

CH 26 : 5, 7, 8, 19, 20, 22, 23, 24, 25, 26, 35, 37, 43, 48, 49, 54, 59, 67, 69, 71

(5)



$$\oint \vec{E} \cdot d\vec{A} = \frac{q_{in}}{\epsilon_0}$$

$$E \cdot 2\pi r \cdot L = \frac{Q \cdot L}{L \epsilon_0}$$

$$E = \frac{Q}{2\pi \epsilon_0 r L}$$

$$R_1 = 2.58 \times 10^{-3} \text{ m}$$

$$Q_1 = 8.10 \mu\text{C}$$

$$R_2 = 7.27 \text{ mm}$$

$$C = ?$$

$$V = ?$$

$$L = 50 \text{ m}$$

$$-dV = \int_{R_1}^{R_2} E \cdot dr = \frac{Q}{2\pi \epsilon_0 L} \int_{R_1}^{R_2} \frac{dr}{r} = \ln R \Big|_{R_1}^{R_2}$$

$$V = \frac{Q}{2\pi \epsilon_0 L} \ln \frac{R_2}{R_1}$$

$$= \frac{(8.1 \times 10^{-6})}{2\pi \cdot 8.85 \times 10^{-12} \cdot 50} \cdot \ln\left(\frac{7.27}{2.58}\right)$$

$$V = 3020 \text{ V}$$

$$Q = CV$$

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

$$= \frac{8.1 \times 10^{-6}}{3020}$$

$$C = 2.68 \times 10^{-9} \text{ F}$$

(7)

$$V = 150 \text{ V}$$

$$\sigma = 30 \text{ nC/cm}^2$$

$$d = ?$$

$$Q = CV$$

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

$$\sigma = \frac{Q}{A}$$

$$\frac{\sigma}{A} = \frac{A \epsilon_0 \cdot V}{d}$$

$$d = \frac{\epsilon_0 V}{\sigma} = \frac{(8.85 \times 10^{-12}) \cdot 150}{30 \times 10^{-9} \text{ C/cm}^2} = 4.43 \times 10^{-6} \text{ m}$$

(8)

$$A = 2.30 \text{ cm}^2$$

$$d = 1.50 \text{ mm}$$

$$C = ?$$

$$V = 12 \text{ V}$$

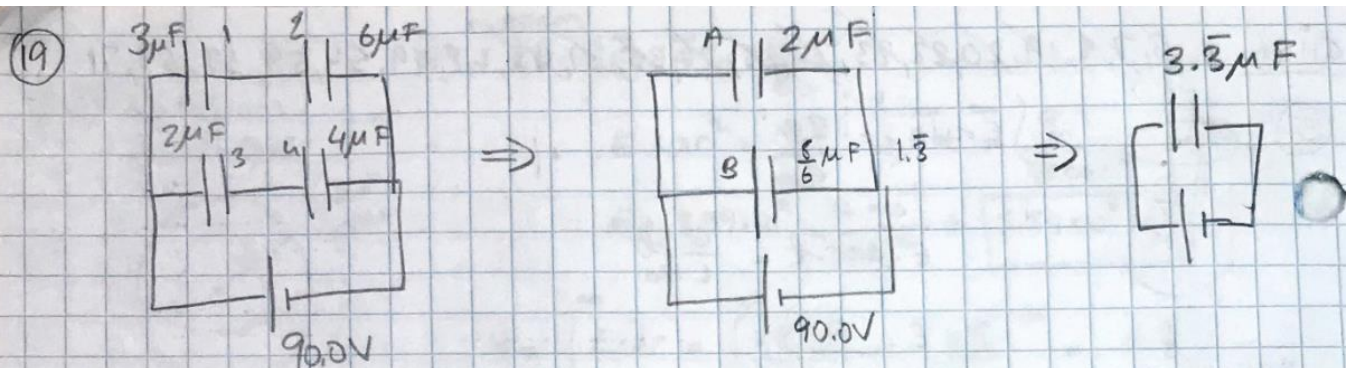
$$Q = ?$$

$$E = ?$$

$$C = \frac{A \epsilon_0}{d} = \frac{(2.30) \cdot 8.85 \times 10^{-12}}{(10^{-4}) \cdot 1.5 \times 10^{-3}} = 1.36 \times 10^{-12} \text{ F}$$

