EE 206 Test #2d - Name ____________________

Thevenin Equivalents - Max Power Transfer - Superposition - Operational Amplifiers

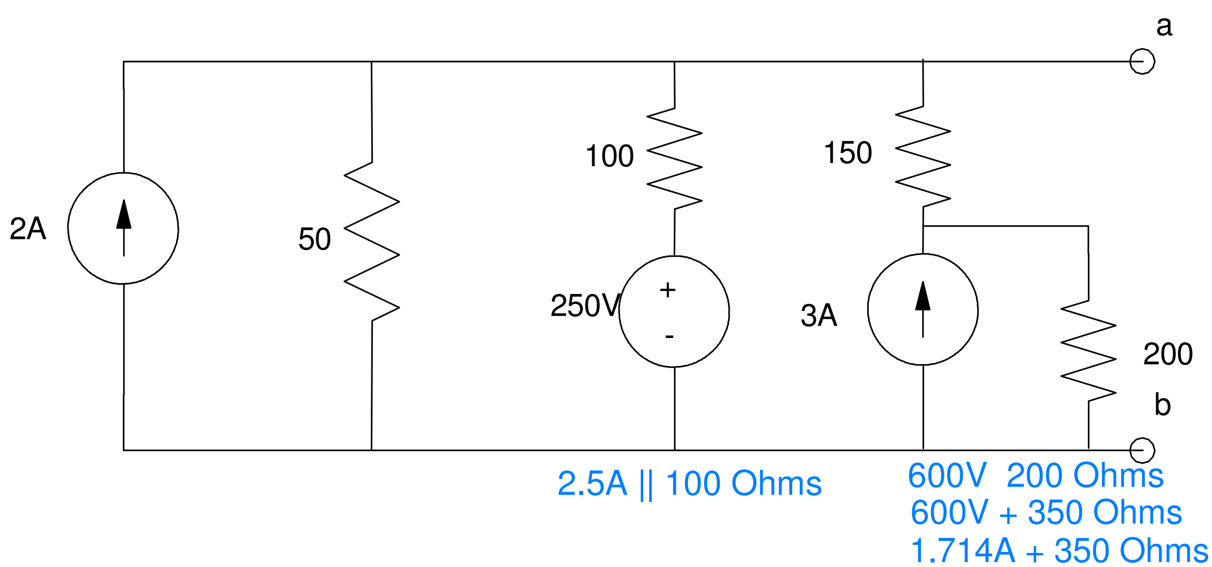
Due Thursday, May 7th at midnight

Open book, open notes, internet, calculators, matlab permitted. Individual effort only.

No aid given, received, or observed: (signature) ________________________

1) Determine the Thevenin equivalent for the following circuit.

