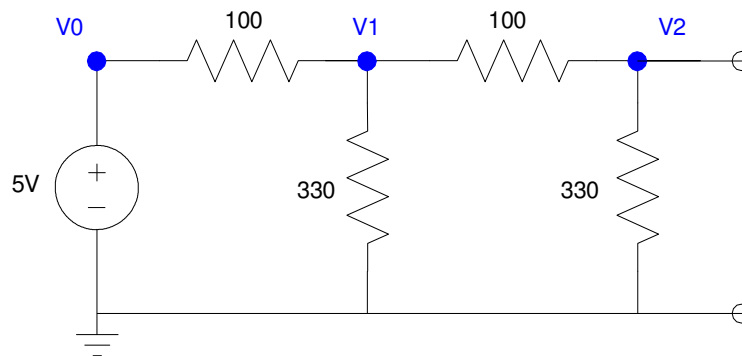


ECE 211: Homework #4

Thevenin, Superposition, Op-Amps.

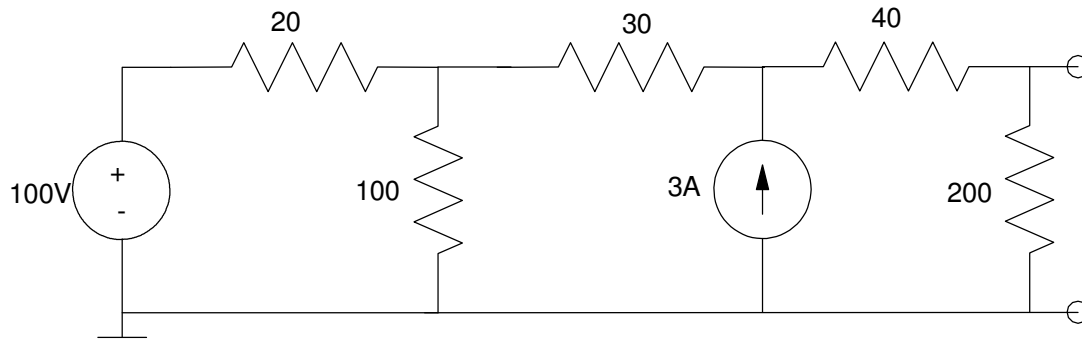
Thevenin Equivalents

1) Find the Thevenin equivalent for the following circuit by transforming between Thevenin and Norton equivalents:



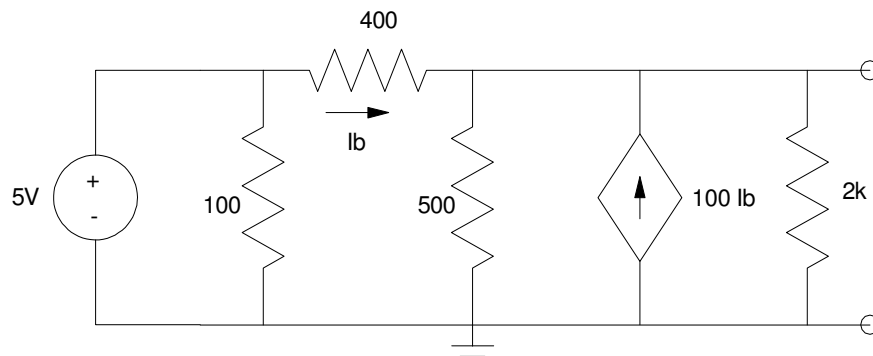
Problem 1

2) Find the Thevenin equivalent for the following circuit by transforming between Thevenin and Norton equivalents:



