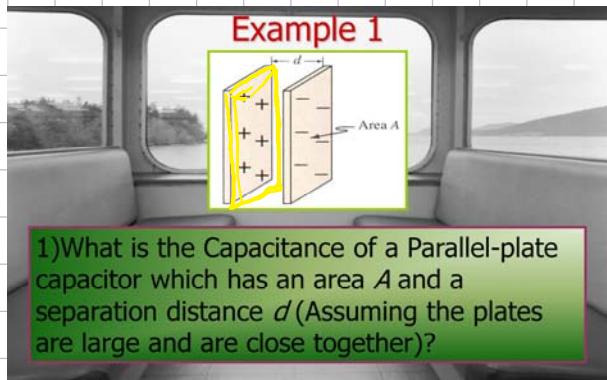
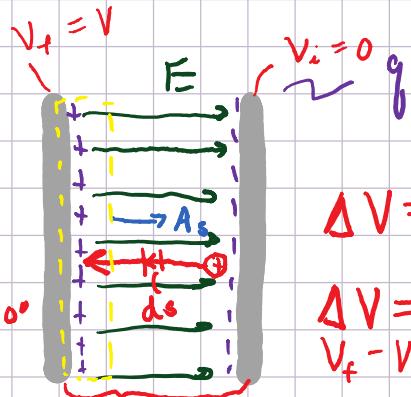


Example 1

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$$q = CV$$



$$\Delta V = - \int E ds \quad \text{Coulomb's Law}$$

$$\Delta V = Ed$$

$$V_f - V_i = Ed$$

$$\Phi = \frac{q_{\text{enc}}}{\epsilon_0}$$

$$EA = \frac{q}{\epsilon_0}$$

$$q = EA\epsilon_0$$

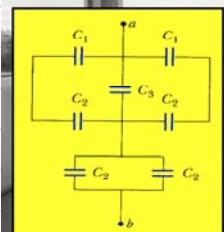
$$\cancel{EA\epsilon_0 = C Ed}$$

$$C = \epsilon_0 \frac{A}{d}$$

Example 2

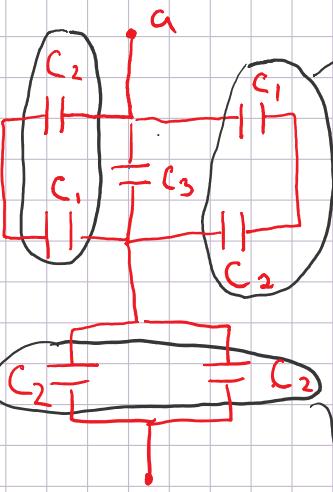
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Example 2



2a) Find the equivalent capacitance between points *a* and *b* if
 $C_1 = 5.00 \mu F$, $C_2 = 10.0 \mu F$, and
 $C_3 = 2.00 \mu F$.

b) If the potential difference between *a* and *b* is 60 V what is the charge stored on C_3 .



