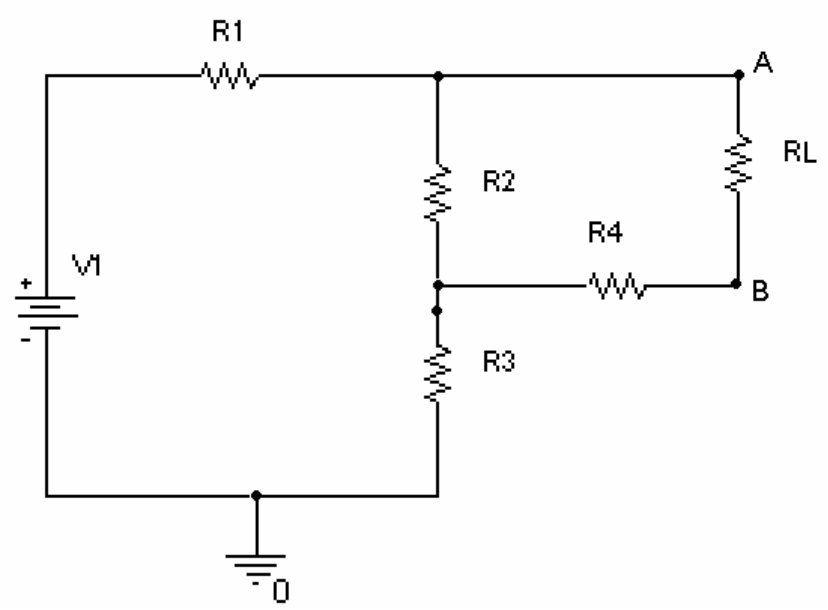
Questions on Thevenin Equivalent Circuits

Fall 2004

2. Thevenin Circuits (25 points)



Let V1=12V, R1=50 ohms, R2=10K ohms, R3=2K ohms, and R4=500 ohms. RL represents the load placed on the circuit between points Aand B.

a) Find the Thevenin voltage between A and B *(7 points)*

b) Find the Thevenin resistance between A and B *(7 points)*

c) Draw the Thevenin equivalent to the circuit shown on the previous page. Include the load resistor RL. *(3 points)*

d) What would be the voltage from A to B if RL were 2K ohms? *(2 points)*

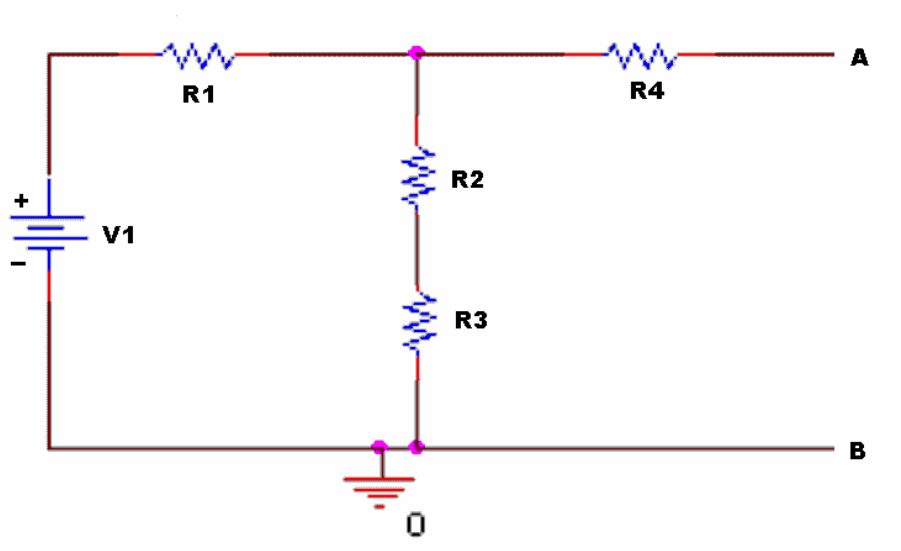
e) What would be the voltage from A to B if RL were 10Meg ohms? *(2 points)*

f) You use the DMM to measure the voltage across the load resistor given in part c (2K ohms) and part d (10Meg ohms). In which circuit would the measured voltage be closer to the voltage you calculated? Why? *(4 points)*