Vth	Rth
189.13 V	**30.4347 Ohms**



Convert everything to a Norton. The net is

IN = 2A + 2.5A + 1.714A = 6.21428 A

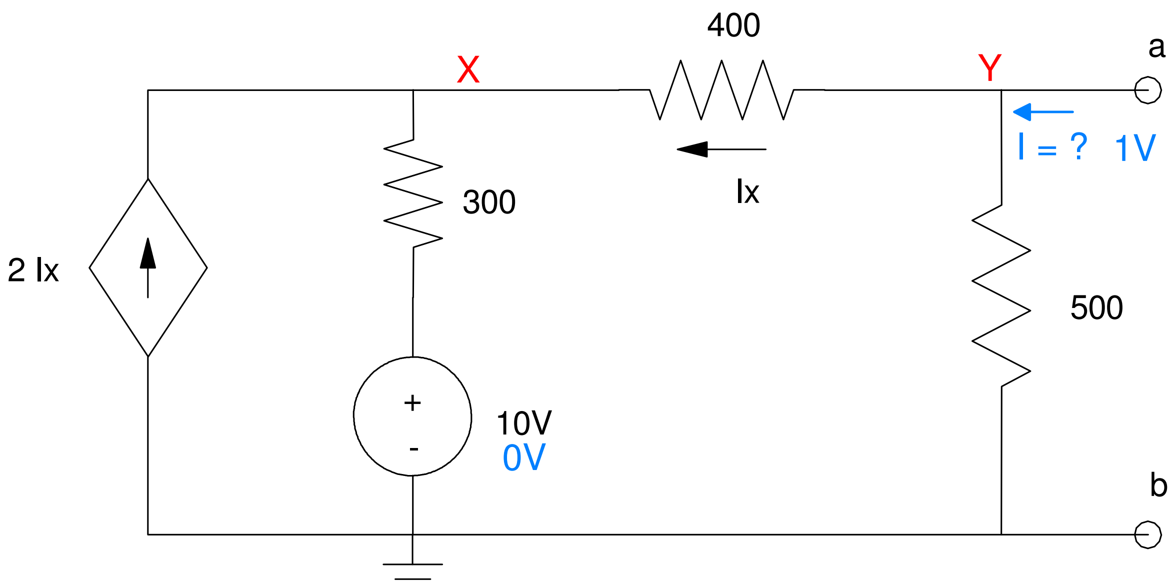
RN = 50 || 100 || 350 = 30.4347 Ohms

Convert back to a Thevenin

Vth = IN * RN = 189.13 V

2)Determine the Thevenin equivalent for the following circuit

Vth	Rth
2.7777 V	**361.1 Ohms**



Write the node equations

$$I_x = -\frac{X}{900}$$

$$-2I_x + \left(\frac{X-10}{300}\right) + \left(\frac{X}{900}\right) = 0$$

$$2\left(\frac{X}{900}\right) + \left(\frac{X-10}{300}\right) + \left(\frac{X}{900}\right) = 0$$

$$X = 5.00V$$

$$Y = \left(\frac{500}{500+400}\right)X = 2.777V$$

Rth: Turn off the sources. Apply 1V to the output. Measure the current

$$I_x = \left(\frac{1-X}{400}\right)$$

$$-2I_x + \left(\frac{X}{300}\right) + \left(\frac{X-1}{400}\right) = 0$$

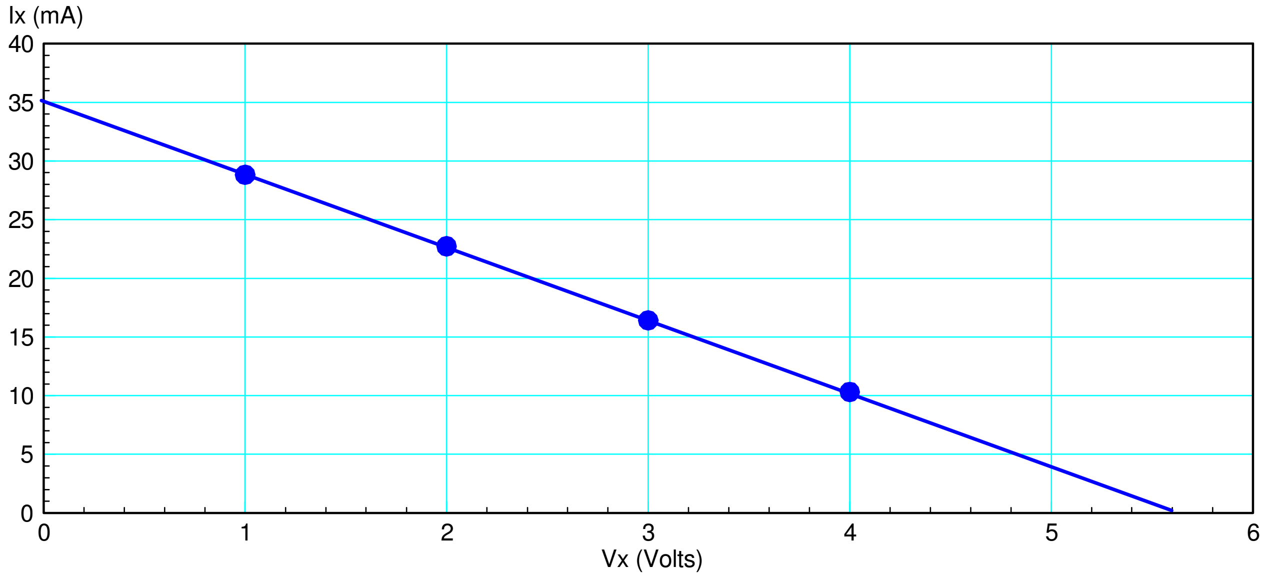
$$2\left(\frac{X-1}{400}\right) + \left(\frac{X}{300}\right) + \left(\frac{X-1}{400}\right) = 0$$

$$X = 0.6923V$$

$$I = \left(\frac{1}{500}\right) + \left(\frac{1-X}{400}\right) = 2.769mA$$ R = 1/I = 361.1 Ohms

3) A resistor (R) is placed across the output of a circuit. The voltage and current through the resistor is then measured:

R	34.7 Ohms	88.9 Ohms	184.6 Ohms	400 Ohms
V	1V	2V	3V	4V
I	28.8 mA	22.5 mA	16.3 mA	10.0 mA

