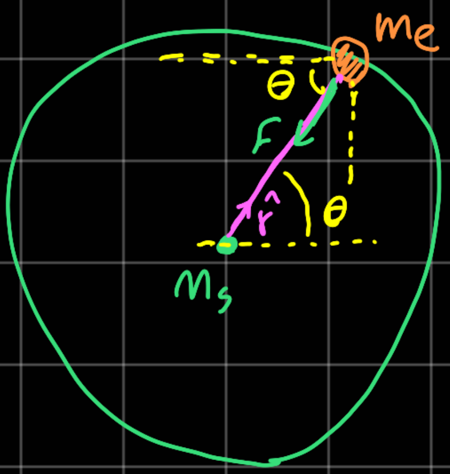

Suppose that the position of Sun is fixed and earth is orbiting around it.

$$F = -G\frac{m_e M_s}{r^2}\hat{r}$$

$$F_x = -F\cos\theta = m_e a_x = m_e\ddot{x}$$
$$F_y = -F\sin\theta = m_e a_y = m_e\ddot{y}$$

$$\Rightarrow \begin{cases} \dfrac{d^2x}{dt^2} = \dfrac{-GM_s}{r^2}\cos\theta \\[2ex] \dfrac{d^2y}{dt^2} = \dfrac{-GM_s}{r^2}\sin\theta \end{cases}$$

Now we want to turn dimensions into those ones that

I) Large/Small number doesn't appear

II) Length - time - mass are comparable with charcteristic length, time, and mass of

the problem.

a good starting point is to set $GM_s = 1$

$$GM_s = [GM_s]\, m^3 kg^{-1} s^{-2} = 1\, m^{*3} kg^{*-1} s^{*-2}$$

Value

to satisfy that we should have :

$$\left(\frac{m^*}{m}\right)^3 \left(\frac{kg^*}{kg}\right)^{-1} \left(\frac{s^*}{s}\right)^{-2} = [GM_s]$$

we all know that a reasonable :

time scaler $\longrightarrow$ 1 year

Length scale $\longrightarrow$ 1 AU sun-earth distance

$s^* = 1$ year $\longrightarrow \left(\frac{s^*}{s}\right) = 31536000 = 1$ [year]

$m^* = 1$ Au $\longrightarrow \left(\frac{m^*}{m}\right) = 149597870700 = 1$ [Au]

$$\Rightarrow \left(\frac{kg^*}{kg}\right)^{-1} = [GM_s][Au]^{-3}[Year]^2 \simeq 10^6\ kg$$