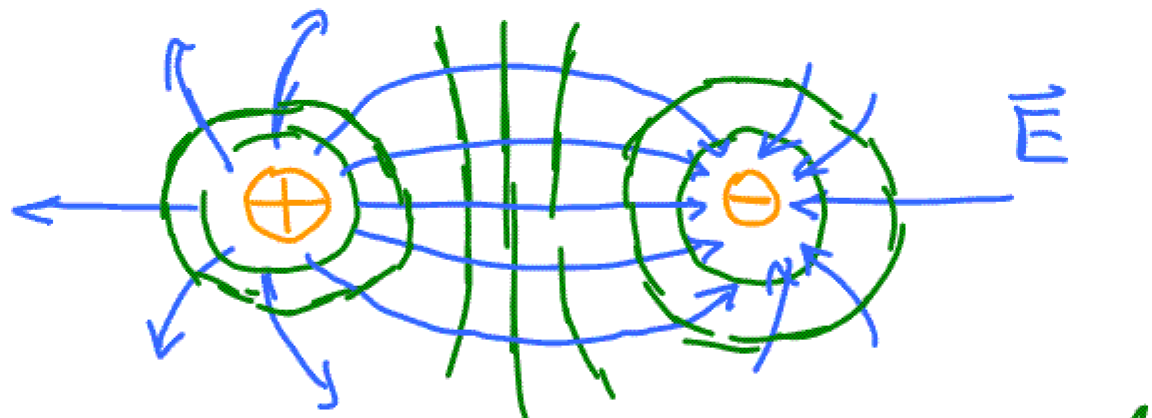
Physics 114 – February 16, 2006

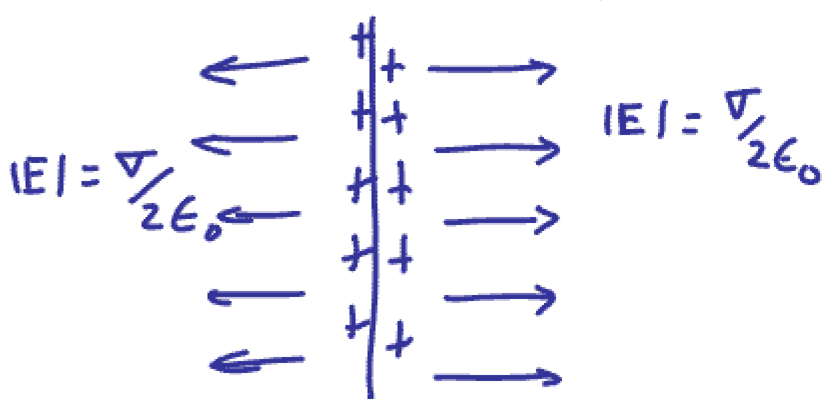
Last Time:

