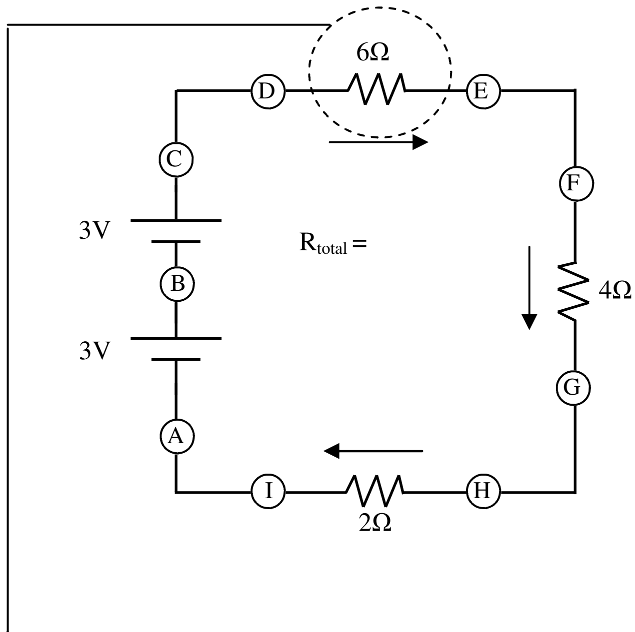
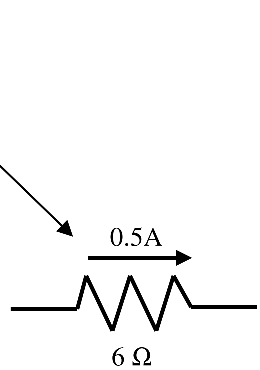
PreAP Circuits 4

Let me talk you thru your first series circuit. [Sniff. "Your mom and I are so proud…"] Some tips to make this easier: 1) Work the circuit first, meaning figure out everything on the diagram, labeling everything as you go. You can answer the questions later; 2) Write all numbers with units or the circuit will get REALLY confusing; 3) when writing current, show an arrow, since current flows.





1. Use the circuit at the left to answer the following questions:
   - A. * What is the voltage at point A? (*label it)*
   - B. * What is the voltage at C? (*label it)*
   - C. From what you saw in Lab 1, by adding resistors in series does the current in the circuit increase or decrease?
   - D. * What is the total resistance of the circuit? (*label this R_{total} and put it in the middle of the loop.)* *Now we are going to use V = IR, but with subscripts.*
   - E. * Since the each of the resistors affects the current in the ENTIRE circuit, use $V_{total} = I_{total} R_{total}$ to calculate the total current flowing thru the loop. (*label this I_{total} and put it in the middle of the loop.)*
   - F. * Since there is only one path for the electrons to flow, which resistor has the greatest current flowing thru it?
   - G. What is I_{R1} (the current flowing thru R_1)? (*label it on the arrow below R_1*)
   - H. * What is I_{R2}? (*label on the arrow near R_2)*
   - I. What is I_{R3}? (*label it.)*

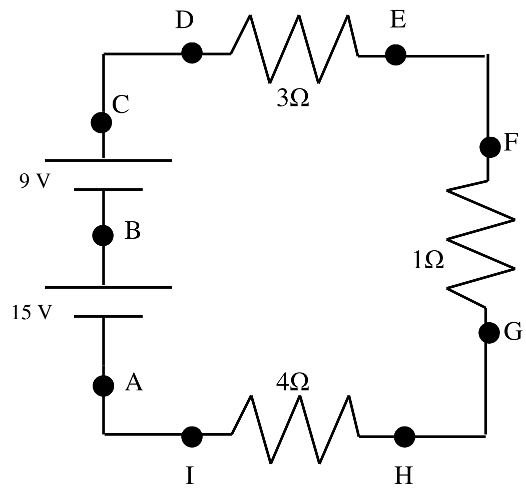
So we need to find the voltage used by each resistor. Now let me show you how.

