AP Physics - Electricity - Capacitors in Series and Parallel

Series

If multiple capacitors are placed in series in a circuit, charge will separate equally on each capacitor.

$$Q_1 = Q_2 = Q_3 = Q$$

Moreover, the total voltage drop over all the capacitors is equal to the sum of the voltage drops over each capacitor.

$$V_T = V_1 + V_2 + V_3$$

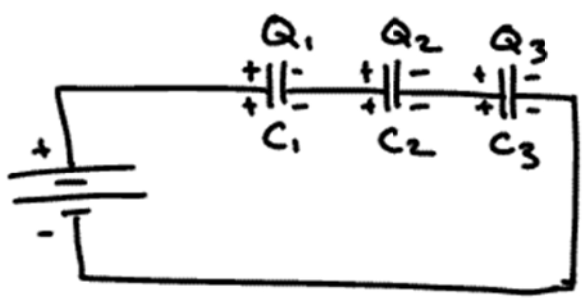
Finally, from the previous unit: $Q = CV$ $\quad V = \frac{Q}{C}$

Therefore: $$V_T = V_1 + V_2 + V_3$$

$$\frac{Q}{C_{eq}} = \frac{Q}{C_1} + \frac{Q}{C_2} + \frac{Q}{C_3}$$

$$\frac{1}{C_{eq}} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3}$$

Equivalent capacitance in series



Parallel

If multiple capacitors are placed in parallel in a circuit, voltage drops across each will be the same.

$$V_1 = V_2 = V_3 = V_T = V$$

The total charge separation for all of the capacitors will be the sum of the charge separation for all the capacitors.

$$Q_T = Q_1 + Q_2 + Q_3$$

Therefore:

$$Q_T = Q_1 + Q_2 + Q_3$$

$$C_T V = C_1 V + C_2 V + C_3 V$$

$$C_T = C_1 + C_2 + C_3$$ Equivalent Capacitance in Parallel