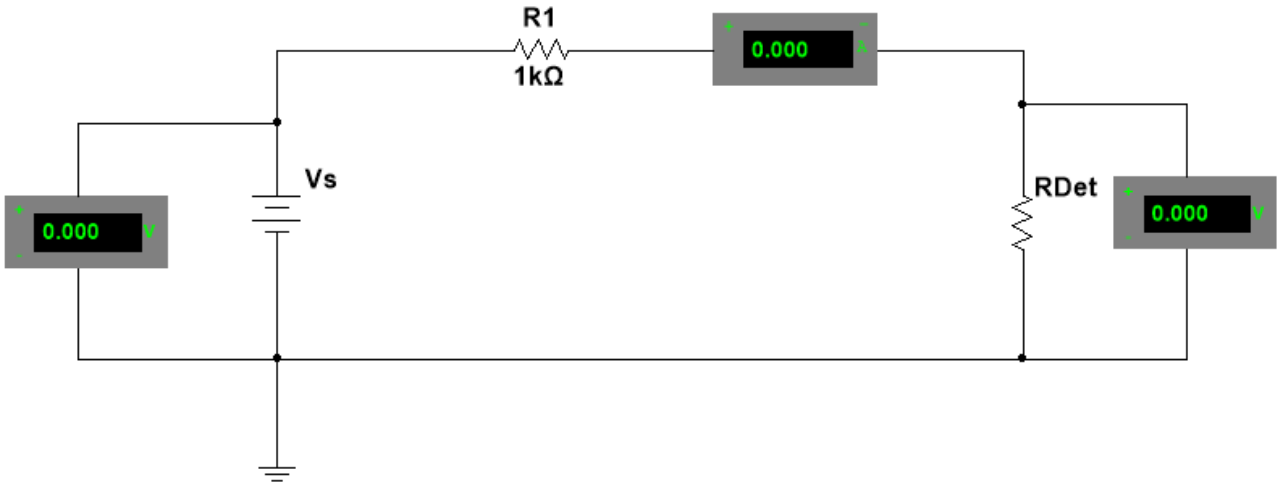
Power Transfers and Complex DC Circuits Lab Exercises

Experiment #1 – i – V Curve for a circuit component

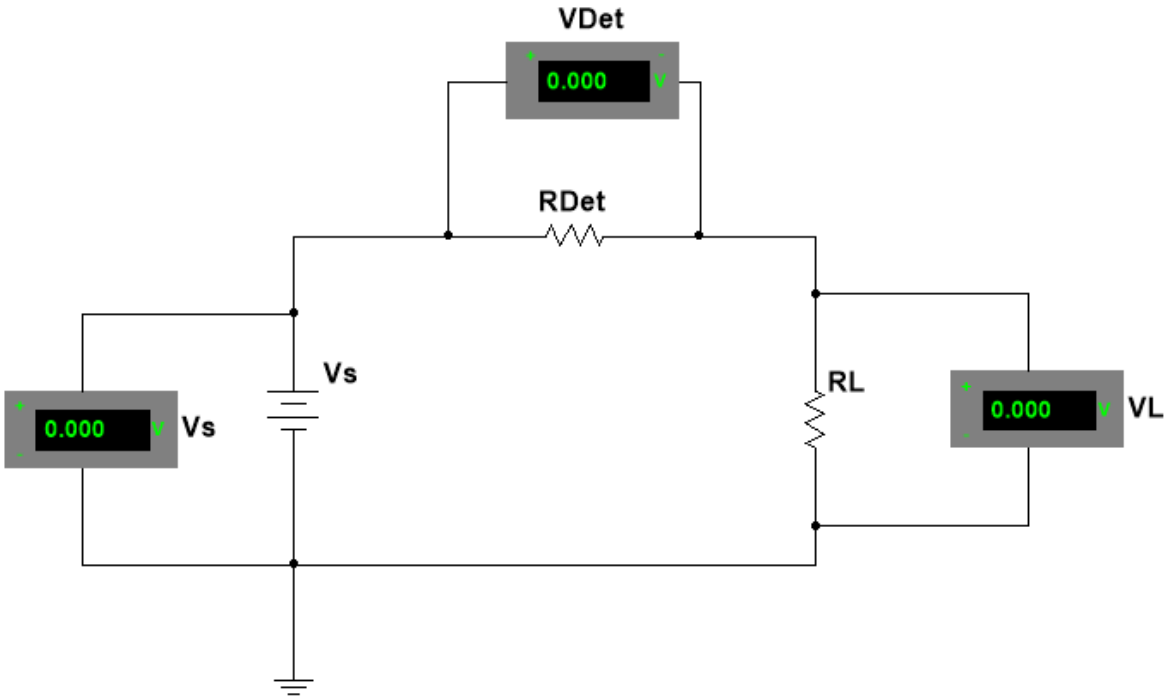
Set up the following circuit:



Use a 4700 Ω resistor for RDet. Vary Vs from about 2.50 to 20 V in steps of 0.5 V. Record i and V across RDet in MATLAB. Use MATLAB to create an i – V plot and find the best straight line. The reciprocal of the slope is your resistance RDet. Y-intercept is a measure of the error in your values. Include your m-file with command window output of slope, y-intercept, and actual resistance of RDet. Include in your plot raw data (markers only) and fitted line. Your legend should provide indication of raw data, fitted line, slope, y-intercept, and RDet value (include your units correctly, proper titles, axis labels, etc.).

