Example 1

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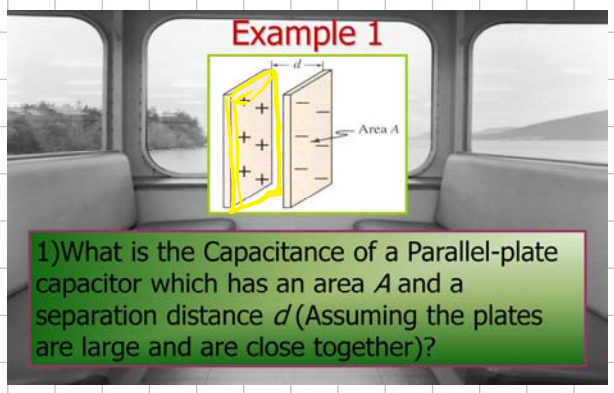
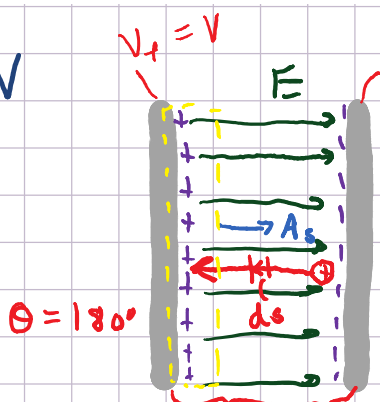
$q = CV$




$\Delta V = -\int E\, ds \cos\theta$ (with $\cos\theta$ raised to $-1$)

$\Delta V = Ed$

$V_f - V_i = Ed$

$V = Ed$

$\Phi = \frac{q_{inc}}{\epsilon_0}$

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

$q = EA\epsilon_0$

$EA\epsilon_0 = C Ed$

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

Example 2

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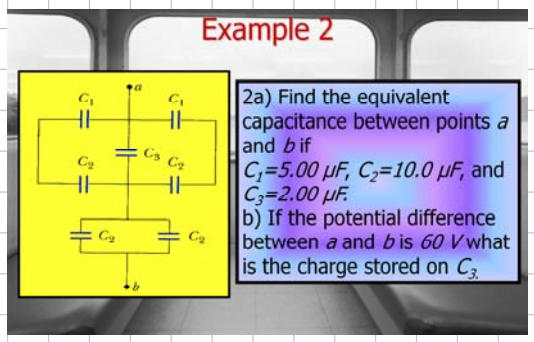
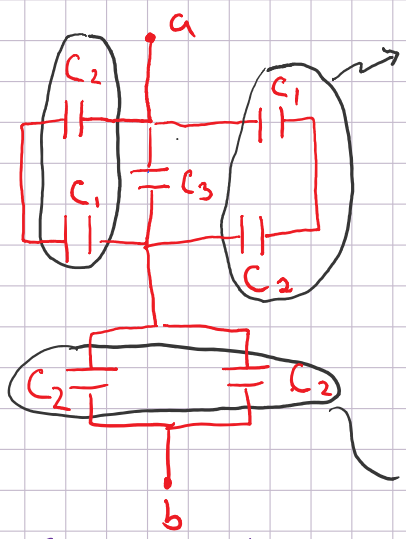



$$\frac{1}{C_{12}} = \frac{1}{C_1} + \frac{1}{C_2}$$

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

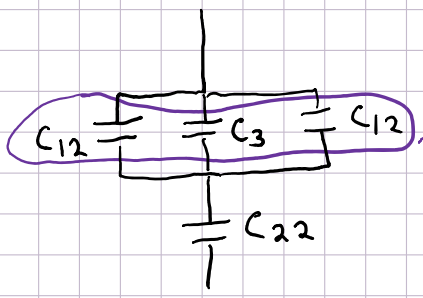
$$\frac{1}{C_{12}} = \frac{2}{10\mu F} + \frac{1}{10\mu F}$$

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

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

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

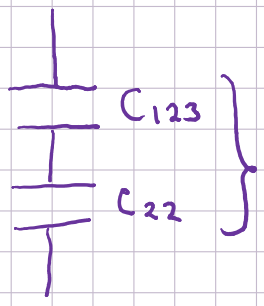
$$C_{22} = 20\mu F$$




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

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

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

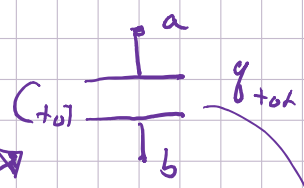



$$\frac{1}{C_{tot}} = \frac{1}{C_{123}} + \frac{1}{C_{22}}$$

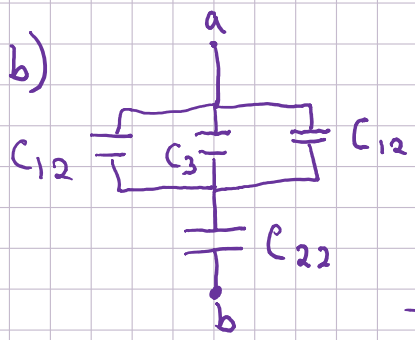
$$\frac{1}{C_{tot}} = \frac{1}{8.67\mu F} + \frac{1}{20\mu F}$$

