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Lecture: 14 (iq12)

1. Gravitational potential energy
2. Electric potential energy **Clicker 14-2**
3. Electric potential **Clicker 14-3**
4. Potentail due to a point charge
5. From V to E
6. **Clicker 14-5**

Announcement:

- Midterm1: Class average 54. See me for one-on-one consultation. Email me to setup appointment time.

- My regular office hours: MWF 9:15 to 10:15 Other time by appointment i of 12

1. Gravitational potential energy

Lift by h $\quad$ h $\quad$ mg $\quad$ $F^{lift} = mg$, work $= mgh$.

(force against gravity) $\quad$ Potential eng gain: $U = mgh$.

When release the ball, downward acc by h $\Rightarrow K = \frac{1}{2}mv^2$.

What is PE? (1) Amount of work done to build up PE

(2) Amt of K released

A

B

$$\underbrace{U_A - U_B}_{\text{PE released}} = \underbrace{K_B - K_A}_{\text{KE gain}}$$

$$(U_A - U_B) - (K_A - K_B)$$

A

B

$K_A + U_A = K_B + U_B$, $=$ const. $\quad$ Total energy is const.

$\cancel{\Delta U + \Delta K = 0 \quad U_A - U_B + K_A - K_B = 0}$

PE released

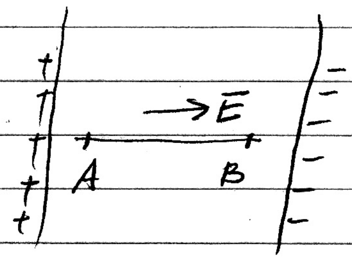
Release of PE

$$\Delta(K + U) = 0$$

$$\underbrace{\Delta U}_{\text{Release of PE}} = \underbrace{-\Delta K}_{\text{Gain of KE}}$$

$$U_A - U_B = K_B - K_A$$

2. Electric PE



From: B to A

$\vec{E}\ \frac{\vec{F}}{q} \xrightarrow[q>0]{} q\vec{E}$ to the right

From A to B:

Work against E $= (-q\vec{E})\cdot\Delta l$

$\leftarrow \quad \leftarrow$

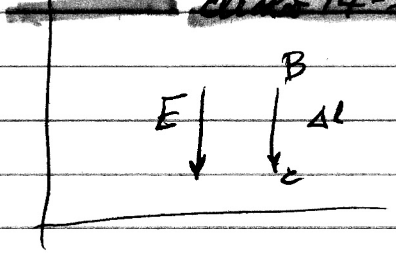
∴ Build up U

$\Delta U = (-q\vec{E})\cdot\Delta l > 0$ Build up ΔU

$\leftarrow \quad \leftarrow$

Potential: $\Delta V = \frac{\Delta U}{q} = -\vec{E}\cdot\Delta\vec{l}$

~~check 14-3~~

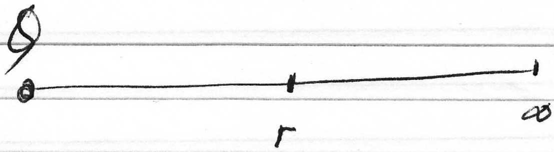


$\Delta V < 0$

$\Delta V = -\vec{E}\cdot\Delta\vec{l} < 0$

Solution: $\Delta V = -\left[\langle 0,-300,0\rangle \cdot \overset{\Delta \vec{l} =}{\langle 0,-2,0\rangle}\right] = +300\times(-2)$
$= -600$

4.



Find: $V(\infty) - V(r)$

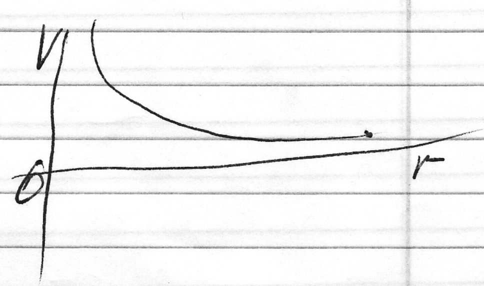
$$\Delta V = -\vec{E} \cdot \Delta\vec{r}$$

$$V(\infty) - V(r) = -\int_r^\infty \frac{kQ}{r^2}\,dr$$

$$= -kQ\left(-\frac{1}{r}\right)\Big|_r^\infty = \frac{kQ}{r}\Big|_r^\infty = -\frac{kQ}{r}$$

$$V(r) = \underset{\overset{\|}{0}}{V(\infty)} + \frac{kQ}{r}.$$

$$V(r) = \frac{kQ}{r}.$$



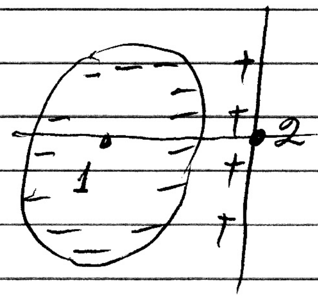
5. $\Delta V = -\vec{E} \cdot \Delta\vec{l} = -E_x \Delta x - E_y \Delta y$

$$E_x = -\frac{\Delta V}{\Delta x} = -\frac{\partial V}{\partial x}$$

$$V(x) = \frac{kQ}{x}$$

$$E_x = -\frac{\partial V}{\partial x} = -kQ\left[-\frac{1}{x^2}\right] = \frac{kQ}{x^2}.$$

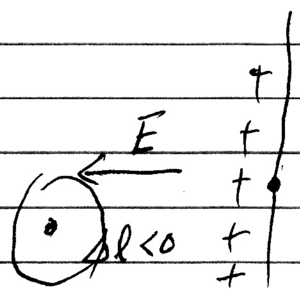
6. ~~clicker 14-5~~



Find the sign of V_2-V_1

SS principle:

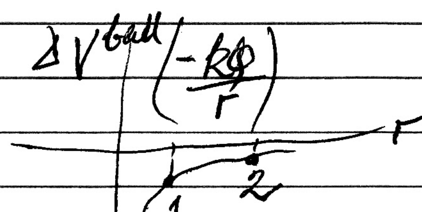
$$V_2-V_1=(V_2-V_1)^{plate}+(V_2-V_1)^{ball}$$



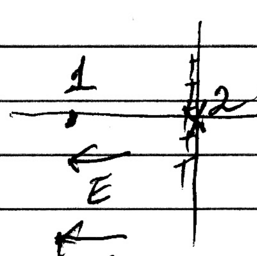
$(V_2-V_1)^{plate}$

$E^{plate}_{\leftarrow}$

$E^{ball}+E^{plastic}$



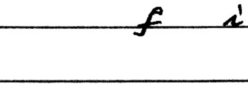
$V_2^{ball}-V_1^{ball}>0$



$$\Delta V^{plate}=(-\vec{E})\cdot(\vec{\Delta l})$$

$$-(\leftarrow \leftrightarrow)$$

$\Delta l = X_2 - X_1$



$$\therefore \Delta V^{plate}=(-\vec{E})\cdot(\vec{\Delta l})$$

$$(\rightarrow)(\rightarrow)>0$$

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