Capacitance -19

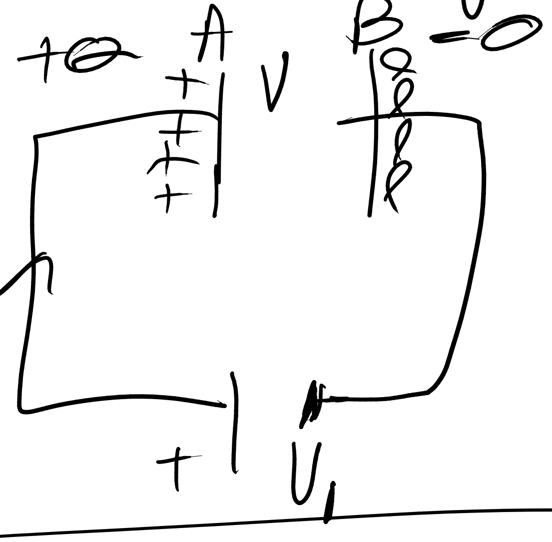
Capacitance is the ability of conductor to store charge.

Capacitance of a capacitor is defined as the ratio of charge on anyone plate to the P.D across them.

$$C = \frac{Q}{V} = CV^{-1} \,/\, F$$

μF or pF or nF

$$1F = \frac{C}{V} = CV^{-1}$$



Capacitance in series

Total charge = Q

total voltage = V

Total capacitance = C_S

$$V = \frac{Q}{C_S}$$

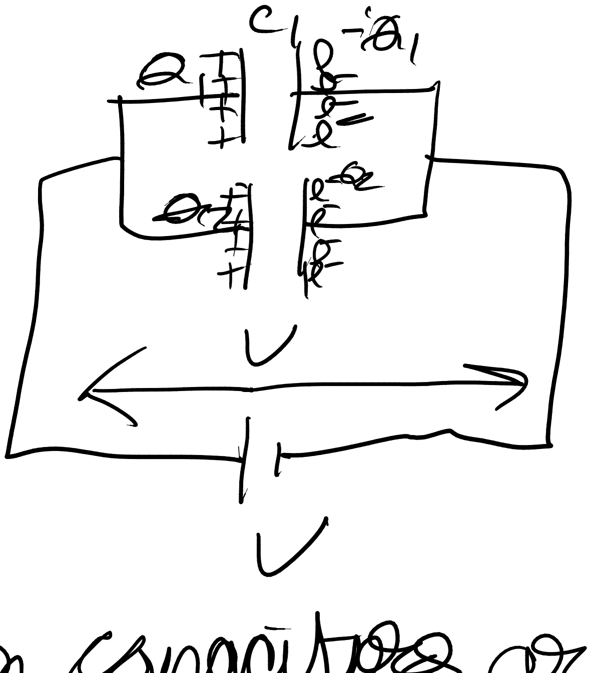
$$V = V_1 + V_2$$

$$\frac{Q}{C_S} = \frac{Q}{C_1} + \frac{Q}{C_2}$$

$$\frac{1}{C_S} = \frac{1}{C_1} + \frac{1}{C_2}$$

when 2 capacitors are connected in series, equal charges will collect on them; however the voltage across each of them will be different. If capacitors in series are discharged then the total charge that flows will be equal to the charge on any one plate.

Capacitors in parallel



Total charge $Q_T = Q_1 + Q_2$

Total Volt $= V$

Total capacitance $= C_T$

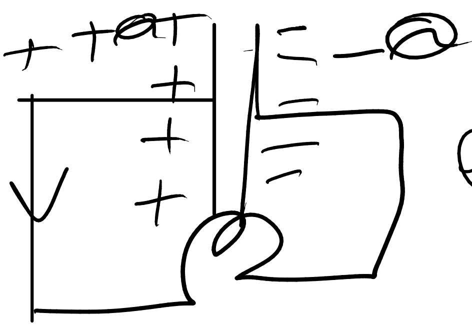
$$Q_T = Q_1 + Q_2$$

$$C_T V = C_1 V + C_2 V$$

$$C_T = C_1 + C_2$$

when capacitors are in parallel, the charge on each of them is different. However, the voltage across each is the same. However, the total charge is the sum of the individu

charges



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

electrical energy → other forms

Energy stored in a capacitor $= \frac{1}{2}CV^2$

$= \frac{1}{2} \cdot \frac{Q}{V} \cdot V^2$

$= \frac{1}{2} QV$

$= \frac{1}{2}$

When a capacitor is charged, it stores electrical energy. For example if it is connected to a bulb then the bulb will glow for a short while. This means electrical energy has changed into light energy.

Discharging a capacitor

Time constant

$\tau = RC\ (s)$

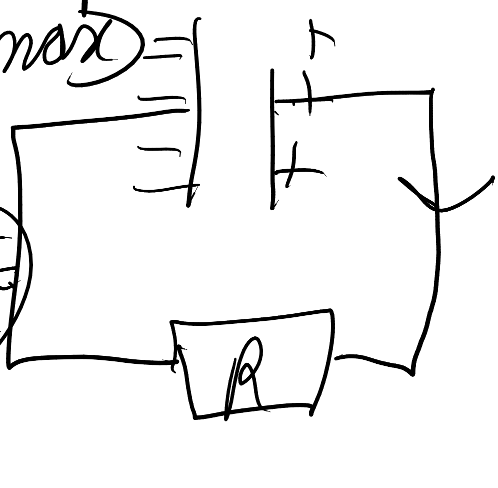
Tau

Initial current $= I_0$ (max)

" " charge $= Q_0$

" " PD $= V_0$

after time t $I = I_0 e^{-\frac{t}{\tau}}$



after time (t) $Q = Q_0 e^{(-t/\tau)}$

after time (t) $V = V_0 e^{(-t/\tau)}$

τ = time taken for 67% of the charge on the capacitor to discharge

energy stored = area under the graph

$= \frac{1}{2} \cdot \Delta Q \cdot \Delta V$