82. (First problem of **Cluster**)

(a) We do not employ energy conservation since, in reaching equilibrium, some energy is dissipated either as heat or radio waves. Charge is conserved; therefore, if $Q = C_1 V_{\text{bat}} = 400\,\mu\text{C}$, and q_1 and q_2 are the charges on C_1 and C_2 after the switch S is closed (and equilibrium is reached), then

$$Q = q_1 + q_2 \quad .$$

After switch S is closed, the capacitor voltages are equal, so that

$$\begin{aligned} V_1 &= V_2 \\ \frac{q_1}{C_1} &= \frac{q_2}{C_2} \end{aligned}$$

which yields $\frac{3}{4} q_1 = q_2$. Therefore,

$$Q = q_1 + \left(\frac{3}{4} q_1\right)$$

which gives the result $q_1 = 229\,\mu\text{C}$.

(b) The relation $\frac{3}{4} q_1 = q_2$ gives the result $q_2 = 171\,\mu\text{C}$.

(c) We apply Eq. 27-1: $V_1 = q_1/C_1 = 5.71$ V.

(d) Similarly, $V_2 = q_2/C_2 = 5.71$ V (which is equal to V_1, of course – since that fact was used in the solution to part (a)).

(e) When C_1 had charge Q and was connected to the battery, the energy stored was $\frac{1}{2} C_1 V_{\text{bat}}^2 = 2.00 \times 10^{-3}$ J. The energy stored after S is closed is $\frac{1}{2} C_1 V_1^2 + \frac{1}{2} C_2 V_2^2 = 1.14 \times 10^{-3}$ J. The *decrease* is therefore 8.6×10^{-4} J.