Planetary Mechanics

$K = \frac{r^3}{T^2}$ (unique for a given central body)

$F_g = \frac{Gm_1m_2}{r^2}$ $\left(F_g = mg\right)$

m_1 - mass of central body

m_2 - smaller/orbiting object

Newton's Hypothesis: $F_g = F_c$

ex: $\frac{Gm_{sat}m_{earth}}{r^2} = \frac{4\pi^2 m_{sat} r}{T^2}$ ← mass in F_c is the orbiting object

$r^3 = \frac{Gm_{earth}}{4\pi^2} T^2$ → mass of the central body

$\left(r^3 = K T^2 \right)$ ← Kepler's Law

A graph of r^3 vs T^2 will be linear with a slope of $K = \frac{Gm_{earth}}{4\pi^2}$ ← could be any central body

or the proportionality constant for $r^3 \propto T^2$

Using proportionalities:

By what factor will F_g change if one mass is doubled, the other is quadrupled and the separation is tripled?

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

$$F_g' = \frac{G(2m_1)(4m_2)}{(3r)^2}$$

$$F_g' = \frac{8}{9}\frac{Gm_1m_2}{r^2} \leftarrow F_g$$

$$F_g' = \frac{8}{9}F_g$$