Homework 11

Problem 1 (5 points)

We derived the free fall time (eq. 12.26). Find how long does it take to contract a cloud to half of it initial size. Assume no rotation, express your answer as fraction of total free fall time. Hint: you will need to solve a numerical equation.

Problem 2 (5 points)

Solve problem 12.18 from the textbook. Hints: In (a) collapse stops when velocity is zero, not when the centripetal acceleration equals to gravity pull. Assume that moment of inertia does not change in a,b, and c subproblems, also treat inner mass as spherical object from the gravitational pull point of view.

Problem 3 (5 points)

Assuming (incorrectly) that solar radiation is all in ultraviolet, find how large would be the radius of the H II emission bubble if the Sun is placed in the middle of hydrogen cloud with density of hydrogen is 10^8 m^{-3} and the recombination coefficient $\alpha = 3 \times 10^{-19}$ m^3 s^{-1}. Express your answer in parsecs.

Problem 4 (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 5 (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 6 (5 points)

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