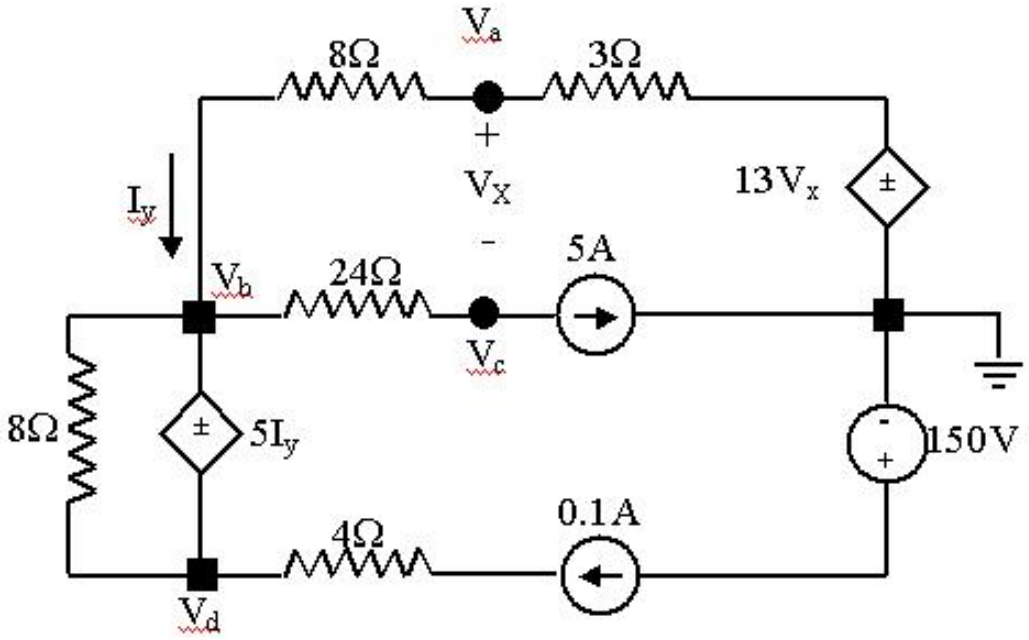
EE 40, Summer 1999
Midterm #1
Professor Dennis M. Sylvester

Problem #1



Node Voltages Va through Vd are labeled on the above circuit diagram. Note the location of ground.

a. Circle all supernodes

b. Write Vx and Iy in terms of variables Va through Vd.

   Vx = _____

   Iy = _____

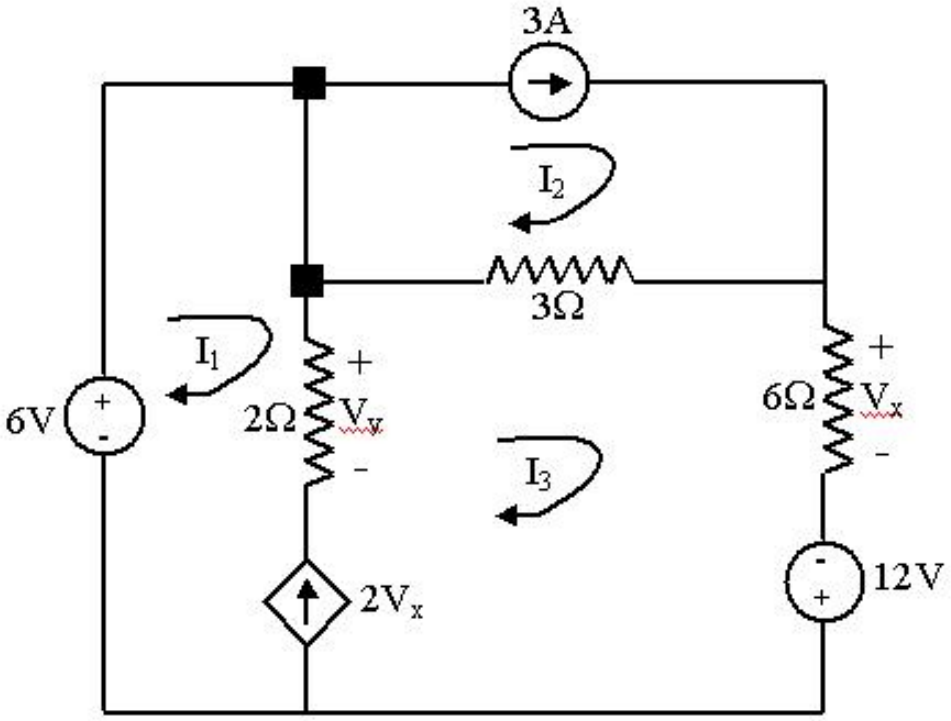
c. Perform nodal analysis for the entire circuit. You should get four simultaneous equations and four unknowns. The unknowns are Va, Vb, Vc, and Vd. Simplify these equations and fill in the blanks below. Do not solve these equations.

