Homework 12

Problem 1 (5 points)

Reread the part about the Schönberg-Chandrasekhar limit in the chapter 13.1. Using Schönberg-Chandrasekhar limit estimate the mass of the iron core assuming that the mass of the star is 100 $M_\odot$ and that outside of the core material consist of ionized hydrogen only.

Problem 2 (5 points)

Assume that outer layers of the star from above are blown away and all we left is the isothermal iron core with temperature 10^8 K. At what size of the core electrons degeneracy pressure overcomes the ideal gas pressure? Make the same calculation for neutron degeneracy pressure.

Problem 3 (5 points)

Assuming ingoing collapse, will the core from the above problem able to resist gravitational collapse?

Problem 4 (5 points)

Derive the exact formula for degeneracy pressure due to relativistic ($v = c$) fermions similar to eq. 16.15, though, express final answer via mass of fermion particle m_f and its density n_f. Assume temperature of the gas to be zero.

Problem 5 bonus (5 points)

The section 15.3 of the text book describes observations of SN 1987A neutrinos arrival. Neutrinos arrive to Earth 3 hours before photons hit the Earth. How would you explain that light, which is supposedly the fastest, was beaten by neutrinos?