PHY 321 JANUARY 26

Example 2 Earth-sun

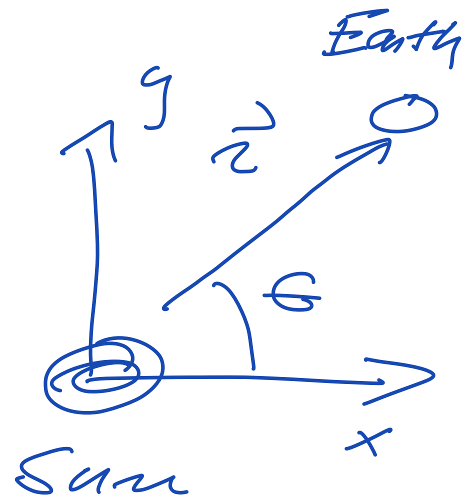
$$\vec{F} = \frac{G M_\odot M_E}{|\vec{r}|^3} \cdot \vec{r} \qquad \frac{\vec{r}}{|\vec{r}|}$$

$|\vec{r}| = 1\,AU = 1.5 \cdot 10^{11}\,m$

$M_\odot = 2 \cdot 10^{30}\,kg$

$M_E \sim 10^{24}\,kg$

2-Dim



$r = \sqrt{x^2+y^2}$

$x = |\vec{r}|\cos\theta$

$\quad \| $

$\quad r$

$y = r \cdot \sin\theta$

$$F_x = -\frac{G M_\odot M_E}{r^3}\, x$$

$F_y = -G M_\odot M_E\, y$

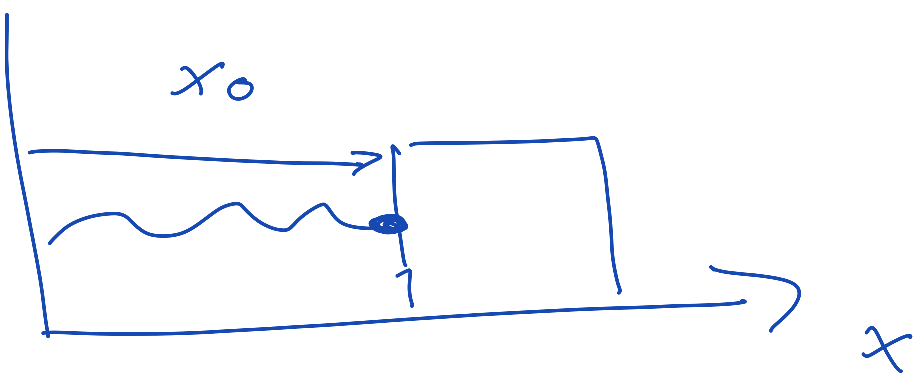
$$\frac{\qquad}{r^3}$$

$$a_x = -\frac{GM_\odot x}{r^3} = \frac{dv_x}{dt}$$

$$a_y = -\frac{GM_\odot x}{r^3} = \frac{dv_y}{dt}$$

$$v_x = \frac{dx}{dt} \wedge v_y = \frac{dy}{dt}$$

Example 3



$$F = -k(x - x_0) \quad \text{1D1M}$$

$$x_0 = 0$$

$$F = -kx$$

$$m\frac{d^2x}{dt^2} = -kx$$

$$\omega_0 = \sqrt{k/m}$$

natural frequency

$$\frac{d^2x}{dt^2} = a = -\omega_0^2 x$$

$$x(t) = A\cos(\omega_0 t) + B\sin(\omega_0 t)$$

2-Dim vector

compact notation

2 DIM object

r = np.zeros((n, 2))

n-time variables

initial conditions

r0 = np.array([0,0, 0.5])

x_0

y_0

initial r at $t=0$

$$r[0] = r_0$$

Exercise 5 HW 2

Taylor 1.38

Two forces

- Normal force with magnitude N and perpendicular to the board

- gravity with mg

$$x: \quad 0 = m\frac{d^2x}{dt^2} = m\ddot{x}$$

$$y: \quad -mg \cdot \sin\theta = m\ddot{y}$$

assume that the puck remains on the board

$\Rightarrow$ $z: N - mg\cos\theta =$

$m\ddot{z} = 0$

initial conditions

$\vec{r}_0 = (0, 0, 0)$

$\vec{v}_0 = (v_{0x}, v_{0y}, 0)$

$t_0 = 0$

$$a_x = \frac{dv_x}{dt} = 0$$

$$\int_0^t \frac{dv_x}{dt} \Rightarrow v_{0x} = v_x$$

$$x = v_{0x} \cdot t$$

$y: \quad v_{0y} - g \cdot \sin\theta \cdot t$

$= v_y(t)$

$z: \quad v_z(t) = ?$

$v_z(t) = 0$

$$\vec{r}(t) = \left(v_{0x} \cdot t,\ v_{0y}t - \frac{1}{2} g_{ome} \times t^2,\ 0\right)$$