Physics 212 Exam 1 Review

Thank you for coming,
please sign into the queue

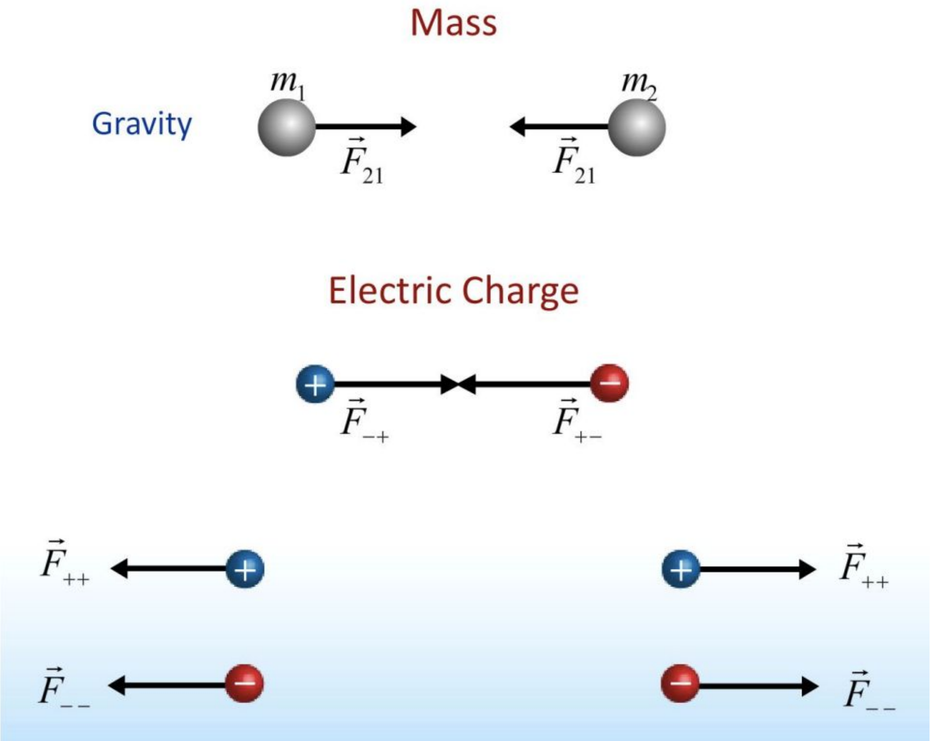
Exam 1 Topics

1. Coulomb's Law
2. Electric Field
3. Gauss' Law
4. Electric Potential
5. Capacitors

Coulomb's Law

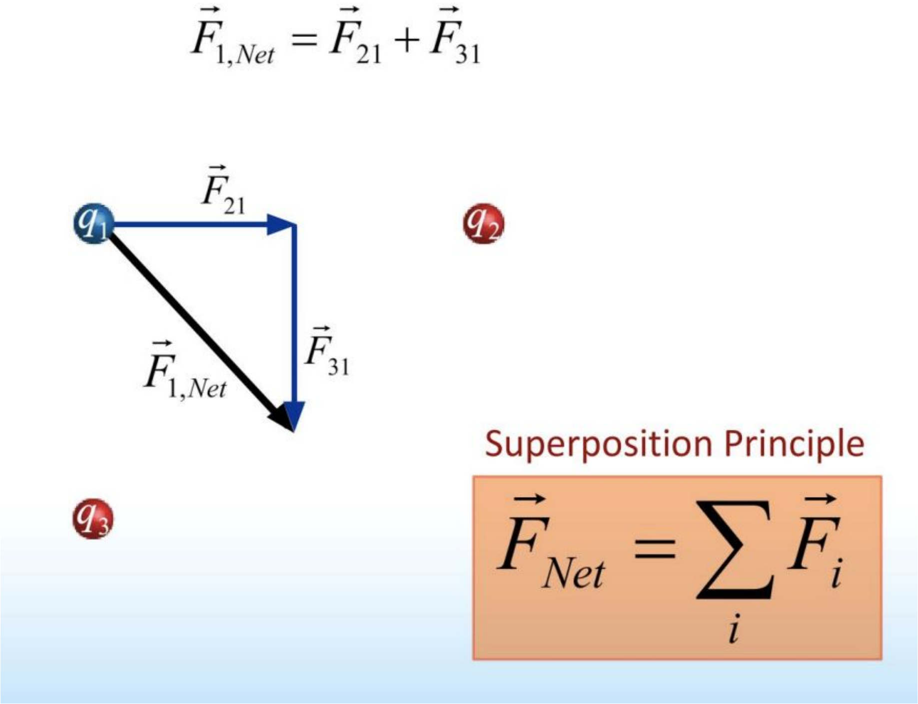
Electrostatic Force (2 Charges)