$$\frac{1}{C_{12}} = \frac{1}{C_1} + \frac{1}{C_2}$$

$$\frac{1}{C_{12}} = \frac{1}{5\mu F} + \frac{1}{10\mu F}$$

$$\frac{1}{C_{12}} = \frac{2}{10\mu F} + \frac{1}{10\mu F}$$

$$\frac{1}{C_{12}} = \frac{3}{10\mu F}$$

$$C_{12} = \frac{10}{3} \mu F$$

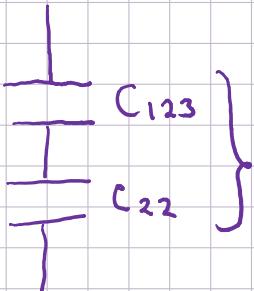
$$C_{22} = C_2 + C_2$$

$$C_{22} = 20 \mu F$$

$$C_{123} = C_{12} + C_{12} + C_3$$

$$C_{123} = \frac{10}{3} \mu F + \frac{10}{3} \mu F + 2 \mu F$$

$$C_{123} = \frac{26}{3} \mu F = 8.67 \mu F$$

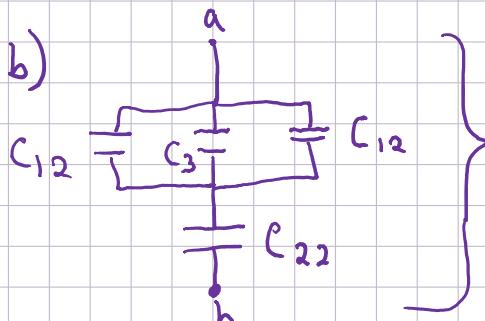


$$\frac{1}{C_{tot}} = \frac{1}{C_{123}} + \frac{1}{C_{22}}$$

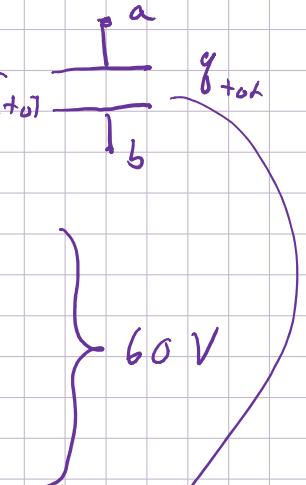
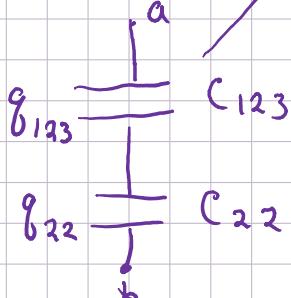
$$\frac{1}{C_{tot}} = \frac{1}{8.67 \mu F} + \frac{1}{20 \mu F}$$

$$\frac{1}{C_{tot}} = .165 \mu F^{-1}$$

$$C_{tot} = 6.05 \mu F$$



$$60 V$$



$$q_3 = C_3 V_3$$

$$q_3 = (2 \mu F)(41.87 V)$$

$$q_3 = 83.74 \mu C$$

$$V_{123} = \frac{q_{123}}{C_{123}}$$

$$V_{123} = \frac{363 \mu C}{8.67 \mu F}$$

$$V_3 = -V_{123} = 41.87 V$$

$$\rightarrow q_{tot} = C_{tot} V$$

$$q_{tot} = (6.05 \mu F)(60 V)$$

$$q_{tot} = 363 \mu C$$

$$q_{22}$$

13 0001100111 / 1 V3 - 1 V125 11.01 V 0.01 0.0001

$$V_{22} = \frac{q_{22}}{C_{22}}$$

$$V_{22} = \frac{363 \mu C}{20 \mu F}$$

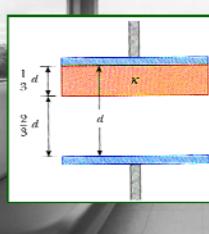
$$\rightarrow V_{22} = 18.15 \text{ V}$$

Example 3

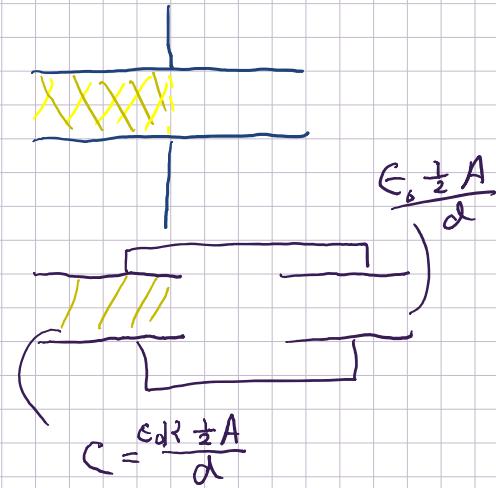
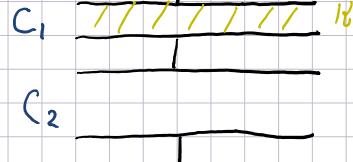
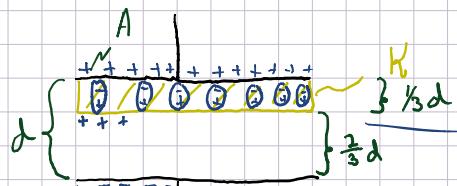
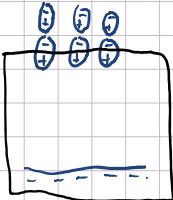
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$$C_0 = \frac{\epsilon_0 A}{d}$$