Eq 1 _____Va + _____Vb +_____Vc +_____Vd = _____
Eq 2 _____Va + _____Vb +_____Vc +_____Vd = _____
Eq 3 _____Va + _____Vb +_____Vc +_____Vd = _____
Eq 4 _____Va + _____Vb +_____Vc +_____Vd = _____

d. Find the power that the 150V voltage source releases into the circuit.

P = _____

Problem #2



a. Solve for the mesh currents I1, I2, and I3. (Hint: Use the dependent sources to find the relationship between I1 and I3)

I1 = _____ I2 = _____ I3 = _____

b. Using your results in part (a), find Vy.

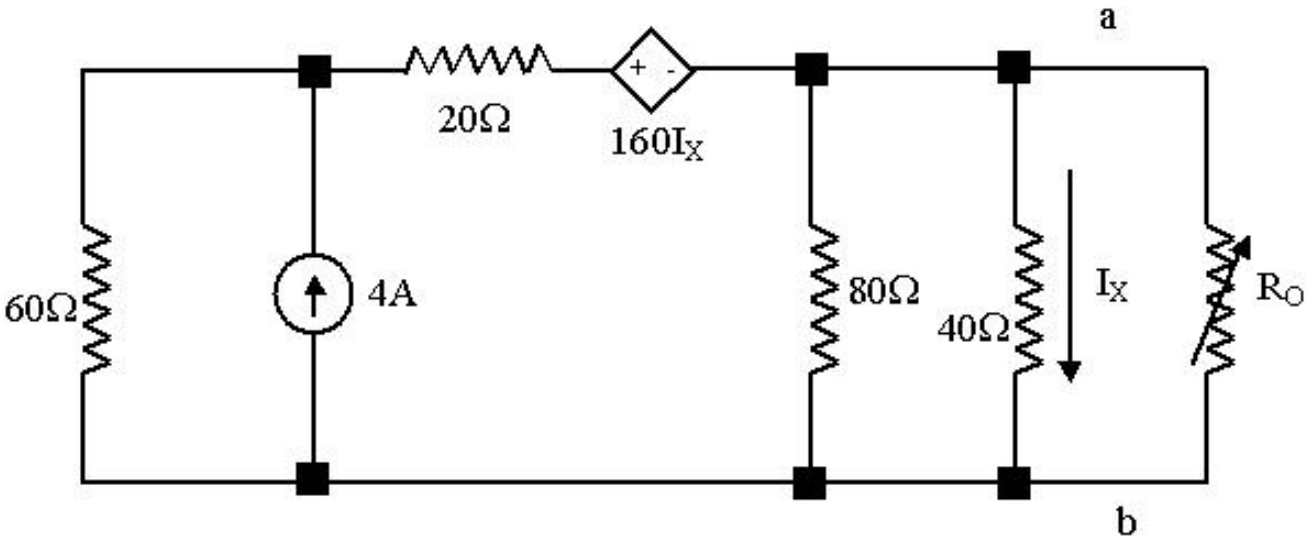
Vy = _____

c. Determine the power that the voltage/current source is releasing into the circuit or absorbing from the circuit:

Circle one

i. The 6V voltage source is [releasing / absorbing] _____ W.
ii. The 12V voltage source is [releasing / absorbing] _____ W.

