$$a_y = \frac{d^2y}{dt^2} =$$

$$y(t) = A\cos(\omega t + \phi)$$

$$x(t) = A\cos(\omega t)$$

$$M = \frac{4}{3}\pi R_E^3\,\rho$$

$$a = \frac{GM}{R_E^2} = \frac{4\pi G\rho R_E^3}{3R_E^2} = \frac{4}{3}\pi G\rho\ R_E$$

$$m = \frac{4}{3}\pi x^3\,\rho$$

$$a = \frac{Gm}{x^2} = \frac{4\pi G\rho x^3}{3x^2} = \frac{4}{3}\pi G\rho\ x$$

$$\vec{a} = -\left(\frac{4}{3}\pi G\rho\right)\ \vec{x}$$

$$\frac{d\vec{x}^2}{dt^2} = -\left(\frac{4}{3}\pi G\rho\right)\ \vec{x}$$

$$\omega \equiv \sqrt{\frac{4}{3}\pi G\rho}$$

$$x(t) = R_E\ \cos(\omega t)$$