Problem Set #6

Due Friday, April 17 by 5pm to Dickinson 104

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

1. Problem 18.51 *Schwarzschild Radii*
2. Recent results of imaging the black hole at the center of our Galaxy has shown it to have an accretion disk – a disk of material slowly falling onto the black hole which will, one day, cross the event horizon. This accretion disk has been measured to be approximately 10^{-2} lyr across. If the Schwarzschild radius/event horizon of the 4 x 10^6 $M_\odot$ black hole at the center of our galaxy fills our classroom -- Dickinson 232 (dimensions approximately 10m x 10m), how big will its accretion disk be?
3. Consider a newly born star cluster with **10^6 total stars**. Use Figures 16.21 and 15.11 to answer the following questions.
    a. There are 261 total stars represented in Figure 16.21. Using the number in each "bin," construct a **fraction** of stars in each mass range (i.e. number of stars in each bin divided by the total number of stars in all bins). Record that fraction for each of the four bins on your problem set. You will use those fractions in parts (b) and (c) to find the *number* of stars in a cluster in each mass "bin."
    b. In a cluster with 10^6 total stars, how many stars will be high mass stars – those with a mass between 10 and 150 solar masses?
    c. In a cluster with 10^6 total stars, how many stars will be low mass stars – those with a mass between 0.08 and 0.5 solar masses?
    d. What is the **total luminosity** of all the highest luminosity stars in the cluster? Use the luminosity of a 60 $M_\odot$ star as the typical luminosity for a single high mass star.
    e. What is the **total luminosity** of all the lowest luminosity stars in the cluster? Use the luminosity of a 0.3 $M_\odot$ star as the typical luminosity for one of these stars.
    f. Using your results above and what you know about stellar evolution, explain why newborn star clusters are blue and why the color of the star cluster rapidly changes as it ages.
4. Problem 19.41 *Unenriched Stars*
5. Problem 19.44 *Future of the Milky Way*