$$\vec{F}_{12} = k\frac{q_1 q_2}{r_{12}^2}\hat{r}_{12}$$

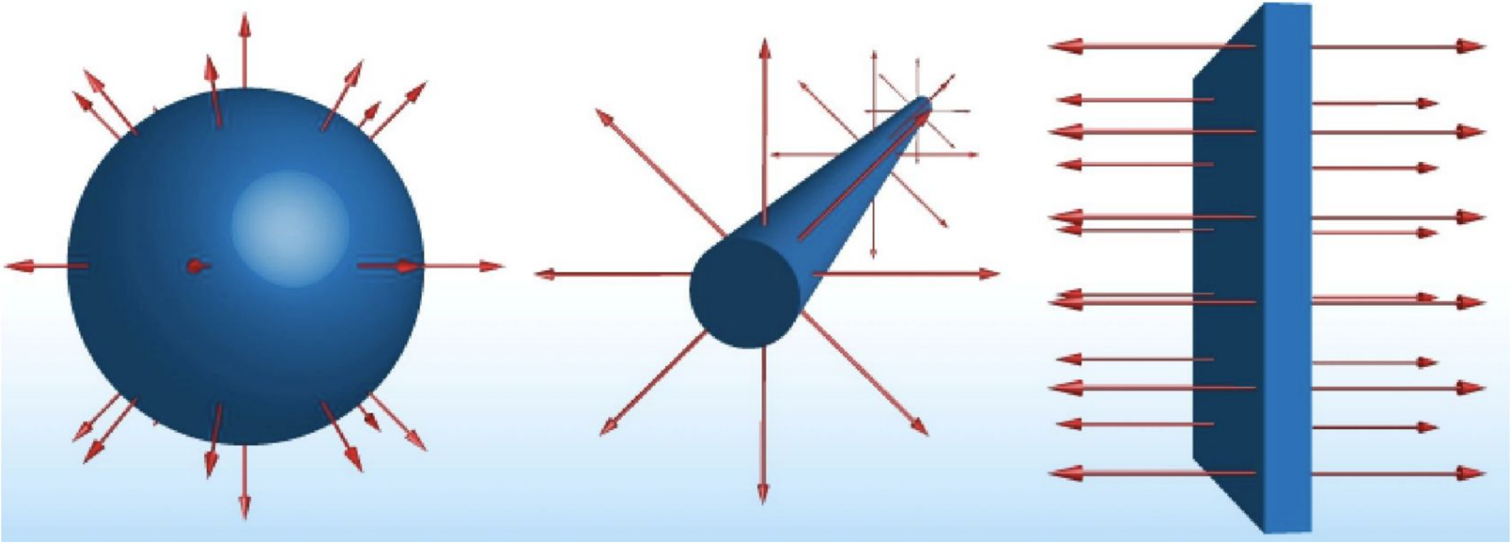


Superposition

When considering multiple charges, break the system into x- and y- components



Sources of Electric Fields

