

Power

&

Energy

$$P = \frac{dW}{dt}$$

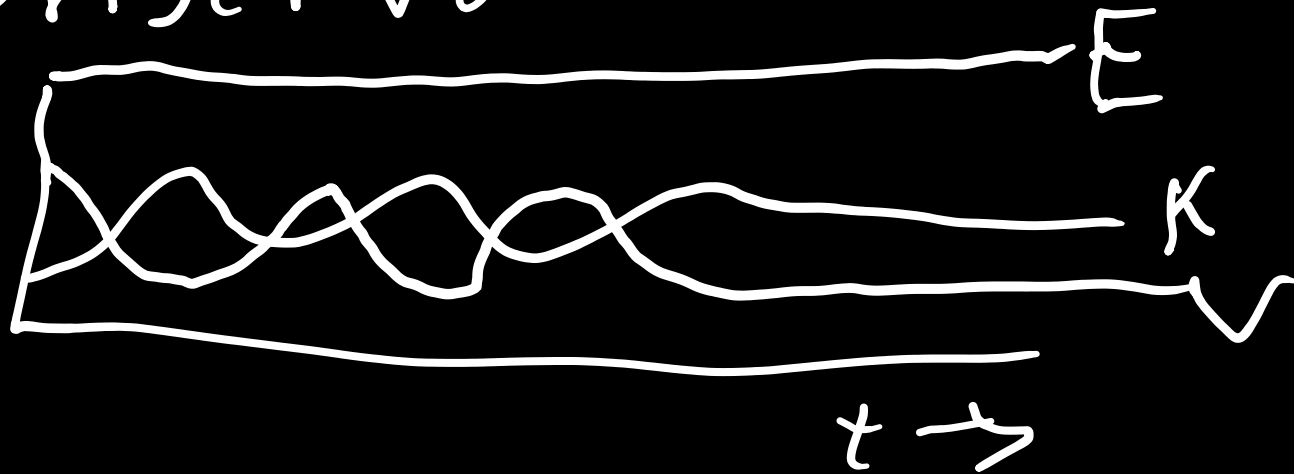
$$W(t) = \int_{t_0}^{t_1} P(t) dt$$

$$W = \int_{\vec{r}(t_0)}^{\vec{r}(t_1)} \vec{F} \cdot d\vec{r} = \int_{t_0}^{t_1} \vec{F} \cdot \dot{\vec{r}} dt$$

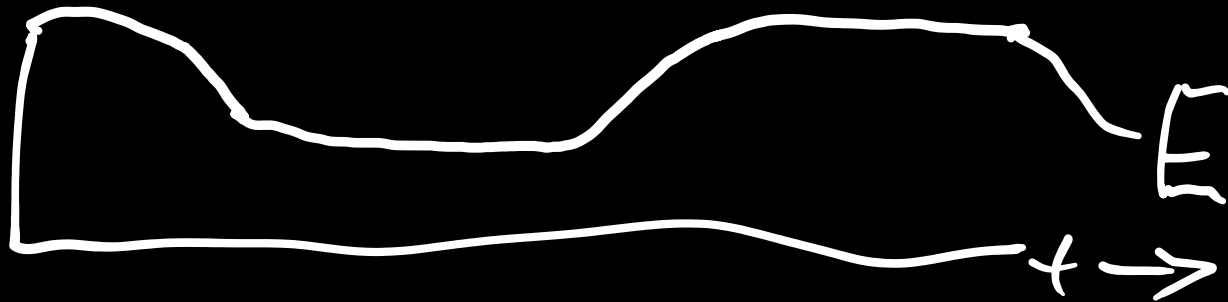
$$P = \vec{F} \cdot \dot{\vec{r}}$$

$$E = K + V$$

conservative



non-conservative



Kinetic

$$K_B = \frac{1}{2} m_B \vec{v}^{N-B_0} \cdot \vec{v}^{N-B_0} + \frac{1}{2} \omega^B \cdot \underline{I}^{B/B_0} \cdot \omega^B$$

