

SECOND MIDTERM

3

Name: _____

Discussion Instructor (circle): Billetter Blake Herring Young

Discussion Section # _____

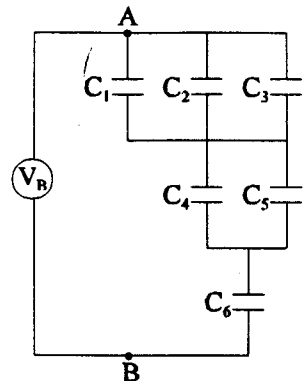
Student ID #: _____

SHOW ALL WORK!!!!
REPORT ALL NUMBERS TO THREE SIGNIFICANT FIGURES!
Use the conversion constants and data given on the front page.

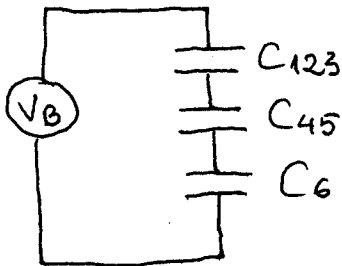
The capacitor system shown is connected to a battery with $V_B = 180 \text{ V}$.

- (a) [9 pts.] Calculate the equivalent capacitance between points A and B.
- (b) [8 pts.] Calculate the potential across C_6 .
- (c) [8 pts.] Calculate the charge on C_3 .

$C_1 = 1.00 \mu\text{F}$ $C_4 = 4.00 \mu\text{F}$
 $C_2 = 2.00 \mu\text{F}$ $C_5 = 5.00 \mu\text{F}$
 $C_3 = 3.00 \mu\text{F}$ $C_6 = 6.00 \mu\text{F}$



(a)



$$\frac{1}{C_e} = \frac{1}{C_{123}} + \frac{1}{C_{45}} + \frac{1}{C_6}$$

$$C_{123} = C_1 + C_2 + C_3 = 6 \mu\text{F} \quad (2 \text{ POINTS})$$

$$C_{45} = C_4 + C_5 = 9 \mu\text{F} \quad (2 \text{ POINTS})$$

$$\frac{1}{C_e} = \frac{1}{6 \mu\text{F}} + \frac{1}{9 \mu\text{F}} + \frac{1}{6 \mu\text{F}} = \frac{8}{18 \mu\text{F}} = \frac{4}{9 \mu\text{F}} \Rightarrow$$

$$C_e = \frac{9}{4} \mu\text{F} = 2.25 \mu\text{F} \quad (5 \text{ POINTS})$$

(b)

$$Q_{123} = Q_{45} = Q_6 = Q_{\text{total}} \quad (3 \text{ POINTS})$$

$$Q_{\text{total}} = C_e V_B$$

$$\Rightarrow \left. \begin{array}{l} Q_6 = C_e V_B \\ Q_6 = C_6 V_6 \end{array} \right\} \Rightarrow C_e V_B = C_6 V_6 \Rightarrow V_6 = \frac{C_e}{C_6} V_B$$

$$V_6 = \frac{2.25 \mu\text{F}}{6 \mu\text{F}} \cdot 180 \text{ V} = 67.5 \text{ V} \quad (5 \text{ POINTS})$$

$$\textcircled{c} \quad Q_{\text{total}} = Q_{123} \quad (2 \text{ POINTS})$$

$$Q_{\text{total}} = C_e V_B$$

$$V_{123} = \frac{Q_{123}}{C_{123}} \quad (3 \text{ POINTS})$$

$$V_{123} = V_3 = \frac{Q_{123}}{C_{123}} = \frac{Q_{\text{total}}}{C_{123}} = \frac{C_e V_B}{C_1 + C_2 + C_3} = 67.5 \text{ V}$$

$$Q_3 = C_3 V_3 = C_3 V_{123} = C_3 \frac{C_e V_B}{C_1 + C_2 + C_3} =$$

$$= 3 \mu\text{F} \times 67.5 \text{ V} = 2.025 \times 10^{-4} \text{ C} \approx \underline{\underline{2.03 \times 10^{-4} \text{ C}}}$$

(5 POINTS)

Bogdan Popescu