Fall 2004 solution
(none available)

Spring 2004

2) Thevenin circuits (20 points)



In the circuit above, V1=6 volts. R1= 50Ω, R2= 500Ω, R3= 800Ω, R4= 3000Ω

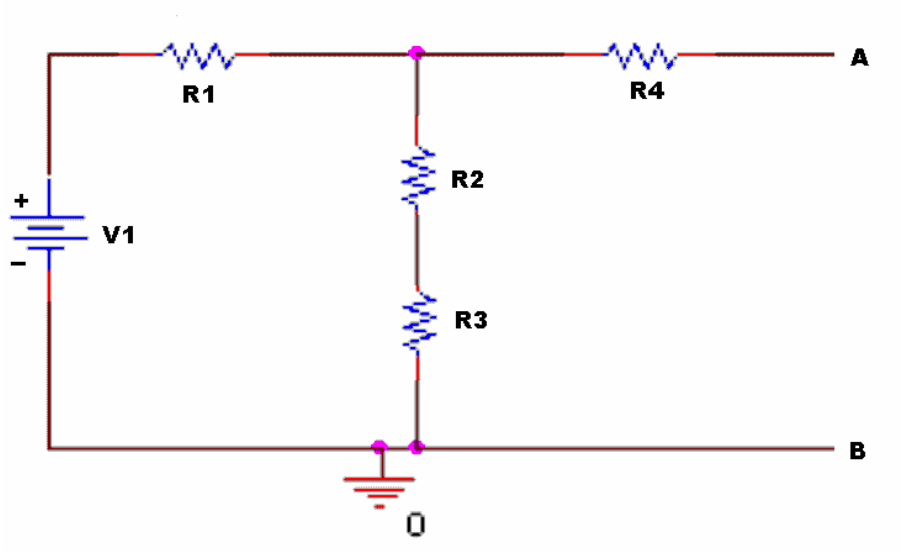
a) Find the Thevenin Voltage (Voc) of the Circuit *(8 points)*

b) Find the Thevenin Resistance *(8 points)*

c) If you place a load resistor of 2K between A and B, what would be the voltage at point A? *(4 points)*

Spring 2004 solution

2) Thevenin circuits (20 points)



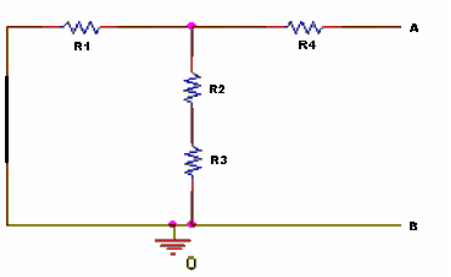
A: In the circuit above, V1=6 volts. R1= 50Ω, R2= 500Ω, R3= 800Ω, R4= 3000Ω

a) Find the Thevenin Voltage (Voc) of the Circuit *(8 points)*

VA = [(R2+R3)/(R1+R2+R3)]V1 = (1300/1350)6 = 5.78 V VB = 0

Vth = VA-VB = 5.78V

b) Find the Thevenin Resistance *(8 points)*



A ---R4--+------R1-----+-------B

| |

+----R2----R3--+

*Rth = R4 + [(R1*R23)/(R1+R23)] R23=500+800=1300*

*Rth=3000+[(50*1300)/(50+1300)]=3048.15 ohms* ***Rth=3048 ohms***

c) If you place a load resistor of 2K between A and B, what would be the voltage at point A? *(4 points)*

