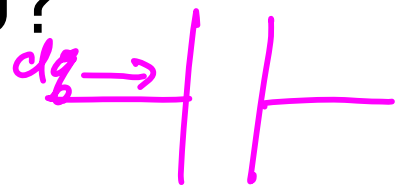
# Energy Stored & Dielectrics

"I think there is a world market for maybe five computers." -- Thomas Watson, chairman of IBM, 1943.

# Energy Stored

- Calculate the work required to move charge onto the plate of a capacitor.
- What are three equations for U?

$\Delta V = \frac{q}{C}$ & $\Delta V = \frac{dU}{dq}$



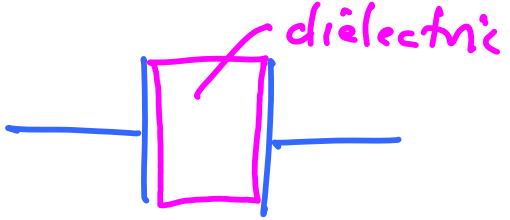

$$\int dU = \int_0^Q \Delta V\, dq = \int_0^Q \frac{q}{C}\, dq$$

$$\Delta U = \frac{q^2}{2C}\Big|_0^Q = \frac{Q^2}{2C}$$

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

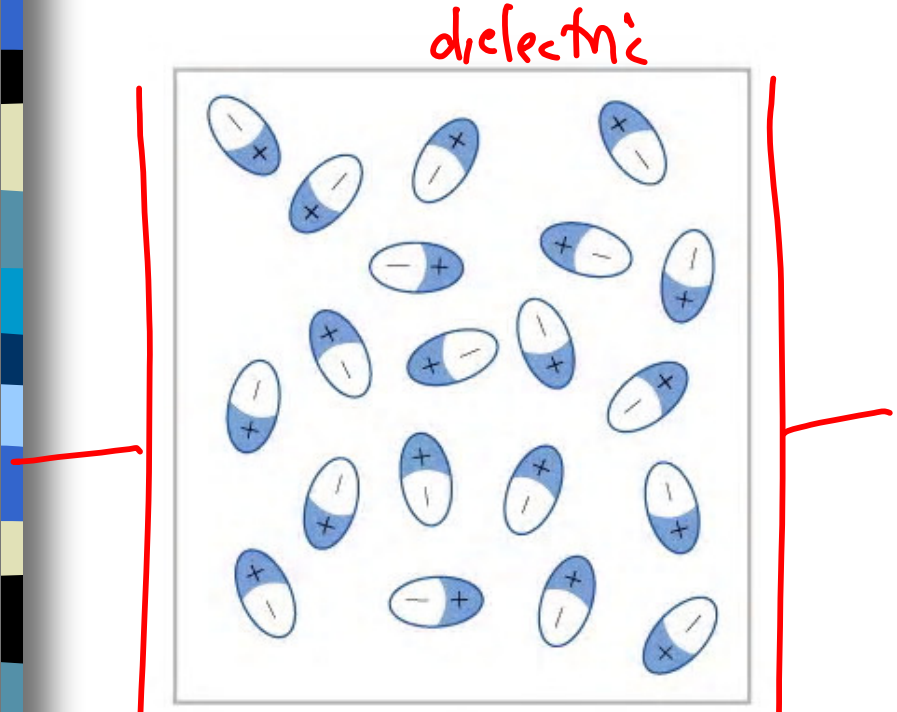
$C = \frac{Q}{\Delta V}$

# Dielectric




- What is a dielectric? a nonconducting material in a capacitor
- $C = \kappa C_0$
- Page 819 has dielectric constants. $\kappa$
- Dielectric Strength max E-field before conduction occurs
- Atomic model of dielectric.
- Geometry of dielectric combinations.

# Dielectric Diagrams

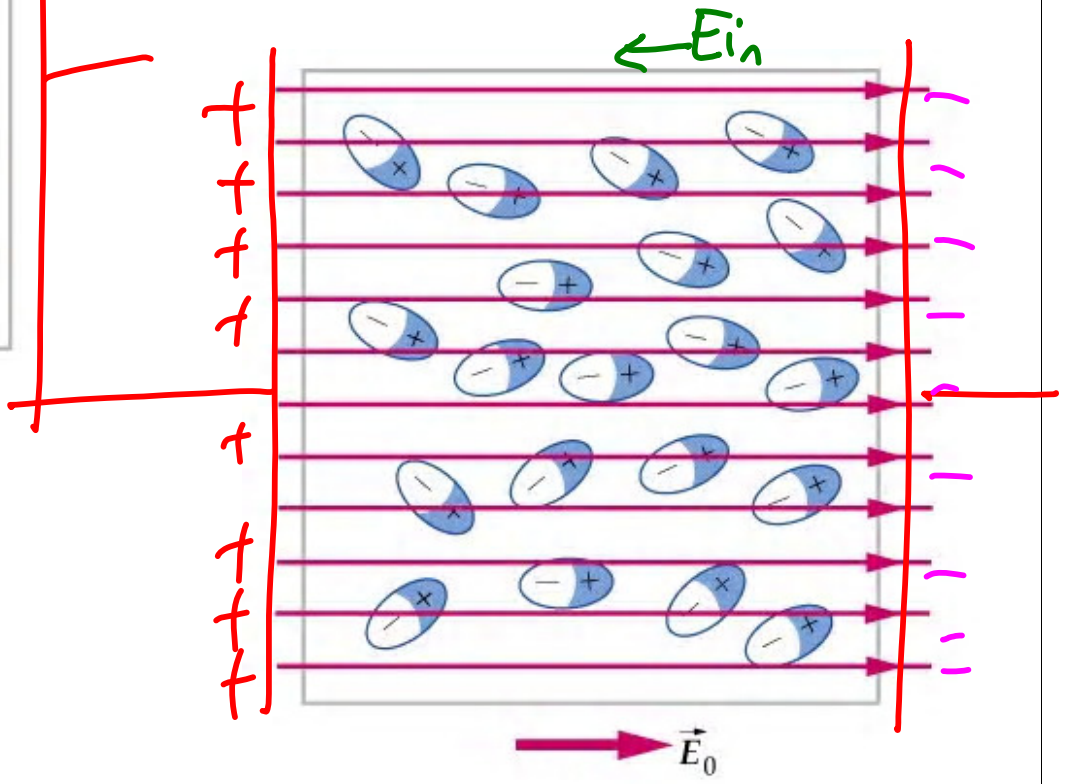



(a)

$E_{TOT} \downarrow$

$\Delta V = E \cdot x \downarrow$

$C = \frac{Q}{\Delta V} \uparrow$

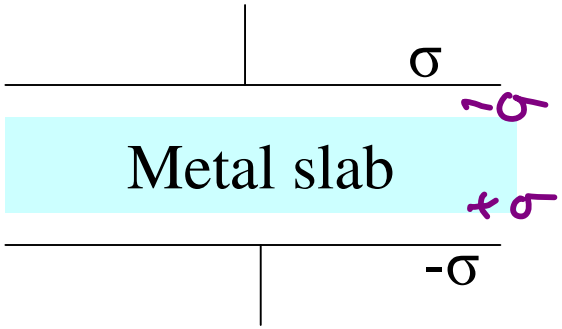



(b)

# Example

1. A metal slab is placed in between two parallel metal plates that are each charged to σ, as shown below. Find the capacitance of the arrangement.

2 capacitors in series




2. Conceptual examples with concentric shells and parallel plates.

2 cap. in //