# PY202

chapter

(23)

Volume elements:

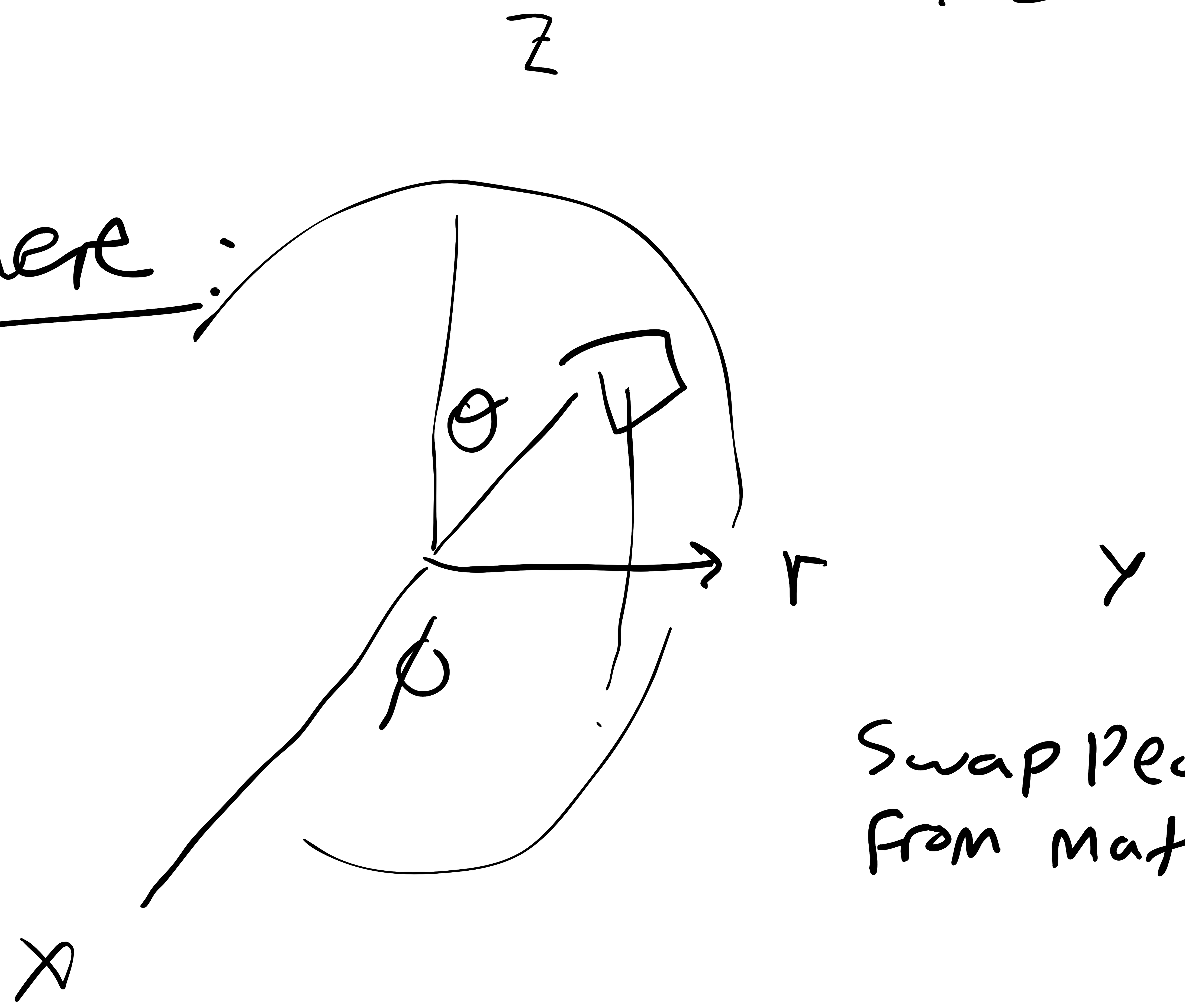
$$\int dV = V$$

Cube:

$$\int dV = \int_0^x dx \int_0^y dy \int_0^z dz$$

$$= xyz$$

Sphere:




Swapped from math.

