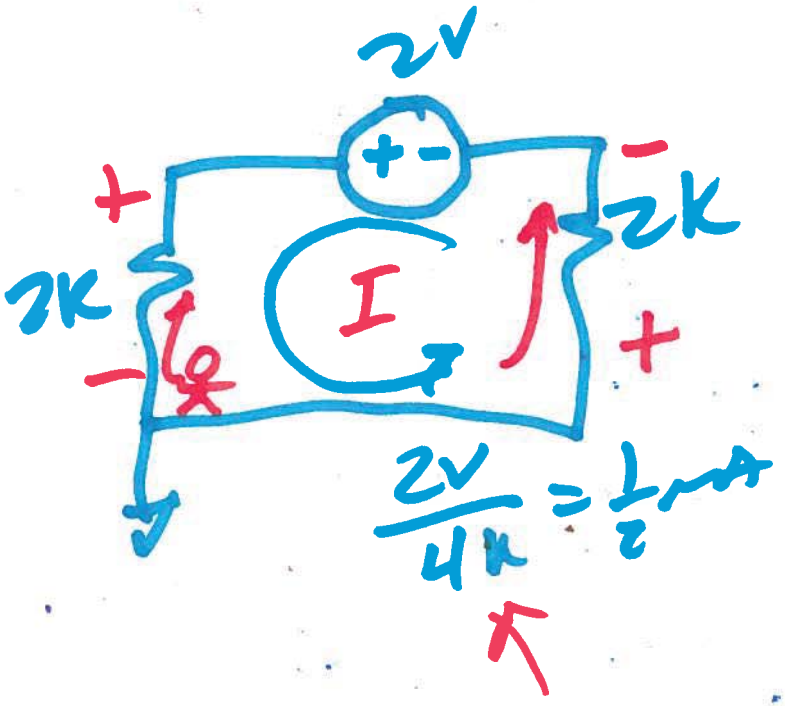
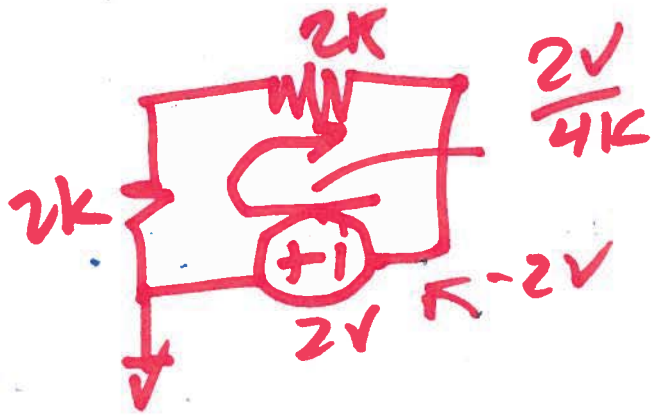
EE 220
circuits I

Lecture 13



$$2K \cdot I - 2 + 2K I = 0$$

$$I = \frac{2}{4K}$$



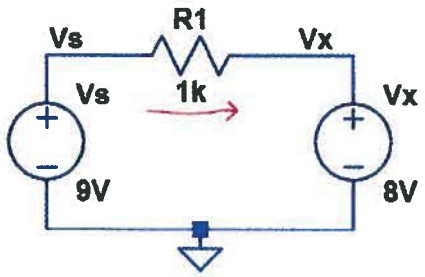
Q & +/

Quiz #1 EE 220 Fall 2016 Name:_____

Closed book and notes.

Show your work for credit!

1. Find the voltages Vs and Vx as well as the current flowing in the direction shown. (5 points)



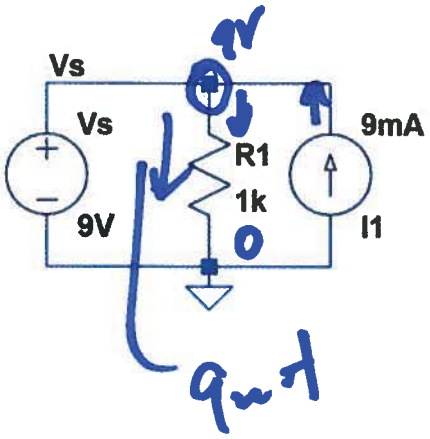
2

Quiz #2 EE 220 Fall 2016 Name:_____

Closed book and notes.

Show your work for credit!

1. Determine the current through Vs. Again, show your work for credit. (5 points)



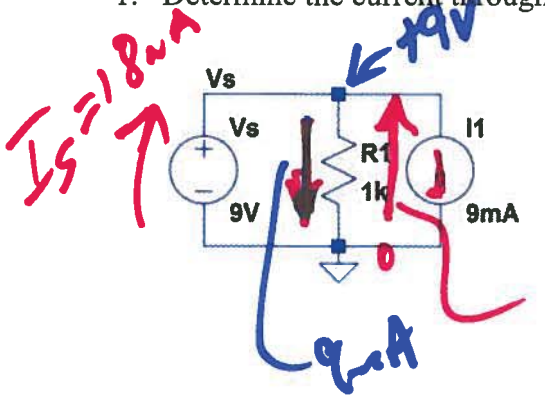
3)

Quiz #3 EE 220 Fall 2016 Name:_____

Closed book and notes.

