PHYSICS 113
Assignment #8
SOLUTIONS

Chapter 15

13. Which is likely to be more common in our Galaxy -- white dwarfs or black holes? Why?

White dwarfs are much more common than black holes in galaxies. The reason for this is that black holes are the remnants (final states) of extremely massive stars (> 25 solar masses) while white dwarfs are the remnants of intermediate and low mass stars (< 10 solar masses). Nature favors the formation of low and intermediate mass stars **much** more than the formation of high mass stars. Thus, since extremely massive stars are quite rare, their remnants are also going to be quite rare.

Chapter 16

10. Consider the following five types of objects: (1) open cluster, (2) giant molecular cloud, (3) globular cluster, (4) group of O and B stars, and (5) planetary nebulae.
a) Which occur only in spiral arms?
b) Which occur only in the parts of the Galaxy other than spiral arms?
c) Which are thought to be very young?
d) Which are thought to be very old?
e) Which have the hottest stars?

a) **open clusters, giant molecular clouds, groups of O and B stars**
b) **globular clusters**
c) **groups of O and B stars, (possibly open clusters and giant molecular clouds)**
d) **globular clusters, (planetary nebulae are the end states of very old stars)**
e) **the central stars of planetary nebulae are the hottest stars known; open clusters (if they contain groups of O and B stars), groups of O and B stars, some molecular clouds also contain fairly hot stars**

14. Where in the Galaxy would you expect to find Type II supernovae, which are the explosions of massive stars and that go through their lives very quickly? Where would you expect to find Type I supernovae which involve the explosions of white dwarfs?

Type II supernovae will only be found in the disk (especially in the spiral arms and galactic bulge). The reason for this is that Type II supernovae are the result of the explosion of massive stars and that massive stars only live for very short periods of time. Thus for us to be able to observe a Type II supernova, we must be seeing the explosion of a young (massive) star that had (therefore) formed recently. The only region of the galaxy in which stars are still forming is the disk of the galaxy since there is an ample supply of gas and dust. The halo contains no more gas and thus all stars in the halo must be old (star formation is not occurring). **Type I supernovae can be found in both the disk and halo**. The reason for this is that Type I supernovae result from the collapse of white dwarfs in binary systems and these systems can be found in both globular clusters (i.e. clusters containing old stars that are found in the halo) and in binary systems that were formed somewhere in the disk of the galaxy.