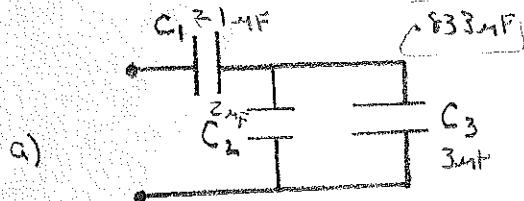


AP E&M Unit 3 – Worksheet 2

Answers

1. Find the equivalent capacitance, in terms of C, for the following circuits:

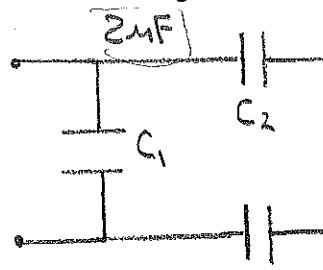


$$C_{eq} = C_2 + C_3$$

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

$$\begin{aligned} C_2 + C_3 &= \frac{C_1}{C_1 + C_2 + C_3} \\ C_{eq} &= \frac{C_1(C_2 + C_3)}{C_1 + C_2 + C_3} \end{aligned}$$

b)



$$C_{eq} = C_1 + \frac{C_2}{2} = \frac{1}{2} (2C_1 + C_2)$$

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

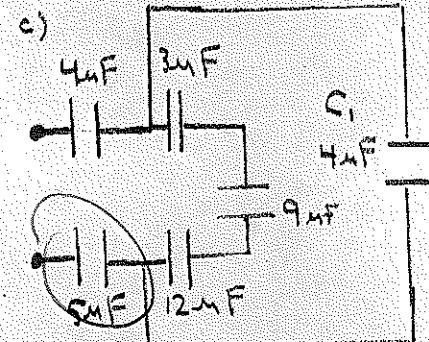
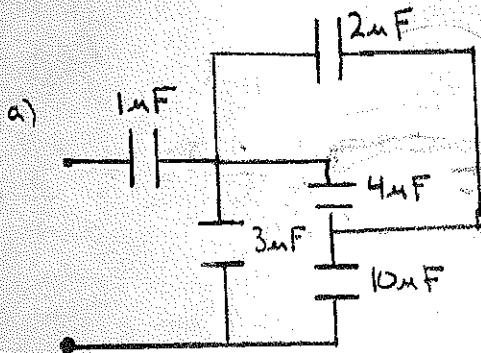
$$\frac{1}{C_{eq}} = \frac{2}{C_2}$$

$$C_{eq} = \frac{C_2}{2}$$

2. Find the charge and potential across each capacitor in 1(a and b) if the potential applied is 15 V and C1 = 5 μF, C2 = 8 μF and C3 = 16 μF.

See separate sheet

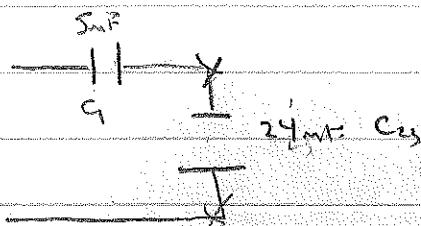
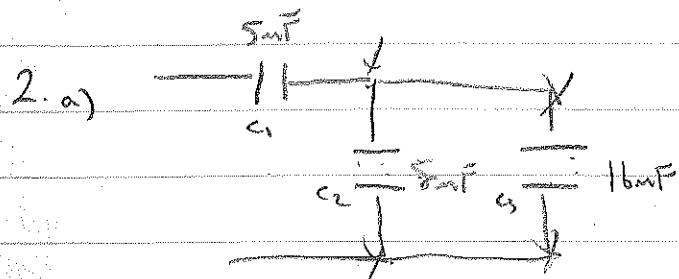
3. Find the equivalent capacitance for each of the following circuits:



