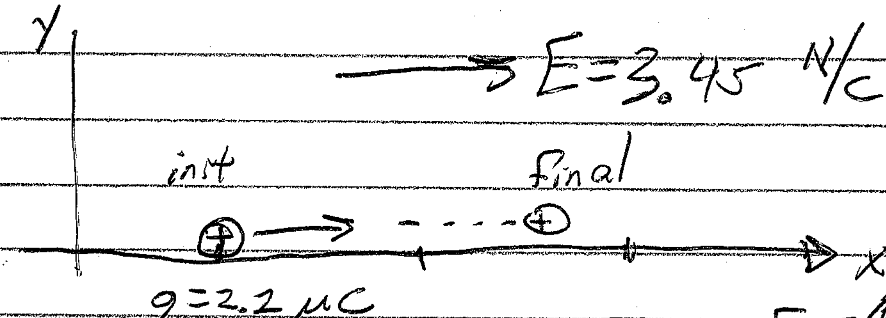
① Phys 1402 2016-09-08 Lec 5

Not finished HW1? Request Extension on WebAssign. 20% / week penalty.

Exam 1 will cover
- Electrostatics HW1
- DC circuits HW2




$F = q_0 E$ = ~~[illegible]~~

$\vec{F} \cdot$ Dist

Work?

Change in PE?

Potential Diff?

① Force is $F = (2.2\,\mu C)(3.45\ N/C)$
$= 7.59\ \mu N$

② Work is $W = F \cdot \Delta x$
$= (7.59\ \mu N)(1.46\ m)$
$= 11.08\ \mu J$
$= 11.1e{-6}\ J$

③ Drop a ball: W is ⊕ (goes faster)
while ΔPE is ⊖ (moving down)
Here: $\Delta PE = -11.1e{-6}\ J$

④ Elec Pot Diff $\Delta V = -11.6\ \mu J / 2.2\ \mu C$
$= -5.04\ V$

4 names for the stuff measured in volts (V):

- Electric Potential
- Potential Difference
- Electromotive Force (EMF)
- Voltage

Two main uses in electrostatics:

- Potential is PE per unit charge.

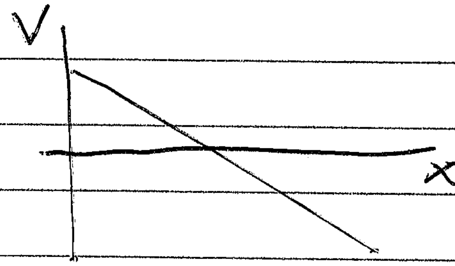
$$\Delta V = \frac{\Delta PE}{q_0}$$

Energy = Voltage · Charge

- Elec Field is downward slope of Elec Potential

If ~~slope is~~ V decreases in x-dir:

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




On the prev page:

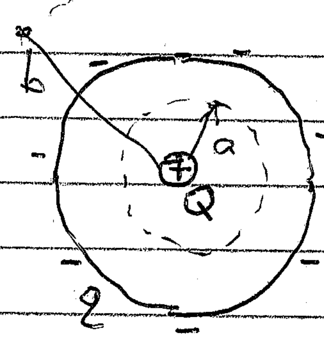
$$E = -\frac{(-5.04\text{ V})}{(1.46\text{ m})} = 3.45\ \frac{\text{V}}{\text{m}} = 3.45\ \text{N/C}$$

# Gauss's Law in Spherical Systems

$$\Phi_E = 4\pi r^2 E = Q_{enc}(4\pi k)$$

- $\Phi_E$ ↑ Elec Flux
- $4\pi r^2$: Area of Sphere
- $Q_{enc}$ ↑ Charge inside sphere

Q in middle is ⊕
q on surface is ⊖




In between the charges (radius a):

- $Q_{enc} = Q = 4.65\ nC$
- $\Phi_E = 4\pi k Q_{enc}$
  $= 4\pi(9\times10^{9})(4.65\times10^{-9})$
  $= 525$
- E?

$$E = \frac{\Phi}{4\pi r^2} = \frac{525}{4\pi(0.5)^2} = 167\ N/C$$

what if we tried:

$$E = \frac{k q_1}{r^2} = \frac{(9\times10^{9})(4.65\times10^{-9})}{(0.5)^2} = 167\ N/C$$

At radius b:

$Q_{enc} = Q + q = 4.65\ nC - 1.90\ NC$
$\Phi = 4\pi k Q_{enc}$
$E = \Phi/(4\pi r^2)$

Capacitor: Stores charge & Energy.

- Charge is always balanced (⊕ & ⊖)
- Charges kept apart inside capacitor.
- More charge means more voltage

Energy $= \frac{1}{2} Q V$

$$Q = C V$$

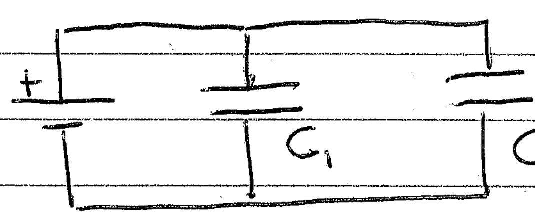
- $Q$ ↑ charge measured in coulombs (C)
- $C$ – capacitance which is constant, measured in farads (F), range from pf → nF → μF (1e-12 → 1e-9 → 1e-6)
- $V$ – Voltage

Battery: Stores Energy

- Generates charges from chemistry
- Charges combine in molecules
- Voltage is fairly constant
  Ex: 1.5 V, 5.0 V, 9.0 V, 12.0 V

Energy $= QV$

325 V




In parallel, $V_1 = V_2$

Charge on $C_1$: $Q_1 = C_1 V = (7.0\,\mu F)(325\,V)$
$= 1260\,\mu C$
$= 1.26\,mC$