VA = [RL/(RL+Rth)]Vth = [2K/(2K+3048)]5.78 = 2.29V **VA = 2.29V**

B: In the circuit above, V1=6 volts. R1= 50Ω, R2= 1000Ω, R3= 500Ω, R4= 2000Ω

a) Find the Thevenin Voltage (Voc) of the Circuit *(8 points)*

VA = [(R2+R3)/(R1+R2+R3)]V1 = (1500/1550)6 = 5.806 V VB = 0

Vth = VA-VB = 5.806V

b) Find the Thevenin Resistance *(8 points) [see pictures for A]*

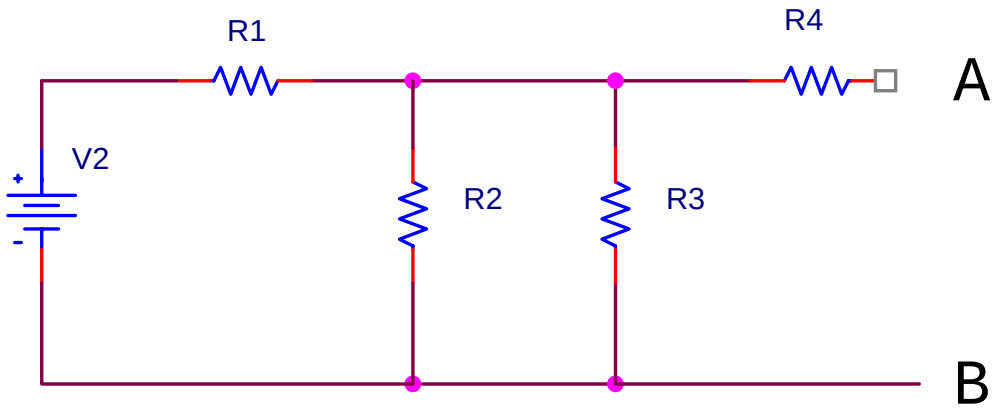
*Rth = R4 + [(R1*R23)/(R1+R23)] R23=1000+500=1500*
*Rth=2000+[(50*1500)/(50+1500)]=2048.38 ohms* ***Rth=2048 ohms***

c) If you place a load resistor of 2K between A and B, what would be the voltage at point A? *(4 points)*

VA = [RL/(RL+Rth)]Vth = [3K/(3K+2048)]5.81 = 3.45V **VA = 3.45V**

Fall 2003

2. Thevenin Circuits (20 points)



Let V2=12V, R1=50 ohms, R2=1K ohms, R3=2K ohms, and R4=500 ohms.

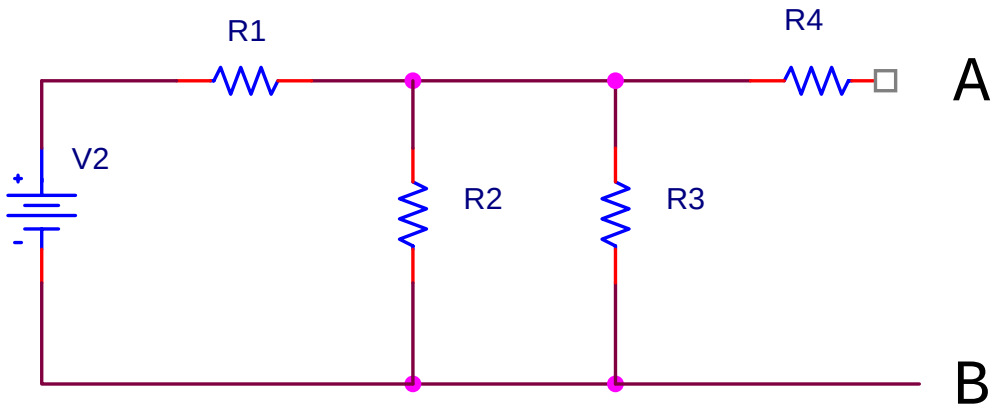
c) Find the Thevenin voltage between A and B *(8 points)*

d) Find the Thevenin resistance *(8 points)*

e) Draw the Thevenin equivalent circuit with a load of 4K ohms. *(4 points)*

Fall 2003 solution

2. Thevenin Circuits (20 points)



Let V2=12V, R1=50 ohms, R2=1K ohms, R3=2K ohms, and R4=500 ohms.

