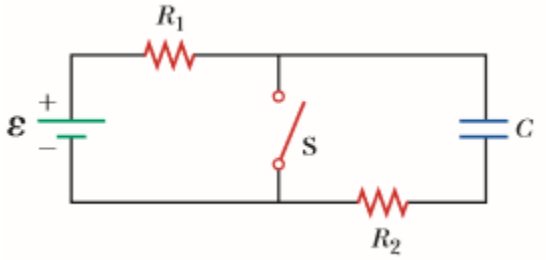
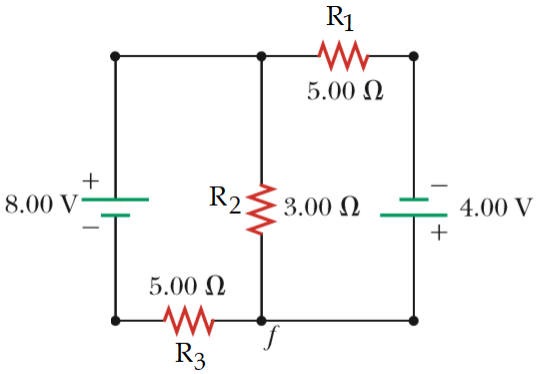
Review Problems for Unit 7 Test (Ch 26,27,28)

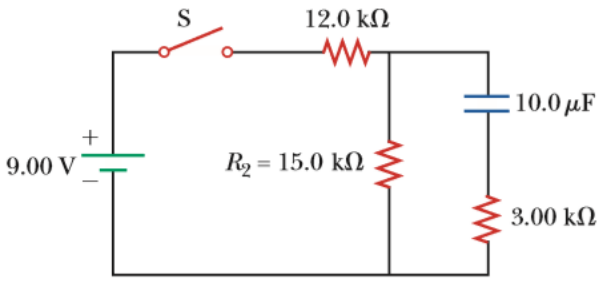
1. Consider the circuit in the figure, where the switch S has been open for a long time. It is then suddenly closed. Determine the time constant (a) before the switch is closed and (b) after the switch is closed. (c) Let the switch be closed at t = 0. Derive an expression for the current in the switch as a function of time.

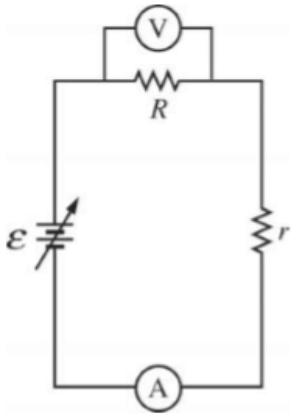


2. Find the direction and magnitude of the current on all the resistors.



3. Consider the circuits in the figure. Suppose the switch has been closed for a time interval sufficiently long for the capacitor to become fully charged. Find
    a. the steady-state current in each resistor and
    b. the charge Q max on the capacitor.
    c. The switch is now opened at t = 0. Write an equation for the current in R_2 as a function of time and
    d. find the time interval required for the charge on the capacitor to fall to one-fifth its initial value.





The circuit shown above consists of a source of variable emf $\mathcal{E}$, an ideal ammeter A, an ideal voltmeter V, a resistor of resistance R, and a sample of wire with resistance r.

(a) How does the current through the wire sample compare with the current through the resistor R ?

_____ It is greater through R. _____ It is greater through the sample.

_____ It is the same through both. _____ It depends on the resistance of the sample.

Justify your answer.

(b) How does the potential difference across the wire sample compare with the potential difference across the resistor R ?

_____ It is greater across R. _____ It is greater across the sample.

_____ It is the same across both. _____ It depends on the resistance of the sample.

Justify your answer.

With the sample of wire in place, the emf of the source is set to a given value. The current through and potential difference across the resistor R are measured. This is repeated for several values of emf, and the data are recorded in the table below.

$\mathcal{E}$(V)	V_R(V)	I_R(A)		
0.250	0.179	0.162		
0.500	0.335	0.327		
0.750	0.520	0.490		
1.000	0.670	0.687		

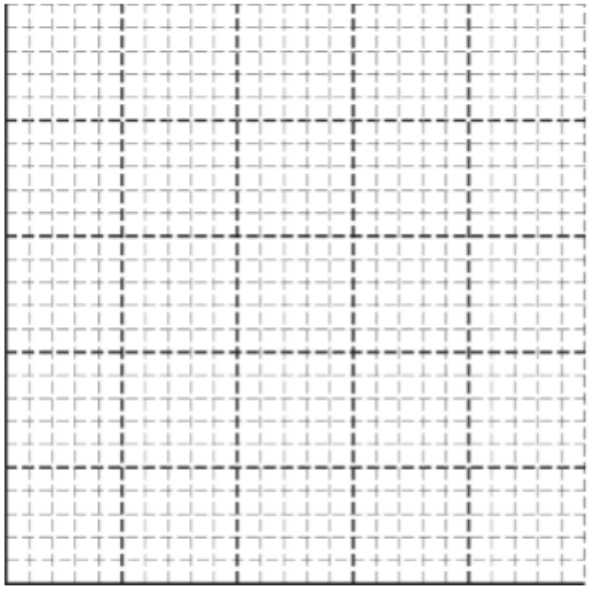
(c) Indicate below which quantities should be graphed to yield a straight line that could be used to calculate a numerical value for the resistance of the wire sample.

Horizontal axis: _____

Vertical axis: _____

You may use the remaining columns in the table above, as needed, to record any quantities that you indicated that are not given.

(d) On the grid below, plot the straight line data points from part (c). Clearly scale and label all axes, including units if appropriate. Draw a straight line that best represents the data.



(e) Use your straight line to calculate the value of the resistance of the wire sample.

(f) The wire sample has a length of 3.00 m and a radius of 1.00×10^{-3} m . Calculate the resistivity of the material from which the wire sample is made.

(g)

i. Suppose the ammeter used to collect these data was not ideal. Would the actual value of the resistance of the wire sample be greater than, less than, or equal to that calculated in part (e) ?

____ Greater than ____ Less than ____ Equal to

Justify your answer.

ii. If the ideal voltmeter is replaced by a voltmeter that is not ideal and the experiment is repeated, would the readings of the ideal ammeter be greater than, less than, or equal to those in the data chart before part (c) ?

____ Greater than ____ Less than ____ Equal to

Justify your answer.