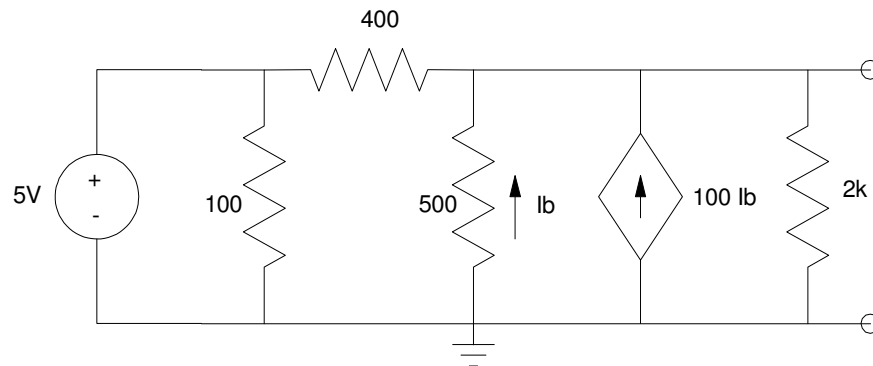
Problem 2

3) Find the Thevenin equivalent for the following circuit:



Problem 3

4) Find the Thevenin equivalent for the following circuit:

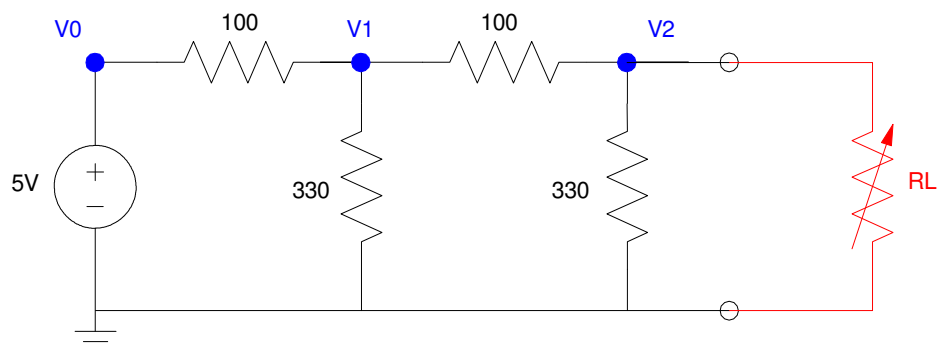


Problem 4

Maximum Power Transfer

5) Determine R_L so that the maximum power is delivered to the load (R_L)

- What is the voltage at V_2 for max power transfer?
- What is the maximum power you can deliver to R_L ?



Problem 5-7

Lab

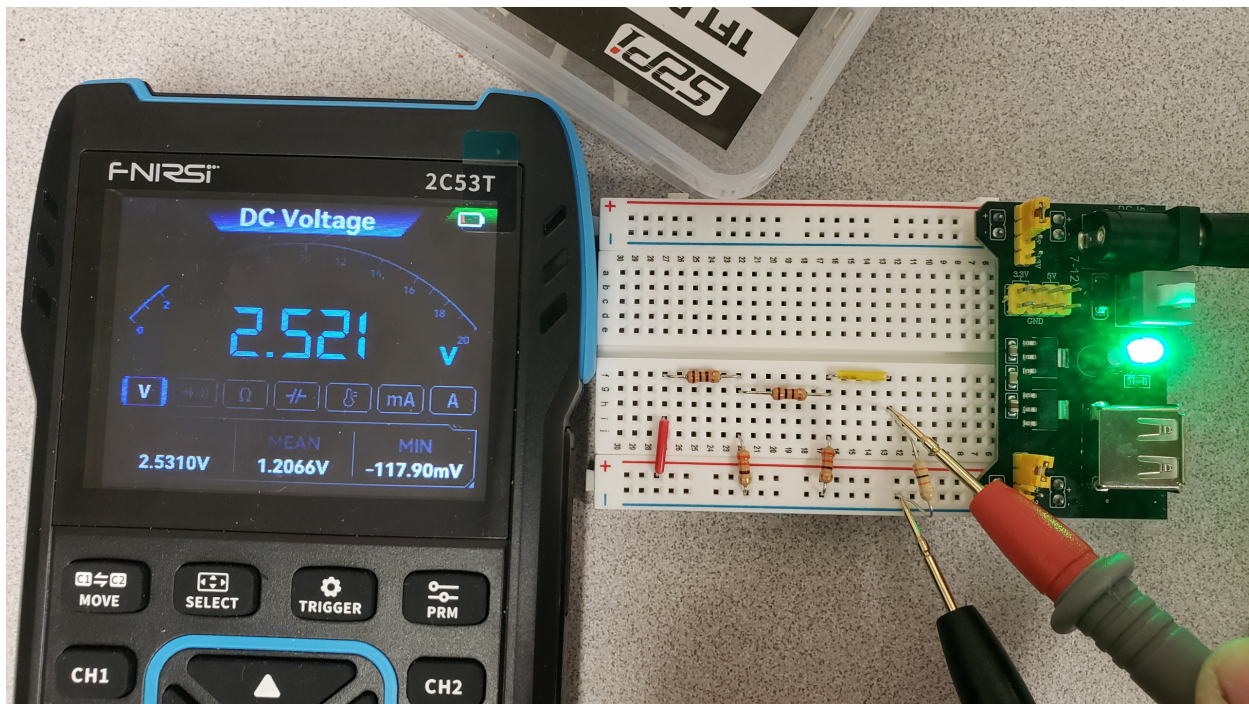
6) For the circuit of problem #5, measure the voltage and current to the load (R_L) as R_L varies from 0 Ohms to infinite Ohms.

