8-10)

Neutron stars are what are thought to cause *pulsars*. A pulsar is an astronomical radio source that emits pulses of radiation, as seen from earth. The regularity of the pulses initially caused the discoverers Jocelyn Bell Burnell and Antony Hewish to speculate that the signals were from another civilization. The pulses were so regularly spaced that it was thought that pulsars could be used as a time standard. However, it was soon seen that the rate of pulse emission slows, but then abruptly increases in events known as *glitches*.

The current model (highly simplified) for a pulsar is a neutron star, one in which the electrons have been pushed down into the nucleuses by extreme gravitational forces to combine with the protons to form neutrons. Material falling onto the surface of the neutron star gets superheated and shoots off in the form of a jet. If the jet doesn't co-incide with the rotational axis of the star, the jet will precess around the axis. If the earth happens to lie on the cone of precession, radiation will arrive at the earth and the pulsar can be detected. The pulsing effect is due to the fact that the jet only points at the earth once per precession. An analog is that of a lighthouse; although the beam is always on, one can see the beam only when it is pointing directly at the observer.

The slow decrease in pulse rate is due to the fact that the pulsar is emitting energy, some of which comes from the kinetic energy of rotation. As the star slows, the crust of the star is placed under stress. When the stain becomes too much, the surface breaks and resettles at a smaller distance from the center; this is called a *star-quake*. Since the mass of the star is now closer to the axis of rotation, the moment of inertia decreases and, much like the skater pulling in her arms, the angular speed increases.

A neutron star with angular speed $\omega_i = 70.4$ rad/sec experiences a glitch such that its angular speed increase by a factor $\Delta\omega/\omega_i = 2.01\times10^{-6}$. If the initial radius were 11km, by how much was the star's radius decreased?

Assume that the star is a uniform sphere if you like, although this assumption is not really necessary.