Astronomy 120: Assignment 5, star death and black holes

1. The Crab Nebula is a supernova remnant and is now 2.7 parsecs in diameter. We observe a spectral line that is normally at 500nm to be at 502.3 nm. About when (which year) did the supernova occur? [6]

2. If a neutron star has a radius of 10 km and rotates 642 times a second what is the speed of the neutron star's surface as a fraction of the speed of light? [6]

3. Calculate the escape velocity of Saturn (the mass of Saturn is 5.7×10^{26} kg and its radius is 60,330 km). The radius of a black hole's event horizon (the Schwarzschild radius) is directly proportional to the mass of the black hole. If the Schwarzschild radius of a 1 solar mass black hole is 3 km, what is the Schwarzschild radius of a 10 solar mass star? What is the Schwarzschild radius of Saturn which has about 1/3500 of the mass of the sun? [6]

4. Use the internet to find a planetary nebula that has not been discussed in the lectures. Write down 3 properties of that particular nebula (e.g. size, distance, age etc.). Include the website(s) that you used to get this information. Over what stellar mass range do PN occur? [6]

5. Describe the 2 types of supernovae: how do they appear different in our observations and how do we believe that each type is formed? [6]