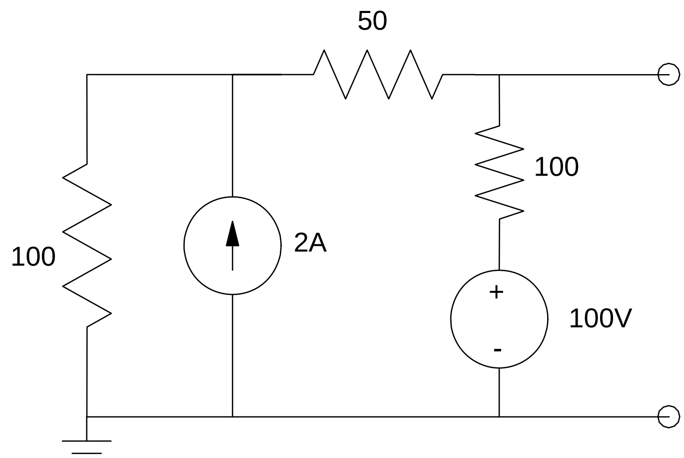
EE 206 Test #2d - Name ______________________

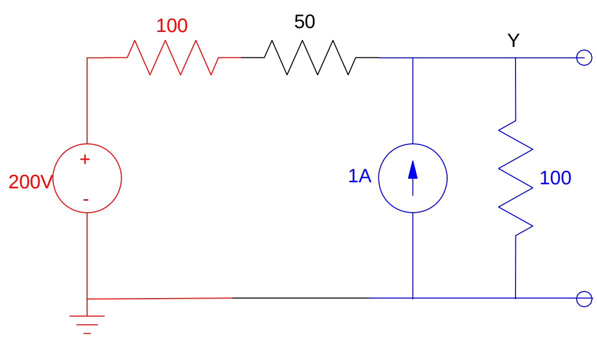
Thevenin Equivalents - Max Power Transfer - Superposition - Operational Amplifiers. April 30-May1, 2019

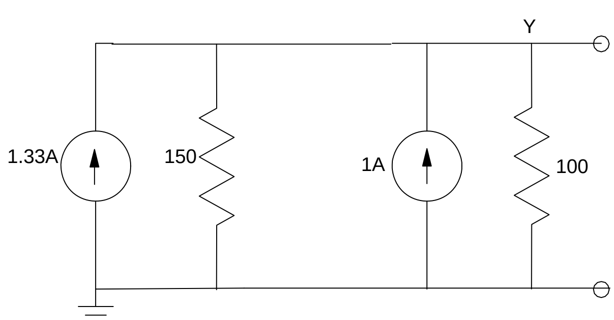
1) Determine the Thevenin equivalent for the following circuit.

Vth	Rth
140.0 V	**60.0 Ohms**



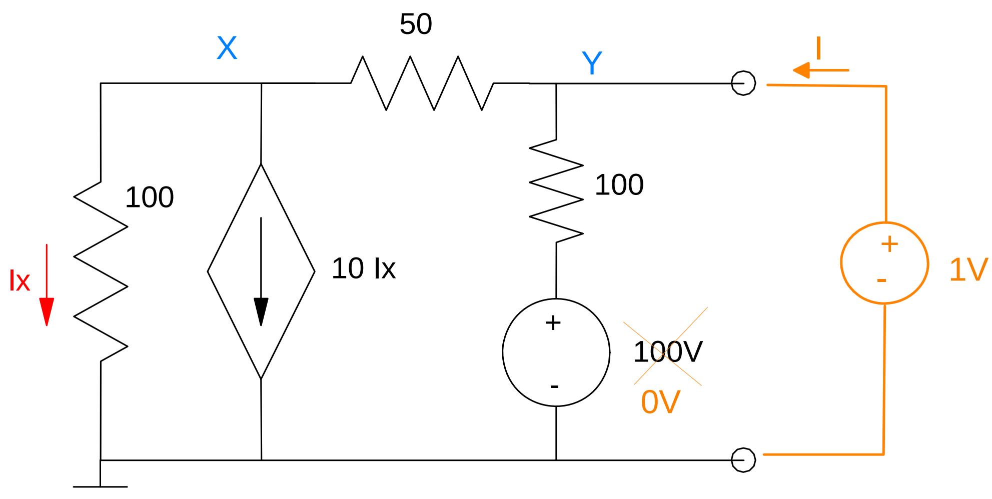
Convert Thevenin between Thevenin and Norton's





2)Determine the Thevenin equivalent for the following circuit

Vth	Rth
37.14 V	**37.14 Ohms**



Vth: Compute the voltage at X

$$\left(\frac{X}{100}\right) + 10\left(\frac{X}{100}\right) + \left(\frac{X-100}{150}\right) = 0 \qquad \Rightarrow X = 5.71V$$

Compute the voltage at Y (knowing that X is 5.71V)

$$\left(\frac{Y-5.71}{50}\right) + \left(\frac{Y-100}{100}\right) = 0 \qquad \Rightarrow Y - 37.14V$$

