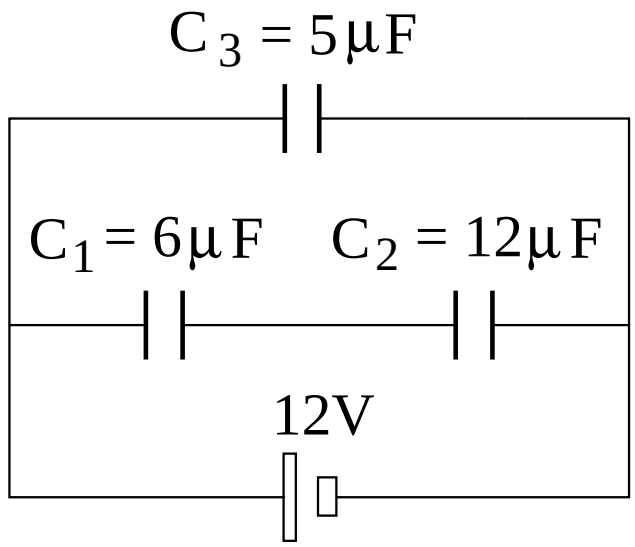
Unit Exam II: Problem #1 (Spring '08)

The circuit of capacitors is at equilibrium.

(a) Find the charge Q_1 on capacitor 1 and the charge Q_2 on capacitor 2.
(b) Find the voltage V_1 across capacitor 1 and the voltage V_2 across capacitor 2.
(c) Find the charge Q_3 and the energy U_3 on capacitor 3.



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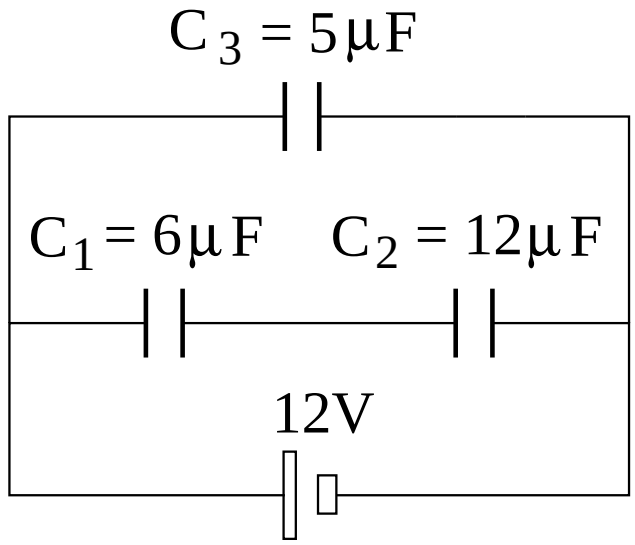


Solution:

(a) $C_{12} = \left(\frac{1}{6\mu\text{F}} + \frac{1}{12\mu\text{F}}\right)^{-1} = 4\mu\text{F},$

