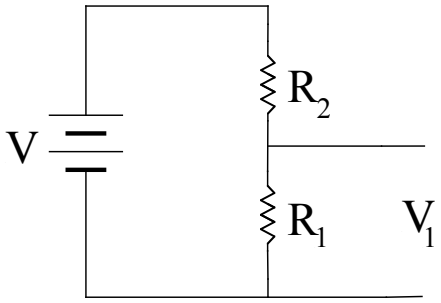
Physics 517/617 Homework 1 (Due June 29th)

Reading: Practical Electronics for Inventors: p 1-80, 159-164.

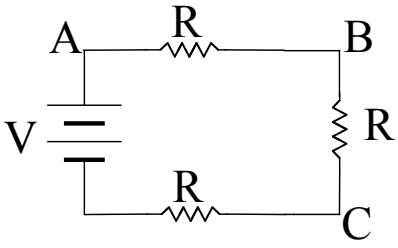
1) The circuit shown to the right is a "voltage divider."



a) Show that the voltage, V, from the supply splits across the two resistors according to the fraction of the total resistance in each segment. In particular: $V_1 = \frac{R_1}{R_1 + R_2} V$.

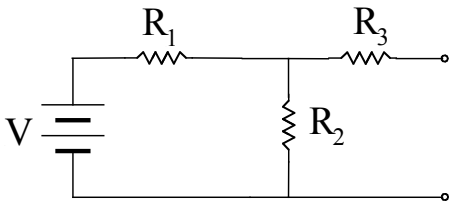
b) This circuit is a convenient way to generate voltages for use in a circuit. For example, suppose we had a device that required 2 V and had a 10 V supply. Then we could generate 2 V by picking the $R_2 : R_1$ in the ratio $8:2$. If we model the device by a "load" resistance, R_L, and consider placing it across the terminals at V_1, what condition must R_L satisfy so as not to significantly change V_1?

2) For the circuit at the right, calculate the voltage at points A, B, and C, if (a) A is grounded, (b) B is grounded, (c) C is grounded.

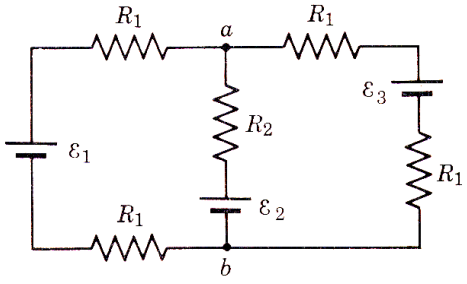


3) An automobile battery has a terminal voltage of 12.8 V with no load. When the starter motor (which draws 90 A) is being turned over by the battery, the terminal voltage drops to 11 V. Calculate the internal resistance of the battery.

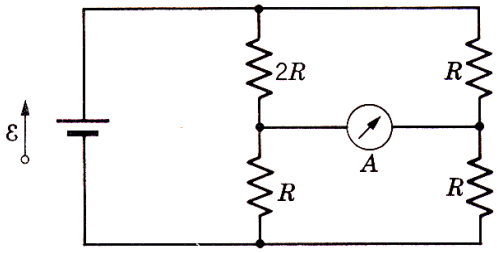
4) Calculate the Thevenin equivalent circuit:



5) (*Fundamentals of Physics*, *Haliday&Resnick 9-45)* Calculate the current through each voltage sources assuming R_1=1.0Ω, R_2=2.0Ω, ε_1=2.0V, ε_2=4.0V, and ε_3=4.0V. Indicate which batteries are charging and which are discharging.



6) (*Fundamentals of Physics*, *Haliday&Resnick 9-47P)* What current, in terms of ε and R, does the ammeter below read? Indicate the current direction on the diagram. (Assume that A has zero resistance.)



7) Review of complex math complex math. In electronics, the square root of -1 is written as "*j*" --- the symbol "*i*" is reserved for currents. Complex numbers can be written either in terms of their real and imaginary parts or the magnitude and phase angle of a "phasor:"

$$X + jY = R \cdot e^{j\theta}$$

Find the magnitude and phase angles for the following pure numbers:

a) 3 b) 2*j* c) -4 d) -4*j*

and the following complex numbers:

e) 2+4*j* f) 2 - 4*j* e) -2+4*j* f) -2 – 4*j*.