$$Q = CV = (1.36 \times 10^{-12})(12) = 16.3 \text{ pC}$$

$$E = \frac{V}{d} = \frac{12}{1.5 \times 10^{-3}} = 8000 \text{ N/C}$$



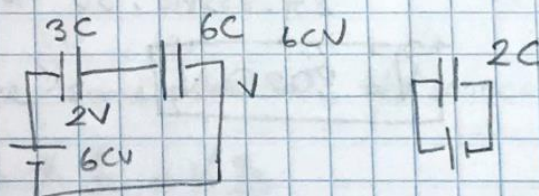
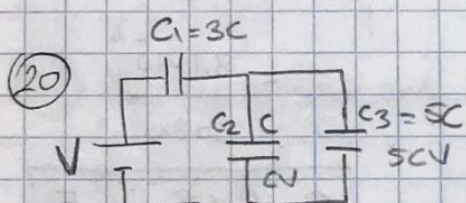
$$C_{eq} = 3.3 \mu F$$

$$Q_A = C_A V_A = 2 \times 10^{-6} \cdot 90 = 1.8 \times 10^{-4} C$$

$$Q_A = Q_1 = Q_2 = 1.8 \times 10^{-4} C \quad V_1 = \frac{Q_1}{C_1} = \frac{1.8 \times 10^{-4}}{3 \times 10^{-6}} = 60V \quad \therefore V_2 = 30V$$

$$Q_B = C_B V_B = \frac{8}{6} \times 10^{-6} \cdot 90 = 1.2 \times 10^{-4} C = Q_3 = Q_4$$

$$V_3 = \frac{Q_3}{C_3} = \frac{1.2 \times 10^{-4}}{2 \times 10^{-6}} = 60V \quad \therefore V_4 = 30V$$



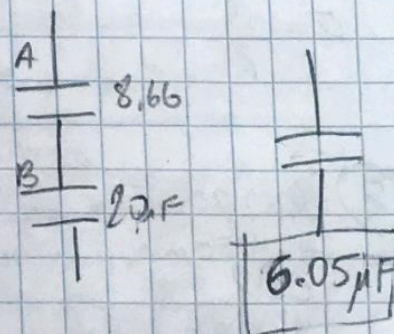
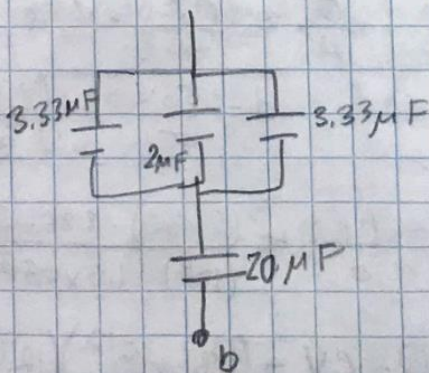
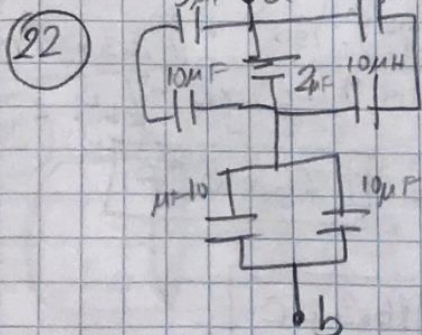
$$C_{eq} = 2C$$

$$V_1 > V_2 = V_3$$

$$Q_1 > Q_3 > Q_2$$

c) If C_3 increases C_{23} & C_{eq} increases that increases the overall Q . so both Q_1 & Q_3 increase.