4. Find the potential across C1 in 3c, if the total potential applied is 25 V.

I_{down}

Übung 3 Wkst 2



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

$$C_{eq} = \frac{1}{\frac{1}{5} + \frac{1}{24} + \frac{1}{24}} = 4,14 \mu F$$

$$Q_{1,3} = C_{eq} V = 4,14 \mu F (15V) = 6,21 \times 10^{-5} C \quad (6,21 \mu C)$$

$$Q_1 = Q_{2,3} = 6,21 \times 10^{-5} C$$

$$G = \frac{1}{Z_1} = 6,21 \times 10^{-5}$$

$$V = Q_1 = \frac{6,21 \times 10^{-5}}{5 \mu F} = 12,42 V$$

$$V_{2,3} = \frac{Q_2}{C_{eq}} = \frac{6,21 \times 10^{-5}}{24 \mu F} = 2,58 V$$

C₁ C₂ C₃

12,42 2,58 2,58
2,1E-5 2,01E-5 4,13E-5

C_{FQ} = 4,14 μC

$$\frac{C_2}{1} \cdot V_2 = 2,58 V$$

$$I_2 = C_2 V_2 \\ = (8 \mu F) (2,58 V)$$

$$Q_2 = 2,01 \times 10^{-5} C$$

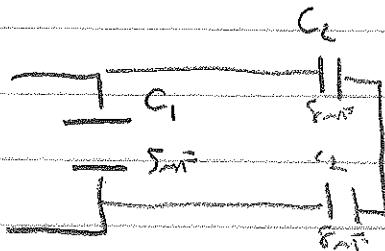
$$\frac{C_3}{1} \cdot V_3 = 2,58 V$$

$$I_3 = C_3 V_3 \\ (2 \mu F) (16 \mu F)$$

$$Q_3 = 4,13 \times 10^{-5} C$$

Übung 3 - Wknt 2

23)



$$\frac{1}{f} + \frac{1}{8} = \frac{1}{4} \Rightarrow f = 4\text{Hz}$$



$$12 = \frac{1}{f} C_{12} \quad C_{12} = 4\text{mF}$$

$$C_{12} = 3986\text{ F}$$

$$V = 15\text{V}$$

$$12 = C_1 V_1$$

$$\rightarrow q_1 = (5\text{mF})(15) = 75 \mu\text{C}$$

$$q_2 = C_{12} V$$

$$(4\text{mF})(15\text{V})$$

$$C_{12} = 3986\text{ F} = q_1 = q_2$$

$$V_2 = q_2 / C_2 = 75 \mu\text{C} / 4\text{mF} = 7.5\text{V}$$

$$C_1 \quad C_2 \quad C_{12}$$

$$Q = 75 \mu\text{C} \quad 6 \mu\text{C} \quad 6 \mu\text{C}$$

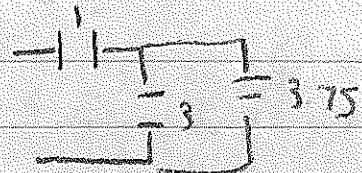
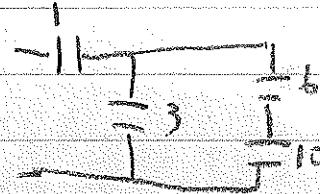
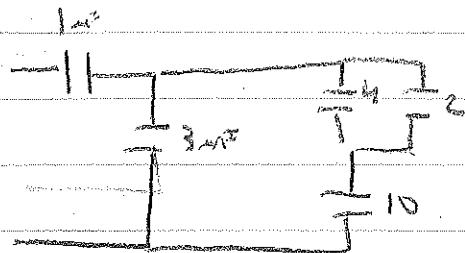
$$V = 15\text{V} \quad 7.5\text{V} \quad 7.5\text{V}$$

$$C_{eq} = 986\text{ F}$$

Unit 3 - when 2

3

a)



