PHYS 231 Review Assignment

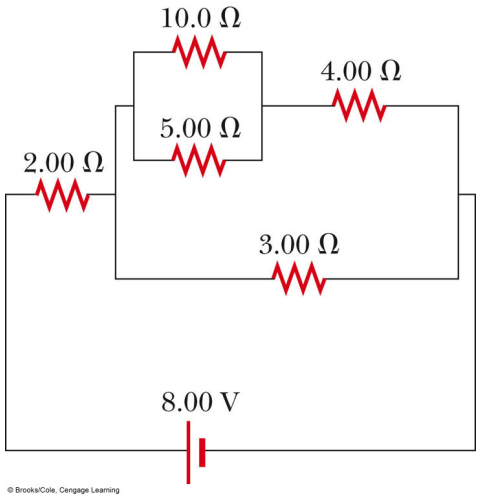
September 9, 2018

This is a review assignment designed to allow you to practice concepts from first-year physics (PHYS 102/122 at UBCO). This assignment requires you to:

- work with parallel and series combinations of resistors and capacitors
- apply Kirchhoff's loop and junction rules
- solve systems of equations

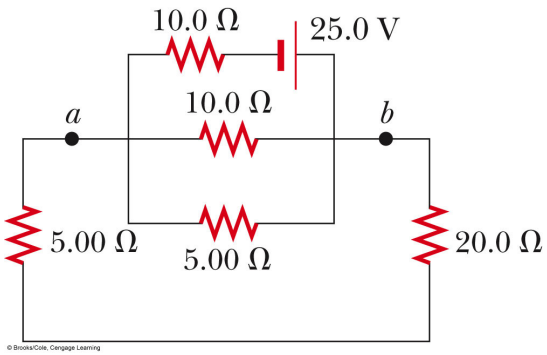
I will *not* collect and grade this assignment, it is for your own practice. The answers are given after each problem. If you struggle with any of the problems, you are strongly encouraged to review the relevant concepts in your first-year textbook or in Eggleston's book.

1. (a) Find the current in the 8.00 V battery. (b) Find the voltage across the 2.00 Ω resistor.



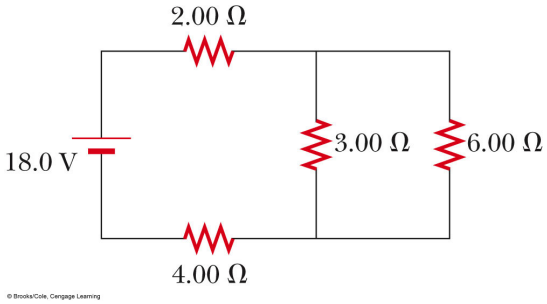
ans: $I = 1.94\,\text{A}$, $V = 3.88\,\text{V}$

2. (a) Find the potential difference between points b and a: $V_{ba} \equiv V_b - V_a$. (b) Find the current in the $10\,\Omega$ resistor that is in series with the $25\,\text{V}$ battery.



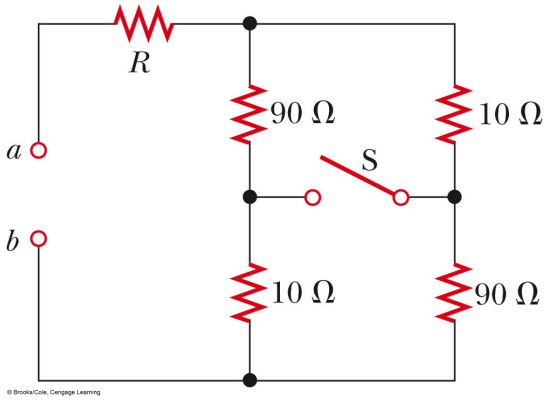
ans: $V_{ba} = +5.68\,\text{V}$, $I = 1.93\,\text{A}$

3. Find the current in the $18\,\text{V}$ battery and each resistor.



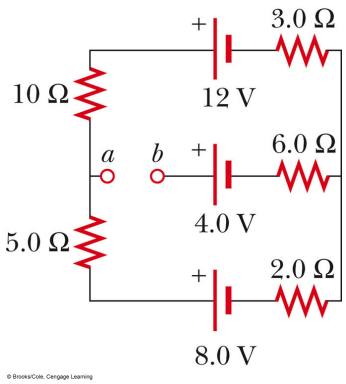
ans: $I_{18} = I_2 = I_4 = 2.25\,\text{A}$, $I_3 = 1.50\,\text{A}$, $I_6 = 0.75\,\text{A}$

4. If $R = 25\,\Omega$, find the resistance across terminals a and b when the switch S is (a) open and (b) closed.



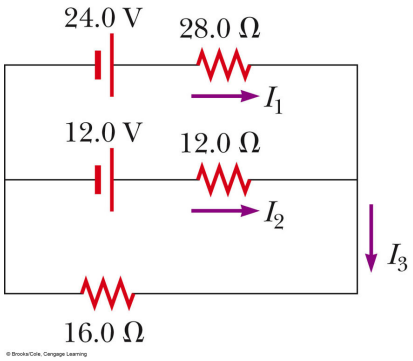
ans: (a) $R_{\text{open}} = 75\,\Omega$, (b) $R_{\text{closed}} = 43\,\Omega$

5. (a) Find the current in each battery and each resistor. (b) Find the potential difference between points b and a: $V_{ba} \equiv V_b - V_a$.