However, since V_1 will increase, V_2 decreases, so does Q_2

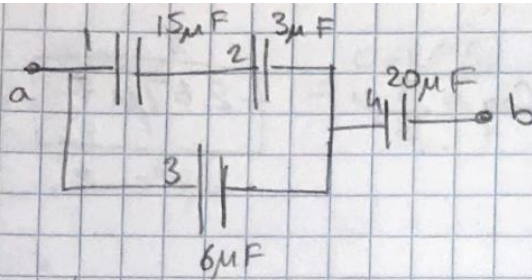


$$Q_{ec} = C_{eq} V = (6.05 \times 10^{-6}) (60) = 3.63 \times 10^{-4} C = Q_A = Q_B$$

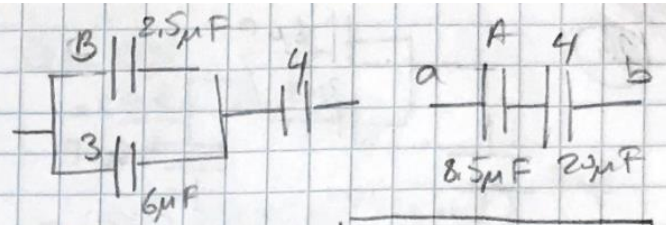
$$V_A = \frac{Q_A}{C_A} = \frac{3.63 \times 10^{-4}}{8.66 \times 10^{-6}} = 41.9V \quad Q_3 = C_3 V_3 = 2 \times 10^{-6} \cdot 41.9$$

$$Q_3 = 8.37 \times 10^{-5} C$$

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$$V_{AB} = 15.0 \text{ V}$$



$$C_{eq} = 5.96 \mu\text{F}$$

$$Q_{eq} = CV = (5.96 \times 10^{-6}) (15) = 8.94 \times 10^{-5} \text{ C} = Q_A = Q_4$$

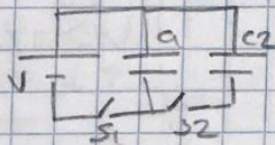
$$V_A = \frac{Q_A}{C_A} = \frac{8.94 \times 10^{-5} \text{ C}}{8.5 \times 10^{-6} \text{ F}} = 10.5 \text{ V} = V_B = V_3$$

$$Q_3 = C_3 V_3 = (6 \times 10^{-6} \text{ F}) (10.5) = 6.31 \times 10^{-5} \text{ C}$$

$$Q_1 = Q_2 = Q_B = C_B V_B = 2.5 \times 10^{-6} \cdot 10.5 = 2.63 \times 10^{-5} \text{ C}$$

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$$C_1 = 6 \mu\text{F} \quad C_2 = 3 \mu\text{F} \quad \Delta V = 20 \text{ V}$$



$$Q = CV = (6 \times 10^{-6} \text{ F}) (20 \text{ V}) = 1.2 \times 10^{-4} \text{ C}$$

$$V = \frac{Q_1'}{C_1} = \frac{Q_2'}{C_2} \quad Q_1' + Q_2' = 1.2 \times 10^{-4} \text{ C}$$

$$\begin{aligned} Q_1' &= 0.8 \times 10^{-4} \text{ C} \\ Q_2' &= 0.4 \times 10^{-4} \text{ C} \end{aligned}$$

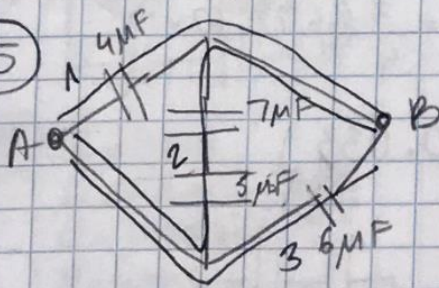
$$\frac{Q_1'}{C_1} = \frac{1.2 \times 10^{-4} - Q_1'}{C_2} \Rightarrow Q_1' C_2 = C_1 \cdot 1.2 \times 10^{-4} - C_1 Q_1'$$

$$Q_1' (C_1 + C_2) = C_1 \cdot 1.2 \times 10^{-4}$$

$$Q_1' = \frac{C_1 \cdot 1.2 \times 10^{-4}}{C_1 + C_2}$$

$$= \frac{6 \times 10^{-6} \cdot 1.2 \times 10^{-4}}{3 \times 10^{-6}} = 0.8 \times 10^{-4}$$

