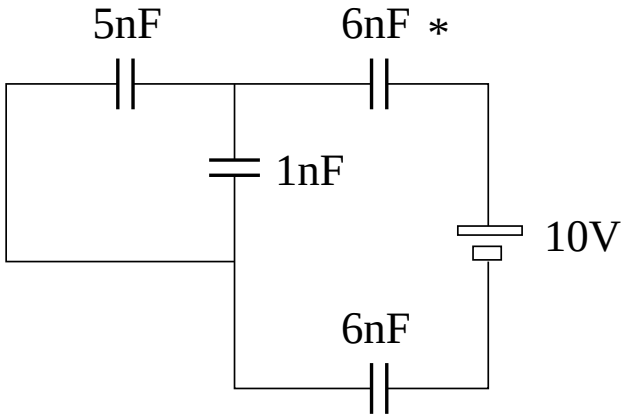
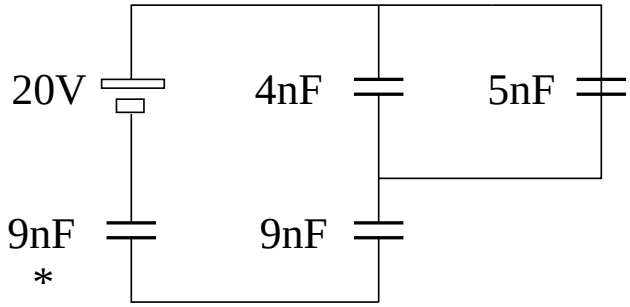
Unit Exam II: Problem #1 (Spring '13)

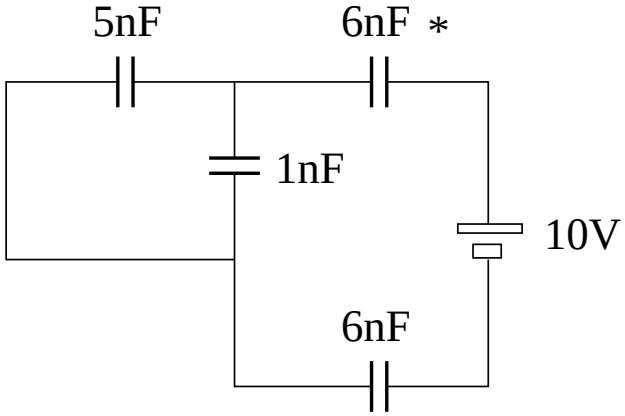
Consider the capacitor circuit shown at equilibrium.
(a) Find the equivalent capacitance C_{eq}.
(b) Find the total energy U stored in the four capacitors.
(c) Find the voltage V_* across the capacitor marked by an asterisk.

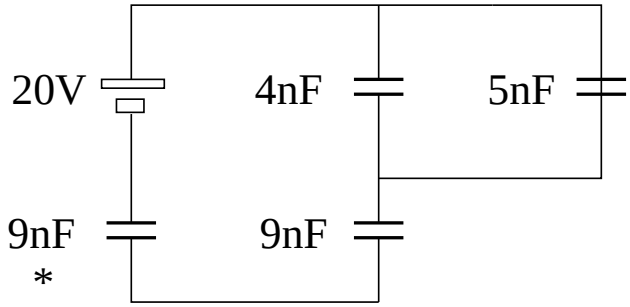




Unit Exam II: Problem #1 (Spring '13)

Consider the capacitor circuit shown at equilibrium.
(a) Find the equivalent capacitance C_{eq}.
(b) Find the total energy U stored in the four capacitors.
(c) Find the voltage V_* across the capacitor marked by an asterisk.





Solution:

$$C_{eq} = \left(\frac{1}{5\text{nF}+1\text{nF}} + \frac{1}{6\text{nF}} + \frac{1}{6\text{nF}}\right)^{-1} = 2\text{nF}$$

$$U = \frac{1}{2}(2\text{nF})(10\text{V})^2 = 100\text{nJ}$$

$$V_* = \frac{10}{3}\text{V} = 3.33\text{V}$$

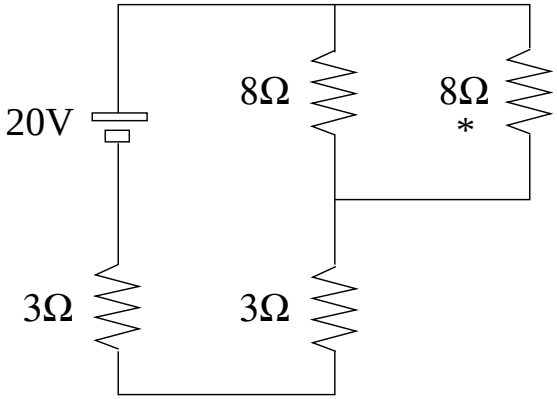
$$C_{eq} = \left(\frac{1}{4\text{nF}+5\text{nF}} + \frac{1}{9\text{nF}} + \frac{1}{9\text{nF}}\right)^{-1} = 3\text{nF}$$

