

6-6 C_1 is charged to $\Delta\phi$, then connected to an initially uncharged C_2 . Find final charges Q_1' , Q_2' and potential difference $\Delta\phi'$.

(Revenge of the 240s problems)

initially $Q_1 = C_1 \Delta\phi = C_1 \Delta\phi$

Finally, in ESE the potentials are the same across C_1 & C_2

$$\Delta\phi' = \frac{Q_1'}{C_1} = \frac{Q_2'}{C_2} \quad \text{where } Q_1 = Q_1' + Q_2'$$

Algebra + $Q_2' = \frac{C_2}{C_1} Q_1'$

$$Q_1 = Q_1' \left(1 + \frac{C_2}{C_1}\right)$$

$$\text{So } Q_1' = \frac{C_1}{C_1 + C_2} Q_1 = \frac{C_1^2}{C_1 + C_2} \Delta\phi$$

$$Q_2' = Q_1 - Q_1' = C_1 \Delta\phi - \frac{C_1^2}{C_1 + C_2} \Delta\phi = \frac{C_1 C_2}{C_1 + C_2} \Delta\phi$$

$$\text{and } \Delta\phi' = \frac{Q_1'}{C_1} = \frac{C_1}{C_1 + C_2} \Delta\phi$$