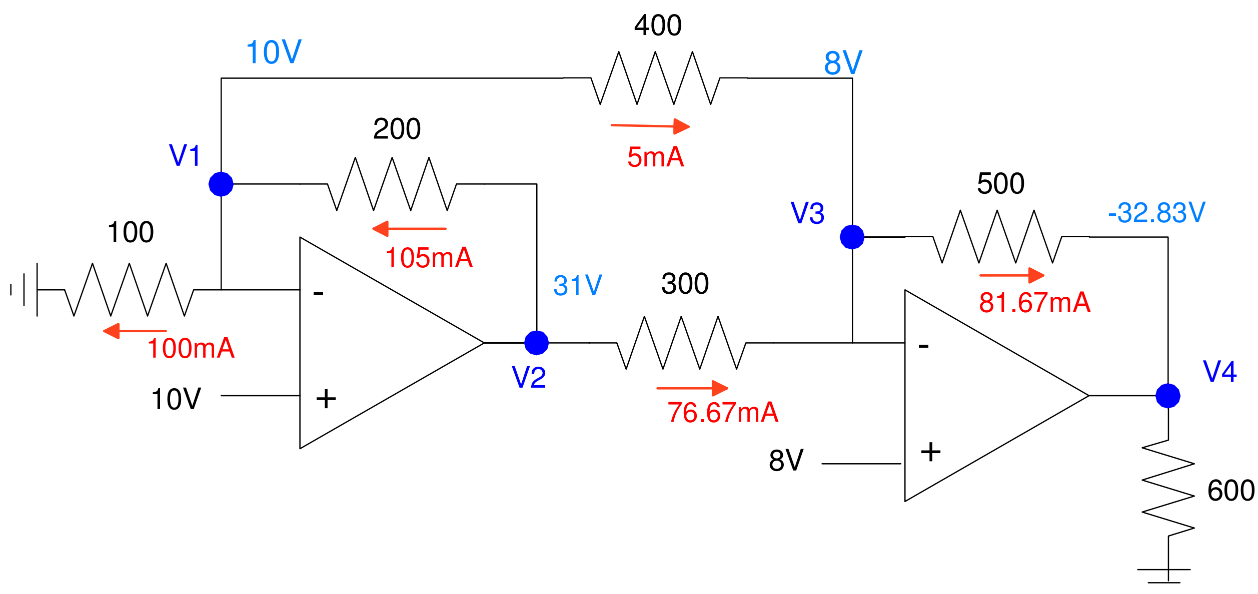


From this data, determine the Thevenin equivalend and the maximum power you can get out of this circuit.

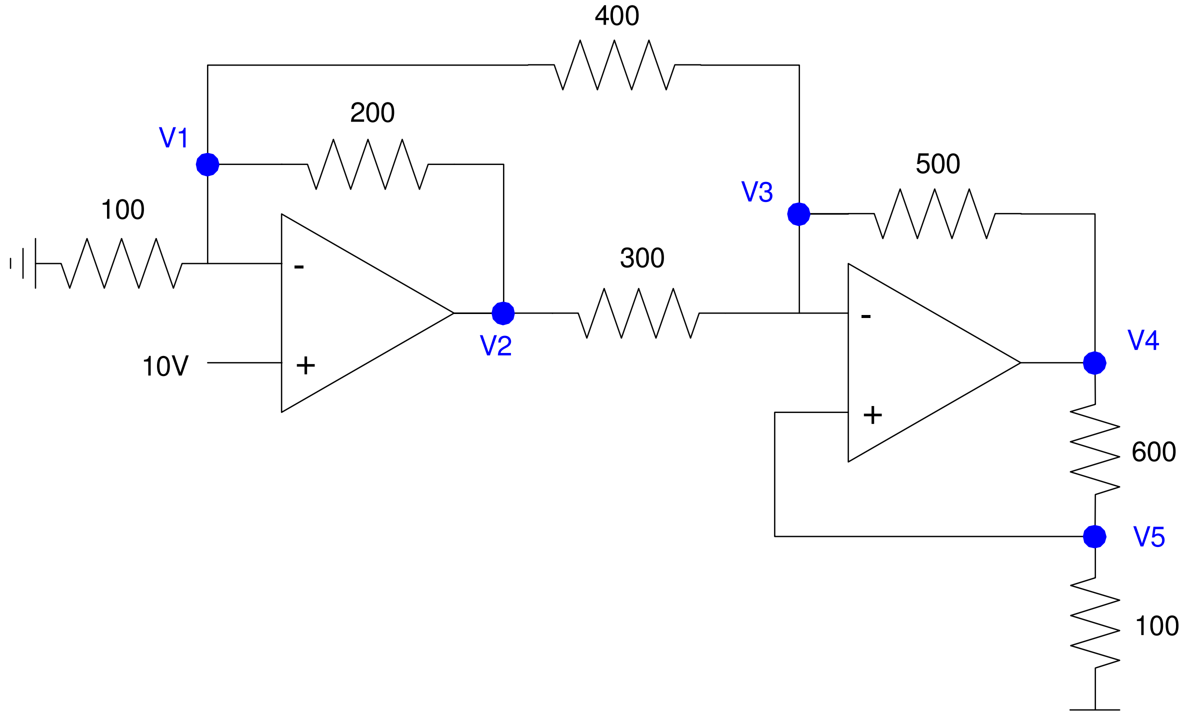
Vth	Rth	R for maximum power transfer	Max power to R
5.60 V	**160 Ohms**	**160 Ohms**	**49mW**