- J. From the series circuit lab, do resistors add or subtract voltage?
- K. So, will the voltage at letter E be greater or less than at D?
- L. * Now we are concentrating on just resistor 1 (zooming in on it). You have the current flowing thru the resistor and its resistance. Calculate V_{R1} (the voltage used by R_1). You will now change V = IR to $V_{R1} = I_{R1}(R_1)$. (*label it on the big circuit, above R_1).*

  Since resistors use up voltage, we can consider V_{R1} negative.
- M. Calculate the voltage remaining at point E by subtracting the voltage used by R_1 from the voltage at letter D (*and label it*).
- N. Since there is no resistor between points E and F, what must be the voltage at point F?
- O. Again, since there is nowhere for the current to go, except thru each resistor, the current in R_2 is the same as R_1, so, following the same logic as for R_1, calculate the resistance used by R_2 and R_3, labeling the diagram as you go.
- P. Calculate the voltage left at point G.
- Q. How does the voltage used by the 4Ω resistor compare with that of the 2Ω resistor?
- R. How does the voltage used by the 6Ω resistor compare with that of the 2Ω resistor?

This is how you will work ALL circuits from now on.

2. After working the circuit at the right, answer the following questions.



   A. Just by looking, which resistor uses the least amount of voltage?
   B. How much voltage does a wire use?
   C. * Which resistor has the greatest current?
   D. What is the total voltage?
   E. What is the total resistance?
   F. * What is the total current?
   G. How many paths are there for the current to flow?
   H. * How much current is flowing thru the 3Ω resistor?
   I. * Given that V = IR (always) how much voltage does the 3Ω resistor use?

   J. Since resistors use up voltage, how much voltage is left at letter E?

   We haven't talked about electrical power, yet, but P = VI (I will show you why later). P is still in watts.

   K. * How much power is used by the 3Ω resistor? (*Use* $P_{3\Omega} = V_{3\Omega} I_{3\Omega}$)

   L. Calculate the voltage used by the 4Ω resistor.

   M. What is the voltage difference between point I and point H?

Let's work with power a bit more.

3. * Remember back to energy. What is the basic equation for power?
4. What are the units for power?
5. * What are the units for power, broken up?

Now, let's combine the two equations.

6. A series circuit has a total voltage of 3.5 volts and draws 0.25 amps.
   A. * Calculate the total power generated by the battery.

   B. Change your units, breaking down watts.
   C. * How much energy does the circuit use in 2 minutes?

7. Given that V = IR and P = VI. Now, let's combine these two equations.
   A. * Write an equation for power that does not have voltage in it. (*Substitute V = IR into P = VI.)*

   B. * Write an equation for power that does not have current in it. (*Solve for I in the first equation and substitute into the second equation.)*

8. Choosing the correct equations for power ($P = VI$, $P = I^2R$, or $P = V^2/R$), how does the power used change if:
   A. * The voltage is doubled.
   B. * The current is doubled and the resistance is doubled.
   C. The voltage is halved and the resistance is halved.
   D. The voltage is halved and the current is doubled.

And if you don't remember: 1 kΩ = 1000 Ω and 1 mA = 0.001 A (or 1×10^{-3} *A).*

9. * A 45kΩ resistor has 65mA flowing thru it. How much power does it dissipate?

1A. 0volts
1B 6V
1C. Increase
1D: 12Ω
1E. 0.5A
1F. Same for all
1H. 0.5A (only 1 path for e's to flow)
1L. 3V

2C: same (aren't they in series?)
2F: 3A (24/8)
2H: 3A
2I: 9V
2K: 27W
3: P = W/t
5: watts = J/sec or Nm/sec
6A: 0.875watts
6C: mult by 120 sec = 105 joules
7A: $P = I^2R$ 7B: $P = V^2/R$
8A: have to use $P = V^2/R$, since if V increases, so will I. So x4
8B: use $P = I^2R$ = (x4)(x2) = x8