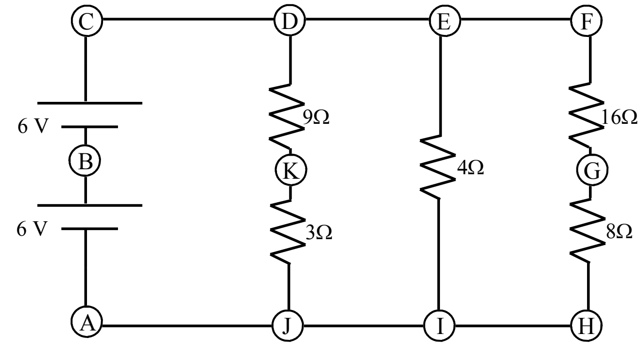
Due Wed., Jan 18

2011-12 PreAP Circuits 8 (*Key on back*)

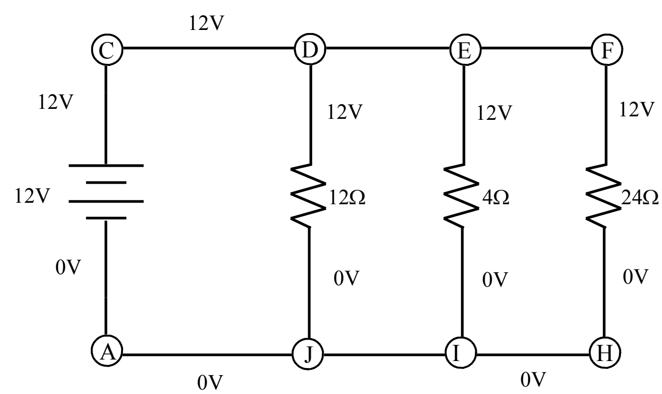
Now that I have walked you thru both series circuits (see "Circuits 4") and parallel circuits (see "Circuits 7") it is time to walk you thru a slightly more advanced combination circuit. Follow along and it will be relatively painless. MAKE SURE TO LABEL THE DIAGRAM AS YOU GO, INCLUDING UNITS!



1. First step is to lay the ground work by totaling up voltages and easy resistor combinations.
   A. Since we like to work with all positive numbers we call the voltage at letter A:
   B. What is the voltage at letter C relative to letter A?
   C. Since wires don't change voltage (called "equipotential surfaces"), what is the voltage at letters D, E and F?
   D. Then what must be the voltage at letters J, I, and H?
   E. What is the equivalent resistance from D to J?
   F. What is the equivalent resistance from F to H?

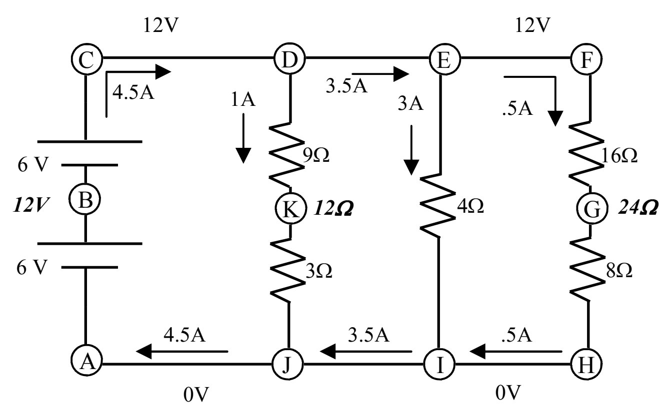
Now comes the new step, which simplifies things. We are going to redraw the circuit, including the simplifications we just figured out. (In the future you will do this mentally for circuits this easy.) And because you have never done this before, I will redraw it for you. Notice the new symbol for the combined battery. This is the symbol for a multi-cell battery like a 9-volt battery or a 12-volt car battery, which have multiple batteries connected in series inside.

2. Since you have the voltages across each resistor, calculate and label the current flowing thru each resistor (each branch).
3. Using arrows, show the flow of current thru the circuit, making sure to add currents at junctions that join (like I) and subtract current at junctions that split (like D).
4. Now you should be able to answer the following questions.
   A. What is the current flowing from I to J?
   B. What is the total current flowing thru the batteries?
   C. Using the total voltage and total current, calculate the total resistance of the circuit.



Then we go back to our original circuit and include all of our new found knowledge about the circuit. This allows us to answer additional questions.

5. Calculate the voltage used by the 9Ω resistor.
6. Calculate the voltage left at point K.
7. Calculate the power used by the 9Ω resistor.
8. How would the total current change if the 4Ω resistor was removed completely?
9. How would the current flowing thru the 16Ω resistor change if the 9Ω resistor was replaced by a wire?
10. Calculate the total power produced by the batteries.



And there you have it: your first combination circuit.

