ASTR 680 Practice questions for lecture 10: Accretion Disks

1. Show that for a particle in a Newtonian orbit with a given angular momentum, the lowest-energy state is a circular orbit. This motivates the claim that dissipation will tend to put fluid elements into nearly-circular orbits.

2. Do a toy problem to determine whether accretion can happen. Start with two particles, both of mass m and both in a circular orbit of radius r around the same star, which we assume has mass $M \gg m$. Suppose that there is some angular momentum exchange, so that particle 1 is now in a circular orbit at $r + \epsilon$, where $\epsilon \ll r$. In the Newtonian approximation:

a. Determine the new orbital radius of particle 2, if after the exchange it is in a circular orbit and the sum of the angular momenta of the two particles is the same as before the exchange.

b. Using your answer, compare the new energy of the system with the old energy (when both particles were in the same orbit). What is the condition for such evolution to be favorable? Do your expressions indicate that the condition is met?