Homework Unit 0

Pols → Exercises 1.1 , 1.2 and 9.2

Calculate Jeans ' mass for an average molecular cloud. Typically, molecular clouds have masses on the order of 1000 M_{Sun} or more, temperatures on the order of 10 K and number densities of approximately 1000 H_2 molecules per cm^3 . Discuss the results vis - - vis star formation.

Calculate the free - fall time for a one-solar -mass molecular cloud.

Find the mean molecular weight μ for completely ionised plasma containing metals with a mass fraction of hydrogen equal to X and a mass fraction of helium equal to Y .

(a) Estimate the *flight time* of a photon from the centre to the surface of a red giant star with M = $1M_{Sun}$ and R 100 R_{Sun}, neglecting the absorptions that may occur during the flight. (b) Estimate the photon flight time taking into account the interactions (absorption and scattering) in the stellar interior. Compare your result with the corresponding results for the Sun

Consider a large 10^4 M_sun molecular cloud with a H_2 density of n_H2 = 5 x 10^9 m^-3, at a temperature of 200 K. Inside this cloud, there is a dense core with a mass of 5 M_sun at a temperature of 10K. Assuming that the core is uniform in density, spherical in shape, and is in pressure equilibrium with the cloud, find the density in the core (in m^-3) and the radius of the core (in pc).

- The core will collapse if the the total gravitational energy is greater than the thermal energy

$G M^2 / R > M kT / \mu m_H$

where the mean molecular mass of H_2 is μ = 2. Will this core collapse?

- For our 10 K cloud core with the density determined above, what is this minimum mass (in M_sun) for collapse?
- Assuming that it can collapse no faster than the free-fall time, what is the minimum number of years it will take to collapse (assume it collapses effectively all the way to a point for this calculation)?