- Calculate the power to the load (note: max power should match your answer in problem #5)

7) Plot the load line: V_L vs. I_L . From the load line, compute the Thevenin equivalent for this circuit

- This should match your calculations from problem #1

	V_L	I_L	Power
$R_L = 0$			
$R_L = 10$			
$R_L = 33$			
$R_L = 100$			
$R_L = 330$			
$R_L = \text{infinite}$			



Sample circuit for problem 6 & 7.

note for your circuit

- use the power (red) and ground (blue) rails for +5V and ground
- Keep your circuit neat (makes debugging easier)
- Vary the load resistor (30k in the photo) and measure the resulting voltage at R_L using your multimeter

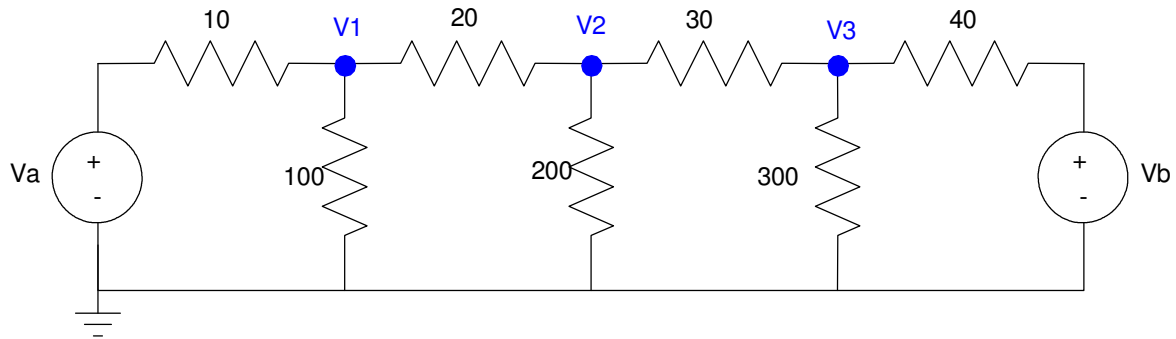
Superposition

8) Use Circuitlab to determine the voltage at Y assuming $V_a = 9V$, $V_b = 0V$.

9) Use Circuitlab to determine the voltage at Y assuming $V_a = 0V$, $V_b = 5V$.

10) Use Circuitlab to determine the voltage at Y assuming $V_a = 9V$, $V_b = 5V$

Does problem 9 + problem 10 = problem 11?



	Va	V1	V2	V3	Vb
$V_a = 9V$ $V_b = 0V$ (problem 8)	9.00 V				0.00 V
$V_a = 0V$ $V_b = 5V$ (problem 9)	0.00 V				5.00 V
$V_a = 9V$ $V_b = 5V$ (problem 10)	9.00 V				5.00 V

Op Amps

12) Write the voltage node equations for the following op-amp circuit. Assume non-ideal op-amps

- $R_{in} = 1M \text{ Ohms}$
- $R_{out} = 100 \text{ Ohms}$
- $\text{Gain} = 100,000$