Example 3



3) A parallel-plate capacitor with a plate separation d has a capacitance C_0 in the absence of a dielectric. What is the capacitance when a slab of dielectric material of dielectric constant κ and thickness $\frac{1}{3}d$ is inserted between the plates.



$$\frac{1}{C_{tot}} = \frac{1}{C_1} + \frac{1}{C_2} = \frac{1}{\kappa\epsilon_0 \frac{A}{\frac{1}{3}d}} + \frac{1}{\epsilon_0 \frac{A}{\frac{2}{3}d}}$$

$$\frac{1}{C_{tot}} = \frac{1}{3\epsilon_0 \frac{A}{d}} \left[\frac{1}{\kappa} + 2 \right]$$

$$\frac{1}{C_{tot}} = \frac{1}{3\epsilon_0 \frac{A}{d}} \left[\frac{1+2\kappa}{\kappa} \right]$$

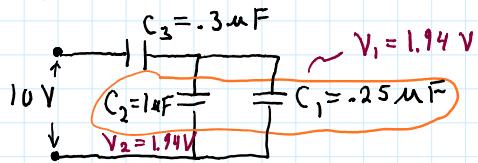
$$C_{tot} = 3 \left(\epsilon_0 \frac{A}{d} \right) \left[\frac{1}{1+2\kappa} \right]$$

$$C_{tot} = 3 \left[\frac{1}{1+2\kappa} \right] C_0$$

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

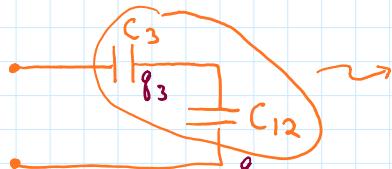
$$\frac{C_2 + C_1}{C_1 C_2}$$

$$C_{tot} = \frac{C_1 C_2}{C_2 + C_1}$$



$$C_{12} = C_1 + C_2$$

$$\underline{C_{12} = 1 \mu F + 0.25 \mu F = 1.25 \mu F}$$

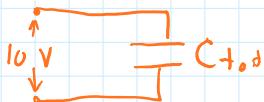


$$\frac{1}{C_{\text{tot}}} = \frac{1}{C_{12}} + \frac{1}{C_3}$$

$$\frac{1}{C_{\text{tot}}} = \frac{1}{1.25 \mu F} + \frac{1}{0.3 \mu F}$$

$$V_{12} = \frac{q_{12}}{C_{12}} \approx \frac{2.42 \mu C}{1.25 \mu F} = 1.94 V$$

$$\frac{1}{C_{\text{tot}}} = 4.13/\mu F$$



$$q_{12} = C_{12} V$$

$$q_{12} = (0.242 \mu F)(10 V)$$

$$q_{12} = 2.42 \mu C \rightarrow \underline{\underline{q_3 = 2.42 \mu C}}$$

$$q_{12} = 2.42 \mu C$$

$$q_1 = C_1 V_1 = (0.25 \mu F)(1.94 V)$$

$$\underline{\underline{q_1 = 0.485 \mu C}}$$

$$q_2 = C_2 V_2 = (1 \mu F)(1.94 V)$$

$$\underline{\underline{q_2 = 1.94 \mu C}}$$

$$\frac{1}{C_{\text{tot}}} = \frac{1}{C_{12}} + \frac{1}{C_3}$$

$$U = \frac{1}{2} C V^2$$

$$U = \frac{1}{2} (0.242 \mu F) (10 V)^2$$

$$\underline{\underline{U = 12.1 \mu J}}$$