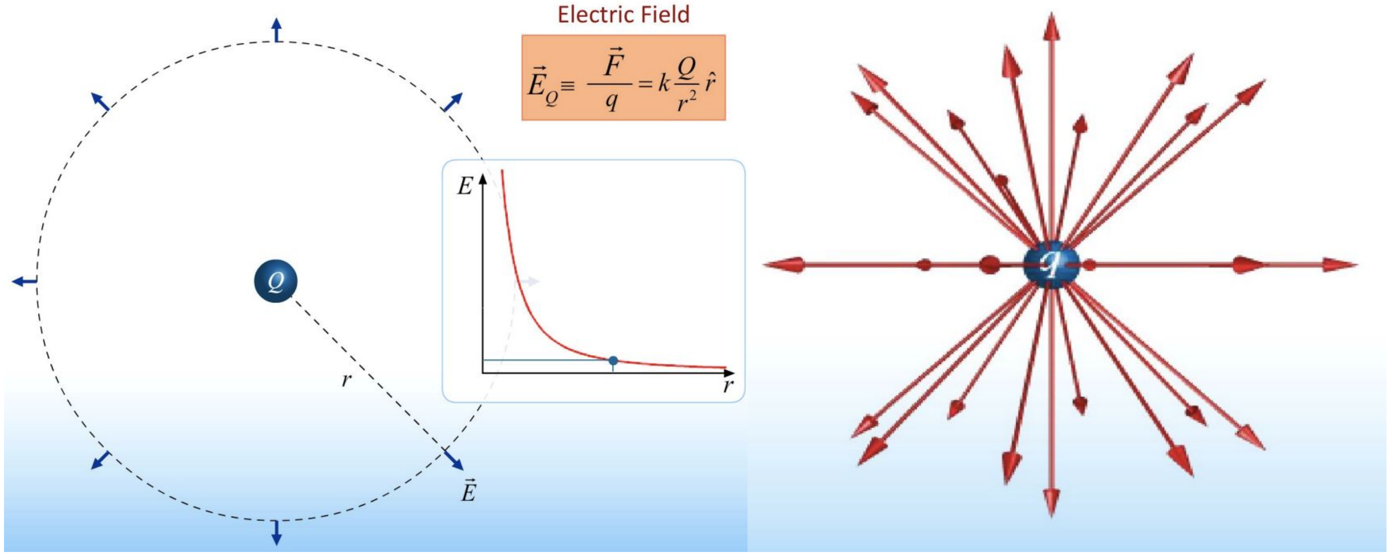


Point Charge

$$E = k\frac{q}{r^2}$$

$E \propto 1/r^2$

$Q = [C]$

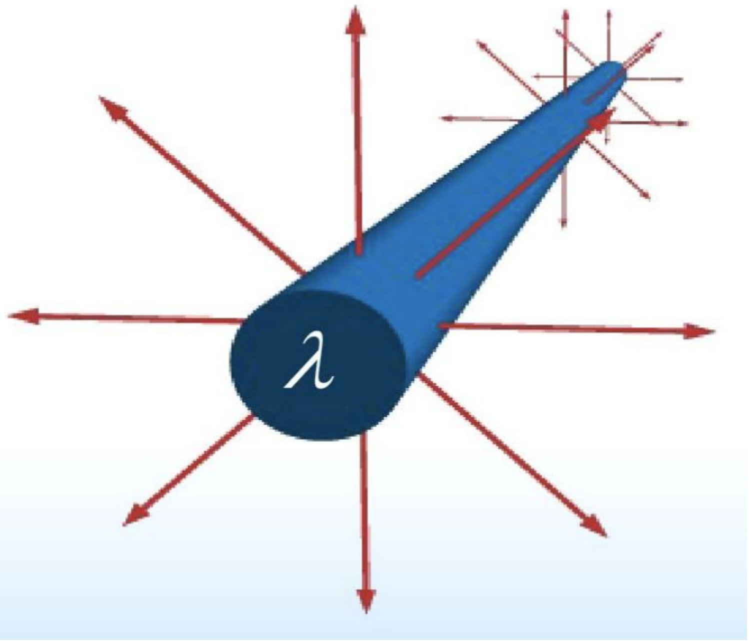


Line Charge

$E \propto 1/r$

λ = [Coulombs/Meter]

