Unit Exam II: Problem #1 (Spring '14)

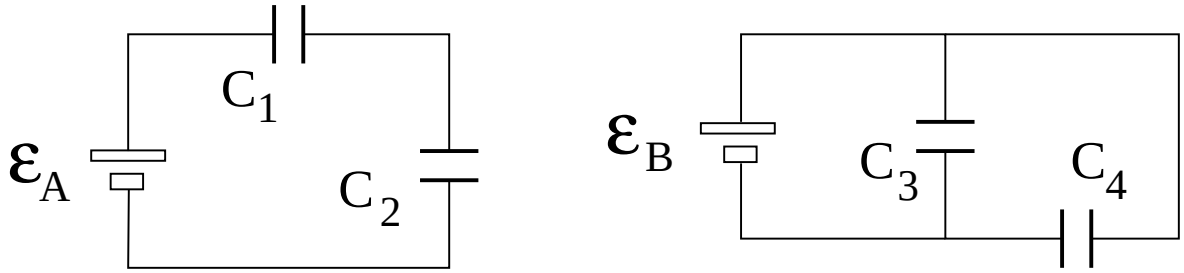
Both capacitor circuits, charged up by batteries as shown, are now at equilibrium. The charge on capacitor $C_1 = 6$pF [8pF] is $Q_1 = 18$pC [16pF] and charge on capacitor $C_4 = 8$pF [4pf] is $Q_4 = 16$pC [12pF].

(a) Find the voltage V_2 across capacitor $C_2 = 4$pF.

(b) Find the emf $\mathcal{E}_A$ supplied by the battery.

(c) Find the charge Q_3 on capacitor $C_3 = 3$pF.

(d) Find the emf $\mathcal{E}_B$ supplied by the battery.



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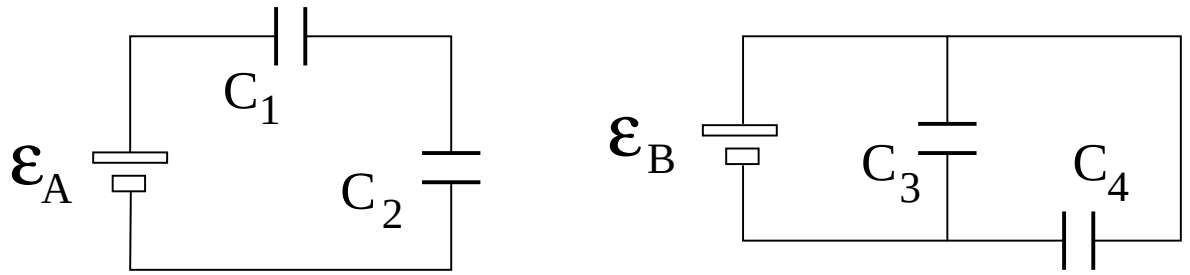


Solution:

(a) $Q_2 = Q_1 = 18\text{pC}, \quad [16\text{pC}], \quad V_2 = \dfrac{Q_2}{C_2} = 4.5\text{V} \quad [4\text{V}].$

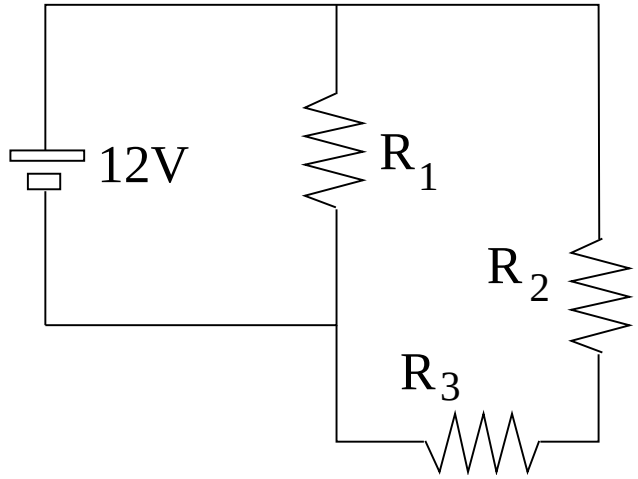
(b) $\mathcal{E}_A = V_1 + V_2 = 3\text{V} + 4.5\text{V} = 7.5\text{V} \quad [2\text{V} + 4\text{V} = 6\text{V}].$

(c) $V_3 = V_4 = \dfrac{Q_4}{C_4} = 2\text{V} \quad [3\text{V}], \quad Q_3 = V_3 C_3 = 6\text{pC} \quad [9\text{pC}].$

(d) $\mathcal{E}_B = V_3 = V_4 = 2\text{V} \quad [3\text{V}].$

Unit Exam II: Problem #2 (Spring '14)

Consider the resistor circuit shown with $R_1 = 2\Omega$ [3Ω], $R_2 = 3\Omega$ [2Ω], and $R_3 = 1\Omega$.
(a) Find the current I_2 through resistor R_2.
(b) Find the voltage V_3 across resitor R_3.
(c) Find the power P_1 dissipated in resistor R_1.
(d) Find the equivalent resistance R_{eq}.