My pen seems to have run out of ink.

$$dV = r^2 dr \sin\theta \, d\theta \, d\phi$$

$$\phi : 0 \rightarrow 2\pi$$
$$\theta : 0 \rightarrow \pi$$

I'm writing blind... remember refills!

$$r : 0 \rightarrow \text{radius}$$

$$\int_0^r r^2 dr \int_0^\pi \sin\theta \, d\theta \int_0^{2\pi} d\phi$$

$$= 4\pi \int_0^R r^2 dr$$

just a 1D-integral.

I'm gonna swap pages (this ink is, thus far, invisible...)

# HW 22

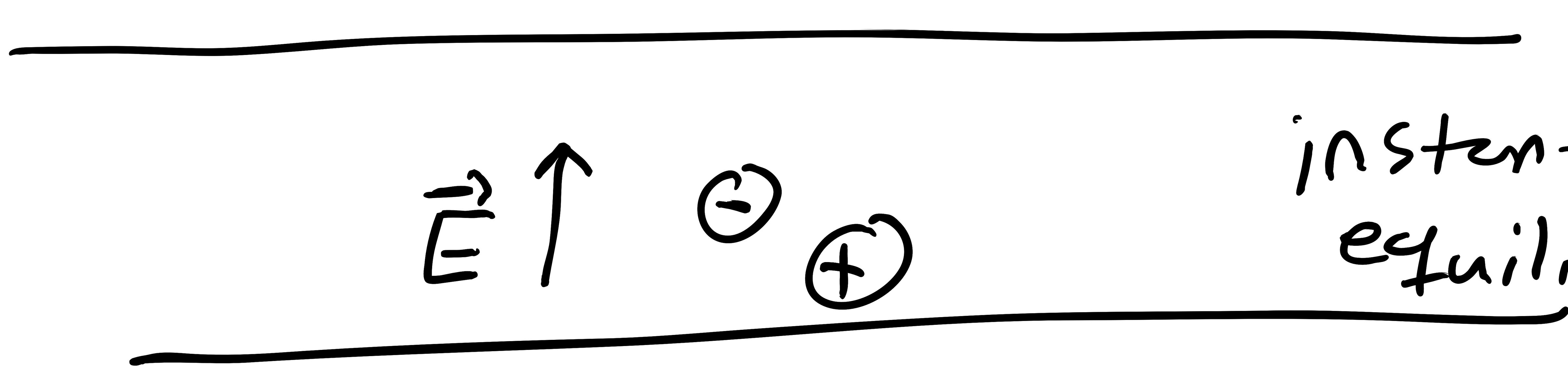
(Lol I can re-use this page)

- #1: E-field of a wire, $E \sim 1/r$
- #2: induced charges, charge separation*
- #3: E-field of infinite disk, plane ($E \,!\!\sim r$)
- #4: $\lambda = \frac{\text{charge}}{\text{length}}$, $\sigma = \frac{\text{charge}}{\text{area}}$, $\rho = \frac{\text{charge}}{\text{volume}}$
- #5: E-field inside conductor: $E = 0$**
- #6: $\Phi_{net} \approx \frac{dE_x}{dx}\Delta V$, $\frac{dE_x}{dx} = \frac{\rho}{\varepsilon_0}$ ← 1-D

