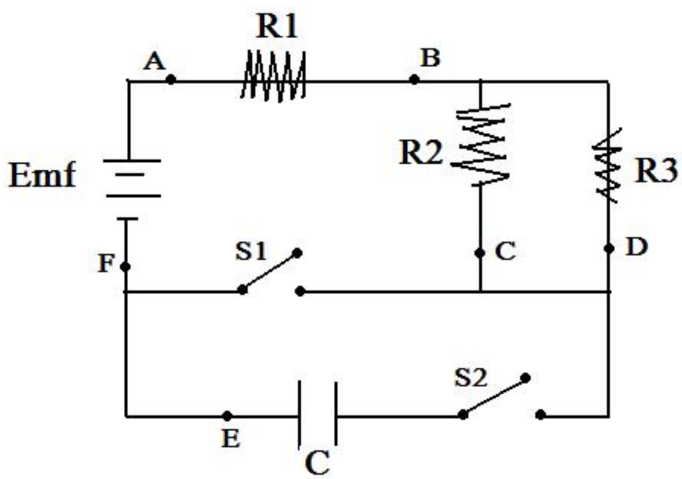
Measuring Along The (Conducting) Path

From Pole to Pole

Physics 204, Yaverbaum

John Jay College of Criminal Justice, the CUNY



In the circuit shown above:

Emf = a battery supplying 15 V.
C = a capacitor of 30 μF.
R_1 = a resistor of 300 Ω.
R_2 = a resistor of 200 Ω.
R_3 = a resistor of 100 Ω.

S_1 is a switch. Initially, it is CLOSED: current can travel through the loop containing the switch.

S_2 is a switch. Initially, it is OPEN: current CANNOT travel through the loop containing the switch.

Points **A** – **F** are just labeled locations in the wire.

a. Now the experiment begins: Assume that S_1 is CLOSED and S_2 is OPEN. It might help you to alter S_1 in the diagram.

Find I, the electric current, at each of the following locations.

A)

B)

C)

D)

E)

F)

b. Continue to assume that S_1 is CLOSED and S_2 is OPEN. Also assume that the circuit is grounded at point **F**. That is, assume that V = **0** Volts at point **F**.

Find V, the electric potential, at each of the following points.

A)

B)

C)

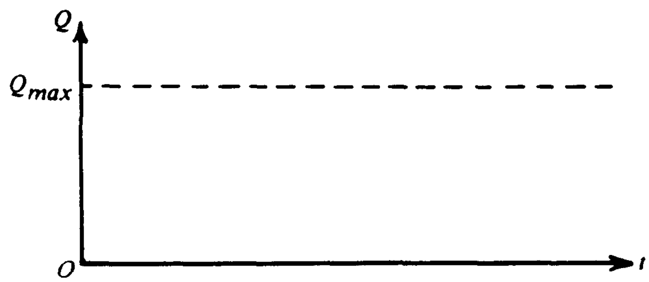
D)

E)

NOW ASSUME that S_1 is OPEN and S_2 is CLOSED. It might help you to indicate this new reality on the diagram.

c. Using Energy conservation, Ohm's Law and the definition of capacitance, show the rate at which charge builds up in the capacitor as a function of time. That is, derive Q as a function of t—where Emf, R_{123} and C are constants. R_{123} stands for the total, "equivalent" resistance provided by R_1, R_2 and R_3 in this circuit.

d. On your own copy of the axes below, neatly sketch the function you derived in (c), above. To the right of the axes, you MUST INDICATE the value of Q(max) in terms of Emf, C and/or R_{123} (3 pts).



e. In ***seconds***, determine a ***NUMERICAL VALUE*** for the amount of time required for the current in this circuit to decay to $\frac{2}{3}$ of its original value.
That is: Determine t such that $I = \frac{2I_0}{3}$ (5 pts).