ENERGY

MATHEMATICAL REPRESENTATION

LINEAR KINETIC ENERGY $\frac{[M][L]^2}{[T]^2} \equiv KE = \frac{1}{2} m |\vec{v}|^2$

- WORK - KINETIC ENERGY

$$\Delta KE = \Sigma W$$

$$\Sigma KE_f - \Sigma KE_i = \Sigma W$$

- WITH $\Sigma W = \Sigma W^{NC}_{INT} + \Sigma W^{C}_{INT} + \Sigma W^{NC/C}_{EXT}$

  - ΣW^{NC}_{INT}: NON-CONSERVATIVE INTERNAL WORK DEPENDS ON PATH
  - ΣW^{C}_{INT}: CONSERVATIVE INTERNAL WORK, $W^{C}_{INT} = -\Delta U^{C}$ (CHANGE IN POTENTIAL)
  - $\Sigma W^{NC/C}_{EXT}$: NON-CONSERVATIVE OR CONSERVATIVE EXTERNAL WORK

$$\Sigma KE_i + \Sigma U_i + \Sigma W^{NC}_{INT} + \Sigma W^{NC/C}_{EXT} = \Sigma KE_f + \Sigma U_f$$

$\Sigma KE_i + \Sigma U_i$: MECHANICAL ENERGY E_i

ΣW^{NC}_{INT} → ΔE^{TH}, ΔU^{CHEM} ....

$$\Sigma E_i + \Sigma W^{NC}_{INT} + \Sigma W^{NC/C}_{EXT} = \Sigma E_f$$

CONSERVATION OF ENERGY

WORK $\frac{[M][L]^2}{[T]^2} \equiv W = \vec{F} \cdot \Delta\vec{r}$ ← FOR CONSTANT $\vec{F}$ (DOT PRODUCT)

IF NOT CONSTANT USE AREA UNDER F_x VS X

$W = |\vec{F}||\Delta\vec{r}|\cos(\theta)$ — SMALLEST ANGLE BETWEEN $\vec{F}$ AND $\Delta\vec{r}$

$W = F_{\parallel}|\Delta\vec{r}|$ $\quad W = |\vec{F}|\Delta r_{\parallel}$

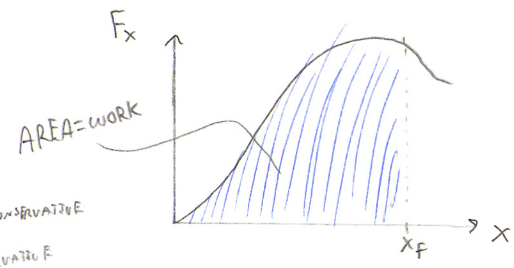
- POTENTIAL ENERGY $\frac{[M][L]^2}{[T]^2} \equiv U$

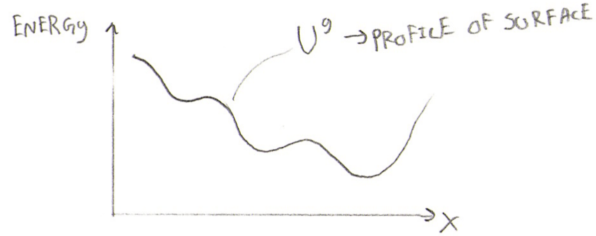
GRAVITATIONAL POTENTIAL ENERGY $\equiv U^g = mgy$

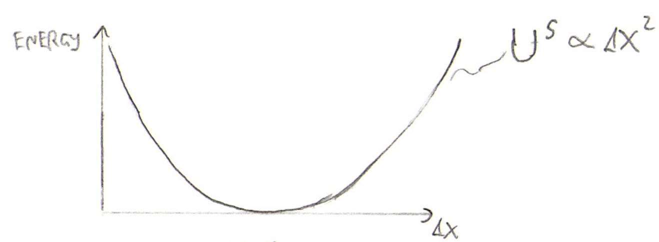
SPRING POTENTIAL ENERGY $\equiv U^s = \frac{1}{2} k \Delta x^2$

(k: SPRING CONSTANT; Δx: DISPLACEMENT FROM EQUILIBRIUM)

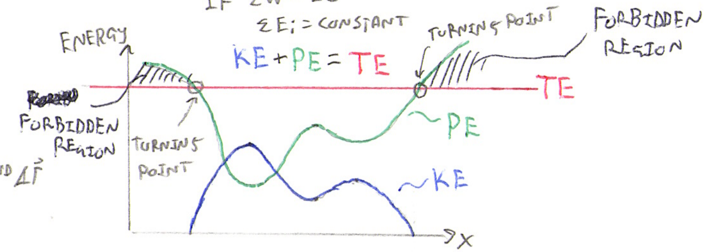
GRAPHICAL REPRESENTATION







IF $\Sigma W^{NC} = 0$
ΣE_i = CONSTANT
KE + PE = TE



GRADIENT

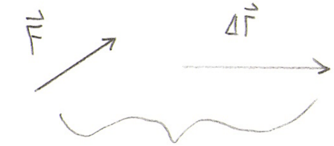
$$\vec{F} = -\vec{\nabla} U$$

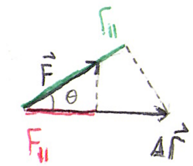
$$\vec{F} = -\left\langle \frac{\Delta U}{\Delta x}, \frac{\Delta U}{\Delta y}, \frac{\Delta U}{\Delta z} \right\rangle$$

F_x, F_y, F_z

PHYSICAL REPRESENTATION

- DOT PRODUCT ... $\vec{F} \cdot \Delta\vec{r} = |\vec{F}||\Delta\vec{r}|\cos(\theta)$





IF	$0 < \theta < 90$	W(+)
	$90 < \theta < 180$	W(-)
	$\theta = 0$	W(+) MAX
	$\theta = 180$	W(-) MAX
	$\theta = 90$	W = 0