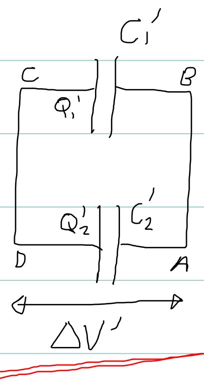
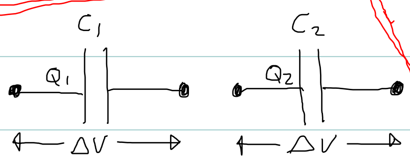
Ⓑ FINAL CONFIGURATION





Ⓐ CHARGING CONFIGURATION

TWO CAPACITORS OF CAPACITANCE C_1 AND C_2 ARE CHARGED BY ~~A~~ THE SAME ~~POTENTIAL DIFFERENCE~~ A BATTERY OF VOLTAGE ΔV AND HENCE ACQUIRE CHARGE OF (DIAGRAM Ⓐ) Q_1 AND Q_2. THE BATTERY THAT CHARGED THE CAPACITORS IS THEN REMOVED. THE CAPACITORS ARE THEN CONNECTED TO EACH OTHER AS IN DIAGRAM Ⓑ. WHAT IS THE VOLTAGE BETWEEN POINTS B AND C IN DIAGRAM Ⓑ? HENCE, WHAT IS THE NEW CHARGE ON EACH CAPACITOR Q_1' AND Q_2'?

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① THE VOLTAGE BETWEEN B AND C. THE RE-CONNECTED CAPACITORS ARE IN PARALLEL BECAUSE THEY HAD THE SAME POTENTIAL DIFFERENCE ACROSS THEM. THE FOLLOWING RULES APPLY: (a) THE TOTAL CHARGE FROM SITUATION Ⓐ TO SITUATION Ⓑ IS CONSERVED $\Rightarrow$ $Q_1 + Q_2 = Q_1' + Q_2'$ (b) THE CAPACITORS ARE PHYSICALLY UNCHANGED $\Rightarrow C_1 = C_1'$ and $C_2 = C_2'$ (c) THE POTENTIAL ACROSS EACH CAPACITOR IS THE SAME IN PARALLEL $\Rightarrow \Delta V' = \Delta V_1' = \Delta V_2'$

NOW, $V_B - V_C = V_A - V_D = \Delta V' = \dfrac{Q_{TOT}'}{C_{EQ}'}$. IN PARALLEL $C_{EQ}' = C_1' + C_2'$, WHICH IS $C_1 + C_2$, HERE ALSO, $Q_{TOT}' = Q_1' + Q_2'$, WHICH IS $Q_1 + Q_2$, HERE.

$$\Rightarrow V_B - V_C = \frac{Q'_{TOT}}{C_{EQ}'} = \frac{Q_1' + Q_2'}{C_1' + C_2'} = \frac{Q_1 + Q_2}{C_1 + C_2}$$

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② THE NEW CHARGE ON EACH CAPACITOR, Q_1' AND Q_2'

WE KNOW FROM THE ANSWER TO PART ① THAT $V_B - V_C = V_A - V_D = \dfrac{Q_1 + Q_2}{C_1 + C_2}$

THE CHARGE ACROSS CAPACITOR 1 IS $Q_1' = C_1' \Delta V'$, WHICH IS $C_1'(V_B - V_C) = C_1'\left(\dfrac{Q_1 + Q_2}{C_1 + C_2}\right)$

AS $C_1' = C_1$, $Q_1' = C_1\left(\dfrac{Q_1 + Q_2}{C_1 + C_2}\right)$, SIMILARLY, $Q_2' = C_2\left(\dfrac{Q_1 + Q_2}{C_1 + C_2}\right)$