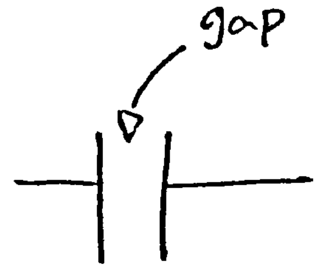
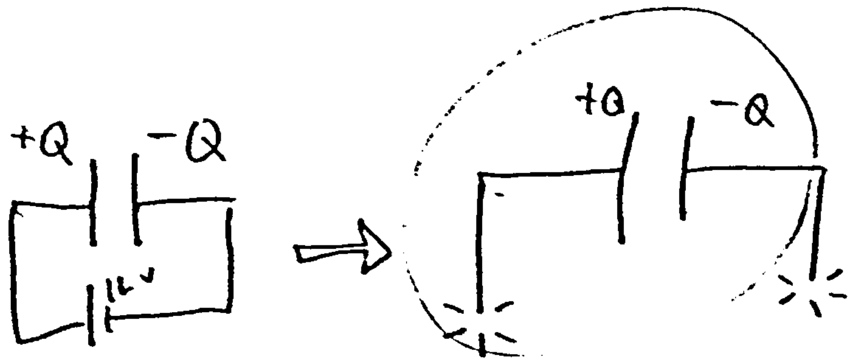
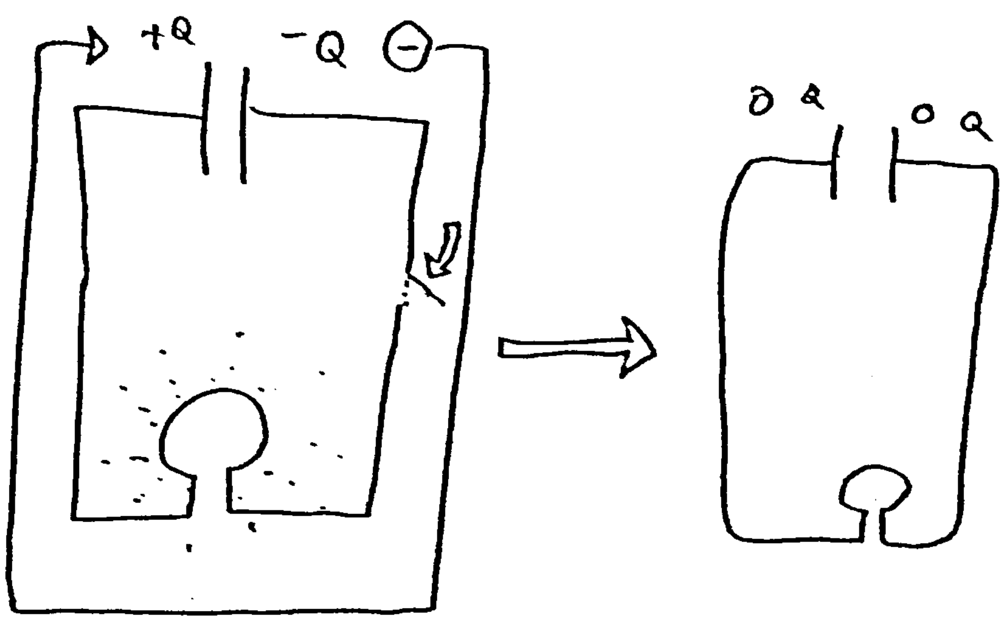
$C = \frac{Q}{V \neq n}$

# PY 202



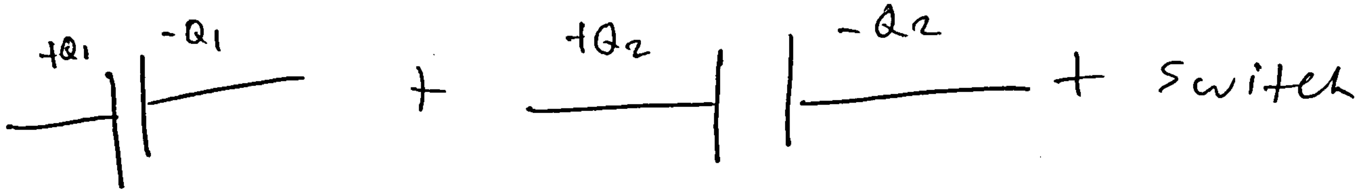

Charge Dynamics w/ Capacitors




Unlike batteries, capacitors don't provide charge for a long time.