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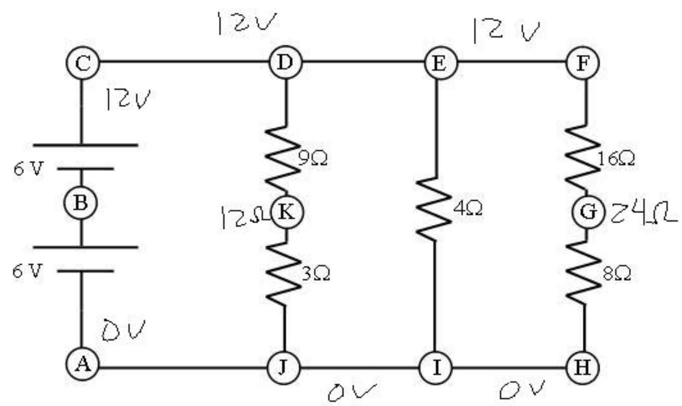
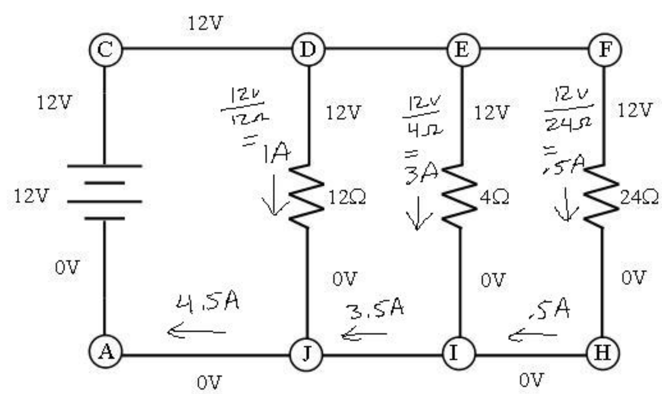


1. First step is to lay the ground work by totaling up voltages and easy resistor combinations.
   A. Since we like to work with all positive numbers we call the voltage at letter A: 0V
   B. What is the voltage at letter C relative to letter A? 12V
   C. Since wires don't change voltage (called "equipotential surfaces"), what is the voltage at letters D, E and F? 12V
   D. Then what must be the voltage at letters J, I, and H? 0V
   E. What is the equivalent resistance from D to J? 12Ω
   F. What is the equivalent resistance from F to H? 24Ω

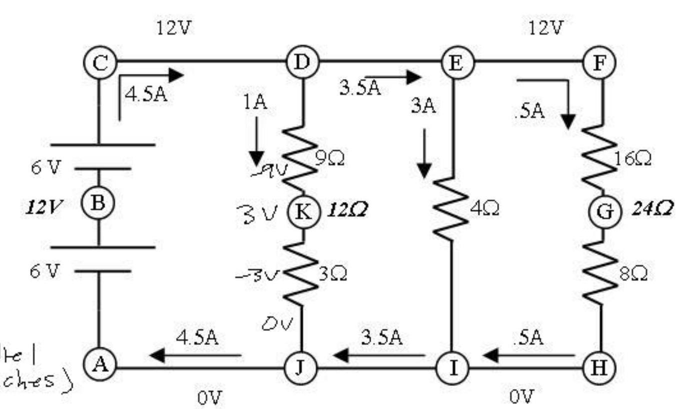
Now comes the new step, which simplifies things. We are going to redraw the circuit, including the simplifications we just figured out. (In the future you will do this mentally for circuits this easy.) And because you have never done this before, I will redraw it for you. Notice the new symbol for the combined battery. This is the symbol for a multi-cell battery like a 9-volt battery or a 12-volt car battery, which have multiple batteries connected in series inside.

2. Since you have the voltages across each resistor, calculate and label the current flowing thru each resistor (each branch). see diagram



3. Using arrows, show the flow of current thru the circuit, making sure to add currents at junctions that join (like I) and subtract current at junctions that split (like D). see diagram
4. Now you should be able to answer the following questions.
   A. What is the current flowing from I to J? 3+.5 = 3.5A
   B. What is the total current flowing thru the batteries? 4.5A
   C. Using the total voltage and total current, calculate the total resistance of the circuit.
   $V=IR$, so $R=\frac{V}{I}=\frac{12}{4.5}=2.67\,\Omega$ (which is less than 4Ω)

Then we go back to our original circuit and include all of our new found knowledge about the circuit. This allows us to answer additional questions.



5. Calculate the voltage used by the 9Ω resistor.
   $V=IR=1(9)=9V$
6. Calculate the voltage left at point K.
   $12-9=3V$
7. Calculate the power used by the 9Ω resistor.
   $P=VI=9(1)=9W$
8. How would the total current change if the 4Ω resistor was removed completely? less total current (1.5A)
9. How would the current flowing thru the 16Ω resistor change if the 9Ω resistor was replaced by a wire? No effect (parallel branches)
10. Calculate the total power produced by the batteries.
    $P=VI=12(4.5)=54\,W$

And there you have it: your first combination circuit.