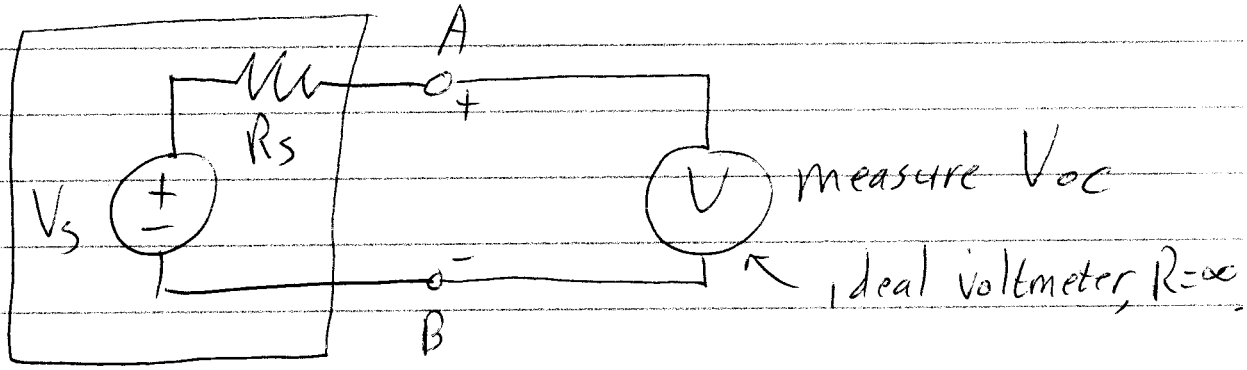
~~209~~

A brief aside to set up the lab for this week:

If I give you a "black box" that has 2 terminals sticking out, and I tell you that it has inside it a V source and a resistor in series, like this:



~~How useful you~~ What measurements could you make to find out V_s and R_s?

You can easily put a Voltmeter between A + B and measure what is called the "Open-Circuit Voltage". (Draw.)

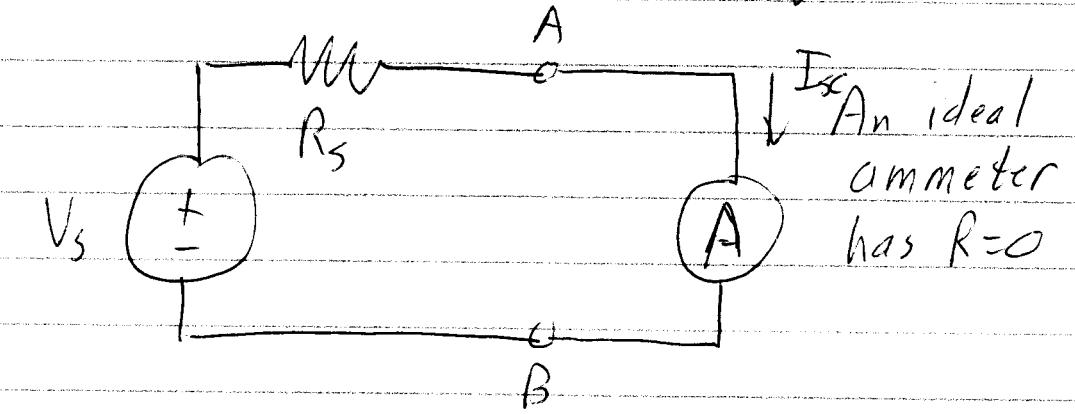
Since $R = \infty$, no current flows through the voltmeter, therefore no current flows through R_s, so the voltage drop across the internal resistor is zero:

$$+ \cancel{R_s I}^{\,0} + V_{oc} - V_s = 0$$

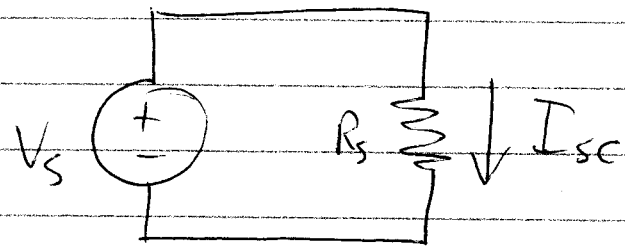
$$V_{oc} = V_s$$

So the internal voltage source is equal to the open-circuit voltage (we often use them interchangeably.)

Now it gets tricky. IN THEORY I could put a short circuit between A + B and measure the current that flows through it:



This is the same as



By Ohm's Law $I_{sc} = \frac{V_s}{R_s}$

or $R_s = \frac{V_s}{I_{sc}} = \frac{V_{oc}}{I_{sc}}$

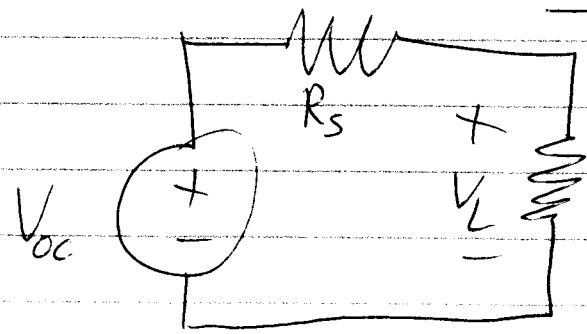
Now, I say IN THEORY because for real power supplies I_{sc} could be hundreds of amps, and it could damage the power supply. Many power supplies are "short circuit protected" and shutoff. Others have circuit breakers or fuses. And, most importantly, ALL AMMETERS HAVE Fuses in them to prevent damage. If you ever try to measure a current & get zero, it is because the fuse is blown.

We will do this in the lab this week because I have set things up carefully, but you should NEVER do it in real life!!! Do not do this at home!!!

How then? One way is to put R's across A+B and measure the voltage across it. Figure out R_s through Voltage Division.

An extension is to Measure V_{oc}, then start with a large R_L and measure V_L, putting smaller + smaller R_L's on until $V_L = \frac{1}{2} V_{oc}$

then $R_s = R_L$



$V_L = \frac{1}{2} V_{oc}$ when $R_L = R_s$