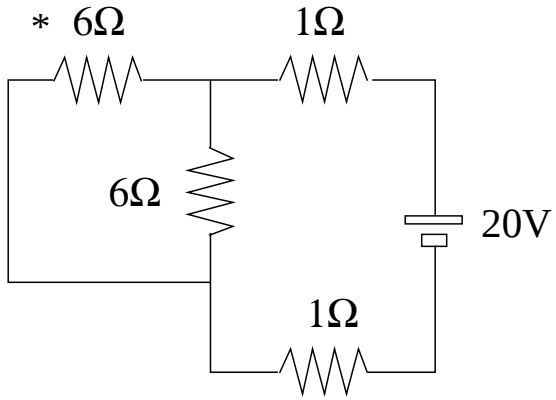
$$U = \frac{1}{2}(3\text{nF})(20\text{V})^2 = 600\text{nJ}$$

$$V_* = \frac{20}{3}\text{V} = 6.67\text{V}$$

Unit Exam II: Problem #2 (Spring '13)

Consider the resistor circuit shown.
(a) Find the equivalent resistance R_{eq}.
(b) Find the current I flowing through the battery.
(c) Find the voltage V_* across the resistor marked by an asterisk.





Unit Exam II: Problem #2 (Spring '13)

Consider the resistor circuit shown.
(a) Find the equivalent resistance R_{eq}.
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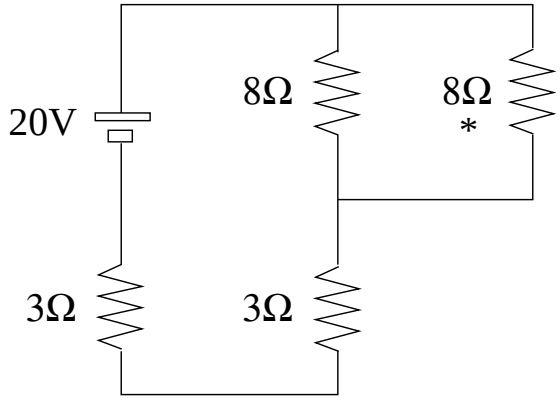
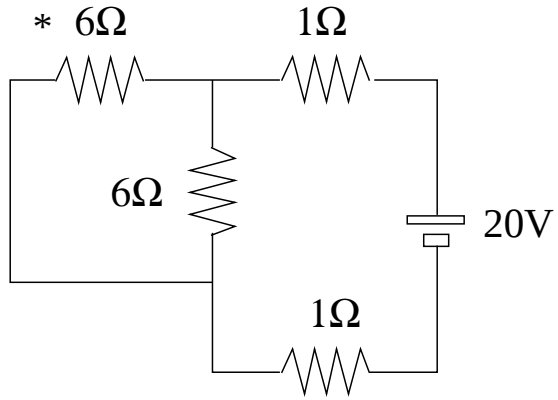




Solution:

$$R_{eq} = \left(\frac{1}{8\Omega} + \frac{1}{8\Omega}\right)^{-1} + 3\Omega + 3\Omega = 10\Omega$$

$$I = \frac{20\text{V}}{10\Omega} = 2\text{A}$$

$$V_* = (1\text{A})(8\Omega) = 8\text{V}$$

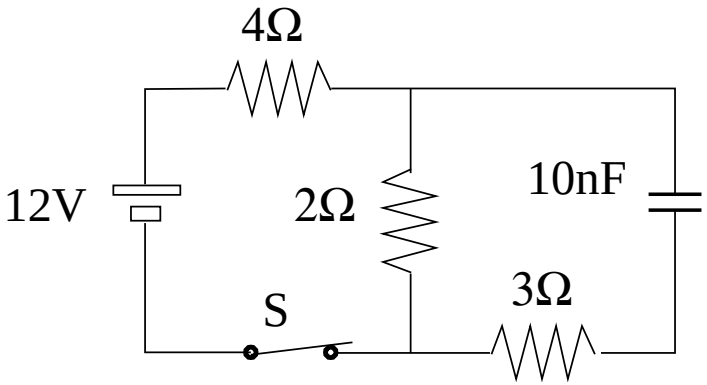
$$R_{eq} = \left(\frac{1}{6\Omega} + \frac{1}{6\Omega}\right)^{-1} + 1\Omega + 1\Omega = 5\Omega$$

