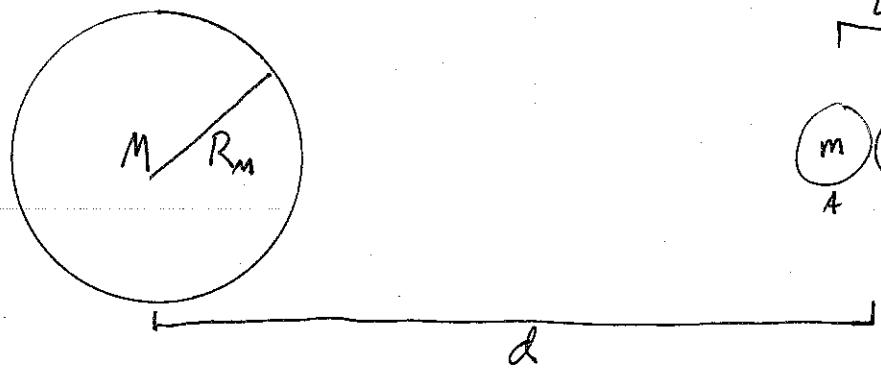
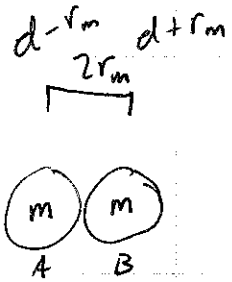
- HW9 ✓
- Exam3 ✓
- HW10
- Observing Assignment ✓
- Final Exam: Monday May 19th 9AM Uris ✓
- Grades + Evaluations ✓

Roche limit





Force between 2 masses $F = \frac{GMm}{(2r_m)^2}$

Tidal force on objects

$$\Delta F = F_A - F_B = \frac{GMm}{(d-r_m)^2} - \frac{GMm}{(d+r_m)^2}$$

$$= \frac{GMm}{d^2(1-\frac{r_m}{d})^2} - \frac{GMm}{d^2(1+\frac{r_m}{d})^2}$$

$$= \frac{GMm}{d^2}\left((1-\tfrac{r_m}{d})^{-2} - (1+\tfrac{r_m}{d})^{-2}\right)$$

$r_m \ll d$ so use $(1+x)^a \sim 1+ax$

$$= \frac{GMm}{d^2}\left(\left(1+\tfrac{2r_m}{d}\right) - \left(1-\tfrac{2r_m}{d}\right)\right)$$

$$= \frac{GMm}{d^2}\left(\frac{4r_m}{d}\right) = \frac{4GMmr_m}{d^3}$$

equate F and ΔF

$$\frac{Gm^2}{(2r_m)^2} = \frac{4GMmr_m}{d^3} \qquad d^3 = 16 r_m^3 \frac{M}{m} \Rightarrow d \sim 2.52\, r_m \left(\frac{M}{m}\right)^{1/3}$$

$$d \sim 2.52 r_m \left(\frac{M}{m}\right)^{1/3}$$

$$M = \frac{4}{3}\pi R_M^3 \rho_M \qquad m = \frac{4}{3}\pi r_m^3 \rho_m \qquad \frac{M}{m} = \frac{R_M^3 \rho_M}{r_m^3 \rho_m}$$

$$\sim 2.52 r_m \left(\frac{R_M^3 \rho_M}{r_m^3 \rho_m}\right)^{1/3} \sim 2.52 R_M \left(\frac{\rho_M}{\rho_m}\right)^{1/3}$$