Capacitors in circuits

Purpose: To investigate the function of capacitors. To understand the function of voltmeters and ammeters and their limitations.

Materials: Power Supply, Voltmeter, Ammeter, 1 lightbulb and holder, 6 leads, 4 banana clips, capacitor

Make a hypothesis about the function of a real voltmeter. What should its resistance be and do you think you will find this to be true? Make a similar hypothesis about a real ammeter

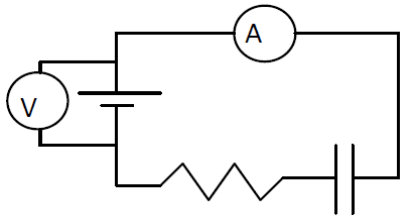
Part A
Connect the voltmeter to the power supply. Use the course adjust to get the voltage to nearly 15V, then the fine adjust knob to get an exact potential difference of 15.00V. Do not use the meter on the power supply. It is not accurate.
While watching the voltmeter, turn off the power supply. Describe what happens.
Connect the 1000μF capacitor in parallel to the power supply and voltmeter and allow it to charge for a few seconds. Make sure you properly connect the positive and negative sides of the capacitor. If you are uncertain ask for help.
While watching the voltmeter, turn off the power supply. Describe the difference between with and without the capacitor.
Recharge the capacitor. While watching the voltmeter, quickly disconnect the circuit from the power supply. Is there any change in the behavior of the voltmeter compared to simply turning off the power supply?
Recharge the capacitor. Without discharging it, disconnect it from the circuit. Disconnect the voltmeter from the power supply. Connect the capacitor directly to the voltmeter. Does it start with 15V of potential difference? What happens to the stored charge?
What can you conclude about the function of the power supply when it is turned off? What can you conclude about the resistance of a voltmeter? Is either of these different than you expect?

Part B
Now we will discharge the capacitor through an ammeter. Leave your circuit so that the voltmeter reads the voltage supplied and the capacitor is charged by that voltage.
Quickly disconnect the charged capacitor from the circuit, and connect it to the ammeter at the 50mA range. Make sure you connect the positively charged side to the positive terminal of the meter.
Repeat the above step using the 500mA range.
Draw the circuit you created. If a capacitor can function like a battery, why would this be a bad way to connect a circuit?
Describe what actually happened. What does this tell you about the ammeter or the wires?
Repeat the above steps to determine what the maximum current is.
Charge the capacitor for approximately 30 seconds. Connect it through the ammeter (as above) and estimate the maximum current in the circuit. Estimate it after a 5s charge. Charge the capacitor for as small a time as possible by just barely touching the leads to the power supply and estimate the maximum current. What does this tell you about the time required to charge this specific capacitor?

Part C

Turn off the power supply and connect the circuit as shown:

(use a lightbulb for the resistor)



While watching the ammeter, turn on the power supply. If you can't see the current, use a smaller range on the ammeter, or reverse the ammeter's positive and negative terminals to ensure you have connected them to the proper sides. When the current has settled, turn off the power supply and carefully watch what happens. Describe the two processes.
Reverse the terminals of the ammeter so it reads a positive current when discharging through the circuit. Repeat the above step. Estimate the maximum current in the circuit after the power supply is turned off (and the capacitor is supplying the current.) What is different about the current while charging and discharging?

Extension Questions:
Why would a capacitor be placed in parallel with a car battery which is used to power a car stereo?
How are the lab meters different from ideal meters?