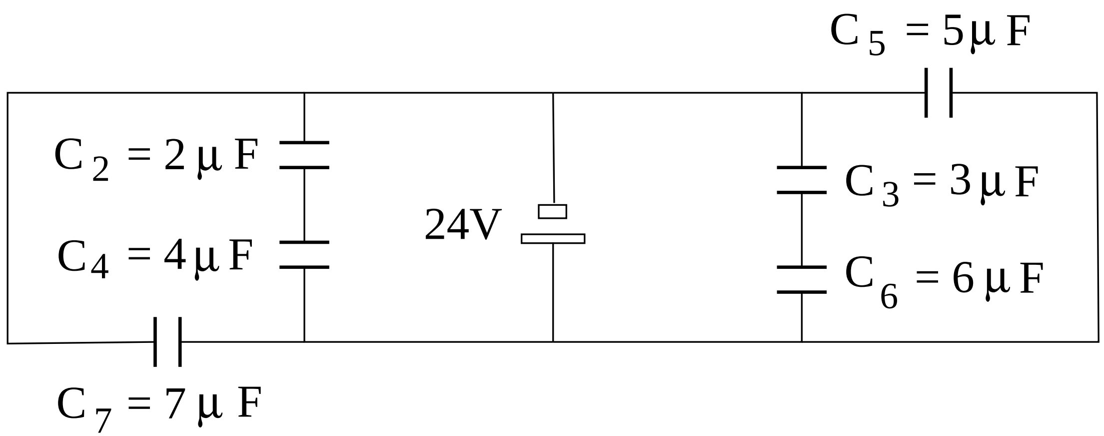
Unit Exam II: Problem #1 (Fall '17)

This circuit is at equilibrium.

- Find the charge Q_7 on capacitor C_7 [Q_5 on C_5].
- Find the energy U_5 on capacitor C_5 [U_7 on C_7].
- Find the voltages V_2, V_4 across capacitors C_2, C_4 [V_3, V_6 across C_3, C_6].



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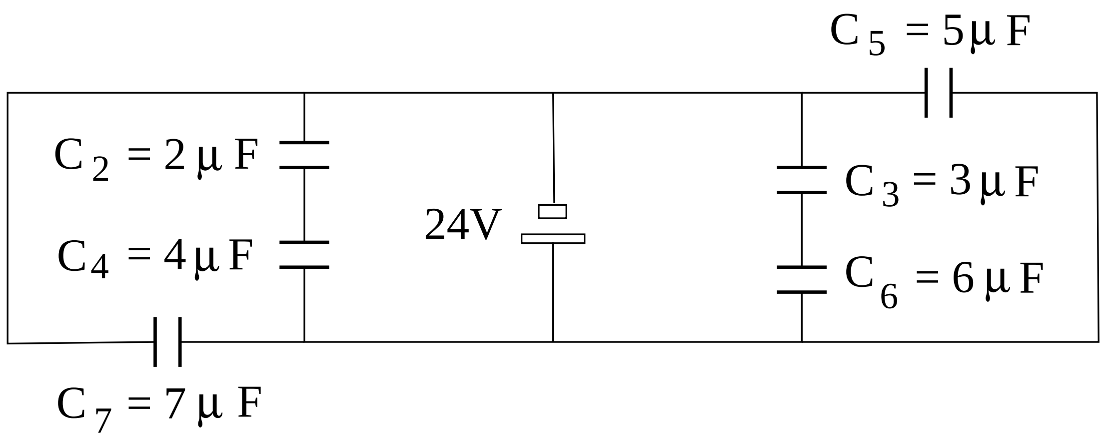


Solution:

