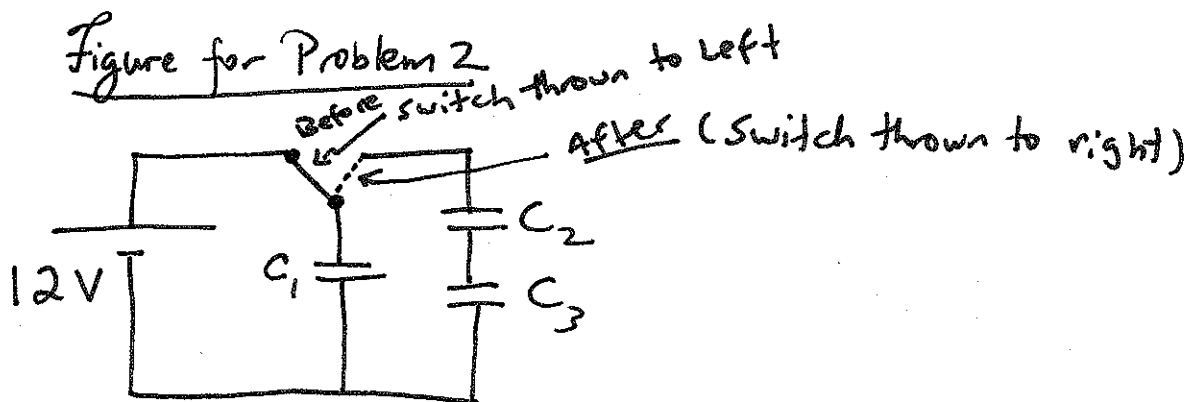


PH 1121: eLectricity and Magnetism
B Term 2006

Name of Group: _____
People in Group: _____

Interactive Set Four: Capacitance

1. One capacitor is charged until its stored energy is 4.0 J. A second uncharged capacitor (having the same capacitance) is then connected to it in parallel. a) If the charge distributes equally, what is now the total energy stored in the electric field? b) Where did the excess energy go?
2. In the figure below, a 12 V battery and three uncharged capacitors of capacitances $C_1 = 4.00 \mu\text{F}$, $C_2 = 6.00 \mu\text{F}$, and $C_3 = 3.00 \mu\text{F}$. The switch is thrown to the left side until capacitor 1 is fully charged. Then the switch is thrown to the right. What is the final charge on (a) capacitor 1, (b) capacitor 2, and (c) capacitor 3?



Solution to Problem 1

$$U_{old} = 4.0 \text{ J} = \frac{1}{2} QV = \frac{1}{2} CV^2 = \frac{1}{2} \frac{Q^2}{C}$$

Charge distributes equally $\Rightarrow Q_{old} = Q_{new}$

$$U_{new} = \frac{1}{2} \frac{Q^2}{C_{new}} = \frac{1}{2} \frac{Q^2}{(2C)} = \frac{1}{2} \left\{ \frac{1}{2} \frac{Q^2}{C} \right\}$$

$$\Rightarrow U_{new} = \frac{1}{2} U_{old} = \boxed{2.0 \text{ J}}$$

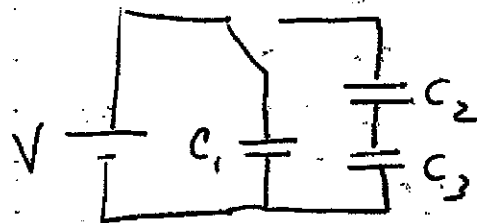
Energy \leftrightarrow 2nd Capacitor
(heat)

IS4

5

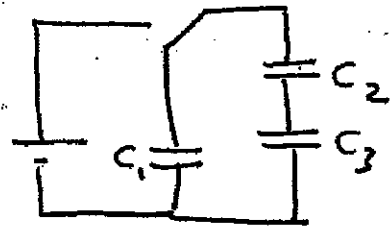
Solution to Problem 2

(h) HRW, 25-21



Before

$$Q = VC_1 = 48 \mu\text{C}$$



After

$$C_{\text{net}} = C_1 + \frac{C_2 C_3}{C_2 + C_3}$$

$$C_{\text{net}} = 6 \mu\text{F}$$

$$Q_{\text{before}} = Q_{\text{after}} \quad (\text{Charge conservation})$$

$$\Rightarrow V_{\text{after}} = \frac{Q}{C} = \frac{48 \mu\text{C}}{6 \mu\text{F}} = 8 \text{V}$$

$$\Rightarrow q_1 = V_{\text{after}} C_1 = \boxed{32 \mu\text{C}}$$

$$q_{23} = V_{\text{after}} C_{23} = 8 \text{V} (2 \mu\text{F}) = 16 \mu\text{C}$$

$$\boxed{q_2 = q_3 = q_{23} = 16 \mu\text{C}} \quad (\text{series})$$