Problem #3



The variable resistor (R0) in the circuit has its resistance adjusted until the resistor absorbs maximum power from the circuit.

a. Find Vab if the variable resistor is replaced with an open circuit.

Vab = _____

b. Find the Thevenin resistance RTH for the entire circuit left of nodes a and b without finding Isc (short-circuit current).

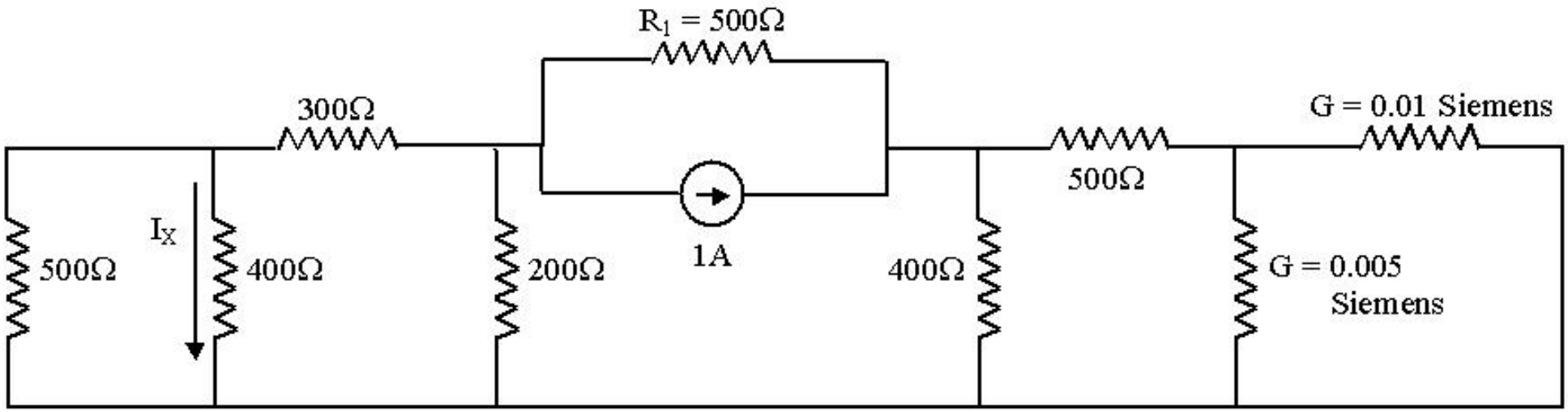
RTH = _____

c. Draw a Norton equivalent circuit for the entire circuit left of nodes a and b.

d. Find the maximum power delivered to the variable resistor.

PMAX = _____

Problem #4



a. Find the power supplied by or absorbed by the current source.

Circle one

The current source is [supplying / absorbing] _____ W.

b. Find the power absorbed by R1.

Power absorbed = _____

c. Find Ix (remember sign convention).