$$E = 2k\frac{\lambda}{r}$$

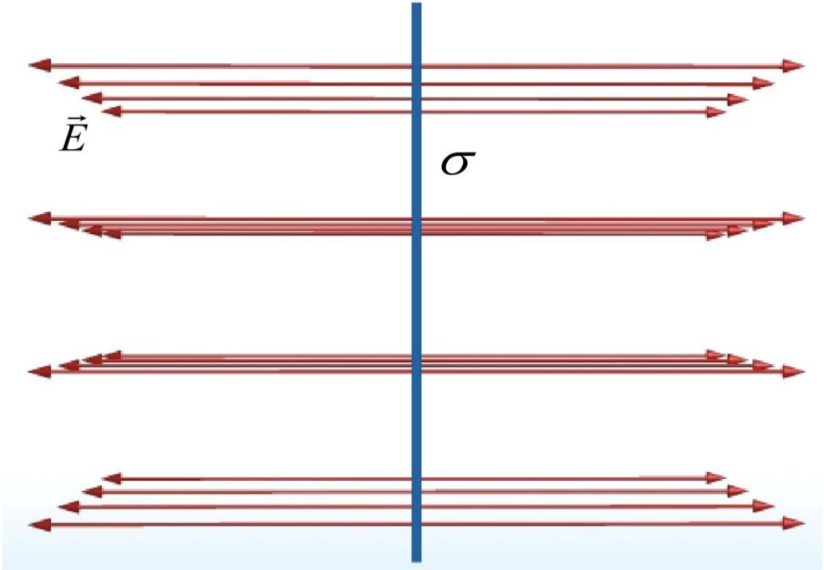


Sheet Charge

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

Electric field has NO distance dependance

σ = [Coulombs/Meter^2]

