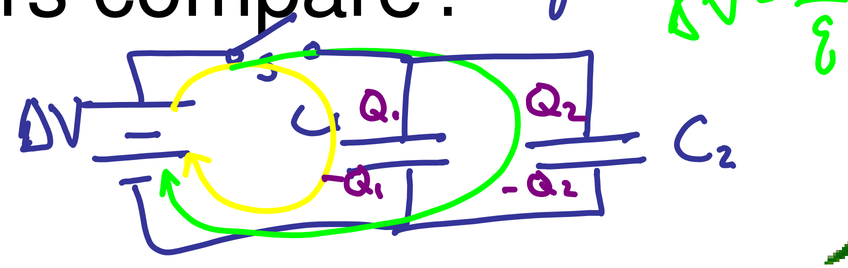
Combinations of Capacitors

"Computers in the future may weigh no more than 15 tons." -- *Popular Mechanics*, forecasting the relentless march of science, 1949.

Parallel Capacitors

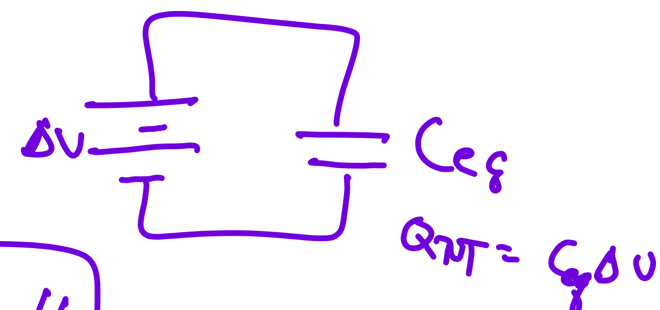
- Symbols for battery, capacitor, switch.
- Draw capacitors in parallel.
- How does potential difference across the two capacitors compare? equal
- Solve for C_{eq}.



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

$Q_{TOT} = Q_1 + Q_2$

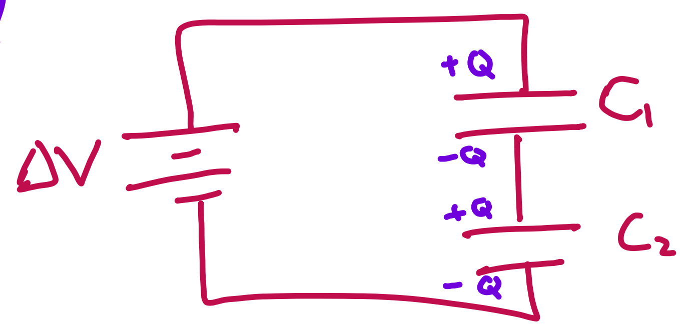
$C_{eq}\Delta V = C_1\Delta V + C_2\Delta V$



$C_{eq} = C_1 + C_2 + \cdots$ for //

Series Capacitors

- Draw capacitors in series and label charge on each plate.
- How does charge on each plate compare? equal
- Solve for C_{eq}.



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

$$\Delta V = \Delta V_1 + \Delta V_2$$

$$\frac{Q}{C_{eq}} = \frac{Q}{C_1} + \frac{Q}{C_2}$$

$$\frac{1}{C_{eq}} = \frac{1}{C_1} + \frac{1}{C_2} = \sum \frac{1}{C_i}$$

Series

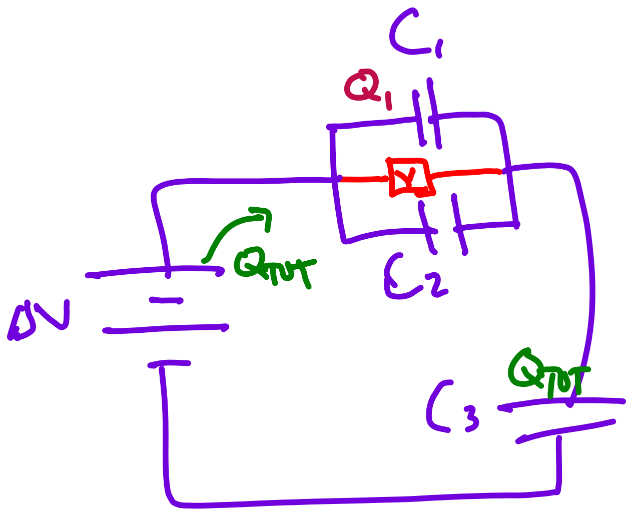
Problem Solving

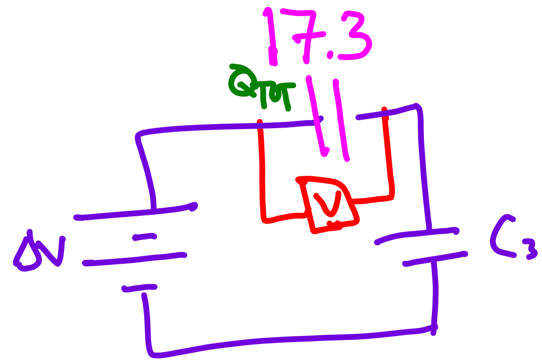
1. Find C_{eq} for the circuit.
2. Find charge stored by ΔV. Q_{TOT}
3. Then determine Q or ΔV on each capacitor by doing C_{eq} in reverse, and remembering whether Q or ΔV is constant for each.

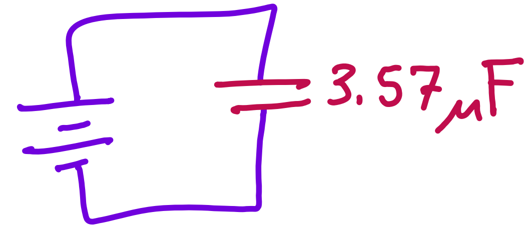
Example: $C_1 = 12\ \mu F$, $C_2 = 5.3\ \mu F$, $C_3 = 4.5\ \mu F$, & $\Delta V = 12.5$ V

a) Find C_{eq}. $= 3.57\ \mu C$

b) Find charge on C_1.







$$\frac{1}{17.3} + \frac{1}{4.5} = \frac{1}{C_{eq}}$$

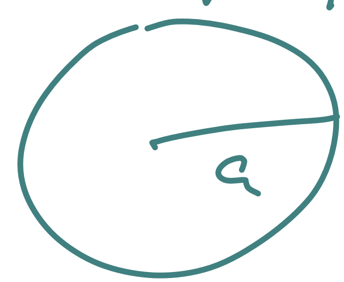
$$C = \frac{Q}{\Delta V} \Rightarrow 3.57 = \frac{Q}{12.5} \Rightarrow \boxed{Q_{TOT} = 44.6 \mu C}$$

$$17.3 = \frac{44.6}{\Delta V} \Rightarrow \boxed{\Delta V = 2.58 V}$$

$$C = \frac{Q}{\Delta V} \Rightarrow 12 = \frac{Q}{2.58} \Rightarrow \boxed{Q = 31 \mu C}$$

FR III #2 & #3

$\rho = Br$



#2 $\frac{d\phi}{dV} =$

(A) Bomb density

i. " , ii. "

(B) $Q = \beta \pi a^4$ ⇐ show

$$\frac{dq}{dV} = \rho$$

$$\int dq = \int \rho \, dV$$

$$Q = \int_0^a \beta r (4\pi r^2 dr)$$

$$4\pi\beta \frac{r^4}{4} \Big|_0^a = \boxed{\pi \beta a^4}$$

(C)