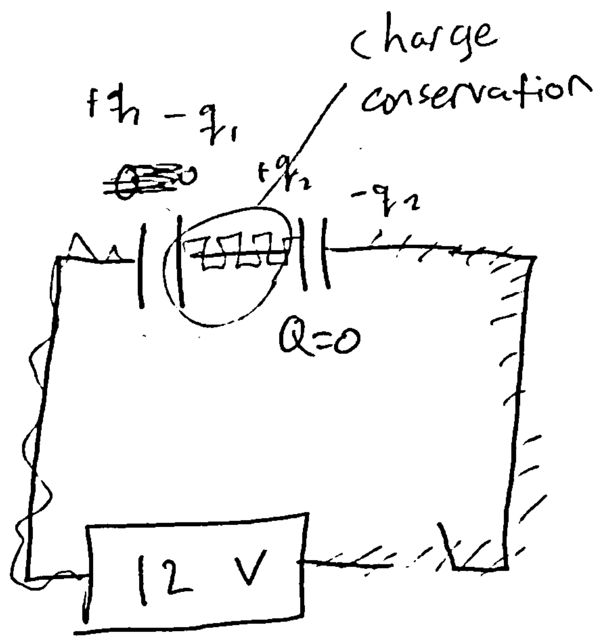

in series

①

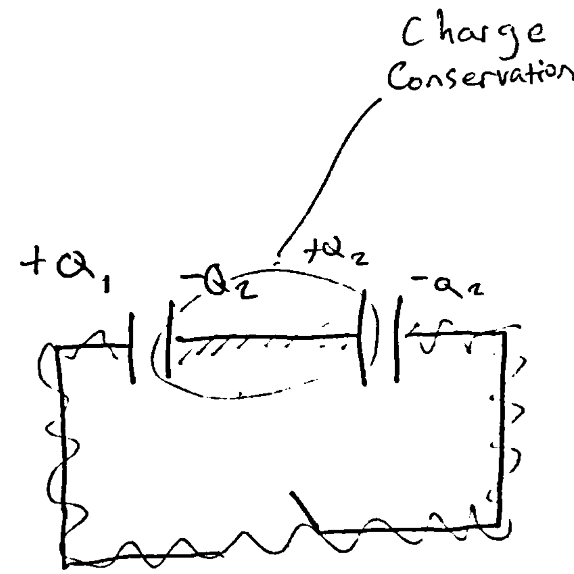



②

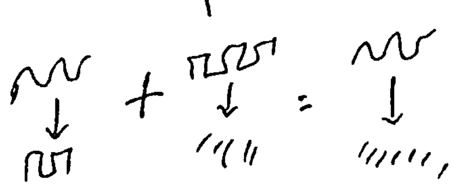
①



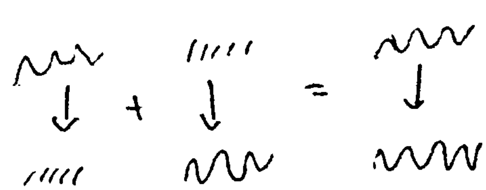

②




$V_1 + V_2 = 12\ V$

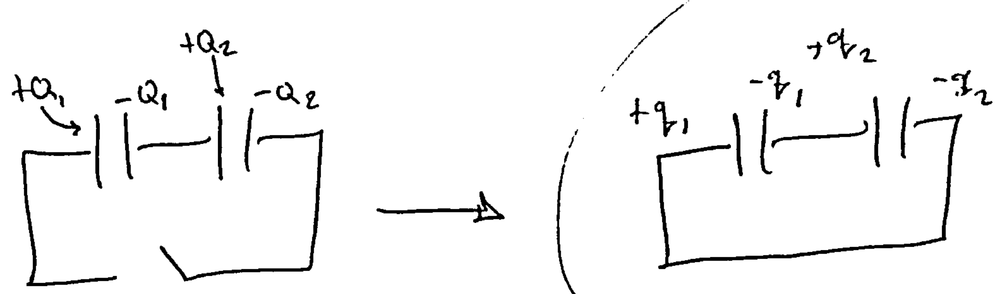


$V_1 + V_2 = 0$

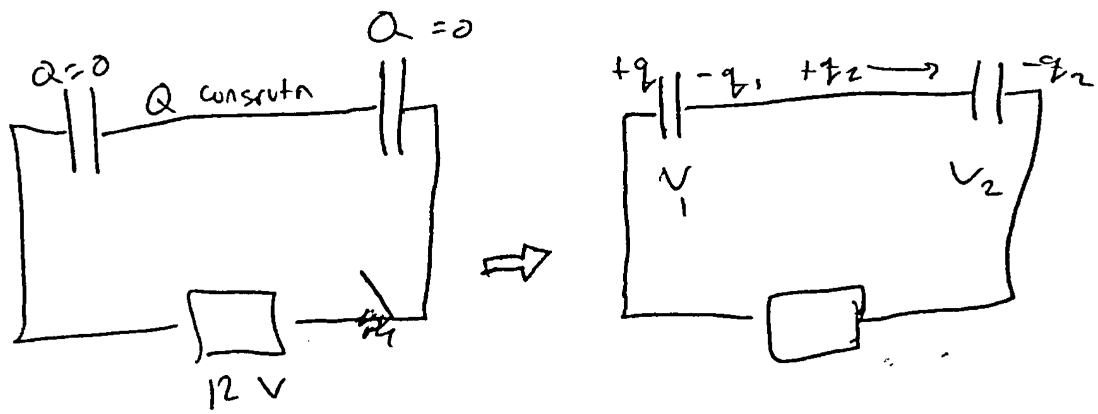


Charge conservation: $-Q_1 + Q_2 = -q_1 + q_2$

2



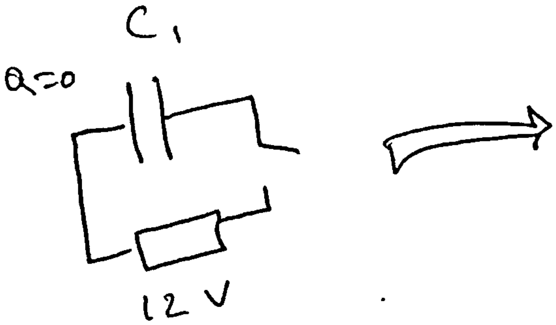

Charge conservation: $0 = -q_1 + q_2$

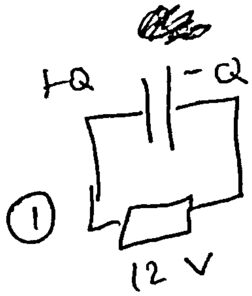



$0 = -q_1 + q_2$ → equal charge

<u>But</u>

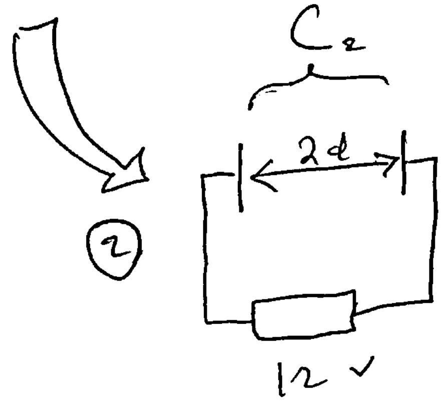
$V_1 \neq V_2$




$A_{C_1} : A$

$d_{C_1} : d$




"d" = 1 d

$C_1 = \frac{\varepsilon_0 A}{d}$

$V_1 = 12 \text{ V}$

start

① $Q_1$

$Q = CV$

$Q_1 = C_1(12)$

$Q_1 = C_1(12)$

---

