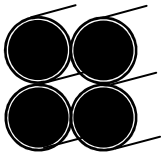
Due Mon., Jan 9

2011-12 PreAP Circuits 7

1. Series or parallel?

   A. ___ Only one path for the electricity to flow.
   B. ___ * Paths are dependent on each other (*one affects the other*).
   C. ___ How your house is wired.
   D. ___ Paths are independent of each other.
   E. ___ If one light turns off, the others stay on.
   F. ___ If you turn off one light, all the lights turn off.
   G. ___ Has more than one path for the electricity to flow.
   H. ___ * Two devices have the same current.
   I. ___ * Two devices have the same voltage.

2. The holes at the right show four pipes.



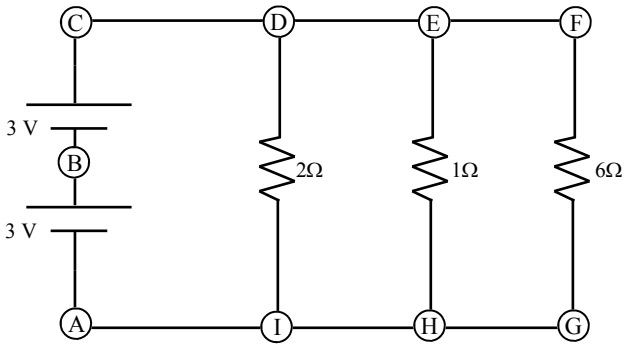
   A. * Are the four holes in parallel or series, as shown?
   B. Together is there a bigger hole or a smaller hole for water to flow thru?
   C. Each pipe can allow 2 gal/sec, how much can flow thru them together?
   D. So, is the combined resistance greater or less than one pipe?

   This is why 4 equal resistors in parallel are the same as a single resistor that is 1/4th as big.

3. Five 100Ω resistors are placed in a circuit. What is the total resistance if they are:
   A. * place in series? B. * place in parallel?

But what about a large and small resistor together in parallel? It is true that electricity (like water) takes the path of least resistance. Compare the two pipes at the left. MOST of the water goes thru the larger pipe (the smaller resistor), but some still flows thru the smaller pipe (the larger resistor). Together the two pipe still are equivalent to a smaller resistor. This is why resistors in parallel decrease the total resistance.

4. The circuit at the right will help us understand the relationship between resistors and current in parallel resistors. Remember to label the diagram (including units) as you go.

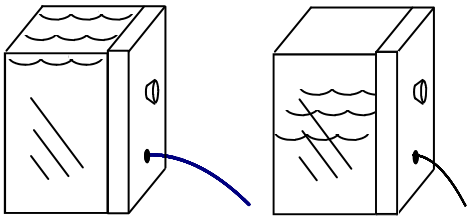


   A. What is the voltage at C, relative to A?
   B. * What is the change of voltage across a wire?
   C. * So, what is the voltage at D, E, and F?
   D. * And what is the voltage at I, H, and G?

   So, the voltage at the top of the circuit is 6V and the voltage at the bottom of the circuit is 0V. Which means that each resistor has the same voltage across it: 6V. So, you have the resistance and voltage for each branch.

   E. * Calculate the current flowing each resistor.
   F. Which resistor has the most current flowing thru it?
   G. Why?
   H. * How does the current flowing thru the 2Ω compare with the 6Ω resistor?
   I. * Is the current directly or inversely proportional to resistance?
   J. * What is the total current (I_{total}) flowing thru the circuit (and provided by the battery)?
   K. * So, now that you have V_{total} and I_{total}, use V = IR to calculate R_{total}.

   And, just as we said before, notice that when resistors are placed in parallel, the total current goes up and the total resistance goes down. If the car and roadway analogy works better for you, think of the 1Ω as a freeway and the 6Ω like a small road. Most cars will take the freeway, but a few cars will take the little road.



So, what is this voltage thing anyway? A Volt = Joules/Coulomb, or energy per charge. 2V give 2 J for every coulomb. 12V gives 12J to every coulomb. More voltage gives more energy per electron.

For water, voltage is like pressure from a water tank. On the left side, the water height and pressure (voltage) is great, so the water flow is greater and goes farther. One the right side, the water height and pressure (voltage) is low, so the water flow is less and goes a shorter distance.

The corked hole has less voltage on the left, and negative voltage on the right.

1B: Series 1H: S 1I: P
2A: parallel 3A: 500Ω 3B: 100/5 = 20Ω
4B: 0 volts (no change over a wire) 4C: 6V
4D: 0V 4E: $I_{2\Omega} = 6V/2\Omega = 3A$. $I_{1\Omega} = 6A$ Do the other yourself.
4H: 3 times as much
4I: Inversely
4J: 10A