$$\frac{1}{6} + \frac{1}{10} = \frac{1}{C_{eq}}$$

$$\frac{10}{60} + \frac{6}{60} = \frac{1}{C_{eq}}$$

$$\frac{16}{60} = \frac{1}{C_{eq}}$$

$$C_{eq} = \frac{60}{16}$$

$$C_{eq} = 3.75$$

$$\frac{1}{C_{eq}} = \frac{1}{6} + \frac{1}{6.75}$$

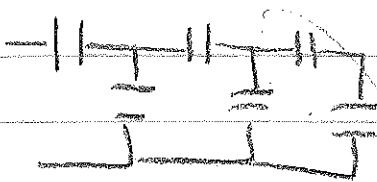
$$\frac{1}{C_{eq}} = \frac{6.75 + 1}{6.75} = \frac{7.75}{6.75}$$

$$C_{eq} = \frac{6.75}{7.75} = \boxed{0.87 \text{ mF}}$$

27
31

Unit 3 - What's

3b



$$\frac{1}{R_1} + \frac{1}{R_2} = \frac{1}{C_{eq}}$$

C_{eq}



$$\frac{1}{R_1} + \frac{1}{R_2} = \frac{1}{C_{eq}}$$

$$\frac{(15)(22.5)}{15+22.5} = 9 = C_{eq}$$



$$\frac{1}{R_1} + \frac{1}{R_2} = \frac{1}{C_{eq}}$$
$$\frac{(15)(22.5)}{15+22.5} = 9 = C_{eq}$$

$$C_{eq} = 9.23 \text{ pF}$$

120

13

Unit 3 notes 2

$$3C \quad \begin{array}{c} 3 \\ \rightarrow | | | + + + | \\ 4 \quad 4 \quad 4 \quad 4 \quad 4 \end{array} \quad \frac{1}{4} + \frac{1}{4} + \frac{1}{4} = \frac{1}{3} \text{ C}_4$$

$$\begin{array}{c} 3 \\ \rightarrow | | | + + + | \\ 5 \quad 5 \quad 2 \end{array} \quad \frac{12}{35} + \frac{4}{35} + \frac{2}{35} = \frac{1}{3} \text{ C}_4$$

Since 5 mF

$$\frac{1}{4} + \frac{1}{4}$$

2.38 mF

$$\frac{112}{47}$$

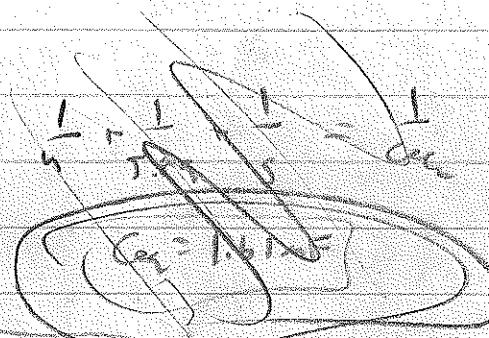
$$\begin{array}{c} 3 \\ \rightarrow | | | + + + | \\ 4 \quad 4 \quad 4 \quad 1 \end{array} \quad 1.89$$

$$\frac{36}{15} = 2.4$$

$$1.89 = \text{C}_4$$

$$\begin{array}{c} 3 \\ \rightarrow | | | + + + | \\ 4 \quad 4 \quad 1 \end{array} \quad 5.89$$

$$\begin{array}{c} 3 \\ \rightarrow | | | + + + | \\ 4 \quad 4 \quad 1 \end{array} \quad 2.38 \text{ mF}$$



4.

10.1 volts
with
no sink

$$\begin{array}{c} 4 \\ \rightarrow | | | + + + | \\ 5 \quad 5 \quad 1 \end{array} \quad 5.09$$

$$25V \quad \frac{1}{1.61 \text{ mF}}$$

$$V = 4C$$

$$25 = 4/1.61 \text{ mF}$$

$\Rightarrow 9 \text{ mF} = \text{sink}$

$$4/1.61 \text{ mF} = 2$$

$$V = 4C \quad \frac{4/1.61 \text{ mF}}{5.09 \text{ mF}}$$

$$5.09 \text{ mF} = 2$$

$V = 10.25 \text{ V}$ which is also voltage across C1

$Q = CV$