$Q_1 = Q_2 = Q_{12} = (4\mu\text{F})(12\text{V}) = 48\mu\text{C}.$

(b) $V_1 = \frac{Q_1}{C_1} = \frac{48\mu\text{C}}{6\mu\text{F}} = 8\text{V},$

$V_2 = \frac{Q_2}{C_2} = \frac{48\mu\text{C}}{12\mu\text{F}} = 4\text{V}.$

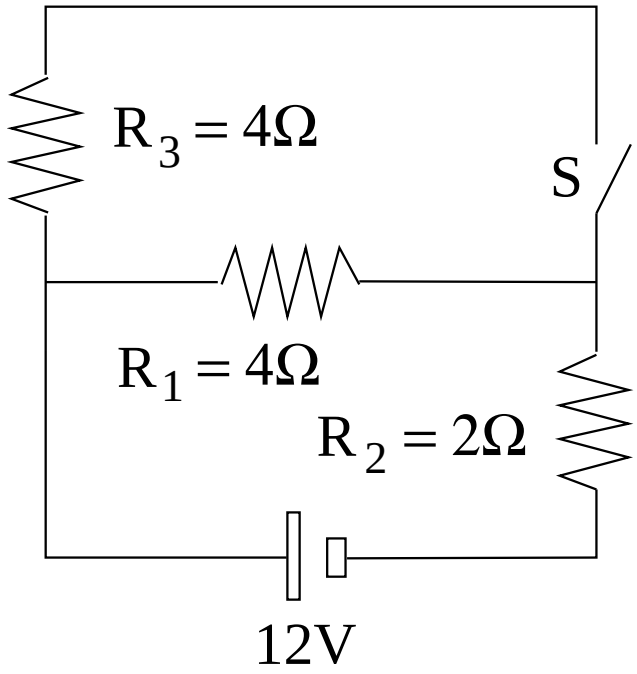
(c) $Q_3 = (5\mu\text{F})(12\text{V}) = 60\mu\text{C},$

$U_3 = \frac{1}{2}(5\mu\text{F})(12\text{V})^2 = 360\mu\text{J}.$

Unit Exam II: Problem #2 (Spring '08)

Consider the electric circuit shown. Find the current I_1 through resistor 1 and the voltage V_1 across it

(a) when the switch S is open,
(b) when the switch S is closed.
(c) Find the equivalent resistance R_{eq} of the circuit and the total power P dissipated in it when the switch S is closed.



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(a) when the switch S is open,
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(c) Find the equivalent resistance R_{eq} of the circuit and the total power P dissipated in it when the switch S is closed.

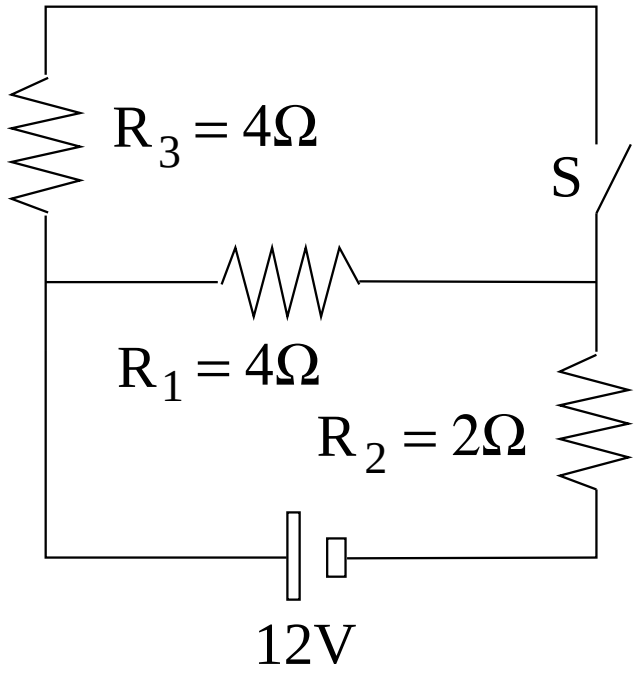
Solution:

(a) $I_1 = \dfrac{12\text{V}}{4\Omega + 2\Omega} = 2\text{A}, \quad V_1 = (4\Omega)(2\text{A}) = 8\text{V}.$

(b) $I_1 = \dfrac{1}{2}\,\dfrac{12\text{V}}{2\Omega + 2\Omega} = 1.5\text{A}, \quad V_1 = (4\Omega)(1.5\text{A}) = 6\text{V}.$

(c) $R_{eq} = \left(\dfrac{1}{4\Omega} + \dfrac{1}{4\Omega}\right)^{-1} + 2\Omega = 4\Omega,$