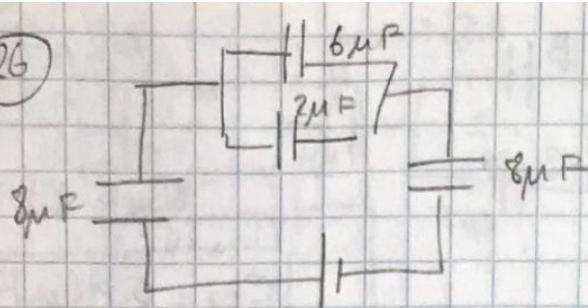
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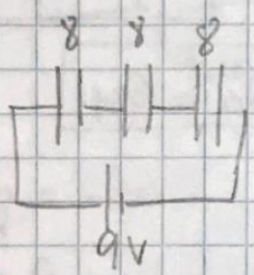
$$4 + \left(\frac{5 \times 7}{5 + 7} \right) + 6$$

$$C_{eq} = 12.9 \mu\text{F}$$

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$$C_{eq} = \frac{8}{3} \mu F = 2.67 \mu F$$



$$V_1 = V_2 = V_3 = 9V$$

$$Q = CV = (8 \times 10^{-6}) 9 = 72 \mu C = Q_1 = Q_2 = Q_3$$

$$Q_2 = 18 \mu C \quad Q_3 = 6 \mu C \quad (Q = CV \leftarrow 3V)$$

35

$C = 10 \mu F$
 $V = 50V$
 $d_1 = 2d$

$$C = QV = 10 \times 10^{-6} \times 50 = 500 \mu C$$

$$C = \frac{A \epsilon_0}{d} \Rightarrow C_1 = \frac{C}{2}$$

$$a) U_0 = 2 \left(\frac{1}{2} C \Delta V^2 \right) = 10 \times 10^{-6} \cdot (50)^2 = 0.025 J$$

$$b) Q_0 = Q_f$$

$$CV_0 + CV_0 = CV_f + \frac{C}{2} V_f$$

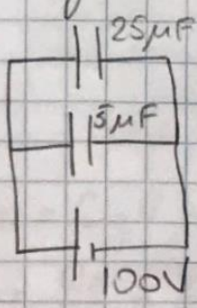
$$2CV_0 = \frac{3}{2} CV_f \Rightarrow V_f = \frac{4V_0}{3} = \frac{4}{3} 50 = 66.7V$$

$$c) U_f = \frac{\Delta V_f^2}{2} \left(C + \frac{C}{2} \right) = \frac{3}{4} V_f^2 C = \frac{3}{4} (66.7)^2 \cdot 10 \times 10^{-6}$$

$\Delta U = +0.0084 J$ external agents do work!

$$U_f = 0.033 J$$

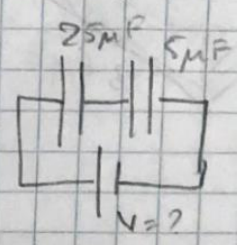
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$$C_{eq} = 25 + 5 = 30 \mu F$$

$$U = \frac{1}{2} C V^2 = \frac{1}{2} (30 \times 10^{-6}) (100)^2$$

$$U = 0.15 J$$



$$C_{eq} = 4.17 \mu F$$

$$V = \sqrt{\frac{2U}{C}} = \sqrt{\frac{2 \cdot 0.15}{4.17 \times 10^{-6}}} = 268V$$

43) $A = 5.00 \text{ cm}^2$

$Q = ?$

$K_{\text{air}} = 1$

$E_{\text{air}} = 3 \times 10^6 \text{ V/m}$

$K_{\text{psi}} = 2.56$

$E = 24 \times 10^6 \text{ V/m}$

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

$Q = CV$

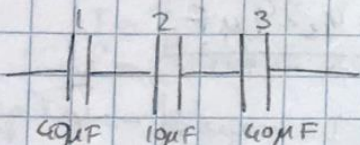
$= \frac{K A \epsilon_0}{d} \cdot E \cdot d$

$= (5 \times 10^{-4}) (8.85 \times 10^{-12}) (3 \times 10^6)$

$Q = 1.33 \times 10^{-8} \text{ C}$

$Q = Q_{\text{air}} \times 2.56 \times 8 = (1.33 \times 10^{-8}) (2.56) (8) = 2.72 \times 10^{-7} \text{ C}$

48)



$V_2 = 4 V_1 = 4 V_3$

$\frac{15 \text{ V}}{4} + (15 \text{ V}) + \frac{15 \text{ V}}{4} = 22.5 \text{ V}$