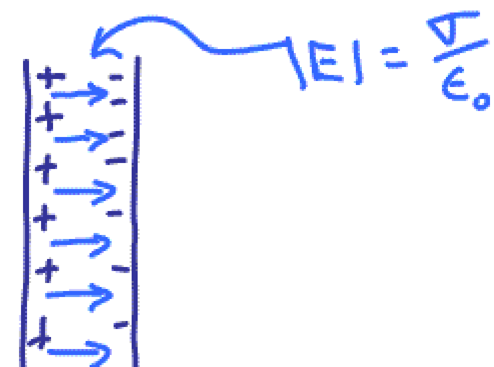
Equipotential lines ⊥ to $\vec{E}$

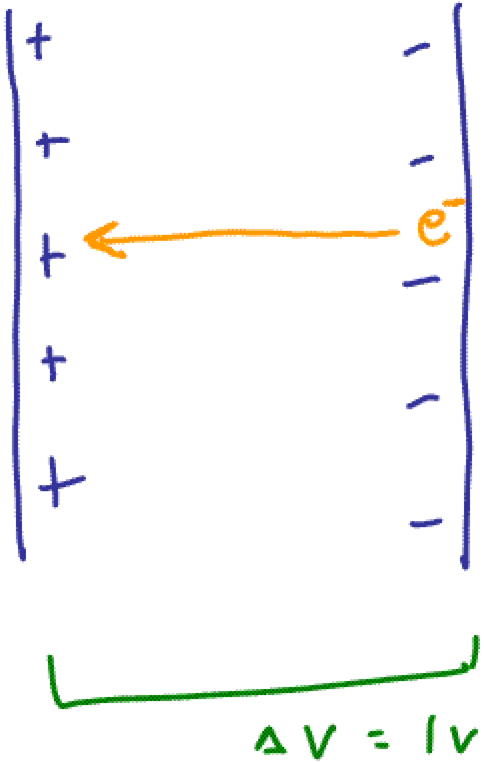


lines of equipotential

∞ plane of chg







$V = W/q$

$W \sim KE = |q|V$

for e^-

$KE = (1.6\times10^{-19})\,\text{Coul}\,(1)\,\text{J}/\text{Coul}$

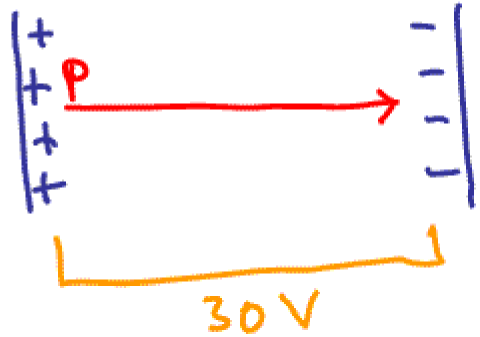
$KE = 1.6\times10^{-19}\ \text{J}$

NOT a convenient #

Define a unit of energy ≡ electron-Volt

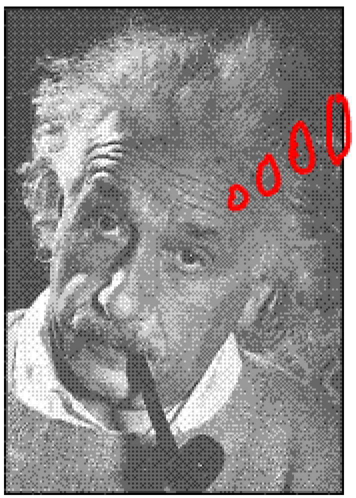
$|e|\,V$

$1\ \text{eV} = 1.6\times10^{-19}\ \text{J}$



$KE \sim 30\ eV$

Also used as Mass unit



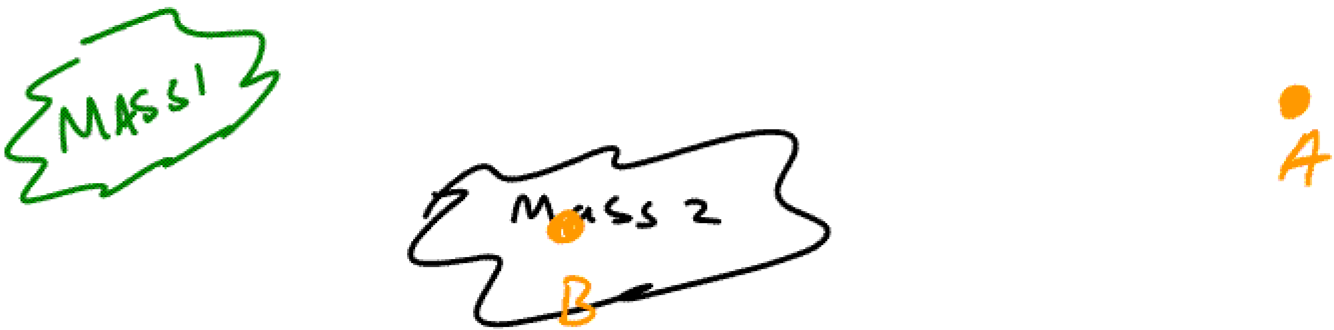
$$E = mc^2 \Rightarrow m = E/c^2$$

$$m_{electron} = 0.511\ MeV/c^2$$

Often physicists leave the c^2 to be "understood".

$$m_e = 0.511\ MeV$$

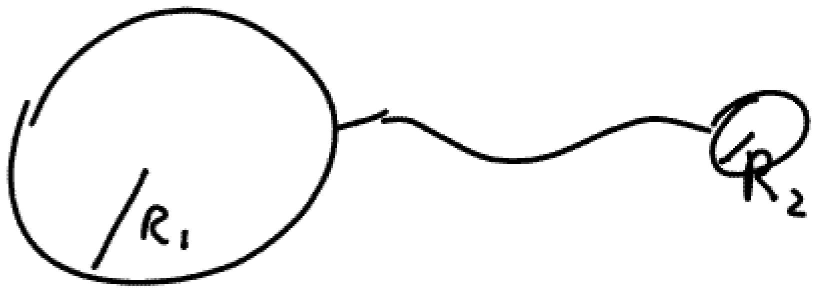
What is the Potential energy stored in a system of 2 masses?



