Problem Set #5

Due Friday, April 3 by 5pm to Dickinson 104

Unless otherwise indicated, all problems come from "The Cosmic Perspective," 8e

1. Problem 17.40 *Homes to Civilization* -- Choose ***two*** of the given stars to write about.
2. Problem 17.48 *Construction of Elements*
3. Problem 17.49 *Expansion of the Crab Nebula*
4. The table below lists 10 stages of star formation and evolution for low mass stars ($M < 8\ M_{\odot}$) and high mass stars ($M > 8\ M_{\odot}$) in no particular order.

(a) Planetary Nebula	**(f)** O spectral class main sequence star
(b) G spectral class main sequence star	**(g)** Large, diffuse Cloud of Gas and Dust
(c) Neutron Star	**(h)** White Dwarf
(d) Supernova	**(i)** Nova
(e) Red Giant	**(j)** Gravitationally Collapsing Cloud of Gas and Dust

   a. Rank, for earliest to latest, the stages for low mass stars *without* a companion. Do not include any stages that do not apply. Explain your ranking, with specific attention to stages included and excluded.
   b. Describe briefly what additions you could make to part (a) if the star had a lower-mass companion. Explain.
   c. Rank, from earliest to latest, the stages of high mass stars without a companion. Do not include any stages that do not apply. Explain your ranking, with specific attention to stages included and excluded.
5. Problem 18.50 *Neutron Star Density*
6. Problem 18.52 *The Crab Pulsar Winds Down*
7. A newly formed neutron star has a surface temperature of ~10^{12} K, but this surface temperature falls to ~10^{6} K within a few years.
   a. Using the Stefan-Boltzmann law, determine by what factor a neutron star's luminosity changes in these first few years. *(Note: assume that the neutron star doesn't change in radius.*)
   b. The faintest objects you can observe with your naked eye have a brightness of approximately 10^{-10} W/m^2. Given that the radius of a typical neutron star is 10 km, how close (in parsecs) would a neutron star have to be to be observable to the naked eye after it cooled to 10^{6} K?
   c. Do you think there are many stars visible to your naked eye that are neutron stars? Explain. (*Hint: Consult Table F.1 in Appendix F to help you think about this last part. How many* ***total*** *stars are within the distance you calculated in part (b)? Given that neutron stars are very rare, how many neutron stars do you think are visible to the naked eye?*)