f) Find the Thevenin voltage between A and B *(8 points)*

*Test A: Vth = V_{R23} R23=R2//R3=1K*2K/(1K+2K)=0.66667K*
V_{AB} = 0.66667K/(0.66667K+50)(12V)=11.16V
V_{AB} = 11.16V

*Test B: Vth = V_{R23} R23=R2//R3=2K*0.5K/(2K+0.5K)=0.4K*
V_{AB} = 0.4K/(0.4K+50)(12V)=10.67V
V_{AB} = 10.67V

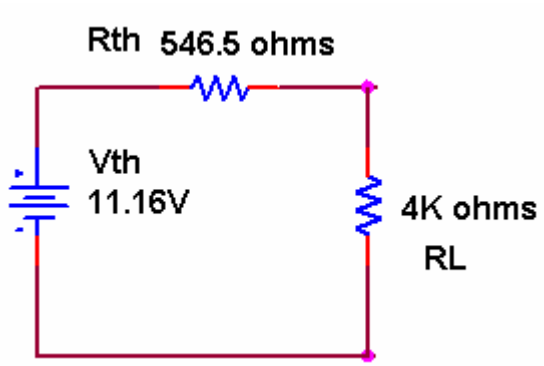
g) Find the Thevenin resistance *(8 points)*

Test A: Rth = R4 + R123
R123 = R1//R2//R3 → 1/R123 = 1/50 + 1/1K + 1/2K → R123 = 46.5 ohms
Rth = 500+46.5 = 546.5 ohms
Rth = 546.5 ohms

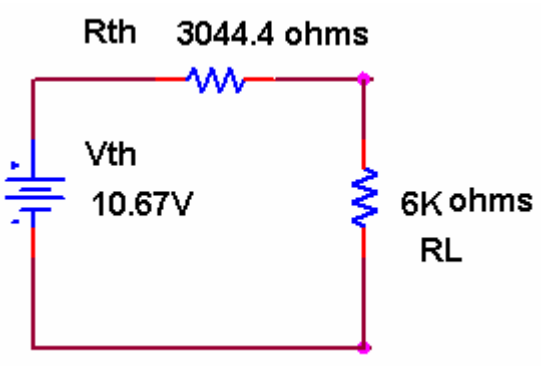
Test B: Rth = R4 + R123
R123 = R1//R2//R3 → 1/R123 = 1/50 + 1/2K + 1/0.5K → R123 = 44.4 ohms
Rth = 3000+44.4 = 3044.4 ohms
Rth = 3044.4 ohms

Draw the Thevenin equivalent circuit with a load of 4K ohms. *(4 points)*

TEST A

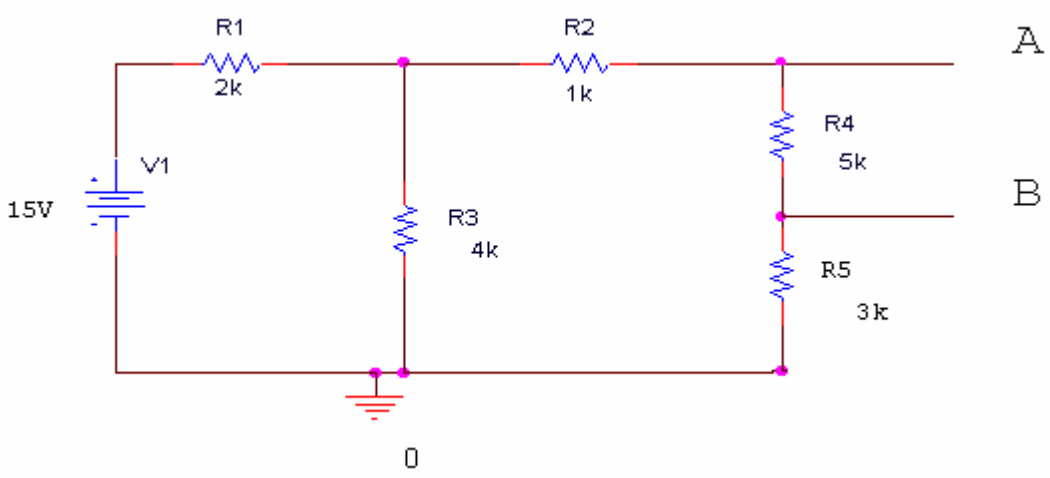


TEST B



Spring 2003

2. Thevenin circuits (20 points)



a) (6 points) Find the Thevenin voltage (Voc) of the circuit assuming the load will be connected between A and B.

