Kepler's 3rd Law

$$\frac{r_1^3}{T_1^2} = k$$

$$k = \frac{r_2^3}{T_2^2}$$

r, T

$$\therefore \quad \frac{r_1^3}{T_1^2} = \frac{r_2^3}{T_2^2}$$

Universal Gravitation

$$F = Gm_1m_2/r^2$$

F, r m_1, m_2

$$F = F_w$$

$$Gm_1m_2/r^2 = F \quad \text{and} \quad F_w = m_2g$$

$$Gm_1\cancel{m_2}/r^2 = \cancel{m_2}g$$

g,r m_1

$$g = Gm_1/r^2$$

$$F = F_c$$

$$F = Gm_1m_2/r^2 \qquad F_c = m_2a_c$$

$$F_c = m_2v^2/r$$

$$Gm_1m_2/r^2 = m_2v^2/r$$

$$Gm_1\cancel{m_2}/\cancel{r^2} = \cancel{m_2}v^2/\cancel{r}$$

v,r m_1

$$Gm_1/r = v^2$$

$$v = \sqrt{Gm_1/r}$$

$$F = F_c$$

$$F_c = m_2 a_c$$

$$F_c = m_2 v^2/r$$

$$F = Gm_1m_2/r^2 \quad \text{and} \quad F_c = m_2 4\pi^2 r/T^2$$

$$Gm_1m_2/r^2 = m_2 4\pi^2 r/T^2$$

$$Gm_1\cancel{m_2}/r^2 = \cancel{m_2} 4\pi^2 r/T^2$$

$$r^3/T^2 = Gm_1/4\pi^2$$

r, T m_1

$$r^3/T^2 = k = Gm_1/4\pi^2$$

$v = \frac{d}{t} = \frac{c}{T} = \frac{2\pi r}{T}$

$v = \frac{2\pi r}{T}$

$a_c = \frac{v^2}{r}$

$a = \frac{v^2}{r} = \frac{(2\pi r/T)^2}{r}$

$a_c = \frac{4\pi^2 r}{T^2}$

$\Sigma f_c = ma_c$ $\quad F \propto a$

$a = \frac{v^2}{r}$

$f_c = \frac{mv^2}{r}$ $\quad F \propto mvr$

$F = ma$

$a = 4\pi^2 r/T^2$

$f_r = \frac{m4\pi^2 r}{T^2}$ $\quad f \propto mrT$

$F = ma$

$f_w = mg$

$F = \frac{mv^2}{r}$

$F = \frac{m4\pi^2 r}{T^2}$

$F = \frac{Gm_1m_2}{r^2}$

$mg = F_w$

$= \frac{Gm_1m_2}{r}$

$g = \frac{Gm_1}{r^2}$

$\frac{mv^2}{r} = F$ $\quad f = \frac{Gm_1m_2}{r^2}$

$v = \sqrt{\frac{Gm_1}{r}}$

$\frac{m4\pi^2 r}{T^2} = F$ $\quad f = \frac{Gm_1m_2}{r^2}$

$\frac{r^3}{T^2} = \frac{Gm_1}{4\pi^2}$

$F = \frac{G m_1 m_2}{r^2}$ F $F \sim \frac{1}{r^2}$

$g = \frac{G m_1}{r^2}$ g $g \sim \frac{1}{r^2}$

$v = \sqrt{\frac{G m_1}{r}}$ v $v \sim \frac{1}{\sqrt{r}}$

$\frac{r^3}{T^2} = \frac{G m_1}{4\pi^2}$ T