Topics for test!
problems by concept

* charge separation ≠ ionization
for conductor, charge is <u>at surface</u>

** $Q_{enc} = 0$




instantaneous equilibrium

inf disk

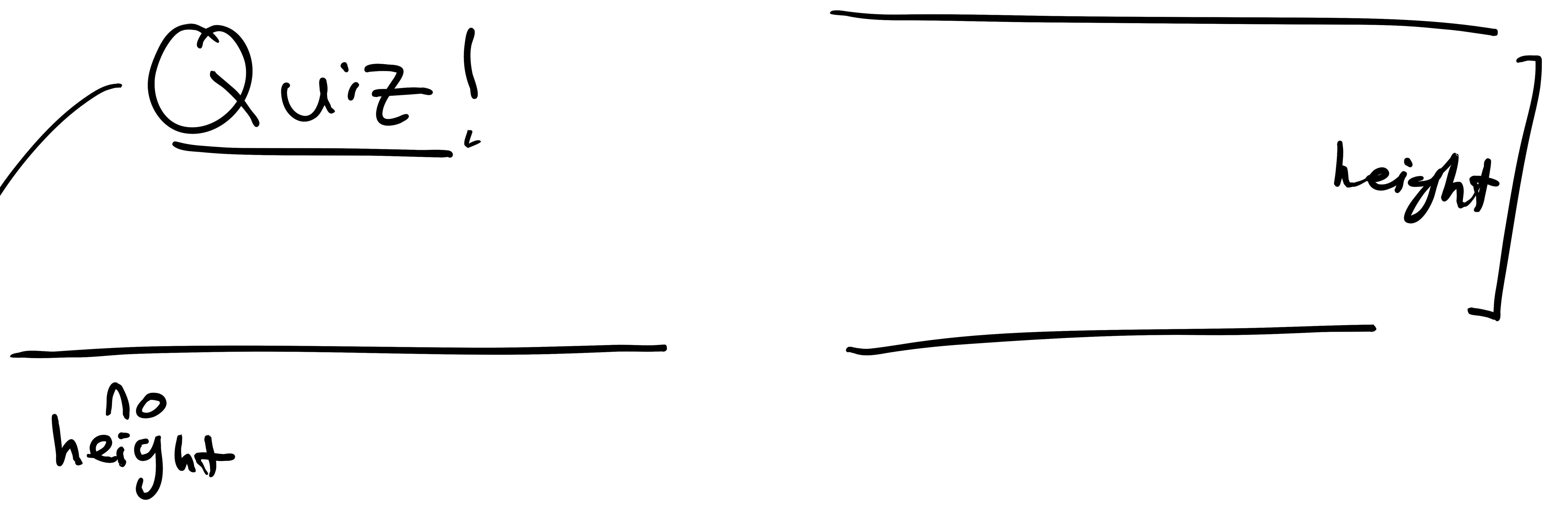
$$E = \frac{\sigma}{2\varepsilon_0}$$

vs

above conductor

$$E = \frac{\sigma}{\varepsilon_0}$$

Quiz!




oops

Missed: proof of Quiz 4, p. 2)

## Ch. 23

Conservative force $\vec{F}$

change in potential E

$$\Delta U = -\vec{F} \cdot d\vec{l}$$

electric force is conservative
$\rightarrow$ electric potential

reference point is at

$r \to \infty \qquad V = 0$

$$V_{pot} = 0$$

$$V_{pot} = V_{pot}(x, y, z)$$

potential <u>differences</u>

$V_{pot} = \Delta V = V_{final} - V_{initial}$

units: $\frac{J}{C} = V$ ← Volt

given $\Delta U = -\vec{F} \cdot d\vec{l}$,

$$\vec{F} = q\vec{E},$$

$$\Delta V = \frac{\Delta U}{q} = -\int \vec{E} \cdot d\vec{l}$$

potential for El. field $\int \frac{\vec{E}}{q} \cdot d\vec{l}$

$\vec{E} = E_x \hat{i}$

Potential difference $\frac{J}{C}$

reference: $V(x=0) = 0$

$$\Delta V = \int_{(x_a, y_a, z_a)}^{(x_b, y_b, z_b)} \vec{E} \cdot d\vec{l}$$

E field only goes in x-dir: $d\vec{l} = dx\,\hat{i} + dy\,\hat{j} + dz\,\hat{k}$

$$E \cdot dl = E x_{\hat{i}} \cdot dx_{\hat{i}}$$

(no ~~y~~ or, z terms in E)

$$\Delta V = -\int \vec{E} \cdot d\vec{l} = -\int E x \hat{i} \cdot dx \hat{i}$$

$$= -\int_{xa}^{xb} E x \, dx$$

$$= -Ex \int_{x_a}^{x_b} dx$$

$$= -Ex(x_b - x_a)$$

for this scenario,

$$\Delta V = -Ex$$

( for $\vec{E} = E\hat{x}$

if $\vec{E} = Ex\hat{x}$

that's an $x$

$$\Delta V = -\frac{E}{2}x^2$$