Since we’re just looking for rough estimates, you may neglect the fact that the sun’s outer layers will probably be lost before its core collapses to become a white dwarf.)

4. Now imagine a neutron star with the same mass as our sun and a radius of only 15 kilometers. By what factor is its diameter less than that of the sun? What is its density, in grams per cubic centimeter?

5. The principle of angular momentum conservation (“figure skater phenomenon”) implies that if an object becomes smaller by a given factor, its period of rotation (the time to spin once) will decrease by the same factor. The sun’s current period of rotation is about one month. What will be its period of rotation if it shrinks to the size of a white dwarf? What if it shrinks to the size of a neutron star?

6. Imagine that our sun were to suddenly collapse to form a black hole. (Such an event is highly unlikely! But we can always dream . . .) What would happen to the earth? (Hint: How big is the “horizon” of a one-solar-mass black hole?)