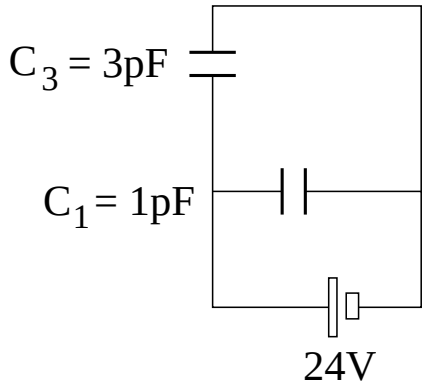
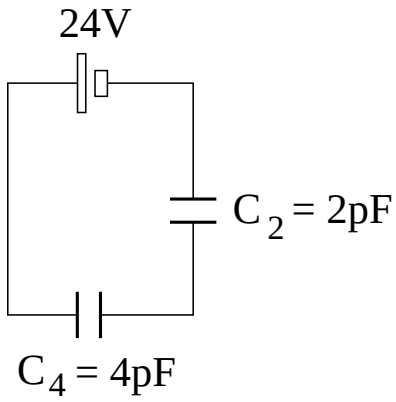
Unit Exam II: Problem #1 (Spring '15)

Both capacitor circuits are at equilibrium.
(a) Find the charge Q_1 on capacitor 1.
(b) Find the energy U_3 stored on capacitor 3.
(c) Find the charge Q_2 on capacitor 2.
(d) Find the voltage V_4 across capacitor 4.





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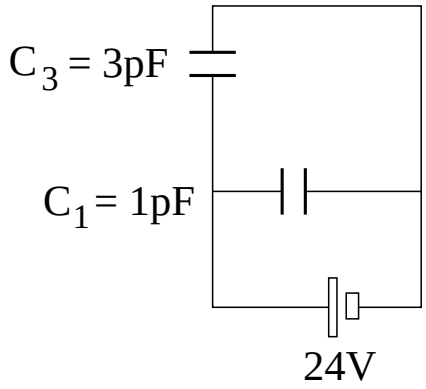
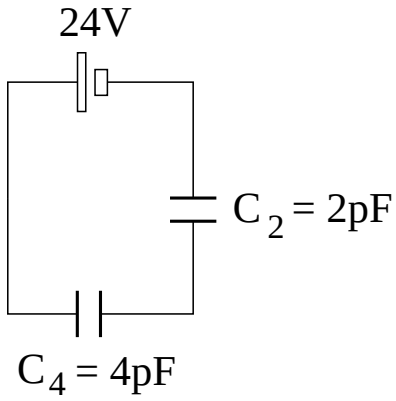




Solution:

(a) $Q_1 = C_1 V_1 = (1\text{pF})(24\text{V}) = 24\text{pC}.$

(b) $U_3 = \frac{1}{2} C_3 V_3^2 = \frac{1}{2}(3\text{pF})(24\text{V})^2 = 864\text{pJ}.$

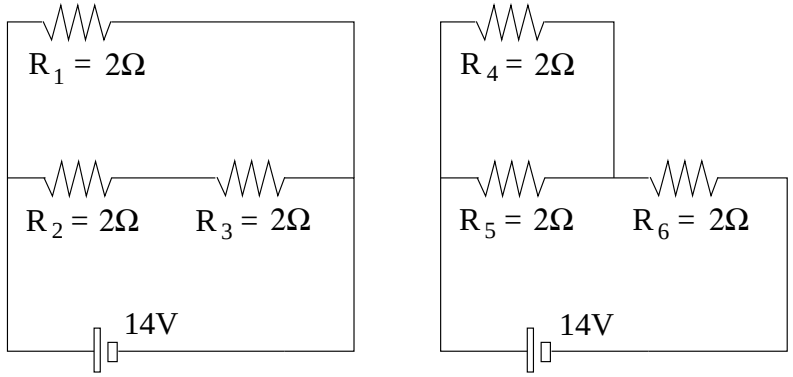
(c) $C_{24} = \left(\frac{1}{C_2} + \frac{1}{C_4}\right)^{-1} = \frac{4}{3}\text{pF},$

$Q_2 = Q_4 = Q_{24} = C_{24} V_{24} = \left(\frac{4}{3}\text{pF}\right)(24\text{V}) = 32\text{pC}.$

(d) $V_4 = \frac{Q_4}{C_4} = \frac{32\text{pC}}{4\text{pF}} = 8\text{V}.$

Unit Exam II: Problem #2 (Spring '15)

In the two resistor circuits shown find the equivalent resistances R_{123} (left) and R_{456} (right). Then find the currents I_1, I_2, I_3 through the individual resistors on the left. and the currents I_4, I_5, I_6 through the individual resistors on the right.



