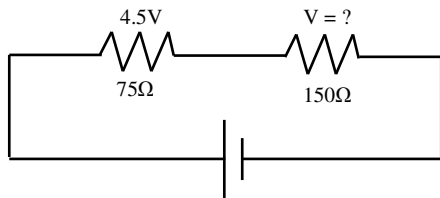
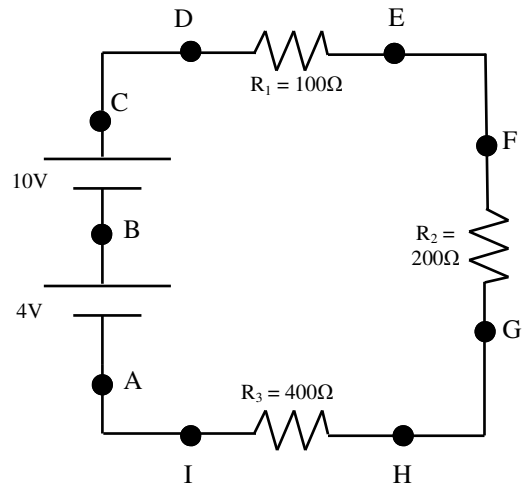


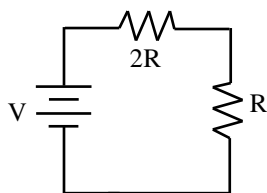
PreAP Circuits 5

1. After working the circuit at the right (*meaning do all your work on the diagram first*), answer the following.

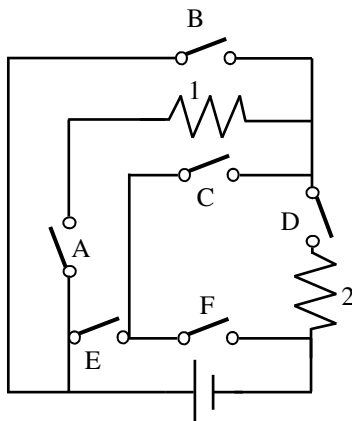
- * Calculate the current flowing thru the circuit.
- How much current is flowing thru the 100Ω resistor?
- * How much voltage is used by the 100Ω resistor?
- * How much power is used by the 100Ω resistor?
- Calculate how much voltage is left at point E.
- * On the diagram, calculate the voltage used by the other two resistors.
- How does the voltage drop across R_1 compare with R_2 ?
- How does the resistance of R_1 compare with R_2 ?
- How does the voltage drop across R_2 compare with R_3 ?
- How does the resistance of R_2 compare with R_3 ?
- Using the V_{total} and I_{total} , calculate P_{total} for the whole circuit.
- If one of the resistors was replaced by a wire, how would the current change (increase, decrease, stay the same)?
- If a third battery was added to the circuit, how would the current change?



- Now, using what you learned from parts G-J above (and the lab),
 - How much voltage is used by the 150Ω ?
 - What is the voltage of the battery?
 - * How much current is flowing (in mA)?



- The new symbol you see in the diagram at the left is a multicell battery (like a 9V), which is made up of a number of smaller single cell batteries (like a 1.5V). Let's say its total voltage is V .
 - Which resistor takes the most voltage?
 - What is the total resistance?
 - In variables, what is the current in the circuit?
 - How does the voltage used by the $2R$ compare with R ?
 - In variables, what is the voltage used by the $2R$ resistor?



In the diagram at the left you will need to decide which switches to close to allow different resistors to have current flowing thru them. This is like maze games—just follow the path. But here are the rules: 1) you must start at the + side of the battery (big side) and get back to the - side; 2) you can't go backwards along the same line (since current only flows from high V to low V); 3) you can't make a short-circuit (make a circuit without a resistor in it).

- So, which switches need to be closed to allow:
 - * only resistor 1 to have current in it?
 - only resistor 2 to have current thru it?
 - to by-pass both resistors?
 - for electricity to go thru both resistors?

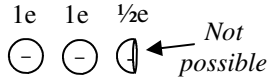
So what are these electrons flowing thru the circuit? Let's learn about charge (positives and negatives).

Electric Charge The unit of charge is a fundamental quantity.

Electron Charge
 $1 \text{ electron} = -1.6 \times 10^{-19} \text{ C}$

The charge of a proton is the same as an electron, only positive:
1 proton = $+1.6 \times 10^{-19} \text{ C}$.

The smallest units of charge are the proton and the electron. You cannot have part of an electron, because it would lose its negative charge. Therefore, you cannot have less than $-1.602 \times 10^{-19} \text{ C}$ of charge and any amount of charge must be multiples of this number. You can have 12 or 13 electrons, but not 12.2 or 12.5 electrons!



Electric charge is quantized, meaning the amount of charge must always be in multiples of e . You can never have part of an electron.

Ex: What is the charge of an object that gains 1.2×10^8 electrons?

Do a conversion :

$$\left(\frac{1.2 \times 10^8 \cancel{e}}{1} \right) \left(\frac{-1.6 \times 10^{-19} \text{ C}}{1 \cancel{e}} \right) = -1.92 \times 10^{-11} \text{ C}$$

Ex: How many electrons are gained or lost if an object has a charge of $4.6 \mu\text{C}$ (microcoulombs)?

$$\left(\frac{4.6 \times 10^{-6} \text{ C}}{1} \right) \left(\frac{1 \cancel{e}}{-1.6 \times 10^{-19} \text{ C}} \right) = -2.875 \times 10^{-13} \text{ e}$$

The negative means it lost e 's (+ object).

5. * What is the charge of 15 electrons?
6. * Given the charge of 1.12×10^{-18} coulombs. How many electrons were gained or lost?
7. What is the charge of 8 protons?
8. Why can't you have a charge of 1.5 electrons?

- 1A: 0.02 A (which is 20 mA)
 1C: $V = IR = .02(100) = 2\text{V}$
 1D: $P = VI$ or $I^2R = 0.04\text{W}$
 1F: $V_2 = 4\text{V}$ $V_3 = 8\text{V}$
 2C: You have the voltage and resistance of one resistor, calculate the current. And since it is a series circuit, isn't that the total?
 4A: Switches: A, C, and D. You can't have D on or R2 comes on. You can't have E on or it will bypass R1 completely with a short circuit.
 5: $-24 \times 10^{-19} \text{ C}$ or $-2.4 \times 10^{-18} \text{ C}$ coulombs
 6: 7 electrons lost