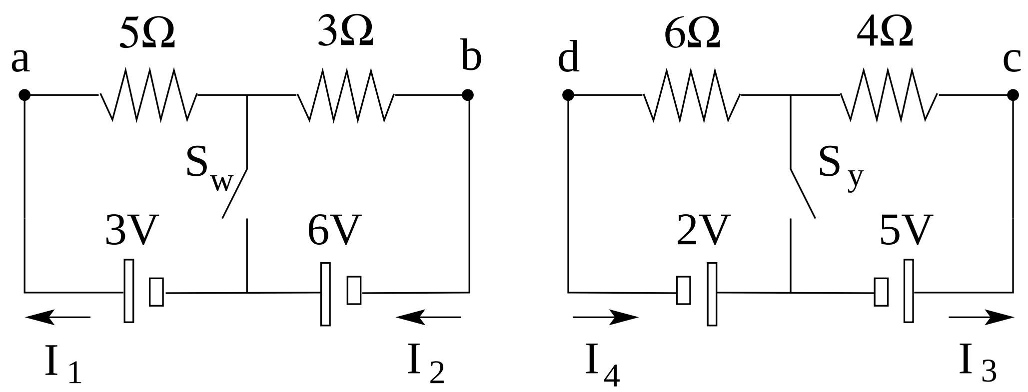
- $Q_7 = (24\text{V})(7\mu\text{F}) = 168\mu\text{C} \quad [Q_5 = (24\text{V})(5\mu\text{F}) = 120\mu\text{C}]$
- $U_5 = \frac{1}{2}(5\mu\text{F})(24\text{V})^2 = 1440\mu\text{J} \quad \left[U_7 = \frac{1}{2}(7\mu\text{F})(24\text{V})^2 = 2016\mu\text{J}\right]$
- $V_2 + V_4 = 24\text{V}, \quad V_2C_2 = V_4C_4 \quad \Rightarrow V_2 = 16\text{V}, \quad V_4 = 8\text{V}$
  $[V_3 + V_6 = 24\text{V}, \quad V_3C_3 = V_6C_6 \quad \Rightarrow V_3 = 16\text{V}, \quad V_6 = 8\text{V}]$

Unit Exam II: Problem #2 (Fall '17)

Consider the resistor circuit on the left [right].
Find the currents I_1, I_2 [I_3, I_4] and the potential difference $V_a - V_b$ [$V_c - V_d$]

(a) when the switch S_w [S_y] is open,

(b) when the switch S_w [S_y] is closed



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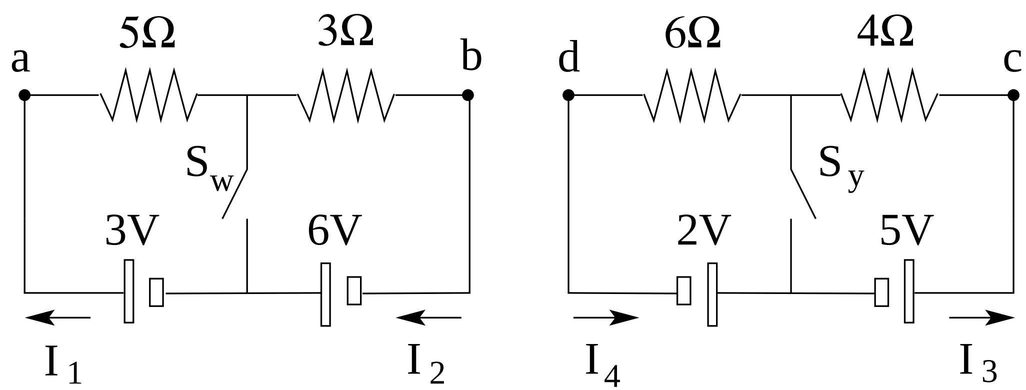


Solution:

(a) $I_1 = I_2 = \dfrac{3\text{V} + 6\text{V}}{5\Omega + 3\Omega} = 1.125\text{A}, \quad V_a - V_b = 9V.$

$\left[I_3 = I_4 = \dfrac{2\text{V} + 5\text{V}}{6\Omega + 4\Omega} = 0.7\text{A}, \quad V_c - V_d = 7V. \right]$