Experiment #2 – Power Transfers

Set up the following circuit:



Use the 4700 Ω resistor from your i-V curve in part 1 as your RDet. Use the actual value you found for RDet not the nominal value of 4700 Ω.

Measure VDet and VL for two sets of measurements:

Measurements 1: Vs = 5.00 V and RL with the following values:

100Ω
$1{,}000\Omega$
$4{,}700\Omega$
$10{,}000\Omega$
$47{,}000\Omega$

Measurements 2: Vs = 10.00 V and RL with the same values.

Find current using the relation $i = \frac{VDet}{RDet}$ of course, using the RDet you found in experiment #1.

Next find the power dissipated in RL by $P = i(VL)$. Record all these values for MATLAB's use.

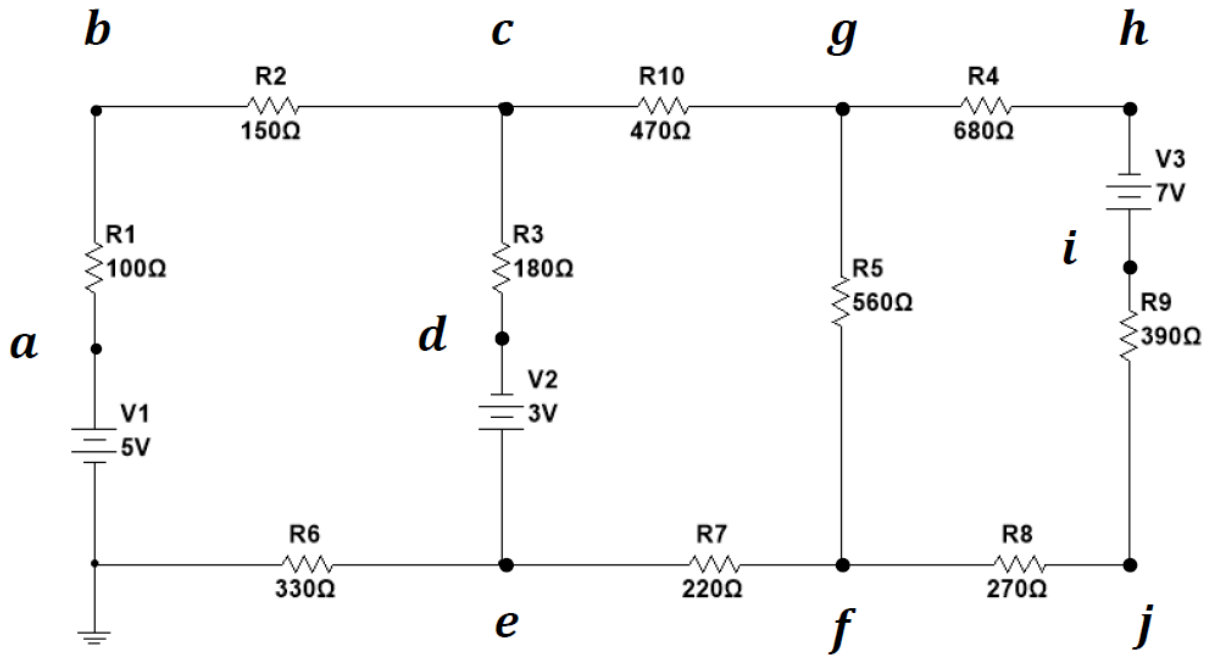
Now create a pair of theoretical plots for P vs. RL using $P = i^2RL$ this time use $i = \frac{Vs}{RDet+RL}$

Use RDet from Experiment #1. For the first theoretical plot, use $Vs = 5.00\ V$ and for the second plot use $Vs = 10.00\ V$. For both plots, vary RL from $100\ \Omega\ to\ 47{,}000\ \Omega\ in\ 100\ \Omega$ steps.

Finally plot the two theoretical plots on the same figure, use different line styles for each plot, and plot both sets of measurements from above use different symbols for the different voltages. Include a proper legend identifying each data, also the usual proper titles, axis labels, etc.

Experiment #3 – More Complex DC Circuit

Set up the following circuit:



Experimentally determine the node voltages at nodes (a) through (j) using multi-meters

Experimentally determine the currents in all parts of the circuit.

Use these experimentally determined values to determine the power supplied or absorbed by each component. Verify by direct calculation that the amount of power supplied is equal to the amount of power absorbed in the entire circuit.

Theoretically determine the equations for the node voltages and use MATLAB to solve for the theoretical value of the node voltages. Compare with the experimental values and provide a relative % error in each case.

Theoretically determine the equations for the mesh currents and use MATLAB to solve for the theoretical value of the mesh currents. Compare with the experimental values and provide a relative % error in each case.

Your work for this part should consist of proper tables to show the comparisons, sets of equations required for the theoretical calculations, the m-files that should have the command window results at the end in a comment block.