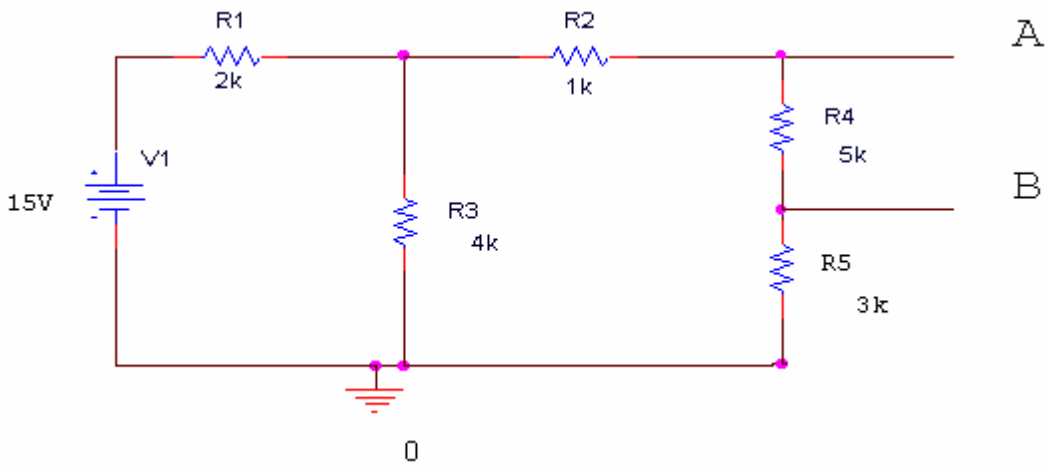
b) (6 points) Find the Thevenin resistance.

c) (4 points) Draw the Thevinen equivalent circuit with a load of 1K ohms.

d) (4 points) Find the voltage between A and B for this circuit with a load of 1K ohms.

Spring 2003 solution

2. Thevenin circuits (20 points)



a) (6 points) Find the Thevenin voltage (Vth) of the circuit assuming the load will be connected between A and B.

R245 = R2+R4+R5 = 1k+5k+3k = 9k
R2345 = R3 // R245 = (9kx4k)/(9k+4k) = 2.77k
V2345 = V1(R2345)/(R1+R2345) = 15x2.77/(2+2.77) = 8.71 volts
V4 = V2345xR4/(R2+R4+R5) = (8.71x5k)/9k = 4.84 volts

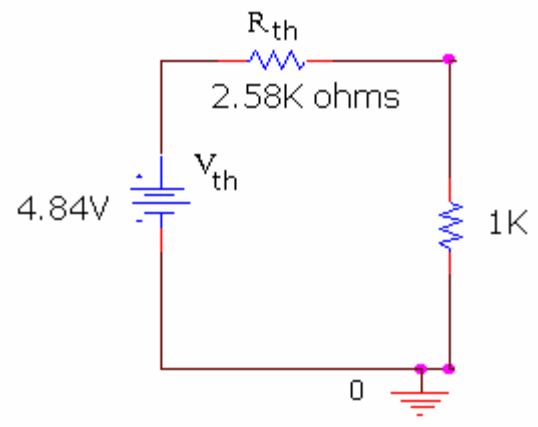
Vth = 4.84 volts

b) (6 points) Find the Thevenin resistance.

R13 = R1//R3=(R1xR3)/(R1+R3) = (2kx4k)/(2k+4k) = 1.33k
R1235 = R13 + R2 + R5 = 1.33K + 1K + 3k = 5.33 K
R12345 = R1235//R4 = (5.33x5)/(5.33+5) = 2.58K ohms

Rth = 2.58 K ohms

c) (4 points) Draw the Thevinen equivalent circuit with a load of 1K ohms.