Show your work for credit!

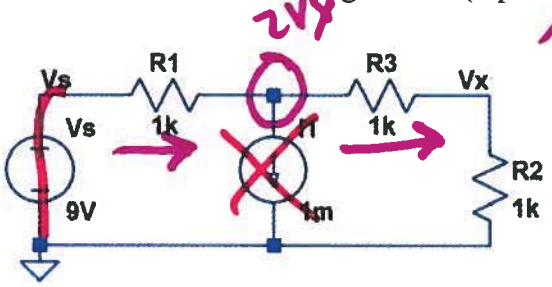
1. Determine the current through Vs. Again, show your work for credit. (2 points)



$I_S = 18mA$ ↑ 9V ↓ 9mA ↓ 9mA

$\frac{0-9}{1K} = -9mA$ ↓ $V = IR$ (+ / −)

2. Find Vx in the following circuit. (5 points)



$\frac{9-2V_x}{1K} = 1mA + \frac{V_x}{1K}$

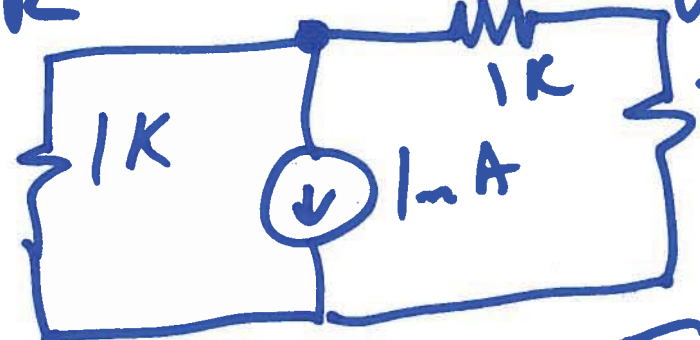
9V source

$V_x = 9 \cdot \frac{1K}{1K+2K} = 3V$

1mA source

$V_x = -.333V$

$V = -I \cdot R$ (+ / −)



$V_J = -\frac{2}{3}V$

$= -666mV$

$= -.666V$

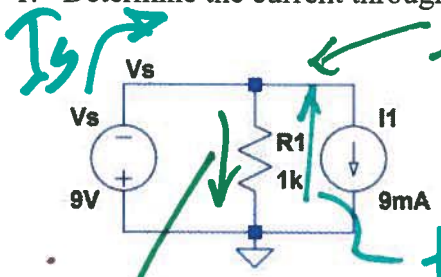
$V_x = 3 - .333V$

$= 2.666V$

4)

Quiz #4 EE 220 Fall 2016 Name:_____
Closed book and notes.
Show your work for credit!

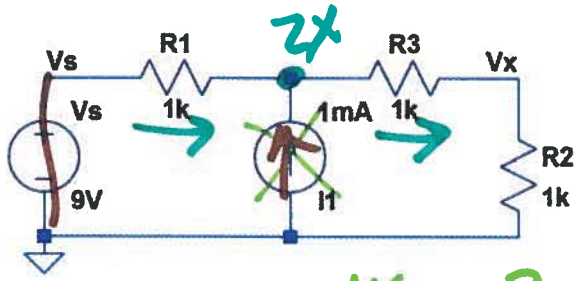
1. Determine the current through Vs. Again, show your work for credit. (2 points)



I_s, -9V, +9mA, $\frac{-9-0}{1K} = -9mA$

$I_s = -9mA + 9mA = 0$

2. Find Vx in the following circuit. (5 points)



$\frac{9-2V_x}{1K} + 1mA = \frac{V_x}{1K}$

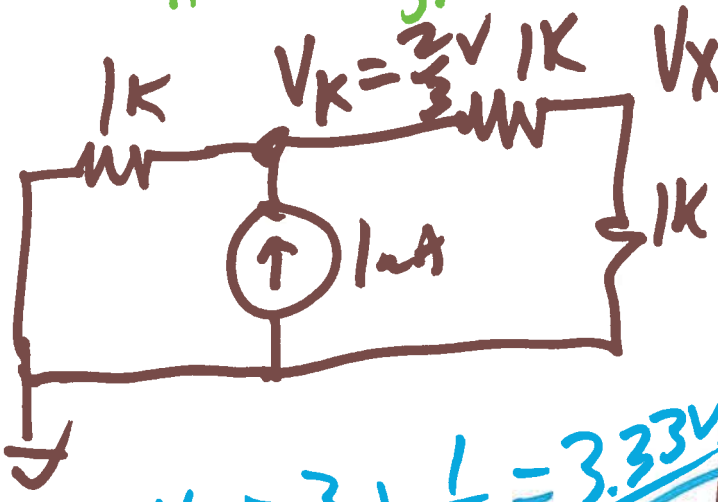
$9 - 2V_x + 1 = V_x$

$10 = 3V_x$

$V_x = 3.33V$

$V_x = 9 \cdot \frac{1K}{3K} = 3V$

$V_x = \frac{1}{3}V$

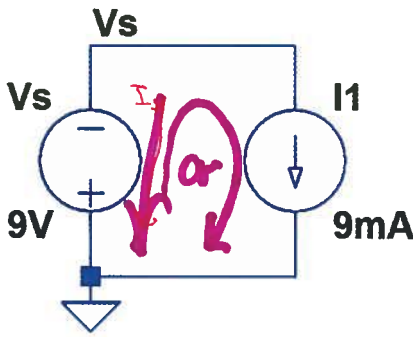


$V_x = 3 + \frac{1}{3} = 3.33V$

5)