4) Determine the voltages for the following op-amp circuit. Assume ideal op-amps.

V1	V2	V3	V4
10 V	**31 V**	**8 V**	**-32.83 V**



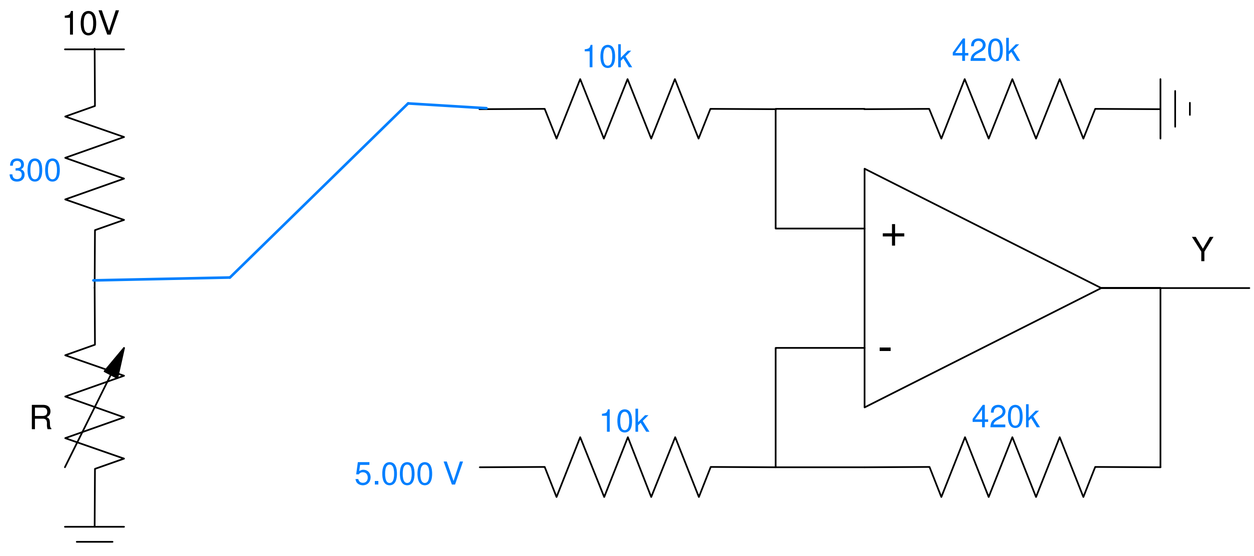
5) Write the voltage node equations for the following circuit. Assume ideal op-amps.



- $V_1 = 10$
- $V_3 = V_5$
- $\left(\frac{V_1}{100}\right) + \left(\frac{V_1 - V_2}{200}\right) + \left(\frac{V_1 - V_3}{400}\right) = 0$
- $\left(\frac{V_3 - V_1}{400}\right) + \left(\frac{V_3 - V_2}{300}\right) + \left(\frac{V_3 - V_4}{500}\right) = 0$
- $\left(\frac{V_5}{100}\right) + \left(\frac{V_5 - V_4}{600}\right) = 0$

6) Design a circuit which outputs

- Y = 0V when R = 300 Ohms
- Y = +10V when R = 330 Ohms
- Y is proportional to R for 300 < R < 330 Ohms



At 300 Ohms (Y = 0V)

$$X = \left(\frac{300}{300+300}\right) 10V = 5V$$

At 330 Ohms (Y = 10V)

$$X = \left(\frac{330}{330+300}\right) 10V = 5.2381V$$

$$gain = \left(\frac{10-0}{5.2381-5}\right) = 42.00$$