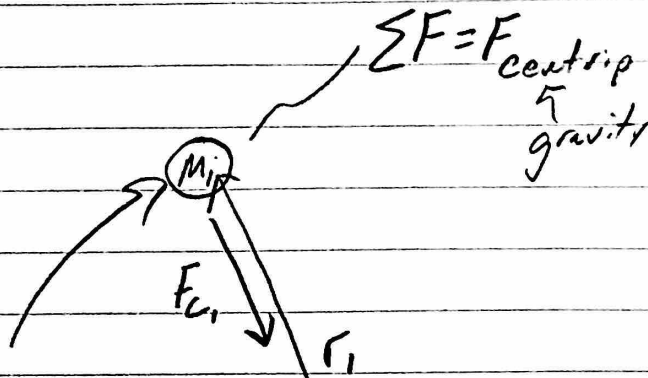


Centripetal force (gravity here)

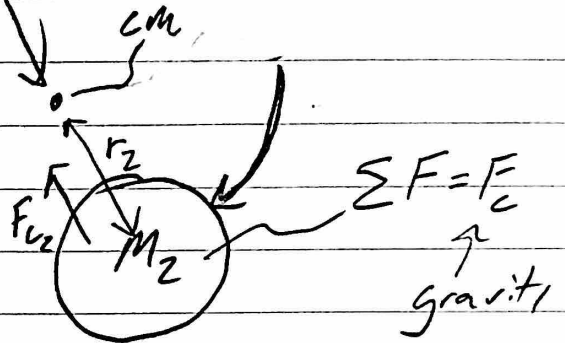
$$F_c = \frac{Mv^2}{r}$$

r - radius of orbit



By Newton's 3rd law,
 $F_{c1} = F_{c2}$ (sort of like tension)

↑ ↑
 gravitational pulls equal



$$\frac{M_1 v_1^2}{r_1} = \frac{M_2 v_2^2}{r_2}$$

Since rpm is equal for both masses,
 $\frac{v_2}{v_1} = \frac{r_2}{r_1}$ speed proportional to radius

Substitute

$$v_2 = \frac{r_2 v_1}{r_1}$$

$$\frac{M_1 v_1^2}{r_1} = \frac{M_2 r_2^2 v_1^2}{r_1^2}$$

$$\frac{M_1}{r_1} = \frac{M_2 r_2^2}{r_1^2} \Rightarrow M_1 = \frac{M_2 r_2^2}{r_1} \Rightarrow \boxed{\frac{M_1}{M_2} = \frac{r_2}{r_1}}$$

$$\boxed{r \propto \frac{1}{m}} \leftarrow \boxed{r_1 m_1 = r_2 m_2}$$