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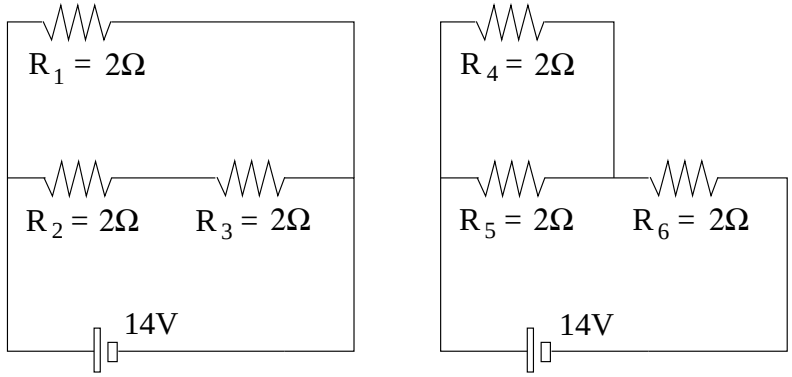
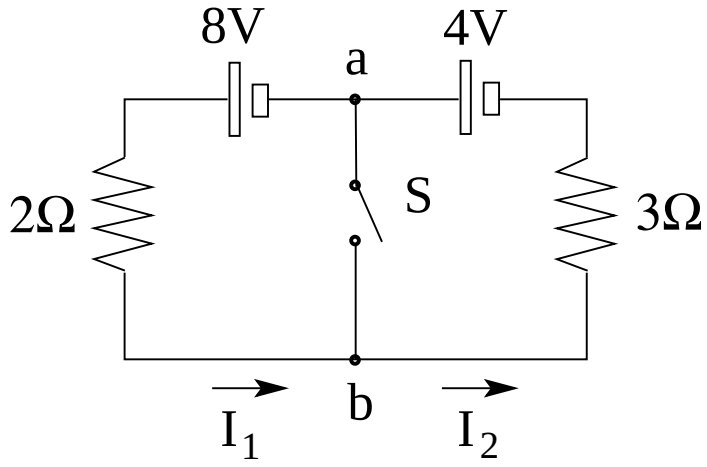


Solution:

- $R_{23} = 2\Omega + 2\Omega = 4\Omega, \quad R_{123} = \left(\frac{1}{2\Omega} + \frac{1}{4\Omega}\right)^{-1} = \frac{4}{3}\Omega$
- $R_{45} = \left(\frac{1}{2\Omega} + \frac{1}{2\Omega}\right)^{-1} = 1\Omega, \quad R_{456} = R_{45} + R_6 = 3\Omega$
- $I_1 = \frac{14\text{V}}{2\Omega} = 7\text{A}, \quad I_2 = I_3 = \frac{14\text{V}}{4\Omega} = 3.5\text{A}$
- $I_6 = I_{45} = \frac{14\text{V}}{3\Omega} = 4.67\text{A}, \quad I_4 = I_5 = \frac{1}{2}I_6 = 2.33\text{A}$

Unit Exam II: Problem #3 (Spring '15)

In the circuit shown find the currents I_1, I_2, and the potential difference $V_b - V_a$
(a) if the switch S is open,
(b) if the switch S is closed.



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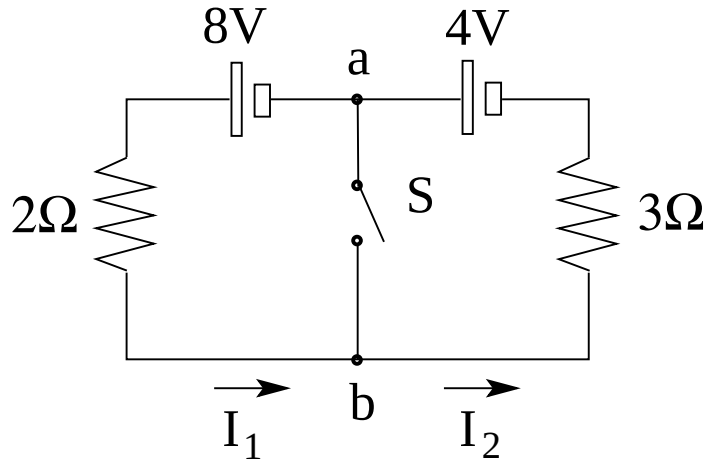

Solution:

(a) $I_1 = I_2 = \dfrac{12\text{V}}{5\Omega} = 2.4\text{A}$

$V_b - V_a = 8\text{V} - (2.4\text{A})(2\Omega) = -4\text{V} + (2.4\text{A})(3\Omega) = 3.2\text{V}.$

(b) $I_1 = \dfrac{8\text{V}}{2\Omega} = 4\text{A}, \quad I_2 = \dfrac{4\text{V}}{3\Omega} = 1.33\text{A}, \quad V_b - V_a = 0.$