Circuits Worksheet

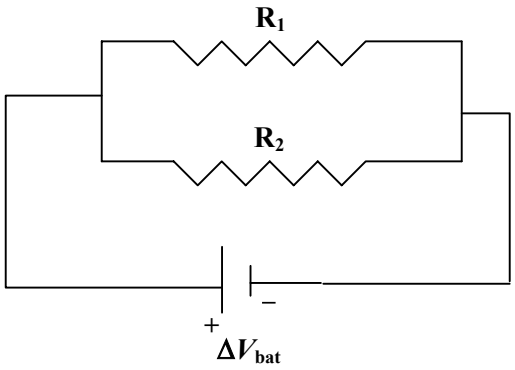
In this circuit, $R_1 = R_2$. I_1 is the current flowing through R_1, and I_2 is the current flowing through R_2.

Find algebraic expressions for the following quantities, in terms of R_1, R_2 and ΔV_{bat}.

$I_1 =$

$I_2 =$

$I_{tot} =$



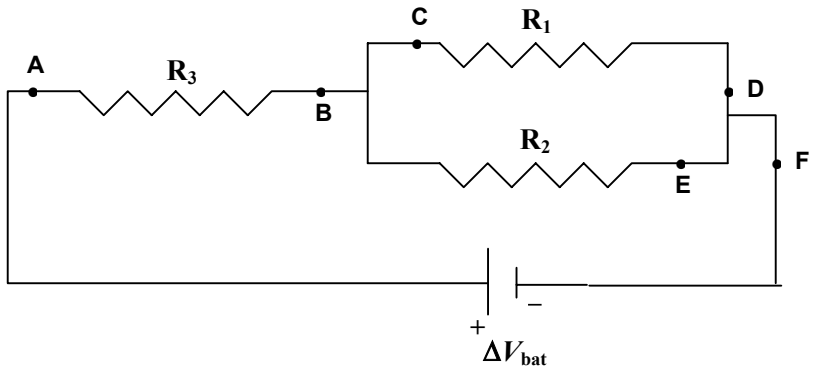
Suppose we add another resistor in parallel (so we have three resistors in parallel, instead of two); we keep the same battery. Draw a diagram of this new circuit. Will I_{tot}, the total current flowing through the battery, *increase*, *decrease*, or *remain the same*? Explain your answer.

Suppose we keep adding resistors in parallel. Will the total current increase, decrease, or remain the same?

Formulate a general rule for what happens to the total current flowing through the battery in a parallel circuit, when more resistors are added. How does this compare to the rule for what would happen when resistors are added to a ***series*** circuit?

The definition of the equivalent resistance of a circuit R_{equiv} is: $R_{equiv} = \dfrac{\Delta V_{bat}}{I_{tot}}$

When we add resistors in parallel, does the equivalent resistance of the circuit increase, decrease, or remain the same? Explain your answer. How does this compare to what happens when you add resistors to a series circuit?



In this circuit, $R_1 = R_2 = R_3$.

1. Rank I_1, I_2 and I_3 from largest to smallest: (largest) _____ (smallest).

What are the relative magnitudes of I_1, I_2 and I_3; i.e.,

I_2 / I_1 = _____?

I_3 / I_1 = _____?

Explain your reasoning:

2. Rank ΔV_1, ΔV_2, and ΔV_3 from largest to smallest: (largest) _____ (smallest)

What are the relative magnitudes of ΔV_1, ΔV_2, and ΔV_3; i.e.,

$\Delta V_2 / \Delta V_1$ = _____?

$\Delta V_3 / \Delta V_1$ = _____?

Explain:

3. Write two separate algebraic expressions relating I_{tot} (the current flowing through the battery) and I_1, I_2 and I_3. (It is not necessary to use all three I's in each equation.)

   I. $I_{tot} =$

   II. $I_{tot} =$

4. Write two separate algebraic expressions relating ΔV_{bat} and ΔV_1, ΔV_2, and ΔV_3. (It is not necessary to use all three ΔV's in each equation.)

   I. $\Delta V_{bat} =$

   II. $\Delta V_{bat} =$

Now assume that $R_1 = R_2 = R_3 = 2$ ohms, and that $\Delta V_{bat} = 12$ V. Find the following values:
Hint: use your results from #2 and #4.

$\Delta V_1 =$ _____

$\Delta V_2 =$ _____

$\Delta V_3 =$ _____

5. Find the following values:

   $I_1 =$ _____

   $I_2 =$ _____

   $I_3 =$ _____

   $I_{tot} =$ _____

6. What is the equivalent resistance of the entire circuit? Explain how you got this.

7. What is the equivalent resistance of the *parallel combination* (R_1 and R_2) *alone*? (That is, if that combination were hooked up to a battery by itself without R_3, what would be its equivalent resistance? Explain your answer.

8. Assume that the potential at the negative terminal of the battery is 0 volts. Write down the value of the potential at each point:

   A. _____
   B. _____
   C. _____
   D. _____
   E. _____
   F. _____

9. Suppose the wire was cut at point C. What would happen to the current flowing through R_1?

   With the wire cut at point C, find these values:

   $\Delta V_{3(with\ wire\ cut)}$ = _____

   $\Delta V_{2(with\ wire\ cut)}$ = _____

10. Compared to the situation ***before*** the wire was cut, would there be an increase, a decrease, or no change in :

A. the amount of current flowing through R_1? Explain.

B. the amount of current flowing through R_3? Explain.

C. the amount of current flowing through R_2? Explain.

D. the amount of current flowing through the battery? Explain.

11. Suppose we go back to the original circuit (i.e., no cut in the wire at point C), and we add a third two-ohm resistor in parallel (to join R_1 and R_2).

Would the equivalent resistance of the *parallel combination* increase, decrease, or remain the same?

Would the equivalent resistance of the whole circuit increase, decrease, or remain the same? Explain your answer.

Would the amount of current flowing through the battery increase, decrease, or remain the same?