Stephen Iota
siota001@ucr.edu
Dr. Sales

Electric Potential Energy

Why do we study Energy?

-> care about ability to do work
-> chemical reactions
-> Energy is conserved

What is Work?
→ Work transfers energy

$W = \vec{F} \cdot \vec{r} = |\vec{F}||\vec{r}| \cos \theta$ (Joules) $(N \cdot m)$

~~Mechanical~~ Total Energy conserved for CONSERVATIVE forces

$\Delta E = \Delta K + \Delta U$ (we're only interested in Δ)

If $\vec{E}_e$ is conservative, we are interested in writing it in terms of Energy

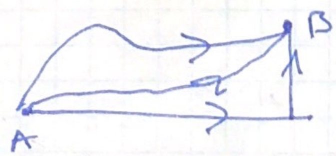
Conservative Vector Field Test

1) $\text{curl } \vec{F} = 0$

2) $W \equiv \oint \vec{F} \cdot d\vec{r} = 0$

3) $\vec{F} = -\text{grad } \Phi$

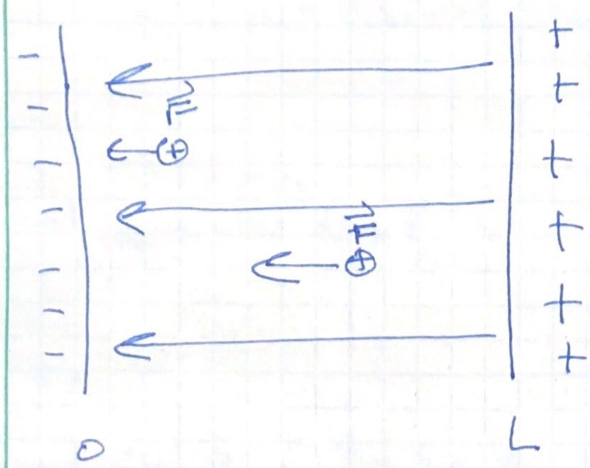
All paths between 2 points require same amount of work if force is conservative



Nature wants to minimize Energy

in equilibrium: $\dfrac{dU}{dt} = 0$

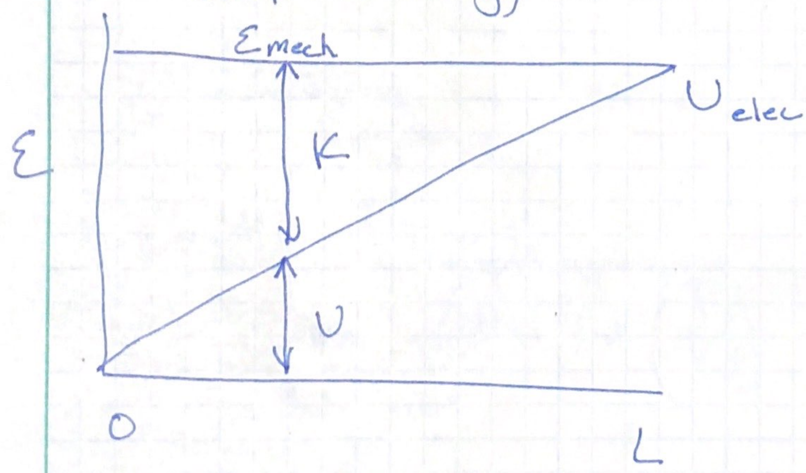
Uniform Electric Field



$\vec{E}(\vec{r})$ doing "Work" on particles

$U \to KE$

Graph of Energy



$$W_{elec} = F\Delta r \cos 0^\circ = qE|r_f - r_i| = qE\Delta r$$

$$\cancel{\Delta U_{elec} = -\Delta W}$$

$$\Delta U_{elec} = -W(i \to f) = qE$$

$$W_{elec} = \int_{x_1}^{x_2} dx\, qE = -\frac{kq_1q_2}{x_f} + \frac{kq_1q_2}{x_i}$$

$$\Delta U = -W = \frac{kq_1q_2}{x_f} - \frac{kq_1q_2}{x_i}$$

$$U_{elec} = \frac{kq_1q_2}{x}$$

Electric Potential

$$V \equiv \frac{U_{elec}}{q} \quad (\text{Volts}) \left(J/q\right)$$