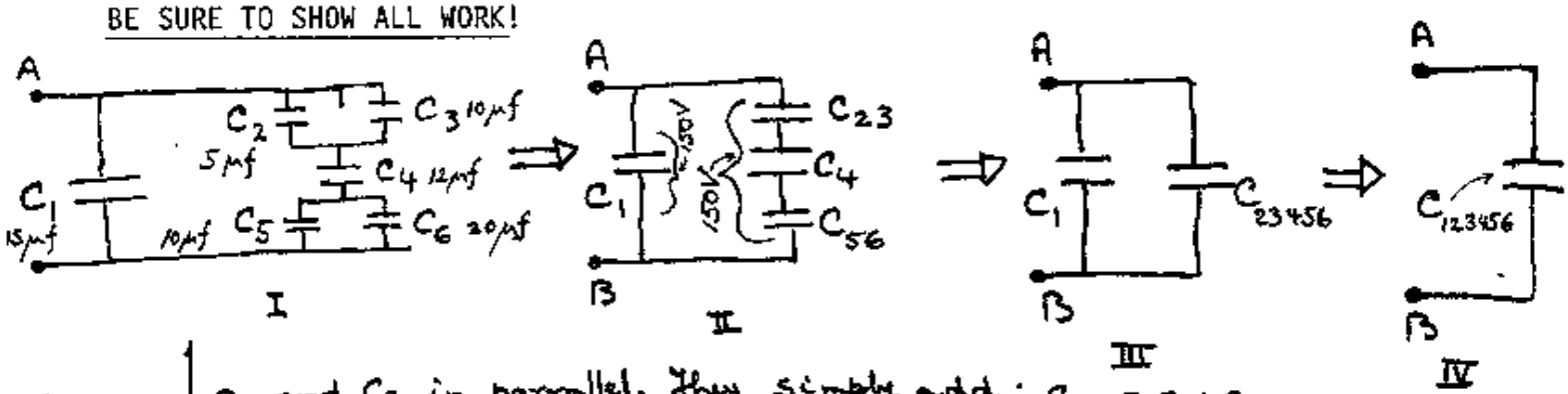
Name (Print) Grader: S. A. MABUD. Average 15.

Name (Sign) _____ S.S. No. _____

Discussion Instructor: Abbott Allen Brumbaugh Bruno Ho Gehrke Kaipa Rino B. Wheeler Sewell

Problem No. 2

(a) BE SURE TO SHOW ALL WORK!




Breakdown of points:

Part (a) total points 9. 7 for setting up eqn. (A). 1 for sig. fig. and 1 for algebra.

$C_2$ and $C_3$ in parallel. They simply add: $C_{23} = C_2 + C_3$.
$C_5$ and $C_6$ in parallel. They simply add: $C_{56} = C_5 + C_6$.
Now you get configuration II. $C_{23}$, $C_4$ and $C_{56}$ in series. The effective capacitance corresponding to these three capacitors is given by: $\frac{1}{C_{23456}} = \frac{1}{C_{23}} + \frac{1}{C_4} + \frac{1}{C_{56}}$. Now you get configuration III, where $C_1$ and $C_{23456}$ are in parallel. The last two capacitors add up to give $C_{123456} = C_1 + C_{23456}$, as in configuration IV.

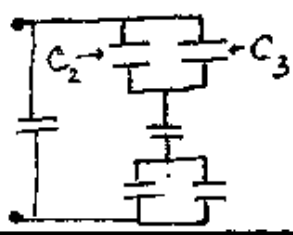
(A) $\rightarrow \therefore C_{123456} = \underbrace{C_1}_{15\mu f} + \underbrace{\left[\frac{1}{C_{23}} + \frac{1}{C_4} + \frac{1}{C_{56}}\right]^{-1}}_{= 5.45\mu f} = \underbrace{20.45}_{\text{sig. Fig.}}\ \mu f.$

(b) Part (b) total points 8. 2 for correct approach, 1 for sig. fig. answer to be correct

Method I: Voltage across A, B is 150V. This means voltage across $C_1$ is 150 V. Also, voltage across $C_{23}$, $C_4$ and $C_{56}$ is 150V. Therefore, charge on $C_{23}$ or $C_4$ or $C_{56}$ is $= C_{23456} V = 5.45 \times 150\ (\mu f . V) = \underbrace{818}_{\text{sig. Fig.}}\ \mu C.$

Method II: Alternatively, find the total charge in the circuit, which is, $q_{\text{total}} = C_{123456} V = 20.45 \times 150\ (\mu f . V) = 3068\ \mu C$. Then find charge on $C_1 \rightarrow q_{C_1} = C_1 V = 15 \times 150\ (\mu f V) = 2250\ \mu C$. Therefore, charge on $C_{23}$ or $C_4$ or $C_{56}$ is $3068 - 2250 = 818\ \mu C$.
[Recall that when the capacitors are in series, they have the same charge].

(c) Same as part (b).




Refer to configuration II above. The total voltage across $C_{23}$, $C_4$, $C_{56}$ is 150V, but the voltages across each of them will be different, ie. Voltage across $C_{23}$ is not necessarily the same as that across $C_4$. But the voltage across $C_2$ and $C_3$ will be the same, since they are in parallel. From (b) above, $q_2 + q_3 = 818\ \mu C$. i.e. $C_2(V_{23}) + C_3(V_{23}) = 818\ \mu C$. $\therefore V_{23} = \frac{818}{15} = 54.5\ V$.