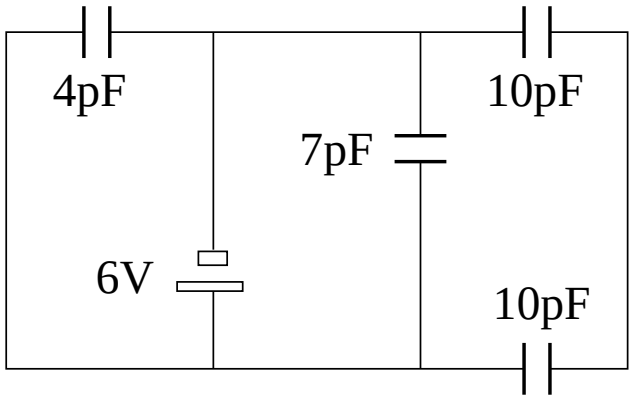
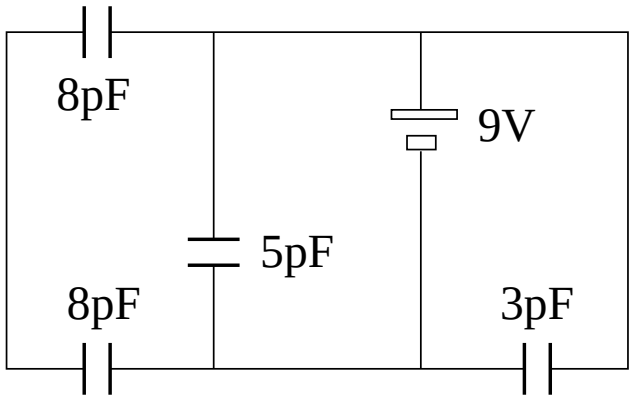
Unit Exam II: Problem #1 (Spring '17)

The capacitors (initially discharged) have been connected to the battery. The circuit is now at equilibrium. Find ...

(a) the charge Q_4 on the 4pF-capacitor,
(b) the energy U_7 on the 7pF-capacitor,
(c) the voltage V_{10} across the upper 10pF-capacitor,
(d) the equivalent capacitance C_{eq}.



(a) the charge Q_3 on the 3pF-capacitor,
(b) the energy U_5 on the 5pF-capacitor,
(c) the voltage V_8 across the lower 8pF-capacitor,
(d) the equivalent capacitance C_{eq}.



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(d) the equivalent capacitance C_{eq}.

Solution:

(a) $Q_4 = (6\text{V})(4\text{pF}) = 24\text{pC}.$

(b) $U_7 = \frac{1}{2}(7\text{pF})(6\text{V})^2 = 126\text{pJ}.$

(c) $V_{10} = \frac{1}{2}\,6\text{V} = 3\text{V}.$

(d) $C_{eq} = 4\text{pF} + 7\text{pF} + 5\text{pF} = 16\text{pF}.$

(a) $Q_3 = (9\text{V})(3\text{pF}) = 27\text{pC}.$

(b) $U_5 = \frac{1}{2}(5\text{pF})(9\text{V})^2 = 202.5\text{pJ}.$

(c) $V_8 = \frac{1}{2}\,9\text{V} = 4.5\text{V}.$

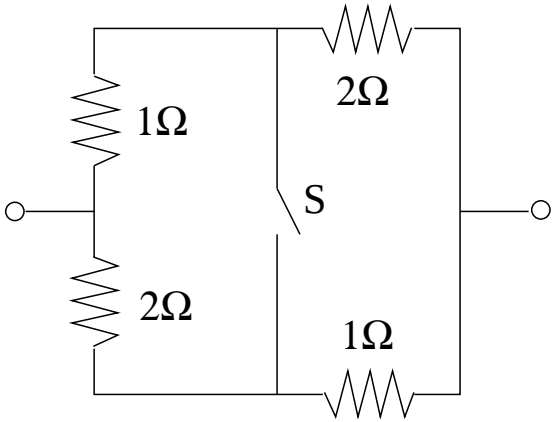
(d) $C_{eq} = 3\text{pF} + 5\text{pF} + 4\text{pF} = 12\text{pF}.$