$$\omega = \Delta K$$

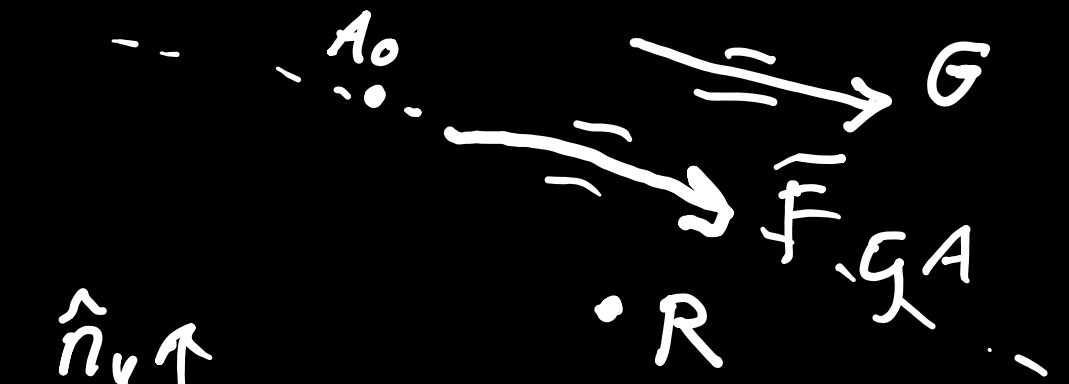
Potential (conservative)

$$F_r = - \frac{\partial V}{\partial q_r} \quad \vec{F} = - \nabla V$$

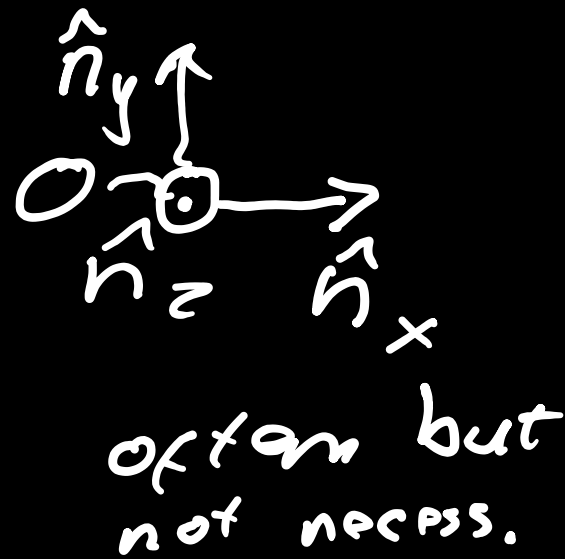
conservative: $\Delta K + \Delta V = 0$

Gravitational

$$\vec{G} = \begin{bmatrix} g_x \\ g_y \\ g_z \end{bmatrix} \quad \text{e.g.} \quad \begin{bmatrix} 0 \\ 0 \\ -g \end{bmatrix}$$



$$\vec{r} = A_0/R = \vec{r} A_0/O - \vec{r} R = \begin{bmatrix} x - x_0 \\ y - y_0 \\ z - z_0 \end{bmatrix}$$



often but not necess.

$$x_0 = y_0 = z_0 = 0$$

$$\vec{F}_{gA} = m_A \vec{G} \quad -\nabla V_g = \vec{F}_g$$

$$V_g = -\vec{F}_{gA} \cdot \vec{r} A_0/R + C$$

$V_g = 0$ at $\vec{r} R$

Spring

$$\vec{N}_S = \vec{N}_r^B - \vec{N}_r^A$$

$$\vec{F}_S = -k(|\vec{S}| - l_0) \frac{\vec{S}}{|\vec{S}|}$$

$$-\nabla V_S = \vec{F}_S$$

$$V_S = \frac{1}{2} k (|\vec{S}| - l_0)^2 + C$$