② 2d:

$C_2 = \frac{\varepsilon_0 A}{2d}$

$V_2 = 12 \text{ V}$

$Q_2$

$Q_2 = C_2(12)$

$Q_2 = C_1(6)$

$Q_2 = \frac{Q_1}{2}$

quiz

$$E = -\vec{\nabla} V$$

So, where slope V is max.

B

$$C = \frac{\varepsilon_0 A}{d} = \frac{ab\varepsilon_0}{d} = \varepsilon_0\left(\frac{ab}{d}\right)$$

$$\varepsilon_0 \frac{(2)^2 ab}{2d} = 2\left(\frac{ab}{d}\right)$$

doubles: B

$$C_{max} = 2C$$

$$C_{min} = \frac{C^2}{2C} = \frac{C}{2} \qquad \frac{2C}{C/2} = 4$$

$$C_{max} = 4\, C_{min}$$ A

$$\gamma_{ws} = \gamma_{ws}^{0} - \frac{CV^2}{2} = \gamma_{ws}^{0} - \frac{\varepsilon_r \varepsilon_0 V^2}{2t}$$

surface tension/energy?

$$\gamma_{ws} = \gamma_s - \gamma_w \cos(\theta)$$

$$\cos\theta = \left( \frac{\gamma_s - \gamma_{ws}^{0} + \frac{CV^2}{2}}{\gamma_w} \right)$$