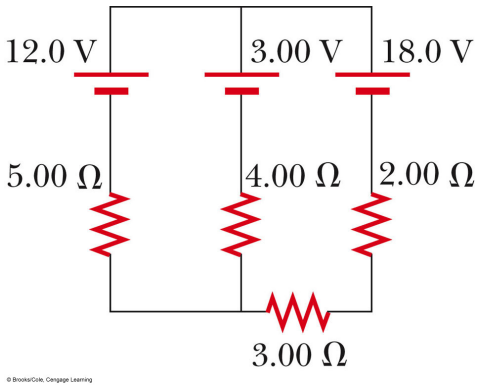
ans: (a) $I_2 = I_3 = I_5 = I_8 = I_{10} = I_{12} = 0.20\,\text{A}$, $I_4 = I_6 = 0\,\text{A}$
(b) $V_{ba} = -5.4\,\text{V}$

6. Find I_1, I_2, and I_3.



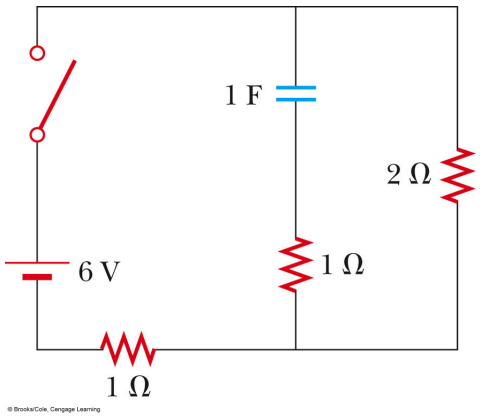
ans: $I_1 = 0.492\,\text{A}$, $I_2 = 0.148\,\text{A}$, $I_3 = 0.640\,\text{A}$

7. Find the voltages across all four resistors.



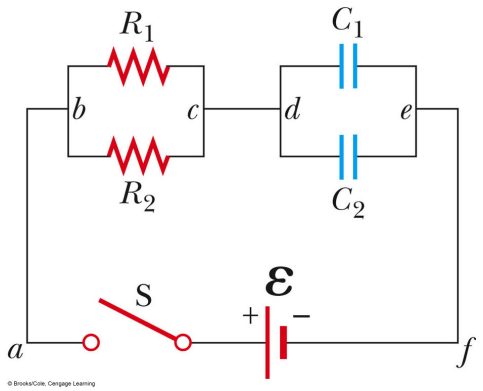
ans: $V_2 = 3.06\,\text{V}$, $V_3 = 4.59\,\text{V}$, $V_4 = 7.40\,\text{V}$, $V_5 = 1.60\,\text{V}$

8. Suppose the switch has been in the open position for a very long time. (a) What is the charge on the 1 F capacitor? What are the currents in the battery, capacitor, and 2 Ω resistor? (b) Now we close the switch a wait for a very long time. What is the charge on the capacitor? What are the currents in the battery, capacitor, and 2 Ω resistor?



ans: (a) $q = 0$, $I_{6\,\mathrm{V}} = I_{1\,\mathrm{F}} = I_{2\,\Omega} = 0$
(b) $q = 4.00\,\mathrm{C}$, $I_{6\,\mathrm{V}} = I_{2\,\Omega} = 2.00\,\mathrm{A}$, $I_{1\,\mathrm{F}} = 0$

9. In the circuit below $R_1 = 1\,\mathrm{k\Omega}$, $R_2 = 2\,\mathrm{k\Omega}$, $C_1 = 1\,\mathrm{nF}$, and $C_2 = 2\,\mathrm{nF}$. Suppose that initially both capacitors are uncharged. Then, at time $t = 0$, switch S is closed. (a) At what time is the voltage across points b and c ($V_{bc} = V_b - V_c$) equal to $\mathcal{E}/2$? (b) What is the voltage across points d and e ($V_{de} = V_d - V_e$) at this time?



ans: (a) $t = 1.39\,\mu\mathrm{s}$
(b) $V_{de} = \mathcal{E}/2$