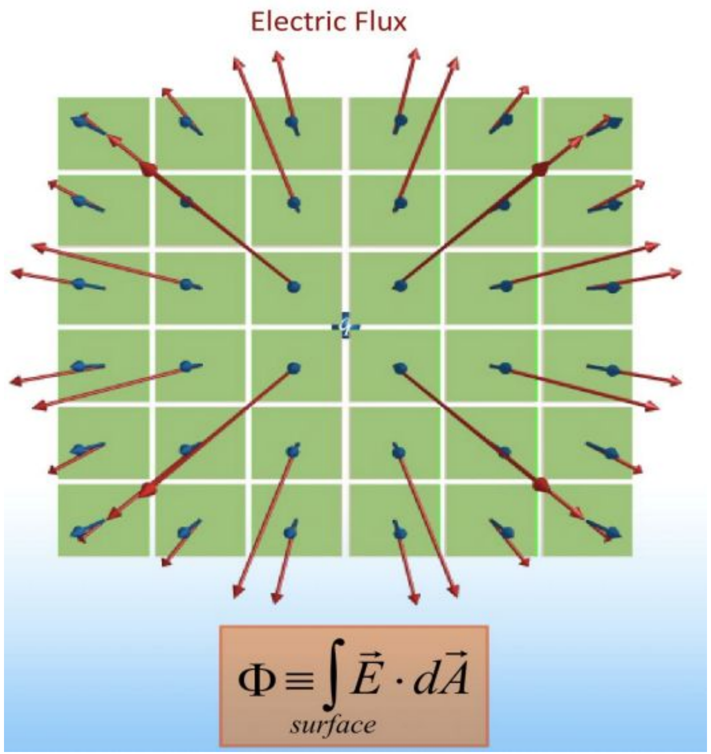


Electric Flux

Amount of electric field that is perpendicular to a surface

+ Flux (Φ) = Outward Flux

- Flux (Φ) = Inward Flux



Gauss' Law

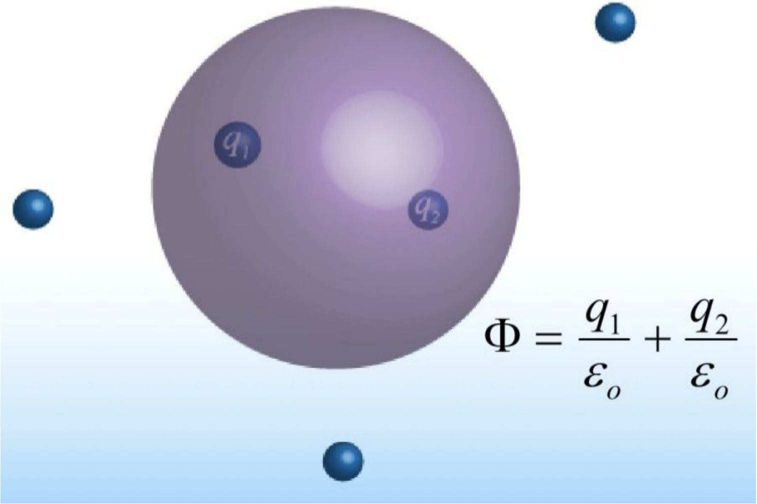
Use a Gaussian surface simplify

$\oint E \cdot dA \rightarrow E * A$

E = electric field

A = surface area of gaussian surface

$$\Phi_{Net} = \oint_{surface} \vec{E} \cdot d\vec{A} = \frac{q_{enclosed}}{\varepsilon_o}$$

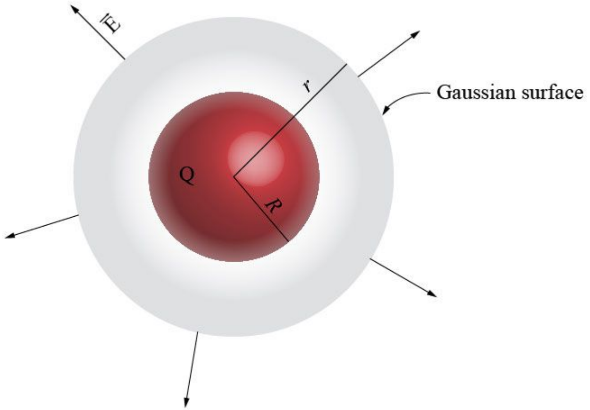


Gaussian Surfaces

For point charge/sphere charge, use a **SPHERE**

For a line/cylinder charge, use a **CYLINDER**

$$\Phi_{Net} = \oint_{surface} \vec{E} \cdot d\vec{A} = \frac{q_{enclosed}}{\varepsilon_o}$$

