2013 PreAP Circuits 9
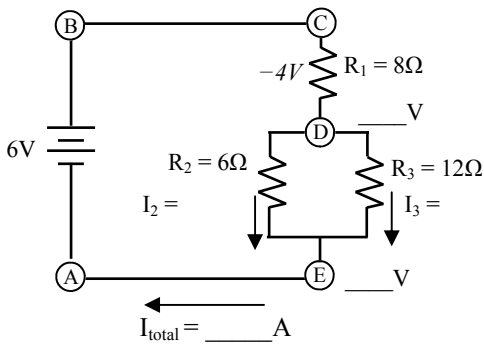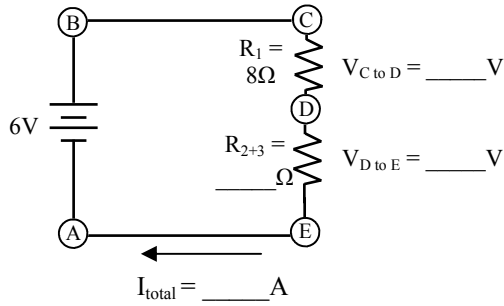
1. Let me know teach you how to work with different combination circuits.

   A. * It should be obvious that the 6Ω and 12Ω are in parallel and that their combination is in series with the 8Ω resistor. So begin with the easiest simplification: find the equivalent resistance of the parallel resistors. Label this on the diagram "Redraw 1".

   B. Turns out that 1 redraw will be enough for this circuit. How many redraws do you do? Until you have a simple series circuit, which we now have.

   C. * On Redraw 1, calculate the total current.

   D. * Calculate the voltage used by the two resistors, as if this was just another normal series circuit.

   E. Now that you have this information we need to return to our previous diagram. On your own, you would just work backwards, but to make this clearer I will give the original diagram for you.

   F. Here's the BIG DEAL: The voltage you just found used by R_{2+3} ($V_{D\,to\,E}$) is the voltage on the first diagram from D to E.

   G. What is the voltage at point E? (Label it.)

   H. * So what MUST BE the voltage at point D?

   I. So label the voltage at point D on the diagram.

   J. * Since R_2 and R_3 are in parallel they must have the same:

   K. You now have enough information to calculate the current flowing thru R_2 and R_3. Do so and label it on the diagram.

   To practice this process, start with the initial diagram, cover up the steps and find the current in all the resistors.

Redraw 1

$V_{C\,to\,D}$ = _____ V

$V_{D\,to\,E}$ = _____ V

I_{total} = _____ A

I_{total} = _____ A

2. And now it is your turn. In the following combination circuit, find the current flowing thru the 3Ω resistor. You should redraw at least once, maybe twice. I will give the answer on the back and the voltage from A to B. To help you out, I made the circuit so that the total current comes out to a whole number. You're welcome.
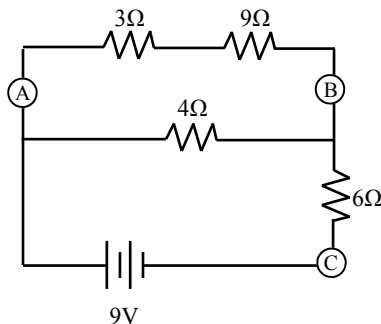
3. Copper or wood

   A. ___ Is a better conductor?   C. ___ Has higher conductivity?
   B. ___ Is a better insulator?   D. ___ Has poorer resistivity?

4. For each of the following quantities, give the units.

   A. Current is in: C. Resistance is in: E. Power is in:
   B. Voltage is in: D. * Charge is in: F. Work is in:

5. Break up the following units into more basic forms (see last hw for help):

   A. Joules breaks into: C. * Ampheres (amps) break into:
   B. Watts break into: D. * Volts break into:

Why we use "r" for distance.
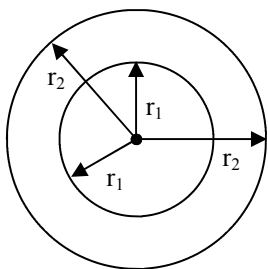
$k_C = 9{\times}10^9\,\mathrm{Nm^2/C^2}$

$$\vec{F} = k_c\,\frac{|q_1 q_2|}{r^2}$$
Electric Force (N)

$$\vec{E} = k_c\,\frac{|q_1|}{r^2}$$
Electric Field (N/C)

$$V = k_c\,\frac{q_1}{r}$$
Voltage (V or J/C)

$$PE = k_c\,\frac{q_1 q_2}{r}$$
Electric PE (J)

We usually use d, x, or y for distance, but for electrostatic equations (and gravity) we use "r". x and y can be negative; r, however, cannot. Think of r as the radial distance, like the radius of a circle. r "radiates" outward in all directions from a point in space. Just like you can't have a negative radius, r cannot be negative.
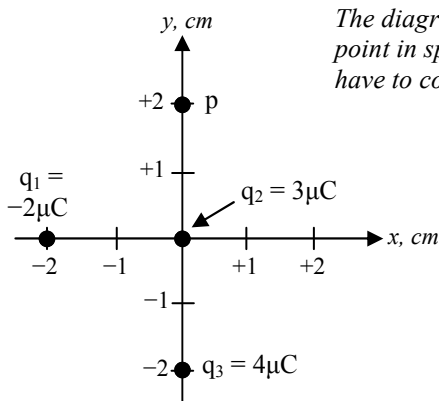
The diagram at the left shows three point charges (charges so small that they are at a single point in space): q_1, q_2, q_3. Notice that the distance given are in centimeters, so you will have to convert them to standard units (meters). And remember that $3\mu C = 3{\times}10^{-6}C$, etc.

6. Calculate the electric force between q_1 and q_2.

7. *Calculate the electrical potential energy between q_2 and q_3.

8. *Calculate the magnitude of the electric field due to q_2 at point p.

Q1A: $1/6 + 1/12 = 1/Rt$ $Rt = 4\Omega$ Q1C: $6V/12\Omega = 0.5A$ Q1D: $V = IR = 0.5(4) = 2V$
Q1H: $0V$ at E $+ 2V = 2V$ at D   Q1J: voltage
Q2: Total current $= 1A$ Total R from A to B $= 3\Omega$ Voltage from A to B $= 3V$
Q4D: [C] (coulombs)
Q5C: [C/sec]   5D: [J/C]
Q7: 5.4 J (remember "r" can't be negative, so r = 0.02 m
Q8: 6.75E7 N/C (r = 0.02m because point P is 2 cm away from q_2.