Rth: Turn off the sources (orange). Apply a 1V test voltage and comptue the current. To do this. solve for X

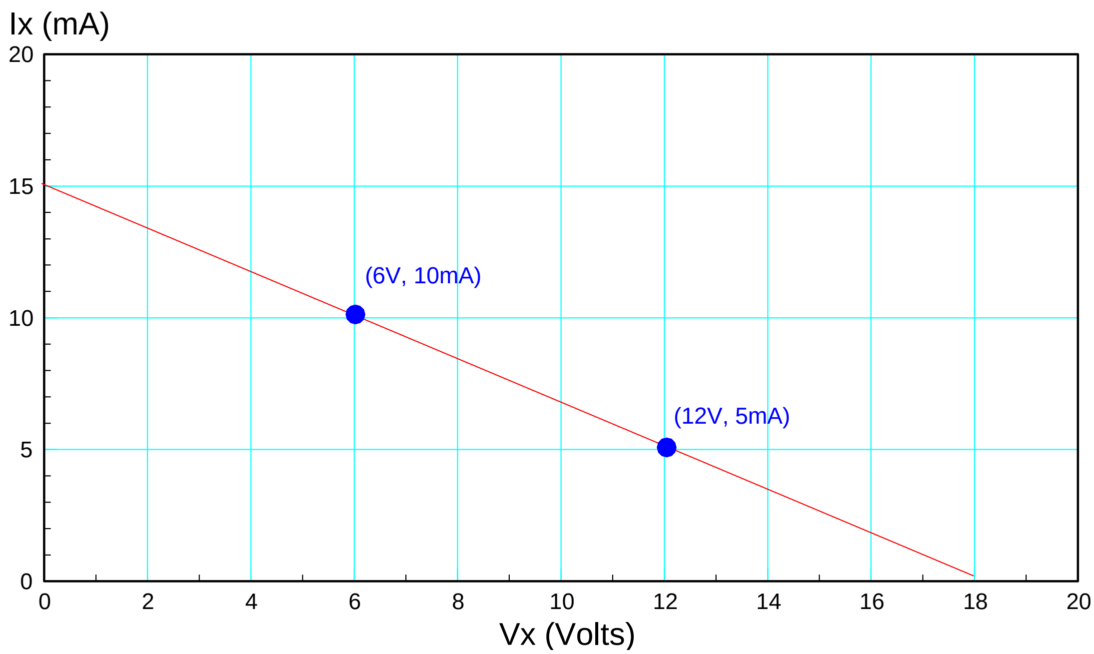
$$\left(\frac{X}{100}\right) + 10\left(\frac{X}{100}\right) + \left(\frac{X-1}{150}\right) = 0 \qquad \Rightarrow X = 0.1538V$$

$$I = \left(\frac{1}{100}\right) + \left(\frac{1-01538}{50}\right) = 0 \qquad \Rightarrow I = 26.92mA$$

$$R_{th} = \frac{1V}{26.92mA} = 37.14\Omega$$

3) The voltage and current for a circuit is measured as the resistance changes.

R	600 Ohms	2400 Ohms
V	6.0V	12.0 V
I	10.0 mA	5 mA



From this data, determine the Thevenin equivalend and the maximum power you can get out of this circuit.

Vth	Rth	R for maximum power transfer	Max power to R
18.0 V	**1200 Ohms**	**1200 Ohms**	**67.5 mW**

Vth is when the current is zero on the load line (18.0V)

$$R_{th} = \left(\frac{V_{open}}{I_{short}}\right) = \left(\frac{18V}{15mA}\right) = 1200\Omega$$

Max power transfer is when Rload = Rth = 1200 Ohms

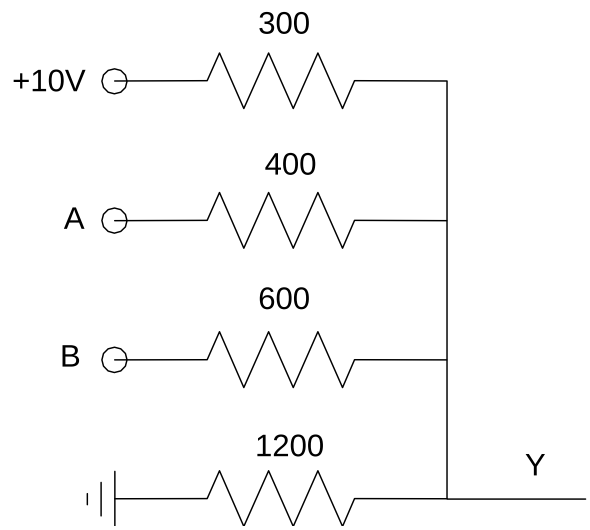
At this resistance, 1/2 of the voltage (9V) goes across the load. The power delivered is then