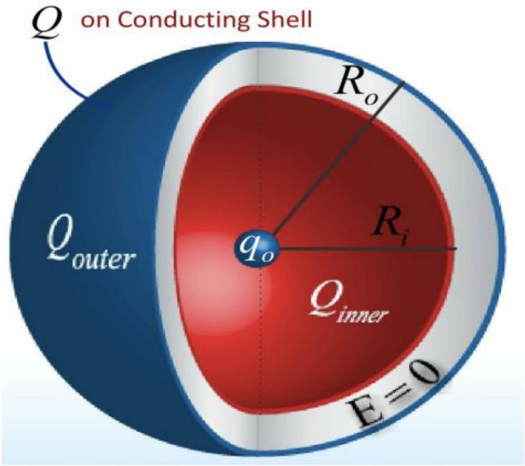


Conductors

Charges arrange themselves so that the electric field is **always zero**

Inside: $Q_{inside} = -1 * Q_{enc}$

Outside: $Q_{outside} = Q_{enc} + Q_{conductor}$

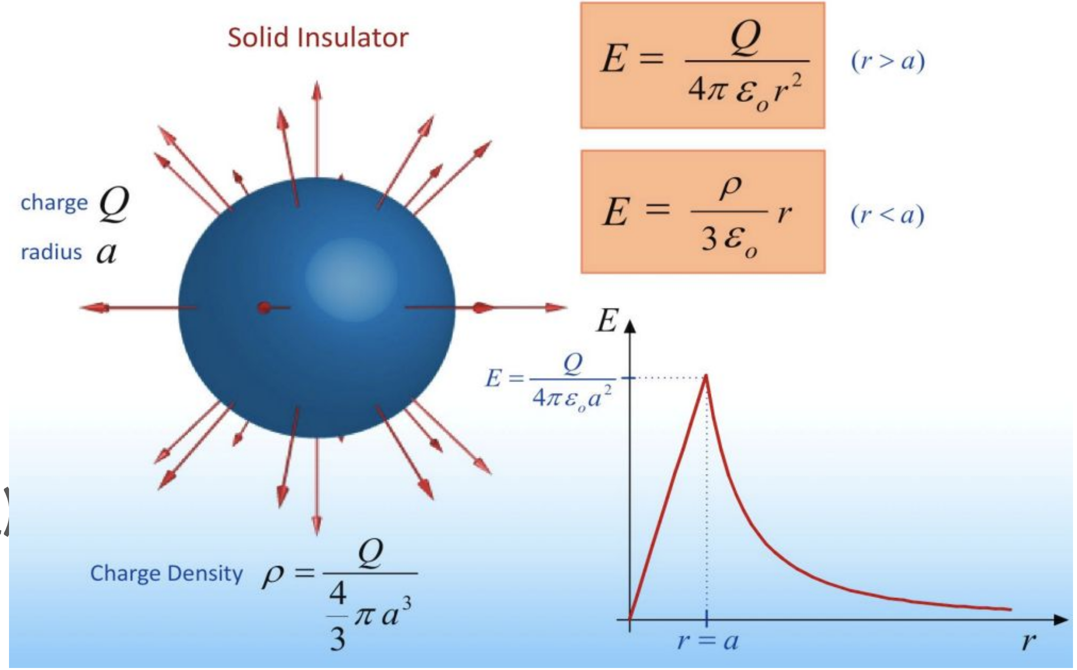


Insulators

Electric Field inside due to

a Q_{enc} for enclosed volume

$Q_{enc} = Q_{insulator}*(V_{enc}/V_{insulator})$



Potential Energy

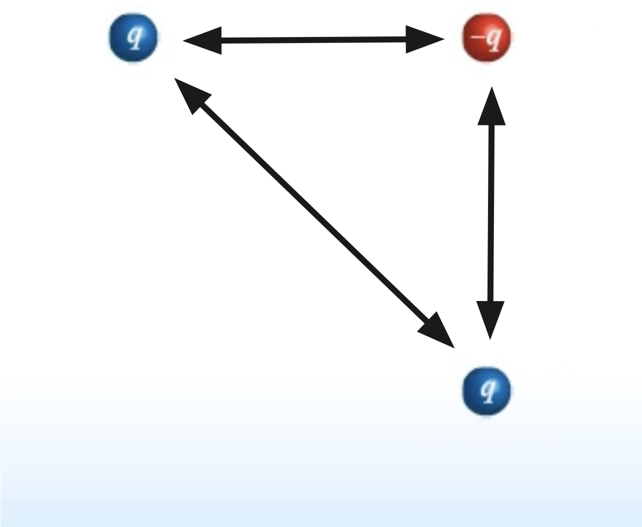
$$U_{12} = \frac{1}{4\pi\varepsilon_0}\frac{q_1 q_2}{r_{12}}$$