(b) $I_1 = \dfrac{3\text{V}}{5\Omega} = 0.6\text{A}, \quad I_2 = \dfrac{6\text{V}}{3\Omega} = 2\text{A}, \quad V_a - V_b = 9V.$

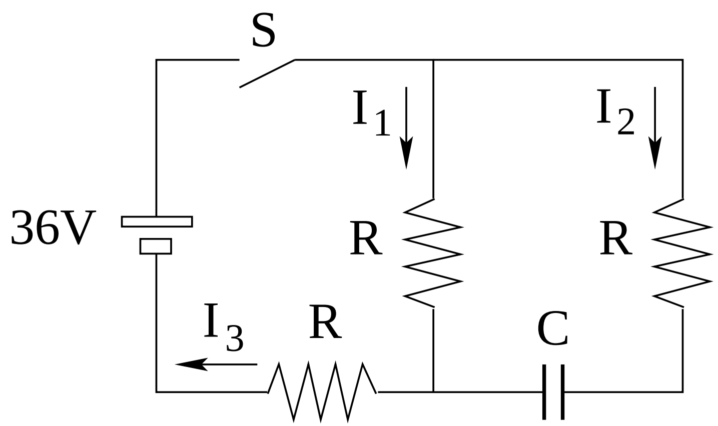
$\left[I_3 = \dfrac{5\text{V}}{4\Omega} = 1.25\text{A}, \quad I_4 = \dfrac{2\text{V}}{6\Omega} = 0.333\text{A}, \quad V_c - V_d = 7V. \right]$

Unit Exam II: Problem #3 (Fall ’17)

The switch S of this circuit has been open for a long time. The capacitor has capacitance $C = 6$pF [$C = 4$pF]. Each resistor has resistance $R = 6\Omega$ [$R = 4\Omega$].

(a) Find the currents I_1, I_2, I_3 right after the switch has been closed.

(b) Find the currents I_1, I_2, I_3 a long time later



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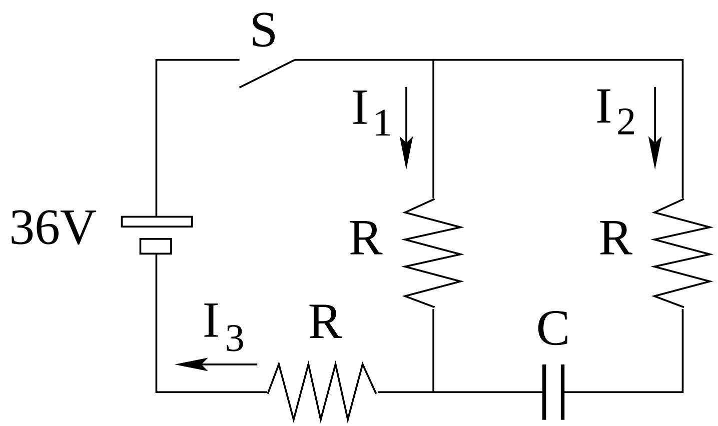

Solution:

(a) no voltage across capacitor: $R_{eq} = 9\Omega \quad [R_{eq} = 6\Omega]$

$$I_3 = I_1 + I_2 = \frac{36\text{V}}{9\Omega} = 4\text{A}, \quad I_1 = I_2 = 2\text{A} \quad \left[I_3 = I_1 + I_2 = \frac{36\text{V}}{6\Omega} = 6\text{A}, \quad I_1 = I_2 = 3\text{A} \right].$$

(b) no current through capacitor: $R_{eq} = 12\Omega \quad [R_{eq} = 8\Omega]$

$$I_1 = I_3 = \frac{36\text{V}}{12\Omega} = 3\text{A}, \quad I_2 = 0, \quad \left[I_1 = I_3 = \frac{36\text{V}}{8\Omega} = 4.5\text{A}, \quad I_2 = 0 \right].$$