Ix = _____

Problem #5

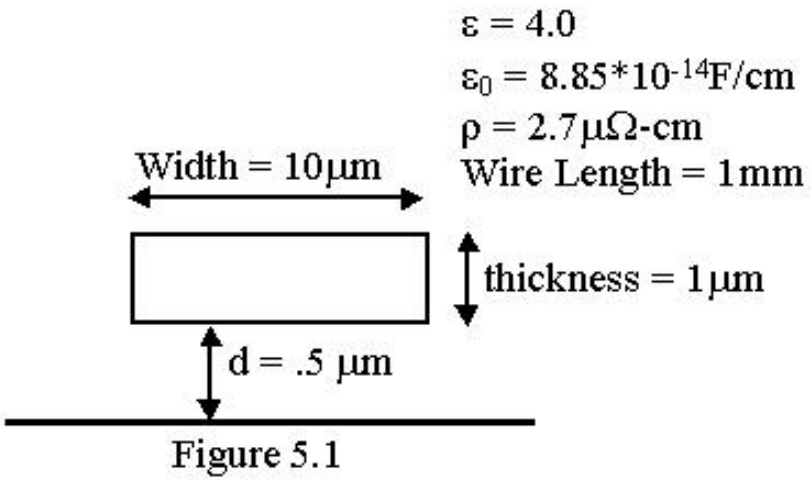


Figure 5.1

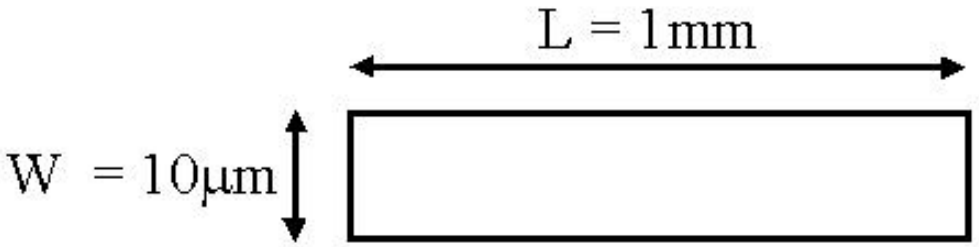


Figure 5.2

The figure 5.1 shows the cross section of a wire surrounded by silicon dioxide (SiO2). The wire is .5 um above another layer of conducting material. Figure 5.2 shows the wire viewed from above.

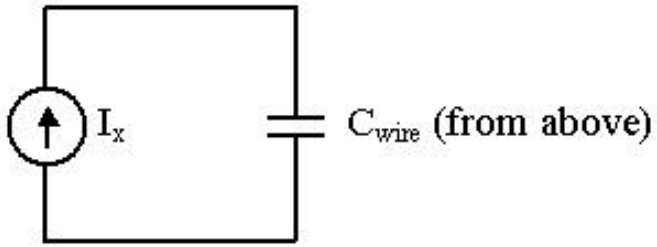
a. Find the sheet resistance and the total resistance of the wire.

   R = _____ RWire = _____

b. Calculate the total capacitance (parallel plate only).

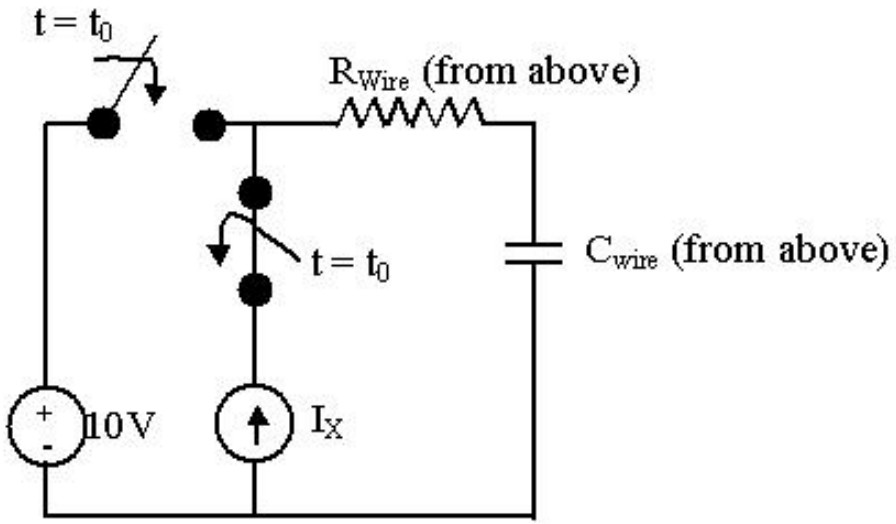
   Cwire = _____

c. Current source Ix charges Cwire to a voltage of 5V in 100ps. The capacitor's initial voltage is zero. Find Ix. For this part of the problem, we are ignoring the wire resistance RWire. If you were unable to find Cwire in part (c), use Cwire = 1 pF.



Ix = _____

d. Cwire is charged to 5V before t0. At time t0+, what is the current through Cwire? If you were unable to find RWire in part (b), use RWire = 5 ohms.



I = _____