Consider all charge-charge interactions

Charges ∞ have no potential energy

To increase the increase of the U takes

positive W_{on}



Electric Potential (V)

$$\Delta V_{A\to B} = -\int_A^B \vec{E}\cdot d\vec{l}$$

Moving with or against electric field lines will change your V

Lines with same voltage are equipotential lines and are perpendicular to electric field lines

Voltage can be thought of as height, E field as slope, and a charge as a ball

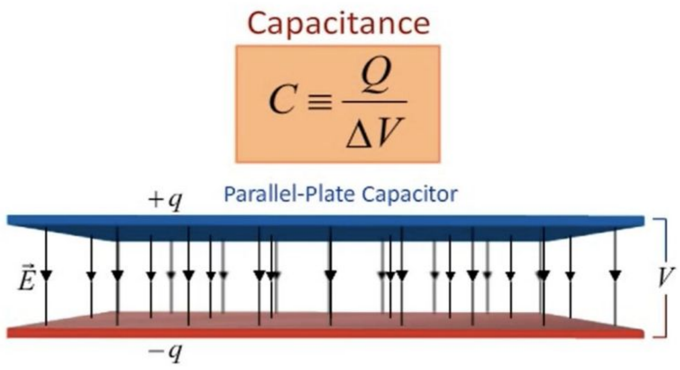
Capacitance

$$U = \frac{1}{2} C V^2$$

$$C = \frac{\kappa \epsilon_0 A}{d}$$

Capacitance can be calculated simply by a capacitors dimensions

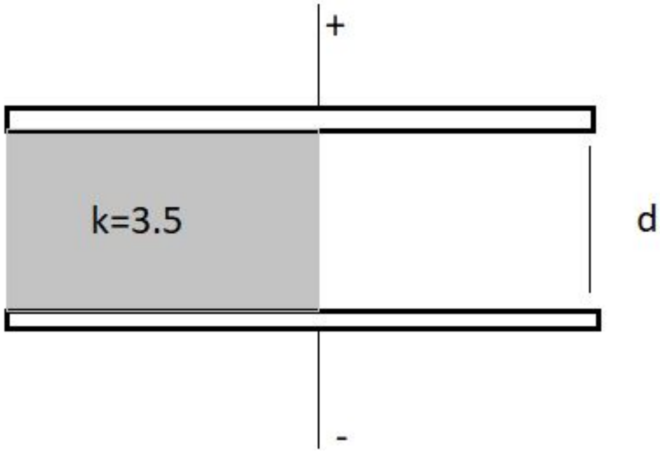
Describes relationship between charges on plates and voltage between plates



Dielectric in a Capacitor

Split the capacitor into two and add them up in series or parallel.

*Don’t forget to divide the length or Area by two!

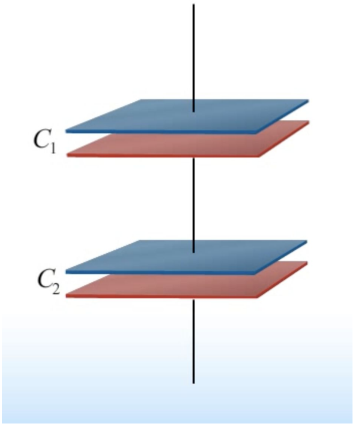


Series and Parallel (Capacitors)