49)

$C = 2.00 \times 10^{-9} \text{ F}$

$\Delta V_i = 100 \text{ V}$

$K = 5.00$

$C_f = \frac{C_0}{5} \Rightarrow V_f = 500 \text{ V}$

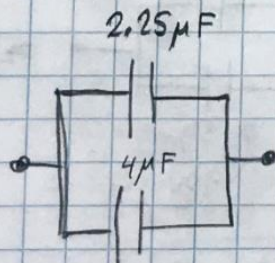
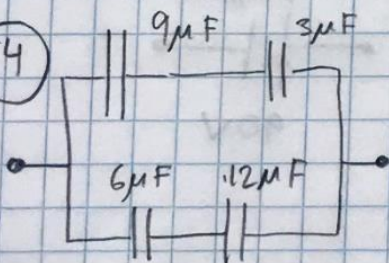
$W = \Delta U = U_f - U_0 = \frac{1}{2} \frac{C}{5} (5 \text{ V})^2 - \frac{1}{2} C V^2$

$= \frac{C V^2}{2} (5 - 1)$
 $= \frac{(2 \times 10^{-9}) (100)^2 (4)}{2}$

$W = +4 \times 10^{-5} \text{ J}$

$Q = CV$
 $\leftrightarrow \downarrow \uparrow$

54)



$\frac{3 \times 9}{12} \mu\text{F}$
 $\frac{6 \times 12}{18} \mu\text{F}$

$6.25 \mu\text{F}$

59)

$K = 3.00$

$E_{\text{max}} = 2.00 \times 10^8 \text{ V/m}$

$C = 0.250 \mu\text{F}$

$V = 4.00 \text{ kV}$

$A = ?$

$V = Ed \Rightarrow d = \frac{V}{E}$

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

$A = \frac{C d}{K \epsilon_0} = \frac{C V_{\text{max}}}{K \epsilon_0 E_{\text{max}}}$

$= \frac{(0.25 \times 10^{-6}) (4 \times 10^3)}{3 (8.85 \times 10^{-12}) (2 \times 10^8)}$

$A = 0.188 \text{ m}^2$

67

$$Q = ?$$

$$V_1 = 100V$$

$$Q_1 =$$

$$C_2 = 10\mu F$$

$$V_{eq} = 30.0V$$

$$Q = C_1 V_1$$

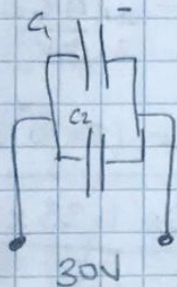
$$\Sigma Q = 100 C_1$$

$$(C_1 + C_2) V = \Sigma Q$$

$$(C_1 + 10\mu) 30 = 100 C_1$$

$$\frac{300 \times 10^{-6}}{70} = \frac{70 C_1}{70}$$

$$C_1 = 4.29\mu F$$



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$$C_1 = 600\mu F$$

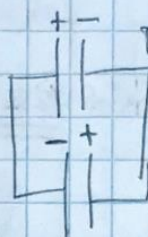
$$C_2 = 2\mu F$$

$$250V$$

$$Q = CV$$

$$Q_1 = 1.5mC$$

$$Q_2 = 0.5mC$$



Discharges!! — yet not fully

$$\Sigma Q = 1.5 - 0.5 = 1mC$$

$$Q_1' = CV = 6 \times 10^{-6} \cdot 125 = 7.5 \times 10^{-4} C$$

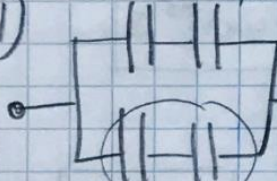
$$Q_2 = C_2 V = 2 \times 10^{-6} \cdot 125 = 2.5 \times 10^{-4} C$$

$$V = \frac{Q}{C} = \frac{1 \times 10^{-3}}{8 \times 10^{-6}}$$

$$V = 125V$$

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$$100\mu F$$



$$C_{eq} = 100\mu F$$

$$V_{eq} = 90V$$

$$C_1 = 100\mu F$$

$$V_{Max} = 50V$$