How does the PE depend on the position of Mass 2?

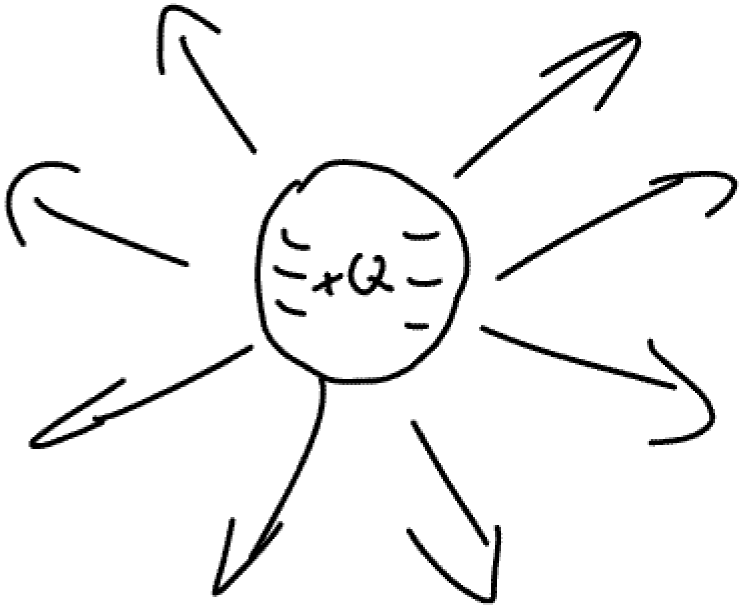
As masses get closer together the Potential energy of the system is reduced.

Same thing in electrostatics



$$\frac{kQ_1}{R_1} = \frac{kQ_2}{R_2} \qquad \frac{Q_1}{Q_2} = \frac{R_1}{R_2}$$

Exam 1 Material ends here



$$V_+ = \frac{kQ}{R} \quad \sim V_+ \propto Q$$

$V_- \propto Q$

$$V_- = -\frac{kQ}{R}$$

Potential diff bet. spheres

$$\Delta V = V_+ - V_- \sim \frac{2kQ}{R}$$

$$\Delta V \sim Q$$

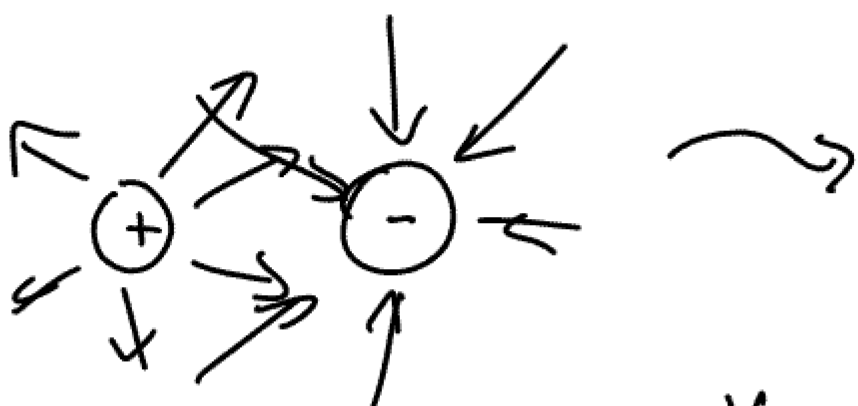
$V \propto Q$ constant of proportionality