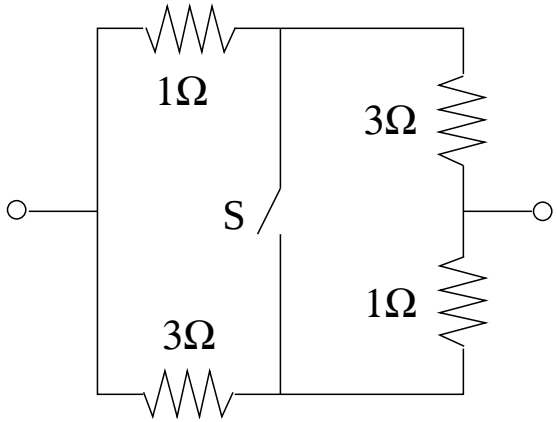
Unit Exam II: Problem #2 (Spring '17)

Consider this circuit with two terminals, four resistors, and one switch.

(a) Find the equivalent resistance $R_{\text{eq}}^{(\text{open})}$ when the switch is open.

(b) Find the equivalent resistance $R_{\text{eq}}^{(\text{closed})}$ when the switch is closed.





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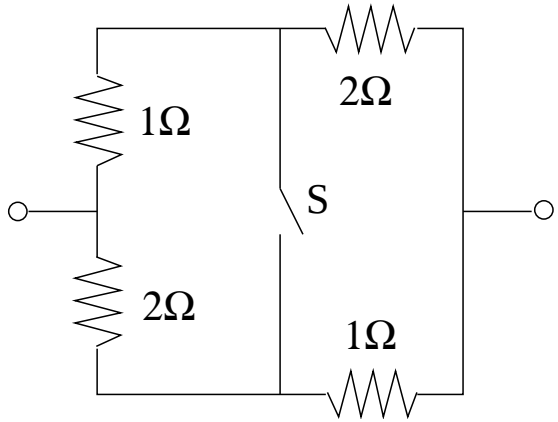
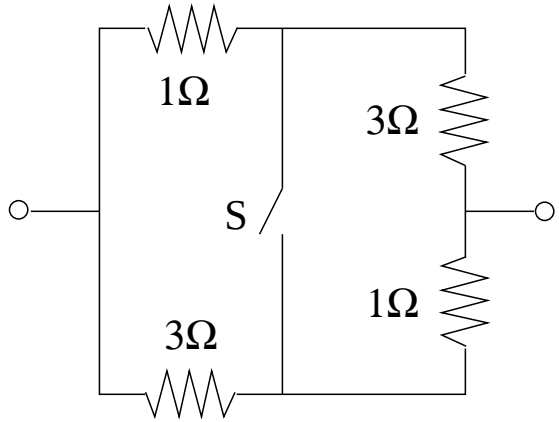




Solution:

$$R_{\text{eq}}^{(\text{open})} = \left(\frac{1}{1\Omega + 2\Omega} + \frac{1}{1\Omega + 2\Omega}\right)^{-1} = \frac{3}{2}\Omega.$$