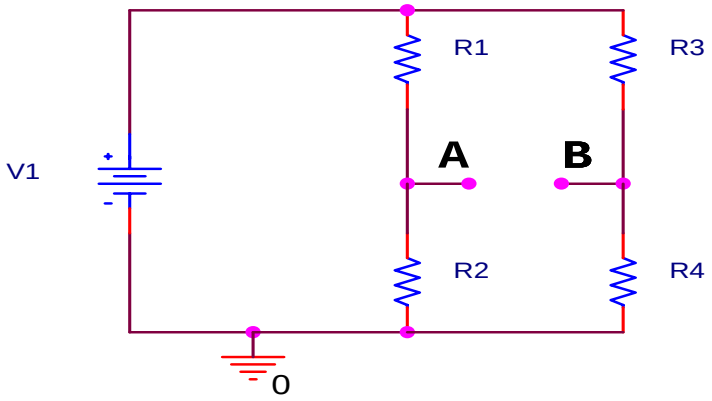
d) (4 points) Find the voltage between A and B for this circuit with a load of 1K ohms.

VAB = (Vthx1K)/(1K+Rth) = (4.84x1k)/(1K+2.58K) = 1.35 volts

VAB = 1.35 volts

Fall 2002

2. Thevenin circuits (20 points)



Given: V1=12 V; R1=2 kΩ; R2=4 kΩ; R3= 8 kΩ; R4= 4 kΩ

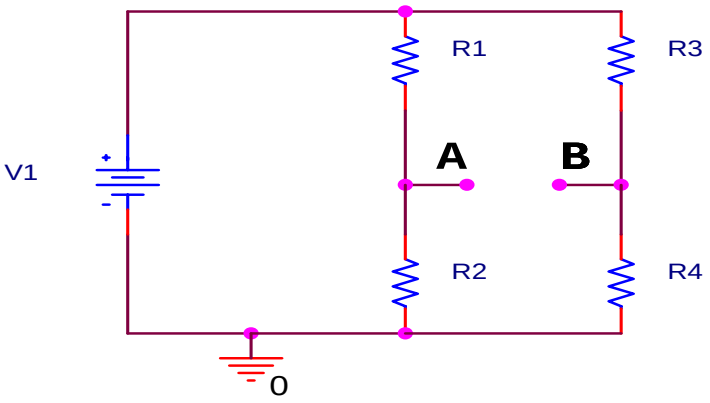
a) Find the Thevenin Voltage (Voc) of the circuit assuming the load will be connected between A and B. (6 points)

b) Find the Thevenin Resistance (6 points)

c) Find the current going from A to B if a 4 kΩ resistor is connected between A and B. (8 points)

Fall 2002 solution

2. Thevenin circuits (20 points)



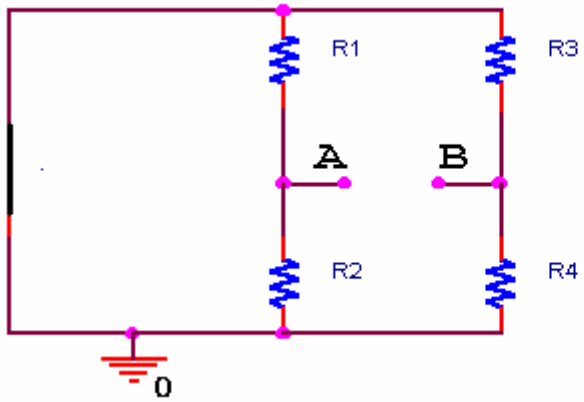
Given: V1=12 V; R1=2 kΩ; R2=4 kΩ; R3= 8 kΩ; R4= 4 kΩ

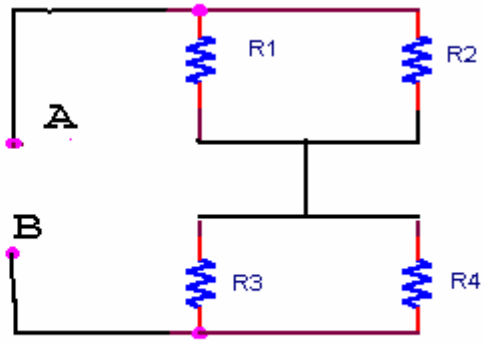
a) Find the Thevenin Voltage (Voc) of the circuit assuming the load will be connected between A and B. (6 points)

