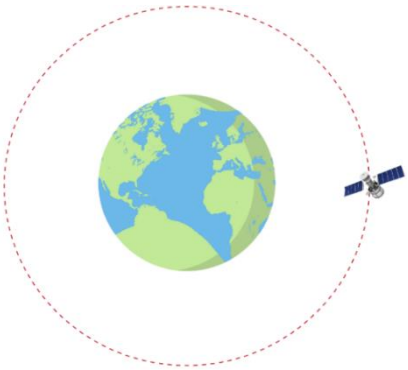
CONCEPT: Kepler's Third Law

● For any circular orbit, the orbital period (**T**) *squared* is proportional to the orbital radius (**r**) *cubed*.

T^2 = _____

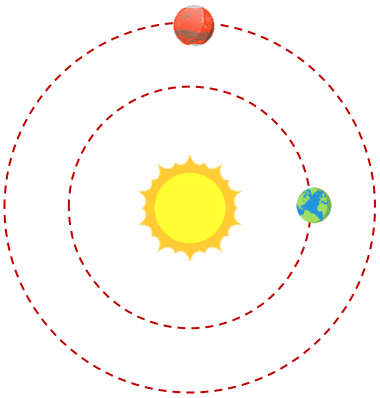


- The relationship between **r** and **T** depends only on (**M | m**).

- If you're given 2 out of 3 (**M, r *or* h, T**) use Kepler's 3rd Law!

● If 2 objects orbit the same mass **M**, their ratios $\frac{r^3}{T^2}$ are a _____ and are _____.

_____ = _____



- Units can be non-SI when comparing, as long as they are consistent.

EXAMPLE: Jupiter orbits once every 11.86 years and orbits at a distance of 5.2 AU, where 1 AU is the average distance between Earth and the Sun. If Neptune's orbital distance from the Sun is 30.11 AU, how long does it take to complete its orbit (in years)? Calculate **without** using M_{SUN}.

EQUATIONS	GRAV. CONSTANTS
$F_G = \frac{Gm_1m_2}{r^2}$ $\quad r = R + h$ $g = \frac{GM}{r^2}$ $\quad g_{surf} = \frac{GM}{R^2}$ $T_{sat}^2 = \frac{4\pi^2 r^3}{GM}$	$G = 6.67\times10^{-11}\ \frac{m^3}{kg\cdot s^2}$ $M_E = 5.97\times10^{24}$ kg $R_E = 6.37\times10^{6}$ m

PRACTICE: Io and Ganymede are two of Jupiter's four Galilean moons. Io orbits at an average distance of 422,000km in 1.77 days. What is Ganymede's average orbital distance (in km), if it takes 4 times longer to orbit Jupiter?

EQUATIONS	GRAV. CONSTANTS
$F_G = \frac{Gm_1m_2}{r^2}$ $\quad r = R + h$ $g = \frac{GM}{r^2}$ $\quad g_{surf} = \frac{GM}{R^2}$ $T_{sat}^2 = \frac{4\pi^2 r^3}{GM}$ $\frac{r_1^{\,3}}{T_1^{\,2}} = \text{constant} = \frac{r_2^{\,3}}{T_2^{\,2}}$	$G = 6.67\times10^{-11}\ \frac{m^3}{kg\cdot s^2}$ $M_E = 5.97\times10^{24}$ kg $R_E = 6.37\times10^{6}$ m