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

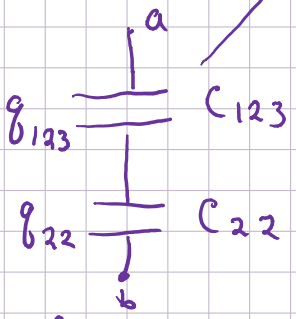
$$\boxed{C_{tot} = 6.05\mu F}$$




b)




60 V




60 V

$$q_3 = C_3 V_3$$

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

$$\boxed{q_3 = 83.74\mu C}$$

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

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

$$V_3 = \rightarrow V_{123} = 41.87 V$$

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

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

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

$q_{22}$

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

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

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

Example 3

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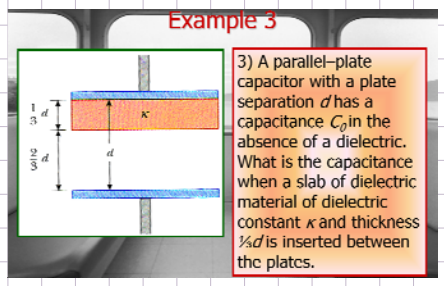
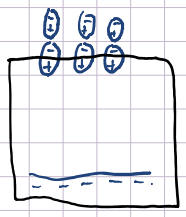
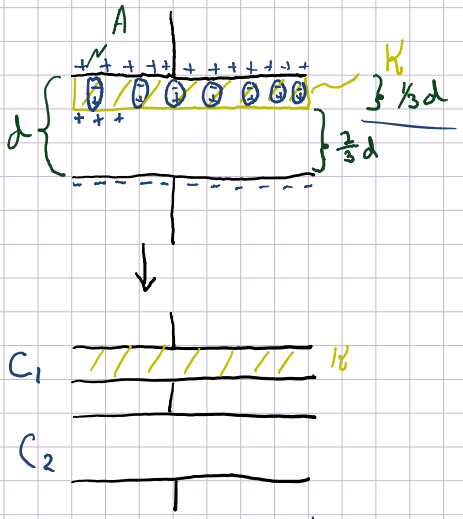
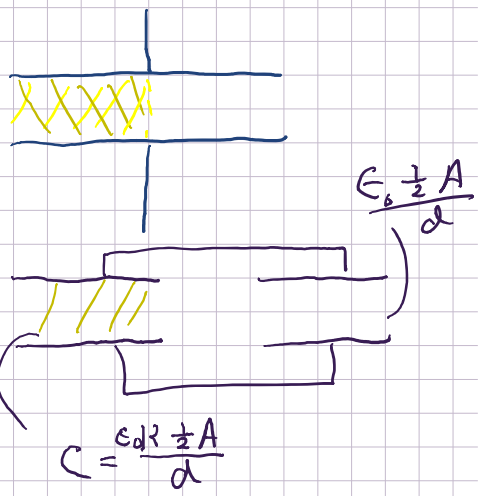
$C_0 = \frac{\epsilon_0 A}{d}$






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

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

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

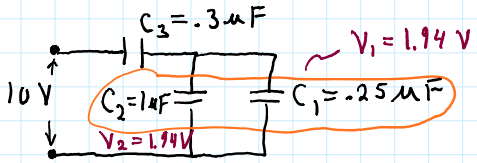
$$\frac{C_2 + C_1}{C_1 C_2}$$

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

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

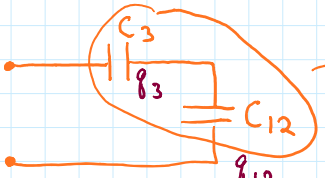
$$C_{tot} = 3\left(\epsilon_0 \frac{A}{d}\right)\left[\frac{\kappa}{1 + 2\kappa}\right]$$

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




$C_{12} = C_1 + C_2$

$C_{12} = 1\mu F + .25\mu F = 1.25\mu F$



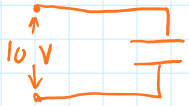

$\frac{1}{C_{tot}} = \frac{1}{C_{12}} + \frac{1}{C_3}$

$\frac{1}{C_{tot}} = \frac{1}{1.25\mu F} + \frac{1}{.3\mu F}$

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

$C_{tot} = .242\ \mu F$

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




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

$q_{tot} = (.242\mu F)(10V)$

$q_{tot} = 2.42\mu C \rightarrow q_3 = 2.42\mu C$

$q_{12} = 2.42\mu C$

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

$U = \frac{1}{2}(.242\mu F)(10\ V)^2$

$U = 12.1\mu J$

$q_1 = C_1 V_1 = (.25\ \mu F)(1.94 V)$

$q_1 = .485\mu C$

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

$q_2 = 1.94\mu C$