*Vth = VA – VB = V1*R2/(R1+R2) – V1*R4/(R3+R4)*
*Vth = 12*4K/6K – 12*4K/(8K+4K) = 8-4 =* ***4 volts***

b) Find the Thevenin Resistance (6 points)

Redraw circuit:





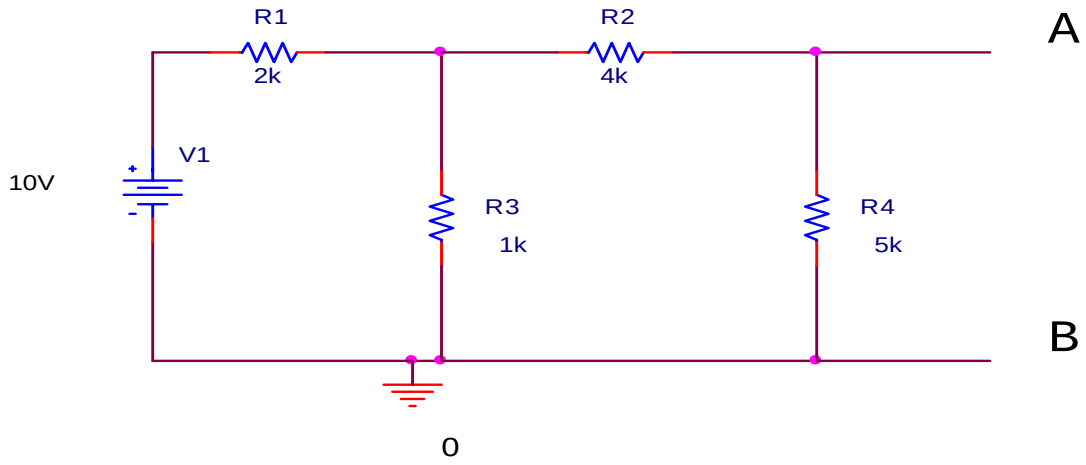
*Rth = R1//R2 + R3//R4 = R1*R2/(R1=R2) + R3*R4/(R3+R4)*
*Rth = 2K*4K(2K+4K) + (8K*4K)/(8K+4K) = 4/3 + 8/3 = 12/3 =* ***4 Kohms***

c) Find the current going from A to B if a 4 kΩ resistor is connected between A and B. (8 points)

V=IR Vth = I (Rth+4K) 4 = I * (4K+4K)*
I = 0.5 mamps

Spring 2002

2. Thevenin circuits (20 points)



a) Find the Thevenin Voltage (Voc) of the Circuit (8 points)

b) Find the Thevenin Resistance (8 points)

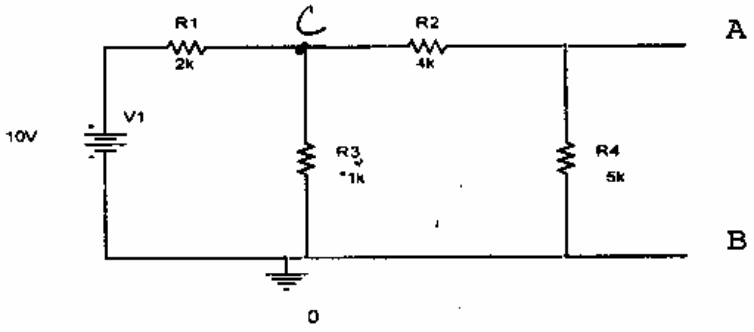
c) Draw the Standard Thevenin Circuit, including a load Resistor (4 points)

Spring 2002 solution

ENGR4300 Test 1A
Spring 2002

Name_____
Section _____

2. Thevenin circuits (20 points)



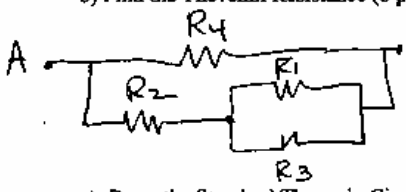
a) Find the Thevenin Voltage (Voc) of the Circuit (8 points)

