Ay 7A - Fall 2009
Final Review Sheet
Given the constants and equations sheet, you should feel fairly comfortable solving these problems. as well as the problems on the first two review sheets.

Stellar Evolution and Death

1. What are the basic stages in the lifecycle of
   (a) low-mass stars
   (b) Sun-like (i.e. moderate mass) stars
   (c) high mass stars (and very high mass stars, aka superstars)
2. What is the basic evolutionary track in the H-R Diagram for (i.e. how does it move around the H-R Diagram)
   (a) low-mass stars
   (b) Sun-like (i.e. moderate mass) stars
   (c) high mass stars (and very high mass stars, aka superstars)

White Dwarfs, Neutron Stars, and Black Holes

1. What is degeneracy pressure? What astrophysical objects are held up against gravity by degeneracy pressure? Which particles are degenerate in each object? Which particles make up the majority of the mass of each object?
2. Consider a hypothetical new star that is supported by the degeneracy pressure from a new kind of fermion that has a mass $m = 10^{-2} m_n$ (and it only contains this fermion; i.e., no protons, no neutrons, etc.). Use scaling arguments to estimate
   (a) the radius of a 1 $M_\odot$ version of this star
   (b) the maximum possible mass for such a star
3. The sun started from a big ball of gas of 1 $M_\odot$ with radius 100 AU and will eventually end up as a WD. Check to see if energy is conserved.
4. Which star likely started its life with more mass, Sirius A or B given that Sirius B is currently a WD?
5. Are all pulsars neutron stars? Are all neutron stars pulsars?
6. The Crab nebula is powered by rotational kinetic energy from the central pulsar. Why does this imply that the neutron star's spin is slowing down? How does the spin period and the change in the spin period relate to the luminosity of the nebula?
7. All on the same graph, plot mass vs. radius for
   (a) white dwarfs
   (b) neutron stars
   (c) black holes (the radius of the event horizon)
8. Label your plot from above with the correct M vs. R scaling relations for each type of object and label the axes with actual values.
9. What are some ways we can observe BHs?

Accretion and Mass Transfer

1. Compare the differential tidal force experienced by an object of mass m near the event horizon of
   (a) a 4 $M_\odot$ BH
   (b) a 10^6 $M_\odot$ BH
2. What is a Roche lobe? What is the Roche Limit?
3. What is accretion? What is an accretion disk? Why do accreting objects shine?
4. How can we observationally determine the mass-transfer rate ($\dot{M}$) of an accreting object?
5. One place BHs are found is in "X-ray binaries". Does accretion onto a BH necessarily have to give rise to X-rays? What if the BH mass is $\gg M_\odot$ or the accretion rate is very small?