Problems on ch 26

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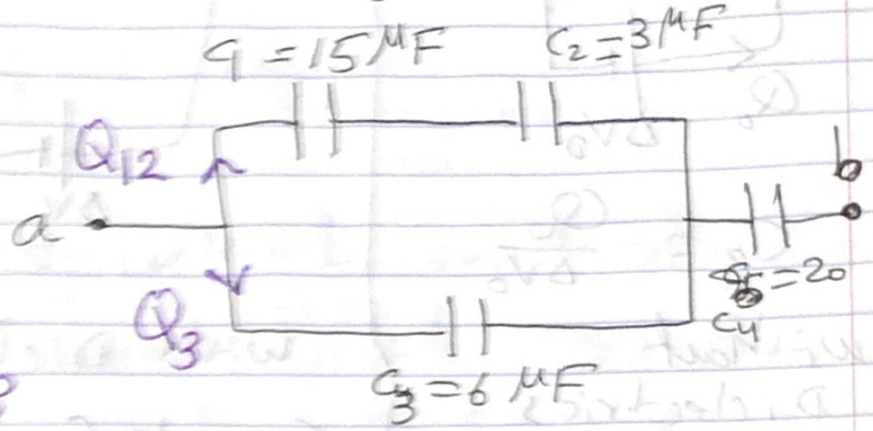
802 | Four capacitors are connected as shown in Figure
(a) Find the equivalent capacitance between a and b
(b) Calculate the charge on each capacitor taking $\Delta V_{ab} = 15$ V



(1) $C_{eq} = ?$

$(15, 3) \xrightarrow{S} \frac{15 \times 3}{15+3} = 2.5\ \mu F = C_{12}$

$(2.5, 6) \xrightarrow{P} C_{eq} = 2.5 + 6 = 8.5\ \mu F$

$C_{eq} = 8.5\ \mu F$

(2) $V_3 = V_{ab} = 15$ Volt

$\longrightarrow Q_3 = V_3 \cdot C_3$

$= 15 \times 6 = 90\ \mu F$

$\longrightarrow V_{12} = V_{ab} = 15$ Volt

$\longrightarrow Q_{12} = V_{12} \cdot C_{12}$

$Q_{12} = 2.5 * 15$

$= 37.5\ \mu C$

$\rightarrow Q_1 = Q_2 = 37.5\ \mu C$

$\rightarrow V_1 = \frac{Q_1}{C_1} = \frac{37.5}{15} = 2.5$ Volt

$\rightarrow V_2 = \frac{Q_2}{C_2} = \frac{37.5}{3} = 12.5$ Volt

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21 | 802

A group of N identical capacitors is connected first in series and then in parallel. The combined capacitance in parallel is 100 times larger than for the series connection. How many capacitors are in the group.

Series

$C_{eq} = \frac{C}{N}$

Parallel

$C_{eq} = NC$

$C_{eq\ parallel} = 100\ C_{eq\ series}$

$NC = 100\left(\frac{C}{N}\right)$

$N^2 = 100$

$N = 10$

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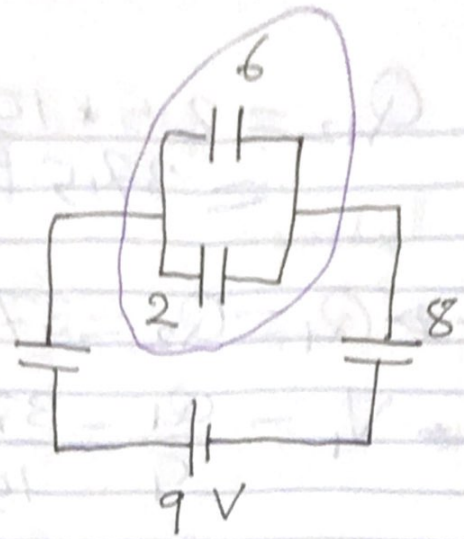
802

Find

① C_{eq} ② Q on each

③ ΔV on each



1) $(6,2) \xrightarrow{P} 6+2=8$

$(8,8,8) \xrightarrow{S} \frac{1}{C_{eq}} = \frac{1}{8}+\frac{1}{8}+\frac{1}{8}$

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

2] $Q_t = C_{eq} \cdot \Delta V$

$= \frac{8}{3} \times 9 = 24\ \mu C$

$Q_8 = 24\ \mu C$

$\Delta V_8 = \frac{Q}{C} = \frac{24}{8} = 3V$

$\Delta V_2 = \Delta V_6 = 3$ Volt

$Q_2 = (\Delta V)(C)$

$= 3 \times 2 = 6\ \mu C$

$Q_6 = (\Delta V)(C)$

$= 3 \times 6 = 18\ \mu C.$

31 | 803 | A 12 volt battery is connected to a capacitor resulting in 54 μC of charge stored on the capacitor.