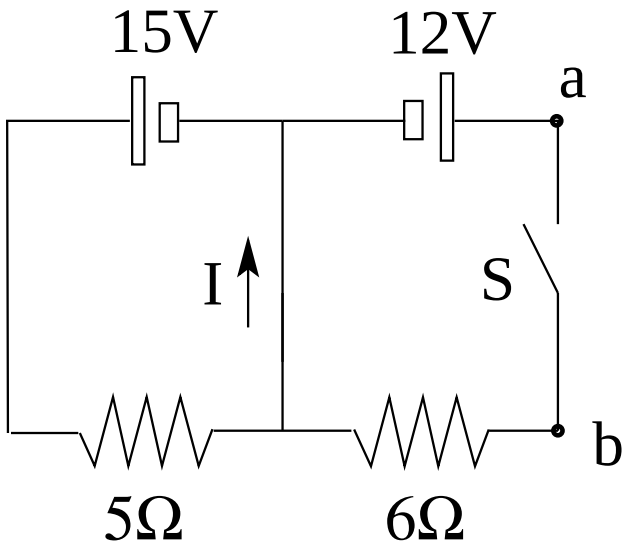
$$R_{\text{eq}}^{(\text{closed})} = \left(\frac{1}{1\Omega} + \frac{1}{2\Omega}\right)^{-1} + \left(\frac{1}{1\Omega} + \frac{1}{2\Omega}\right)^{-1} = \frac{4}{3}\Omega.$$

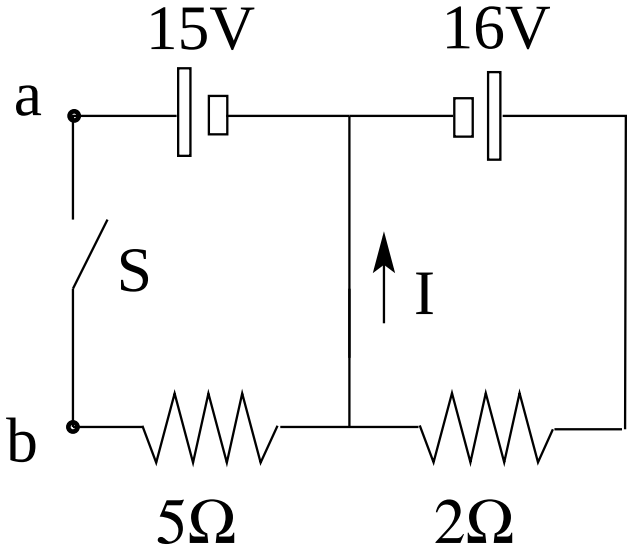
$$R_{\text{eq}}^{(\text{open})} = \left(\frac{1}{1\Omega + 3\Omega} + \frac{1}{1\Omega + 3\Omega}\right)^{-1} = 2\Omega.$$

$$R_{\text{eq}}^{(\text{closed})} = \left(\frac{1}{1\Omega} + \frac{1}{3\Omega}\right)^{-1} + \left(\frac{1}{1\Omega} + \frac{1}{3\Omega}\right)^{-1} = \frac{3}{2}\Omega.$$

Unit Exam II: Problem #3 (Spring '17)

Consider this circuit with two batteries, two resistors, and one switch.
(a) Find the current I when the switch is open.
(b) Find the current I when the switch is closed.
(c) Find the potential difference $V_a - V_b$ when the switch is open.
(d) Find the potential difference $V_a - V_b$ when the switch is closed.





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(a) Find the current I when the switch is open.
(b) Find the current I when the switch is closed.
(c) Find the potential difference $V_a - V_b$ when the switch is open.
(d) Find the potential difference $V_a - V_b$ when the switch is closed.

Solution:

(a) $I = \dfrac{15\text{V}}{5\Omega} = 3\text{A}.$

(b) $I = \dfrac{15\text{V}}{5\Omega} + \dfrac{12\text{V}}{6\Omega} = 3\text{A} + 2\text{A} = 5\text{A}.$

(c) $V_a - V_b = 12\text{V}.$

(d) $V_a - V_b = 0.$

(a) $I = \dfrac{16\text{V}}{2\Omega} = 8\text{A}.$

(b) $I = \dfrac{16\text{V}}{2\Omega} + \dfrac{15\text{V}}{5\Omega} = 8\text{A} + 3\text{A} = 11\text{A}.$

(c) $V_a - V_b = 15\text{V}.$

(d) $V_a - V_b = 0.$