LAST HOMEWORK!

Density period relation at onset of mass transfer

$R_1 \sim R_{L1}$; $q = \dfrac{M_2}{M_1} \Rightarrow M_2 = qM_1$

Eggleton's formula: $R_{L1} \simeq a \cdot \dfrac{0.49q^{2/3}}{0.6q^{2/3} + \ln(1+q^{1/3})}$

Need to find $a \Rightarrow$ Kepler's 3rd Law: $a^3 = \dfrac{G(M_1+M_2)P^2}{4\pi^2} = \dfrac{GM_1(1+q)P^2}{4\pi^2}$

$$\rho_1 = \frac{3M_1}{4\pi R_1^3 \sim R_{L1}^3} \simeq \frac{3M_1\left(0.6q^{2/3} + \ln(1+q^{1/3})\right)^3}{4\pi\left(a \cdot 0.49q^{2/3}\right)^3} \text{ (sub in Eggleton's)}$$

(sub in a^3)

$$\simeq \frac{3}{4\pi} \frac{M_1\left(0.6q^{2/3} + \ln(1+q^{1/3})\right)^3}{\left[\left(\frac{GM_1(1+q)P^2}{4\pi^2}\right)^{1/3}\right]^3 (0.49q^{2/3})^3}$$

$\Rightarrow \rho_1 \propto P^{-2} \cdot \underbrace{\text{other stuffs (ignore all const.)}}_{q\text{ denpendent}} = \dfrac{\left[0.6q^{2/3} + \ln(1+q^{1/3})\right]^3}{q^2(1+q)}$