PHYS 1444 - Lecture 7
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1 Meters

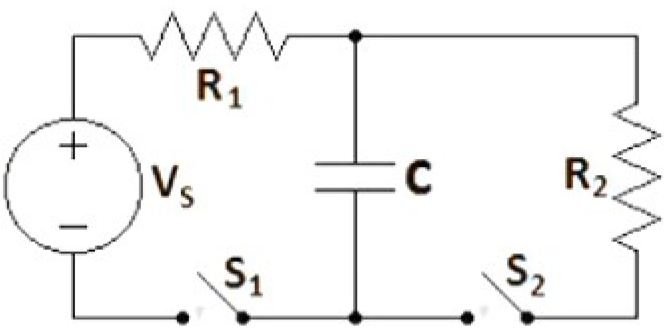
An **ammeter** measures current (amps). It is placed in series so that current flows through it. It needs to be very low resistance so it doesn't affect the current. Do not place in parallel.

A **voltmeter** measures voltage. They are placed in parallel. They are very high resistance so little current flows through it.

Multimeters can measure voltage or current, and often resistance.

2 RC circuits

RC means "resistor and capacitor". There are also switches.



Now we're dealing with time. Remember Ohm's law ($V = IR$) and the equation for capacitance ($Q = CV$)

He proceeds to do some fucky shit with differential equations, but gets to a result which we can just read off the formula sheet. Here's the long and short of it:

$$\tau(\text{time constant}) = RC$$

$$V_C = V_{SS}\left(1 - e^{\frac{-t}{RC}}\right)$$

$$Q_C = Q_{SS}\left(1 - e^{\frac{-t}{RC}}\right)$$

$$I_C = I_0 e^{\frac{-t}{RC}}$$

The time constant is how long it takes for the charge to fall off by a factor of $\frac{1}{e}$, which is basically dropping to a third. Waiting about 10 time constant will pretty much bring you to steady state.

Example

- A 12 V source is connected in series with an uncharged 36 μF capacitor, a 30 $k\Omega$ resistor, and an open switch. (a) how long after the switch is thrown will it take for the voltage across the capacitor to reach 6 V? (b) what is the voltage across the capacitor when the current is 100 μA?

  We can solve the V_C equation above for time t

  $$t = -RC \ln\left(1 - \frac{V_C}{V_{SS}}\right) = 0.749\ s$$

  We don't need anything complicated for part b, just Ohm's law. $V = IR$

  $$V_C = V_S - IR = 12\ V - (100 \times 10^{-6}\ A)(30 \times 10^3\ \Omega) = 9\ V$$