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

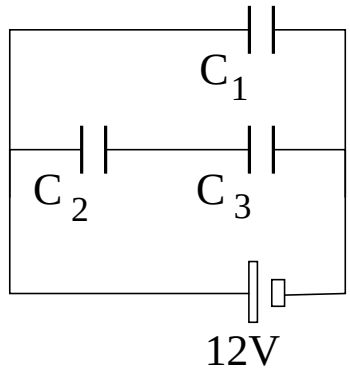
Both capacitor circuits, charged up by batteries as shown, are now at equilibrium. Each of the six capacitors has a 2pF capacitance.

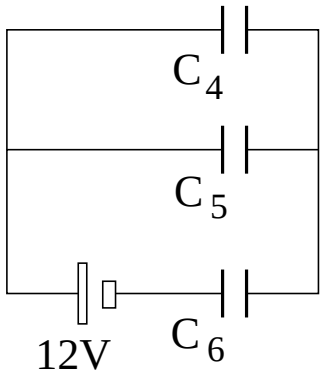
(a) Find the equivalent capacitance of the circuit on the left.

(b) Find the voltages V_1, V_2, V_3 across capacitors C_1, C_2, C_3, respectively.

(c) Find the equivalent capacitance of the circuit on the right.

(d) Find the charges Q_4, Q_5, Q_6 on capacitors C_4, C_5, C_6, respectively.





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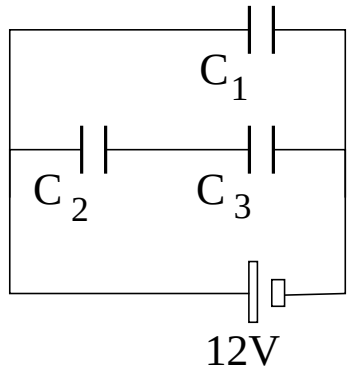
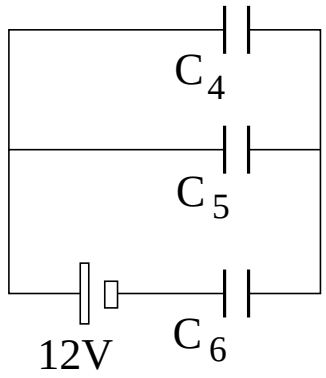




Solution:

(a) $C_{eq} = 2\text{pF} + \left(\frac{1}{2\text{pF}} + \frac{1}{2\text{pF}}\right)^{-1} = 3\text{pF}.$

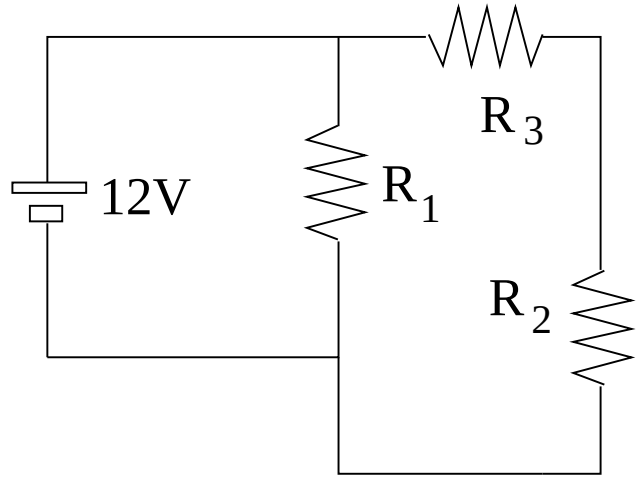
(b) $V_1 = 12\text{V}, \quad V_2 = V_3 = 6\text{V}$

(c) $C_{eq} = \left(\frac{1}{2\text{pF} + 2\text{pF}} + \frac{1}{2\text{pF}}\right)^{-1} = \frac{4}{3}\text{pF}.$

(d) $Q_{45} = Q_6 = C_{eq}(12\text{V}) = 16\text{pC} \quad \Rightarrow \; Q_4 = Q_5 = 8\text{pC}.$

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

Consider the resistor circuit shown with $R_1 = 5\Omega$, $R_2 = 1\Omega$, and $R_3 = 3\Omega$.
(a) Find the equivalent resistance R_{eq}.
(b) Find the currents I_1, I_2, I_3 through resistors R_1, R_2, R_3, respectively.
(c) Find the voltages V_1, V_2, V_3 across resistors R_1, R_2, R_3, respectively.



