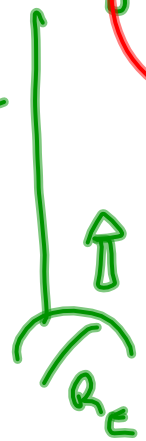
Test 2

2



$r = R_E + h$

$K = 0$

$U = -\frac{GM_E m}{r}$

$\Delta K + \Delta U = 0$

$\Delta K = K - K_0$

$\Delta U = U - U_0$

Initial case

$K_0 = \frac{1}{2} m v_0^2$

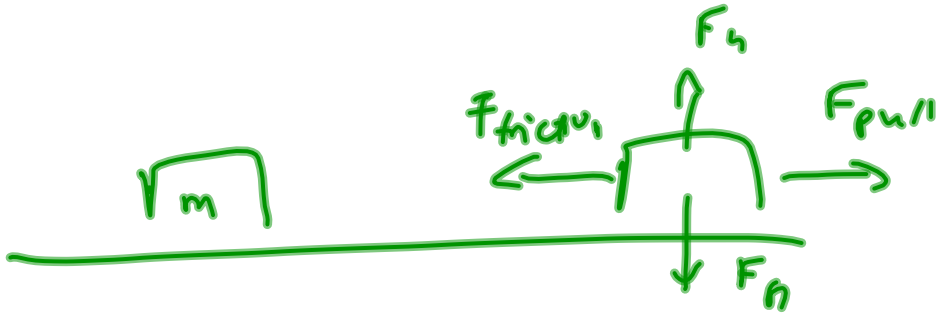
$U_0 = -\frac{GM_E m}{R_E}$

$$-\frac{GM_E m}{r} = \frac{1}{2} m v_0^2 - \frac{GM_E m}{R_E}$$

$$r = \left(\frac{1}{R_E} - \frac{v_0^2}{2GM_E} \right)^{-1}$$

$h = 530$ km

#4



$K_0 = 0$

$U_0 = 0$

$K = \frac{1}{2}mv^2$

$U = 0$

$\Delta K = K - K_0$

$\Delta U = U - U_0$

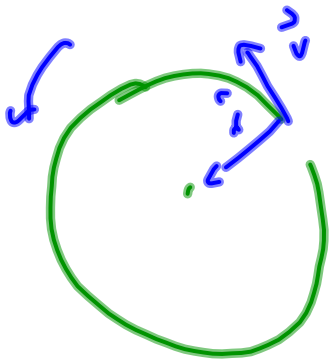
$\Delta K + \Delta U \neq 0$

$= W_{nc}$

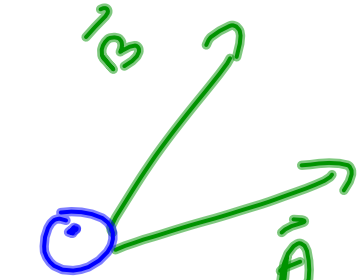
$W_{nc} = F \cdot d = \frac{1}{2}mv^2$

Angular momentum (continued)

$\vec{L} \equiv \vec{r} \times \vec{p}$ $\quad [kg\,m^2/s]$



$\vec{A} \times \vec{B} = -\vec{B} \times \vec{A}$



right hand rule

out of the page

θ in the page

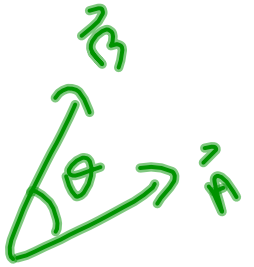
$$\vec{L} \equiv \vec{r} \times \vec{p} \quad \Big| \frac{d}{dt}$$

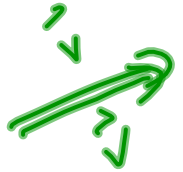
$$\frac{d\vec{L}}{dt} = \vec{\tau}$$

$$\frac{d\vec{L}}{dt} = \frac{d\vec{r}}{dt} \times \vec{p} + \vec{r} \times \frac{d\vec{p}}{dt}$$

$$= \vec{v} \times m\vec{v}$$

$$= \vec{r} \times \vec{F} \equiv \vec{\tau}$$





$\vec{A} \times \vec{B} = |\vec{A}||\vec{B}| \sin\theta$

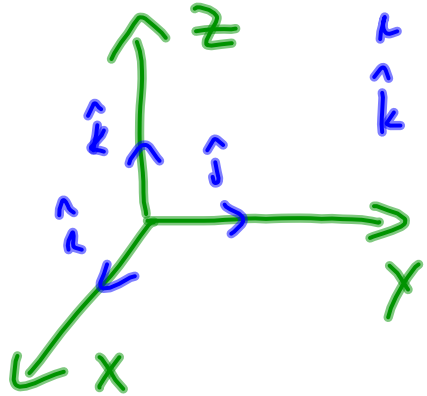
direction determined by right hand rule

$$\vec{\tau} = \vec{r} \times \vec{F}$$

$\vec{r} = 3\hat{i} + 2\hat{j} + 5\hat{k}$

$\vec{F} = 5\hat{i} - 3\hat{j} - 2\hat{k}$

HW check



$\hat{i} \times \hat{k} = -\hat{j}$

$\hat{k} \times \hat{i} = \hat{j}$

$\vec{\tau} = ?$

$\vec{\tau} = (3\hat{i} + 2\hat{j} + 5\hat{k}) \times (5\hat{i} - 3\hat{j} - 2\hat{k})$

$= -3\hat{k} - 6(-\hat{j}) + 10(-\hat{k})$

$= -4\hat{i} + 25\hat{j} + 15\hat{i}$

$= 11\hat{i} + 31\hat{j} - 19\hat{k}$

i	j	k
$i \times j = +k$		
$j \times k = i$		
$k \times i = j$		

$i \; j \; k \ldots$

$\hat{i} \times \hat{i} = 0$

$\hat{j} \times \hat{j} = 0$

$\hat{k} \times \hat{k} = 0$

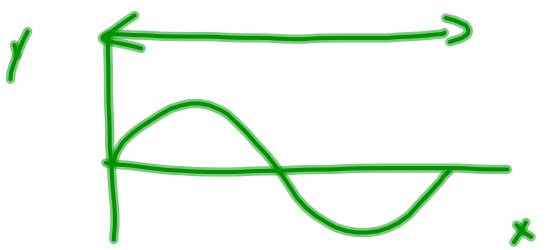
$$\vec{r} = 3\hat{i} + 2\hat{j} + 5\hat{k}$$

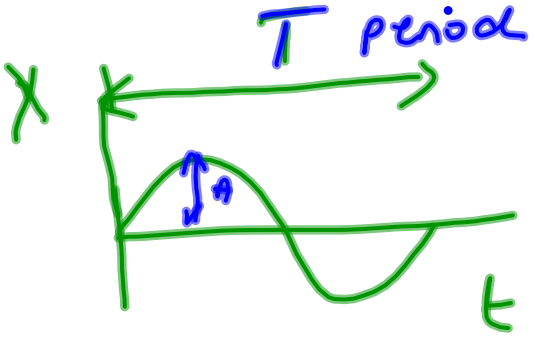
$$\vec{F} = 5\hat{i} - 3\hat{j} - 2\hat{k}$$

$$\begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 3 & 2 & 5 \\ 5 & -3 & -2 \end{vmatrix}$$

Oscillations

λ wavelength (before the pattern starts repeating itself)





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

A amplitude

$f = \frac{1}{T}$ [Hz] frequency

$\omega = \frac{2\pi}{T}$