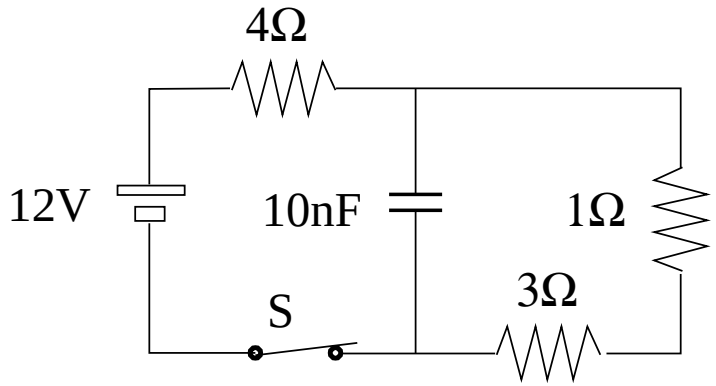
$$I = \frac{20\text{V}}{5\Omega} = 4\text{A}$$

$$V_* = (2\text{A})(6\Omega) = 12\text{V}$$

Unit Exam II: Problem #3 (Spring '13)

Consider the RC circuit shown. The switch has been closed for a long time.
(a) Find the current I_B flowing through the battery.
(b) Find the voltage V_C across the capacitor.
(c) Find the charge Q on the capacitor.
(d) Find the current I_3 flowing through the 3Ω-resistor right after the switch has been opened.





Unit Exam II: Problem #3 (Spring '13)

Consider the RC circuit shown. The switch has been closed for a long time.
(a) Find the current I_B flowing through the battery.
(b) Find the voltage V_C across the capacitor.
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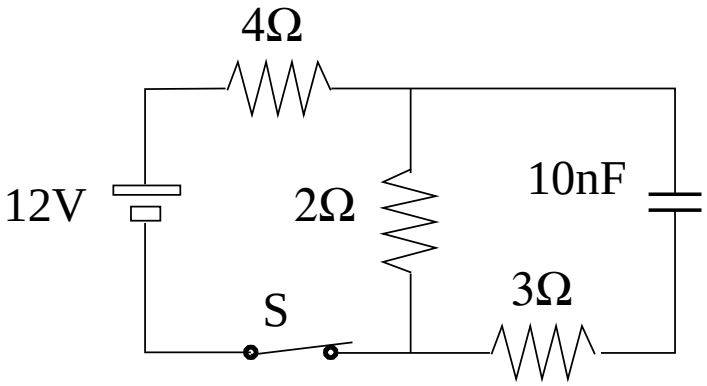

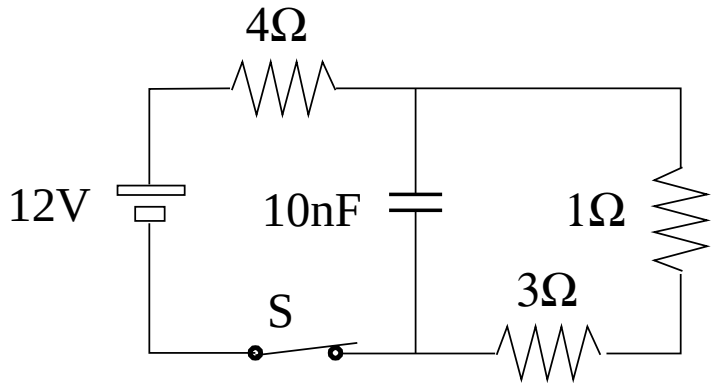

Solution:

$$I_B = \frac{12\text{V}}{2\Omega + 4\Omega} = 2\text{A}$$

$$V_C = (2\text{A})(2\Omega) = 4\text{V}$$

$$Q = (4\text{V})(10\text{nF}) = 40\text{nC}$$

$$I_3 = \frac{4\text{V}}{2\Omega + 3\Omega} = 0.8\text{A}$$

$$I_B = \frac{12\text{V}}{3\Omega + 1\Omega + 4\Omega} = 1.5\text{A}$$

$$V_C = (1.5\text{A})(3\Omega + 1\Omega) = 6\text{V}$$

$$Q = (6\text{V})(10\text{nF}) = 60\text{nC}$$

$$I_3 = \frac{6\text{V}}{3\Omega + 1\Omega} = 1.5\text{A}$$