→ fluoropolymers
→ Patterning

1. FluoroPel
(super-) hydrophobic V-Series
2. CYTOP
3. Teflon AF

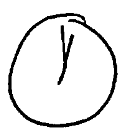
or EWOLF

electrowetting
microfluidics (droplet-based)

microdroplets: droplet generation
motion
sorting
merging
breakup

air 

↓

dielectric 

$\kappa > 1$

less charge on electroscope
↓
more charge on capacitor

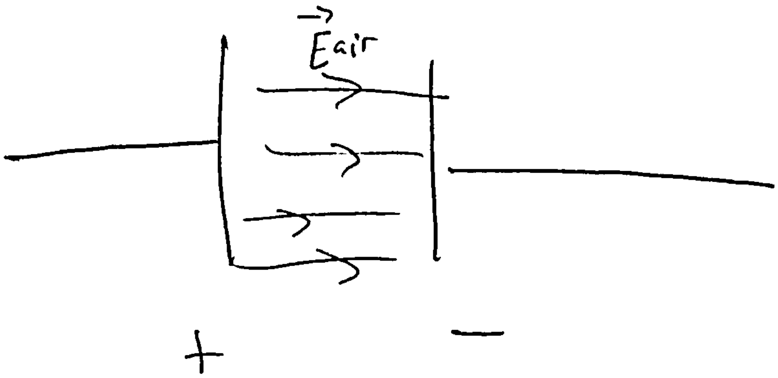
$$C_{air} = C_0$$

$$C_{air} = \frac{Q_{air}}{V_{air}}$$

$$\cancel{\kappa} C_{air} = C_{diel} = \frac{Q_{air}}{V_{diel}} = \frac{Q_{air}}{V_{air}/\kappa}$$

$$C_{dielectric} = \kappa C_0$$

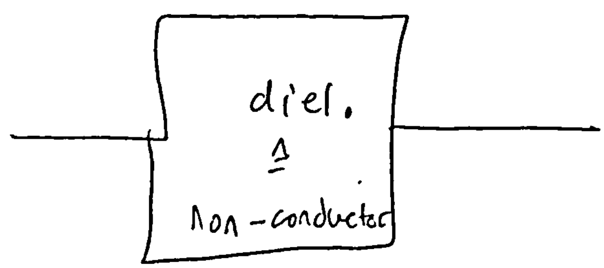
$$\boxed{C_{diel} = \kappa C_{air}} \quad \boxed{V_{diel} = \frac{V_{air}}{\kappa}} \quad \cancel{\kappa} \frac{Q_{air}}{V_{air}}$$





$$V_{air} = -\int_0^d \vec{E}\cdot d\vec{l} = E_{air}\, d$$

$$V_{diel} = \frac{V_{air}}{K} = \frac{E_{air}\, d}{K} = \frac{E_{air}}{K}\, d = E_{diel}\, d$$





energy storage:

go from $Q=0$ to $+Q$ $-Q$

**Energy Storage**

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

For each charge $dq$ added, el. potential E of plate changes:

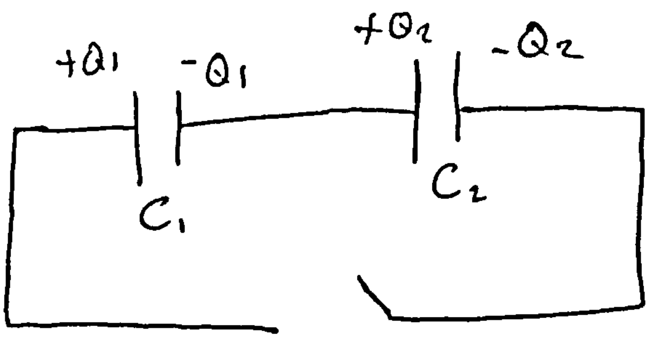
$$\boxed{dU = \frac{q}{C}\,dq} \Rightarrow \boxed{U = \int dU = \int_0^Q \frac{q\,dq}{C}}$$

$$C = \frac{Q}{V} \Rightarrow \boxed{U = \frac{1}{2} QV}$$

$$Q = CV \Rightarrow \boxed{U = \frac{1}{2} CV^2}$$

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

ex)




$V_1 + V_2 = 0$

$V_1 = ?$

$V_2 = ?$

$U_1 = \frac{1}{2} \frac{q_1^2}{C_1}$ $U_2 = \frac{1}{2} \frac{q_2^2}{C_2}$

→ disconnected cap: use C and Q to find U

→ connected cap: $Q = CV$, etc.