$P = \dfrac{(12\text{V})^2}{4\Omega} = 36\text{W}.$

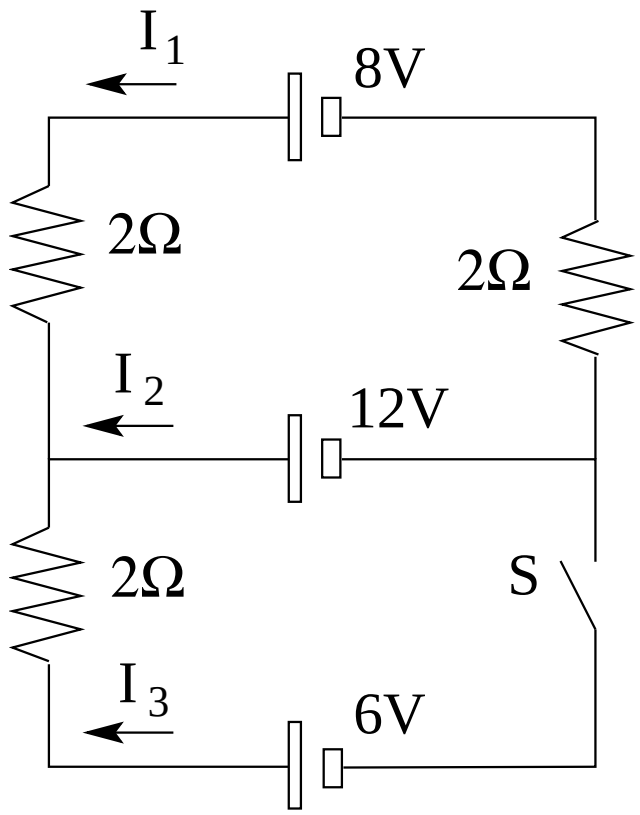


Unit Exam II: Problem #3 (Spring '08)

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

(a) with the switch S open,

(b) with the switch S closed.



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(a) with the switch S open,

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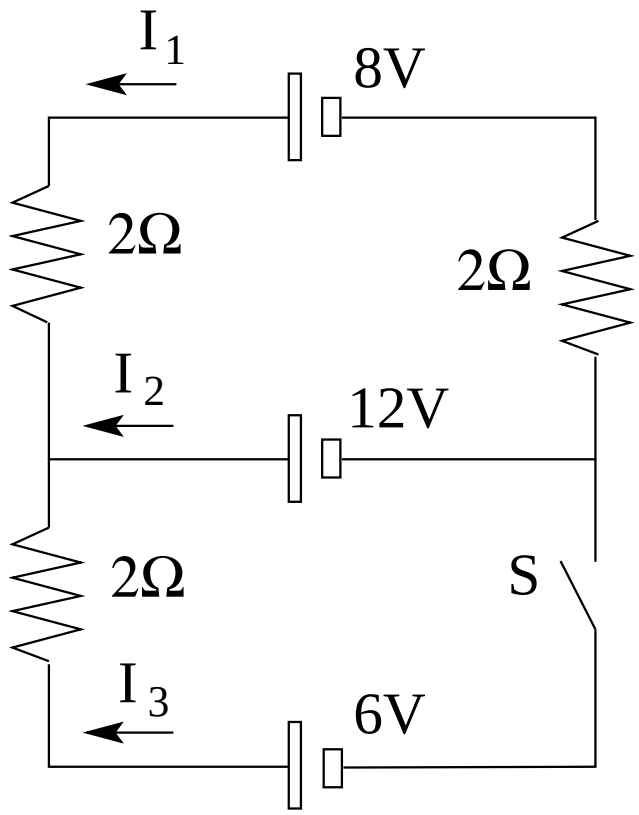

Solution:

(a) $I_1 = \dfrac{8\text{V} - 12\text{V}}{4\Omega} = -1\text{A},$

$I_2 = -I_1 = +1\text{A}.$

$I_3 = 0.$

(b) $I_1 = \dfrac{8\text{V} - 12\text{V}}{4\Omega} = -1\text{A},$

$I_3 = \dfrac{6\text{V} - 12\text{V}}{2\Omega} = -3\text{A}.$

$I_2 = -I_1 - I_3 = +4\text{A}.$