Newton's Law

$$\vec{F}_{\text{on } m \text{ due to } M}(\vec{r}_m) = -G\frac{M\cdot m}{|\vec{r}_m-\vec{r}_M|^2}\underbrace{(\vec{r}_m-\vec{r}_M)}_{\vec{r}}$$

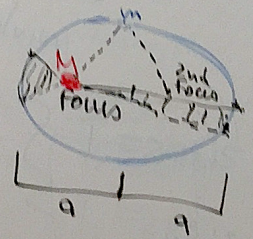
$$\vec{a}_{\text{of } m \text{ due to } M} = -G\frac{M}{|\vec{r}_m-\vec{r}_M|^2}\hat{r}$$

$$U_{\text{grav}} = -G\frac{M\cdot m}{|\vec{r}_m-\vec{r}_M|}$$

KEPLER

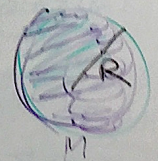
1) All closed orbits are ellipses
2) Angular momentum $\vec{L} = m\cdot\vec{r}\times\vec{v}$ conserved
3) $T^2 \sim a^3$ $\quad T \sim a^{3/2}$

Period of full revolution



Office Hours: Fri 11:00 and Tue 11:00 Learning Ctr

2 more relevant findings of Newtonian gravitation



$$U_{pot} = -\frac{3}{5}G\frac{M^2}{R}$$

Virial Theorem: $T_{kin} = \frac{1}{2}|U_{pot}|$

collection of pre-moving, permanently bound masses