$R_{24} = 4K+5K = 9K \quad R_{324} = \frac{9K \cdot 1K}{9K+1K} = 0.9K$

$V_C = 10\left(\frac{0.9K}{2K+0.9K}\right) = 3.103V \quad V_A = 3.103\left(\frac{5K}{4K+5K}\right) = 1.72V$

$V_B = 0$ $\quad V_{AB} = V_{OC} = V_{TH} = 1.724V$

b) Find the Thevenin Resistance (8 points)



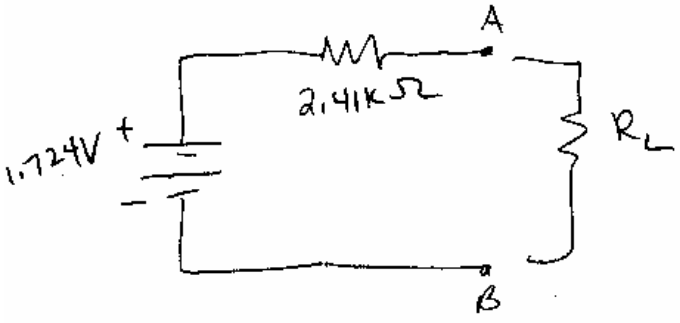
$R_{13} = \frac{2K \cdot 1K}{2K+1K} = \frac{2}{3}K$

$\therefore R_{213} = 4K + \frac{2}{3}K = \frac{14}{3}K$

$R_{4213} = \frac{5K \cdot \frac{14}{3}K}{5K + \frac{14}{3}K} = 2.41K\Omega$

$R_{TH} = 2.41K\Omega$

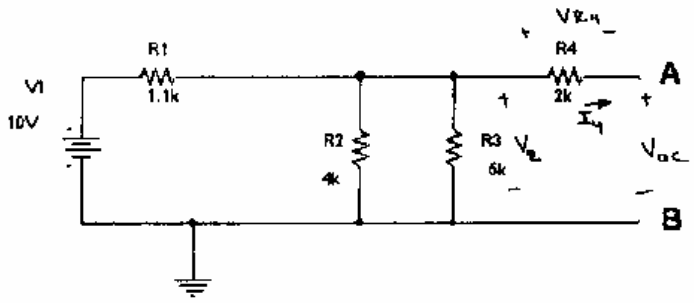
c) Draw the Standard Thevenin Circuit, including a load Resistor (4 points)



Fall 2001 solution

ENGR4300 Test 1A Fall 2001 Name_____ Section ____

2. Thevenin circuits (20 points)

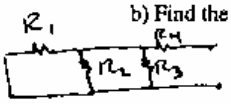


a) Find the Thevenin Voltage (Voc) (8 points)

$V_{oc} = V_2 - V_{R4}$, $V_{R4} = R_4 I_4 = 0$ $\Rightarrow$ $V_{oc} = V_2$ $\left\{ R_{23} = \frac{R_2 R_3}{R_2 + R_3} = 2.22\,k\Omega \right.$

$V_2 = \frac{R_{23}}{R_1 + R_{23}} V_1 = \frac{2.22\,k\Omega}{1.1\,k\Omega + 2.22\,k\Omega} 10V = 6.69\,V$ $\Rightarrow$ $\boxed{V_{th} = V_{oc} = 6.69\,V}$

b) Find the Thevenin Resistance (8 points)



$R_{th} = R_4 + (R_1 \| R_{23}) = R_4 + \frac{2.22\,k\Omega \cdot 1.1\,k\Omega}{2.22\,k\Omega + 1.1\,k\Omega} = R_4 + 735\,\Omega$

$= 2k\Omega + 735\Omega$

$\Rightarrow$ $\boxed{R_{th} = 2.735\,k\Omega}$

c) Draw the Standard Thevenin Circuit, inserting the values you have found. (4 points)