$Q_1 = Q_2 = Q_{12}$

$1/C_{12} = 1/C_1 + 1/C_2$

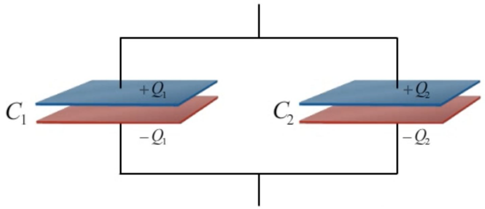
Shares Charge



$V_1 = V_2 = V_{12}$

$C_{12} = C_1 + C_2$

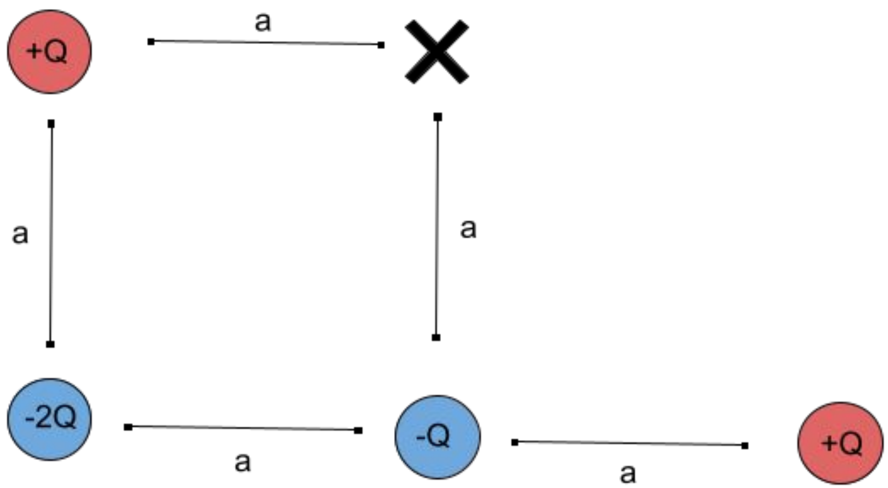
Share Voltage



Practice Problems

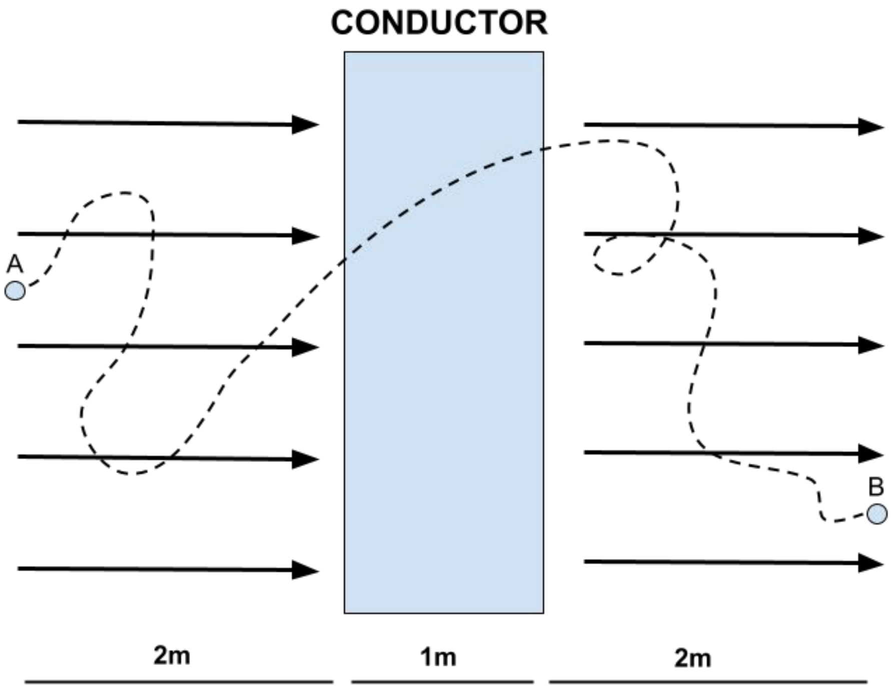
How much work is needed to put a positive charge on the "X"?

a. W = negative
b. W = positive
c. W = 0
d. It depends



In a constant E - field of 3[N/C] you travel from A to B. What is the ΔV?

a. 12 Volts
b. -15 Volts
c. 15 Volts
d. -12 Volts



Thank You!

Sign into the queue to access the worksheet, solutions will be posted later!