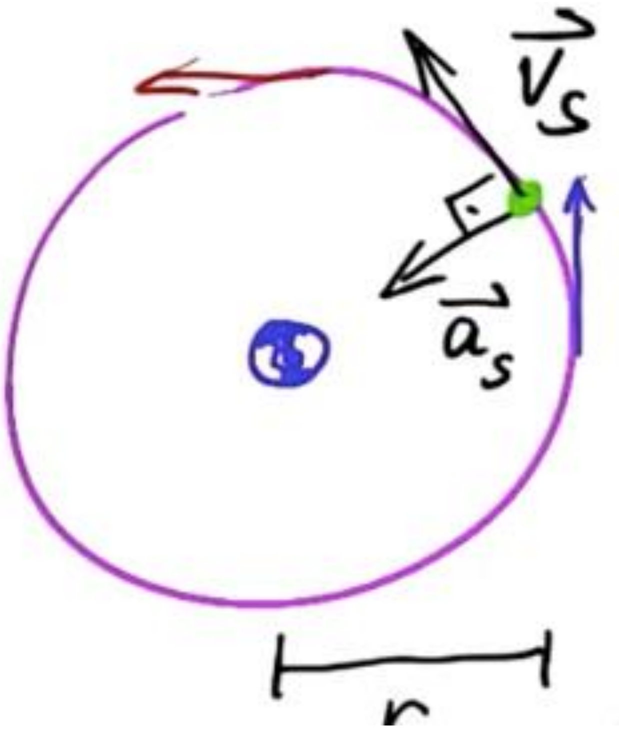

$$velocity = ||\frac{d\vec{r}}{dt}|| = ||\overrightarrow{v_s}|| = \frac{2\pi r}{T}$$

$$acceleration = \left\|\frac{d\overrightarrow{v_s}}{dt}\right\| = ||\overrightarrow{a_s}|| = \frac{2\pi\frac{2\pi r}{T}}{T} = 4\pi^2\frac{r}{T^2}$$

For geostationary orbit:

$$G\frac{m_E}{{r_{gs}}^2} = 4\pi^2\frac{r_{gs}}{T^2}$$

Thus the geostationary orbit radius (distance between the satellite and the mass center of earth) is:

$$r_{gs} = \sqrt[3]{\frac{Gm_E T^2}{4\pi^2}} \cong 42000km$$

Kinetic Energy:

$$\frac{1}{2}m_s||\vec{v}_s||^2$$

Potential Energy:

$$-G\frac{m_E m_s}{||\vec{x}_s||}$$

Energy Conservation:

$$\frac{1}{2}m_s||\vec{v}_s||^2 - G\frac{m_E m_s}{||\vec{x}_s||} = Constant$$