(a) How much energy stored in the capacitor

(b) What is the capacitance

$\Delta V = 12 \quad Q = 54\,\mu C$

$\frac{1}{2} C \cdot \Delta V^2$

$\frac{1}{2} \cdot \frac{Q}{\Delta V} \Delta V^2$

1) $U = \frac{1}{2} \cdot Q \cdot \Delta V$

$= \frac{1}{2} \cdot 54 \times 10^{-6} \times 12$

$= 324 \times 10^{-6}\ J = 324\,\mu J.$

2) $C = \frac{Q}{\Delta V} = \frac{54 \times 10^{-6}}{12} = 4.5\,\mu F$

3) If the Battery is removed and dielectric constant of $K = 5$ is inserted between the plates

Calculate

(1) $C = K C_0 = 5 \times 4.5 = 22.5\,\mu F$

(2) $Q = Q_0 = 54\,\mu C$

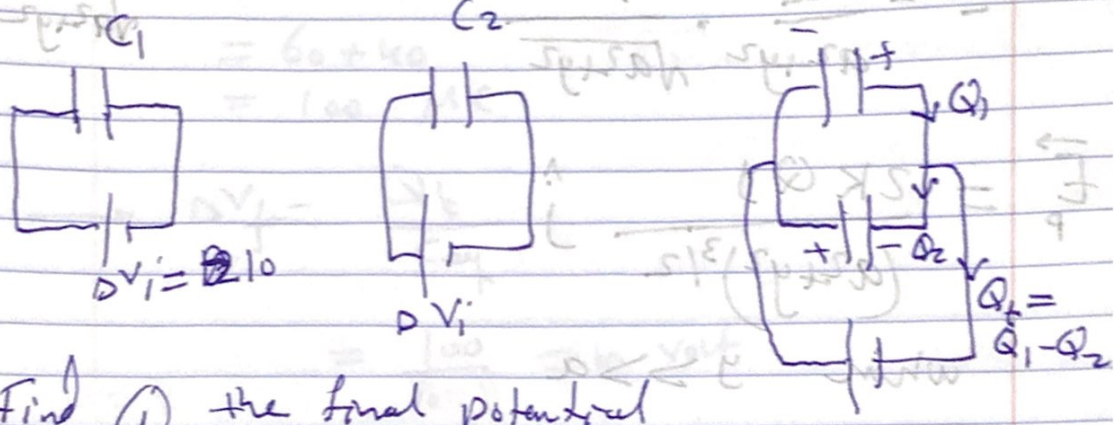
(3) $\Delta V = \frac{\Delta V_0}{K} = \frac{12}{5} = 2.4$ Volt

(4) $U = \frac{U_0}{K} = \frac{324}{5} = 64.8\,\mu J.$

chap 26 Q. C capacitors

Ex: 26.4 / 788

Two capacitors C_1 and C_2 where $C_1 = 6\ \mu F$, $C_2 = 4\ \mu F$ are charged to the same initial potential difference $\Delta V_i = 10$ Volt. The charged capacitors are removed from the battery and their plates are connected with opposite polarity, Find as in Figure



Find ① the final potential difference $\Delta V_f = ??$

$$Q_1 = C_1 \cdot \Delta V_i = 6 \times 10 = 60\ \mu C$$

$$Q_2 = C_2\ \Delta V_i = 4 \times 10 = 40\ \mu C$$

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$$C_{eq} = C_1 + C_2 = 6 + 4 = 10\ \mu F$$

$$Q_t = Q_1 - Q_2 = 60 - 40 = 20\ \mu C$$

$$\rightarrow \Delta V_f = \frac{Q_t}{C_{eq}} = \frac{20}{10} = 2 \text{ Volt.}$$

$$Q_1' = \Delta V_f \cdot C_1 = 2 \times 6 = 12\ \mu C$$

$$Q_2' = \Delta V_f C_2 = 2 \times 4 = 8\ \mu C$$