$Q = CV$ Capacitance

$$C \equiv \frac{\text{Coulombs}}{\text{Volt}} = \text{Farad}$$

ΔV

$Q_+ = C_+ V_+$ $Q = C_{+-} V_{+-}$ $Q_- = C_- V_-$

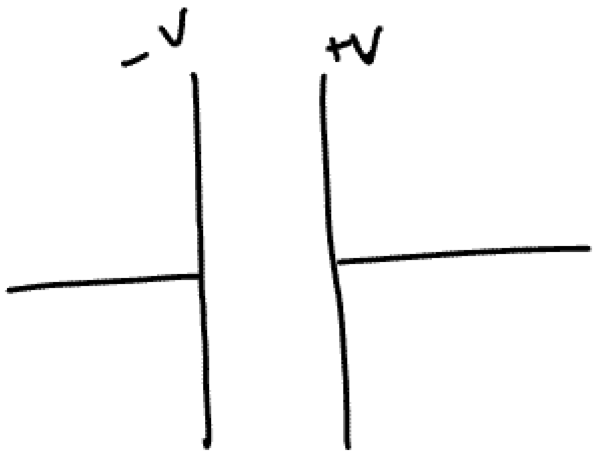


$V_{+-_{new}}$

$V_{+-_{New}} < V_{+-}$

Capacitance is increased

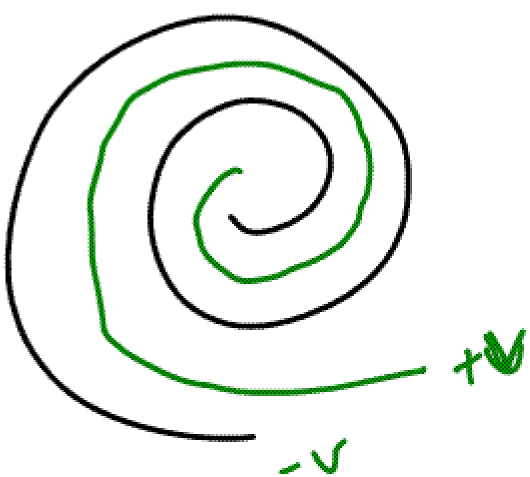
Capacitance only depends on geometry

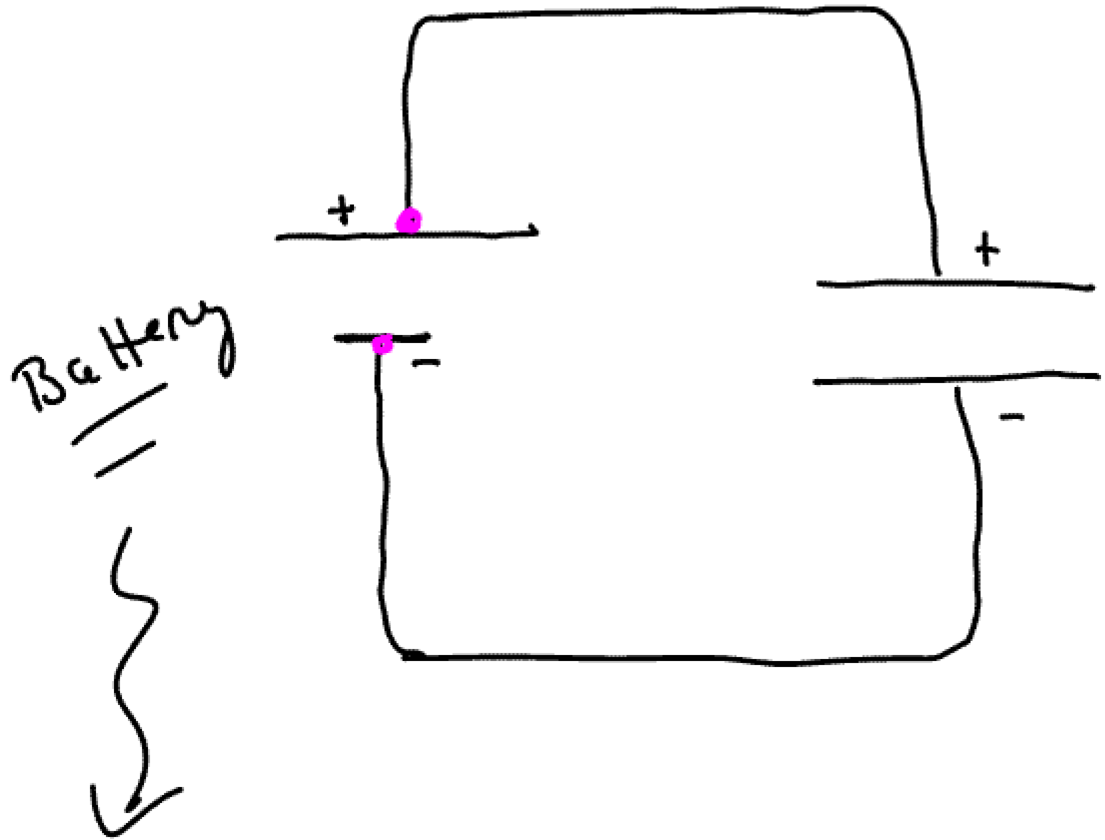


Capacitor

↓

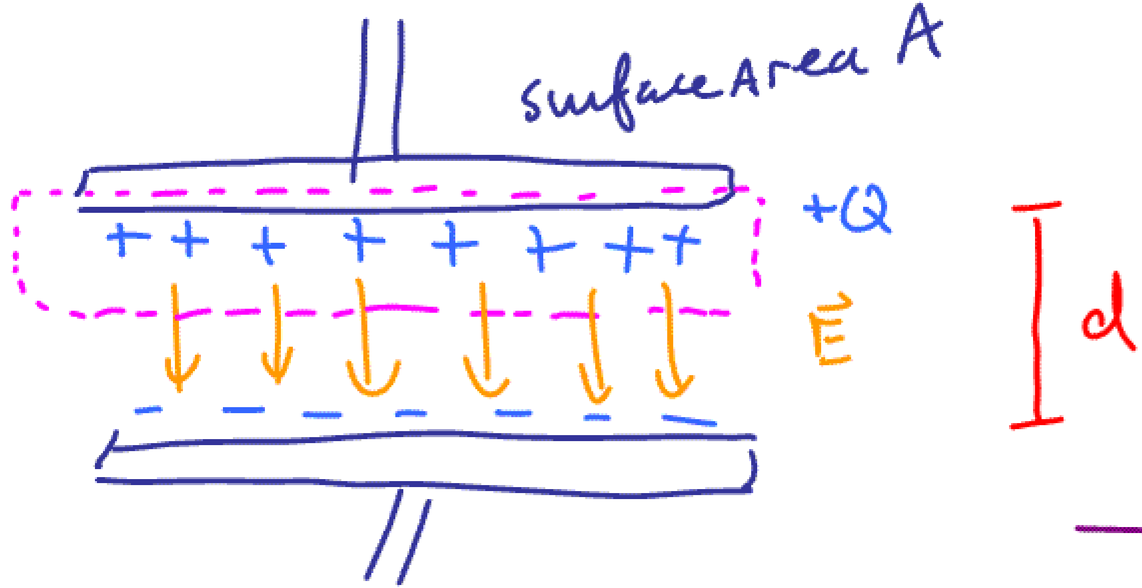
acts as charge storage device