$$P = \frac{V^2}{R} = \frac{9^2}{1200} = 67.5mW$$

4) Find the voltage at Y as a function of A and B

$$Y = aA + bB + c$$

a	b	c
0.30	**0.20**	**4.00**



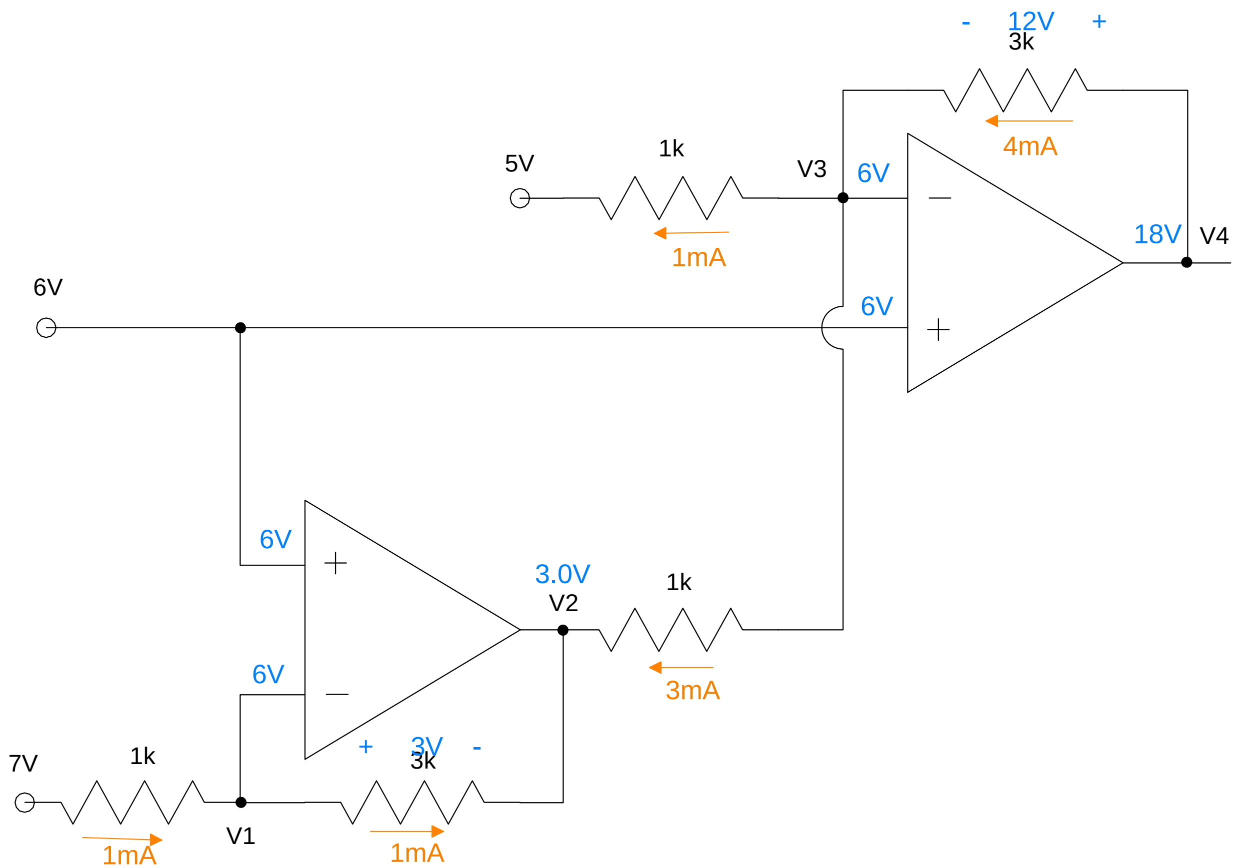
$$\left(\frac{Y-10}{300}\right) + \left(\frac{Y-A}{400}\right) + \left(\frac{Y-B}{600}\right) + \left(\frac{Y}{1200}\right) = 0$$

$$\left(\frac{1}{300} + \frac{1}{400} + \frac{1}{600} + \frac{1}{1200}\right)Y = \left(\frac{A}{400}\right) + \left(\frac{B}{600}\right) + \left(\frac{10}{300}\right)$$

$$Y = 0.3A + 0.2B + 4$$

5) Determine the votlages V1, V2, V3, V4. Assume ideal op-amps.

V1	V2	V3	V4
6V	**3V**	**6V**	**18V**



When you have negative feedback, Vp = Vm

- V1 = 6V
- V3 = 6V

If V1 = 6V, there is 1mA flowing through the 1k resistor. This also flows through the 3k resistor

- Creating a 3.0V drop
- Meaning V2 = V1 - 3V = 3V

If V2 = 3V, then

- There is 3mA flowing through the 1k resisor (from 6V to 3V)
- There is 1mA flowing through the 1k resistor (from 6V to 5V)
- Meaning there is 4mA flowing through the 3k resistor
- Meaning there is 12V across the 3k resistor
- Meaning that V4 is V3 + 12V