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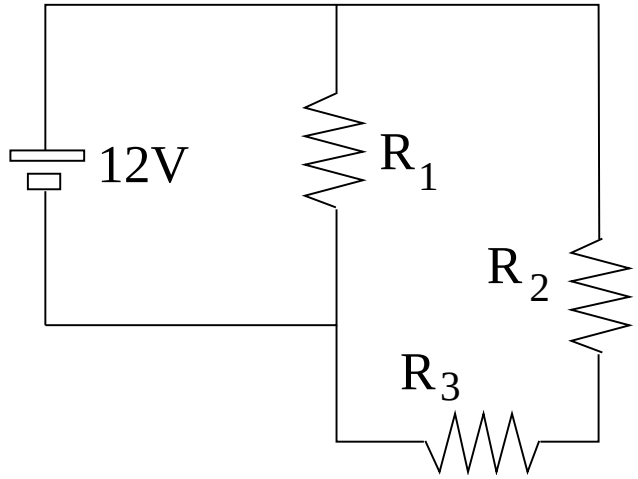


Solution:

(a) $I_2 = \dfrac{12\text{V}}{3\Omega + 1\Omega} = 3\text{A} \quad \left[\dfrac{12\text{V}}{2\Omega + 1\Omega} = 4\text{A}\right].$

(b) $V_3 = (3\text{A})(1\Omega) = 3\text{V} \quad [(4\text{A})(1\Omega) = 4\text{V}].$

(c) $P_1 = \dfrac{(12\text{V})^2}{2\Omega} = 72\text{W} \quad \left[\dfrac{(12\text{V})^2}{3\Omega} = 48\text{W}\right].$

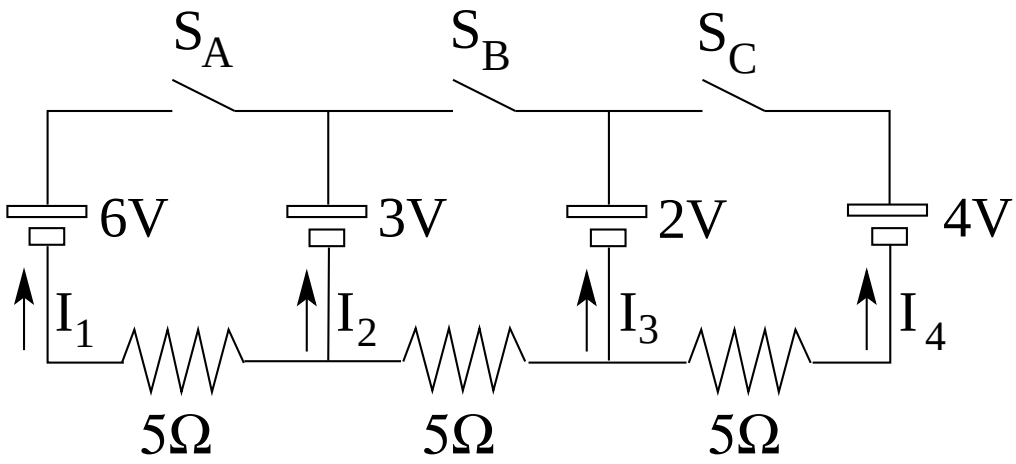
(d) $R_{eq} = \left(\dfrac{1}{2\Omega} + \dfrac{1}{3\Omega + 1\Omega}\right)^{-1} = \dfrac{4}{3}\,\Omega \quad \left[\left(\dfrac{1}{3\Omega} + \dfrac{1}{2\Omega + 1\Omega}\right)^{-1} = \dfrac{3}{2}\,\Omega\right].$

Unit Exam II: Problem #3 (Spring '14)

Consider the electric circuit shown. Find the currents I_1, I_2, I_3, I_4 when ...

(a) only switch S_A is closed,
(b) only switch S_B is closed,
(c) switches S_A and S_B are closed.

(a) only switch S_C is closed,
(b) only switch S_B is closed,
(c) switches S_B and S_C are closed.



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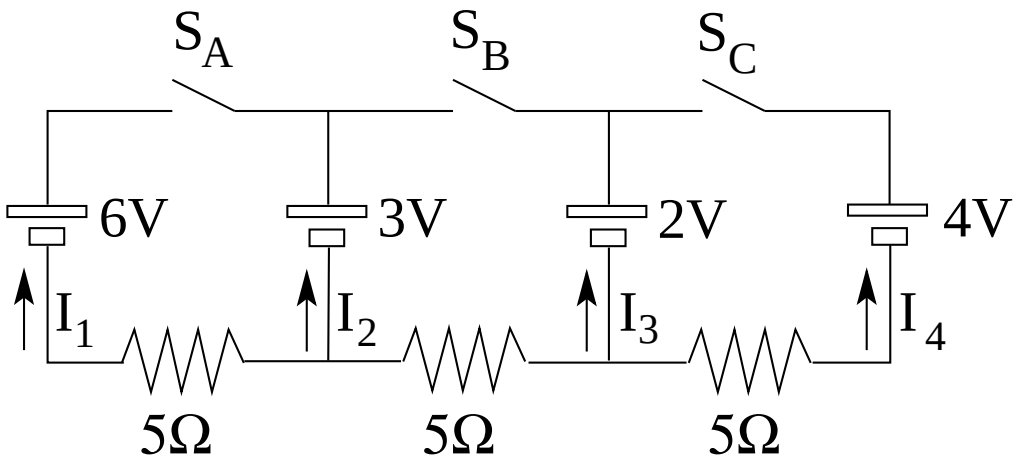

Solution:

(a) $I_1 = 0.6\text{A},\ I_2 = -0.6\text{A},\ I_3 = 0,\ I_4 = 0.$

(b) $I_1 = 0,\ I_2 = 0.2\text{A},\ I_3 = -0.2\text{A},\ I_4 = 0.$

(c) $I_1 = 0.6\text{A}, I_2 = -0.4\text{A},$
$I_3 = -0.2\text{A},\ I_4 = 0.$

(a) $I_1 = 0,\ I_2 = 0,\ I_3 = -0.4\text{A},\ I_4 = 0.4\text{A}.$

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