EMF ≡ Electromotive force

maintain constant potential difference between Terminals



$$\oint E \cdot dA = \frac{Q_{encl}}{\epsilon_0}$$

$$V = \frac{W}{q} = \frac{Fd}{q} = Ed$$

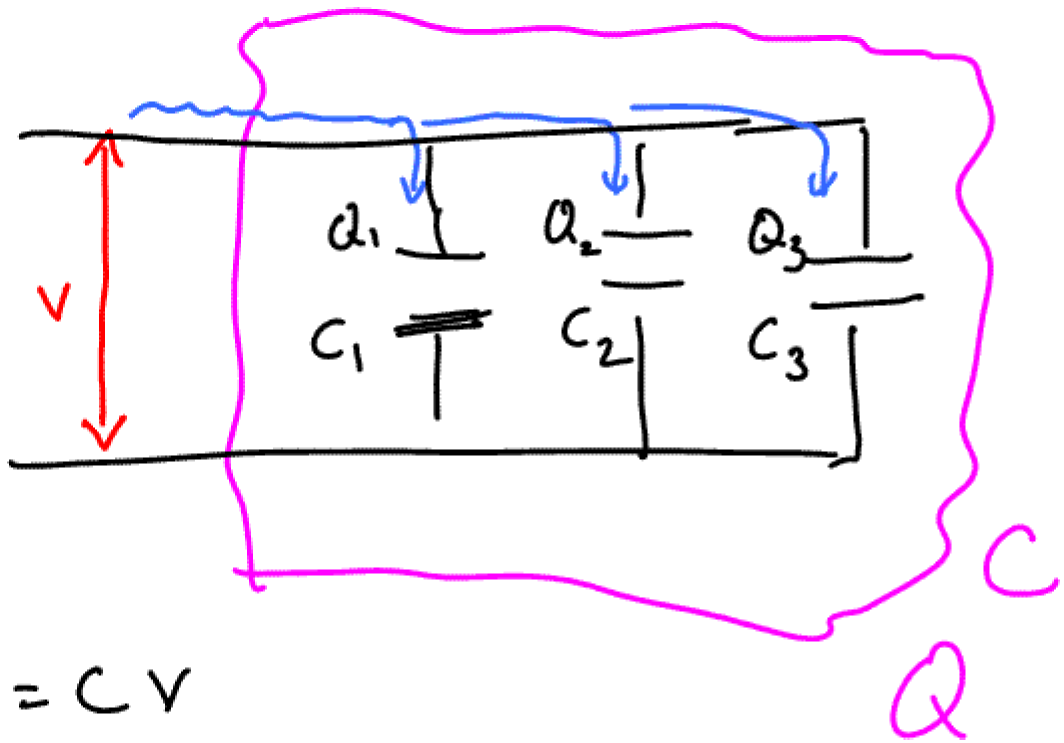
$$|\vec{E}|A = \frac{Q}{\epsilon_0}$$

$$Q = CV$$

$$C = \frac{Q}{V} = \frac{\epsilon_0 E A}{Ed} = \frac{\epsilon_0 A}{d}$$

capacitance of // plate configuration

⟹ depends only on geometry



Capacitors in Parallel

$Q = CV$