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

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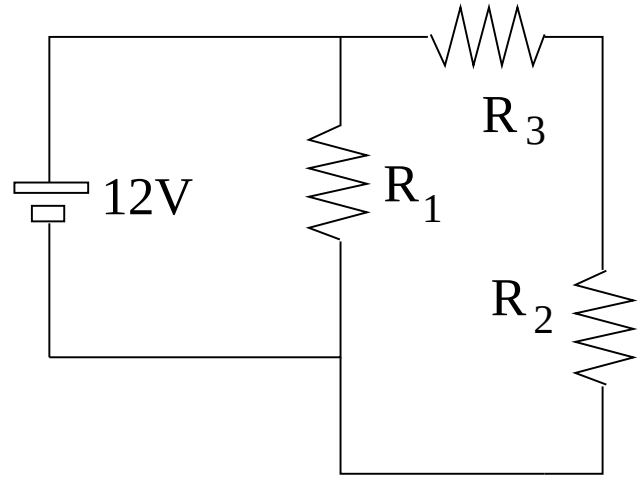


Solution:

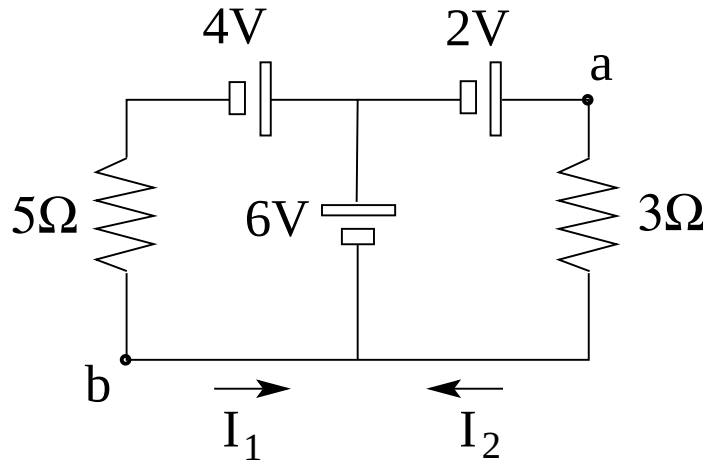
(a) $R_{eq} = \left(\dfrac{1}{1\Omega + 3\Omega} + \dfrac{1}{5\Omega} \right)^{-1} = \dfrac{20}{9}\,\Omega = 2.22\Omega.$

(b) $I_1 = \dfrac{12\text{V}}{5\Omega} = 2.4\text{A}, \quad I_2 = I_3 = \dfrac{12\text{V}}{1\Omega + 3\Omega} = 3\text{A}.$

(c) $V_1 = R_1 I_1 = 12\text{V}, \quad V_2 = R_2 I_2 = 3\text{V}, \quad V_3 = R_3 I_3 = 9\text{V}.$

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

Consider the two-loop circuit shown.
(a) Find the current I_1.
(b) Find the current I_2.
(c) Find the potential difference $V_a - V_b$.



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

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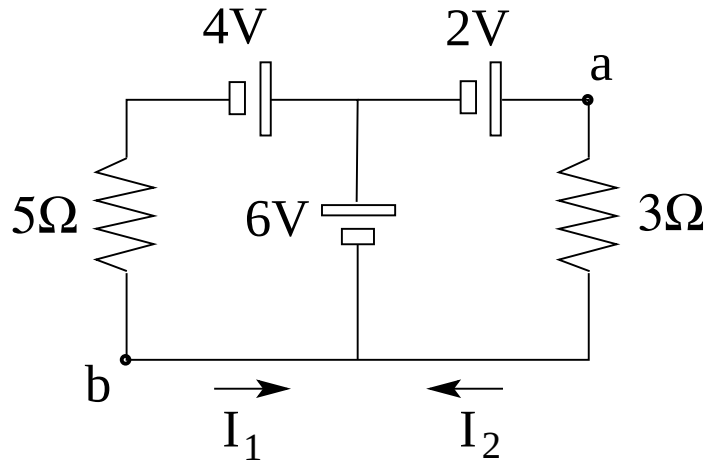

Solution:

(a) $I_1 = \dfrac{6\text{V} - 4\text{V}}{5\Omega} = 0.4\text{A}.$

(b) $I_2 = \dfrac{6\text{V} + 2\text{V}}{3\Omega} = 2.67\text{A}.$

(c) $V_a - V_b = 6\text{V} + 2\text{V} = 8\text{V}.$