$Q_1 = C_1 V$

$Q_2 = C_2 V$

$Q_3 = C_3 V$

$Q = Q_1 + Q_2 + Q_3$

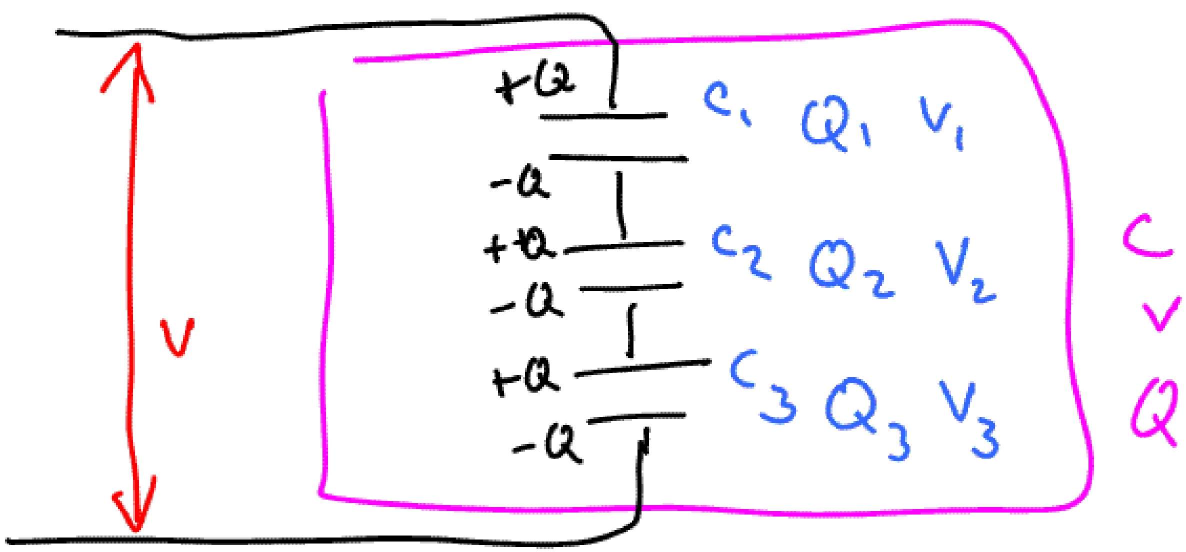
$CV = C_1 V + C_2 V + C_3 V$

$C = C_1 + C_2 + C_3$

Capacitors in //

$$C_{TOT} = \sum C_i$$

Capacitors in series



$$V = V_1 + V_2 + V_3$$

$$\frac{Q}{C} = \frac{Q_1}{C_1} + \frac{Q_2}{C_2} + \frac{Q_3}{C_3}$$

$$\frac{1}{C} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3}$$

Capacitors in Series

$$\frac{1}{C} = \sum \frac{1}{C_i}$$