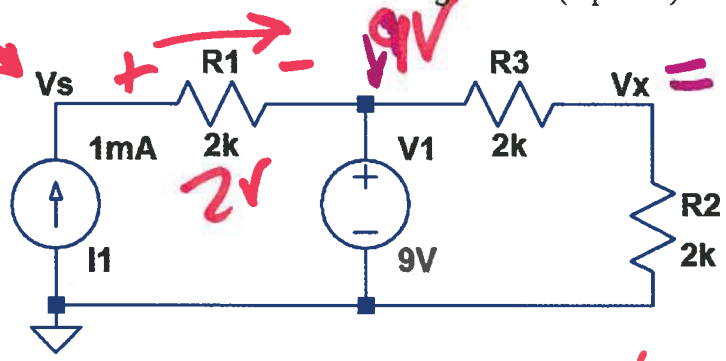
Quiz #5 EE 220 Fall 2016 Name:_____
Closed book and notes.
Show your work for credit!

1. What is Is as defined in the direction seen below? Just write the answer. (1 point)



$I_S = -9mA$

2. Find Vs and Vx in the following circuit. (4 points)



$V_x = 9 \cdot \frac{2k}{2k+2k} = 4.5V$

$V_S = 9V + 1mA \cdot 2k$

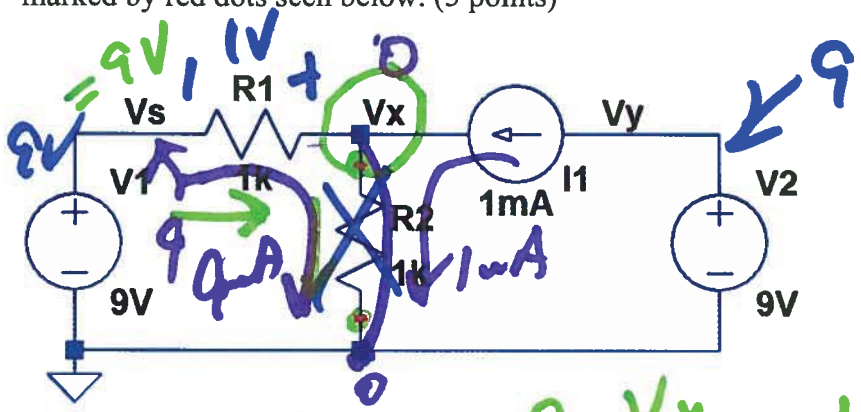
$V_S = 11V$

Quiz #6 EE 220 Fall 2016 Name:_____

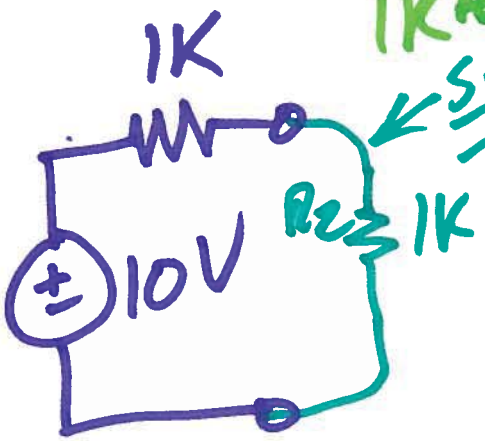
Closed book and notes.

Show your work for credit!

1. Find the Thevenin and Norton equivalent circuits, with R2 removed, at the terminals marked by red dots seen below. (5 points)



$$\frac{V_x}{1K} = \frac{9 - V_x}{1K} + 1mA$$

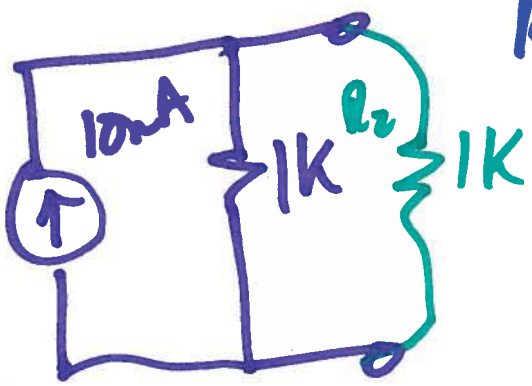


$V_x = 9 - V_x + 1$

$2V_x = 10, \quad V_x = 5V$

$V_{TH} = 10V \qquad I_{SC} = I_N = 10mA$

$R_{TH} = 1K$



$V = 500 \cdot 10mA = 5V$

$1K \| 1K$

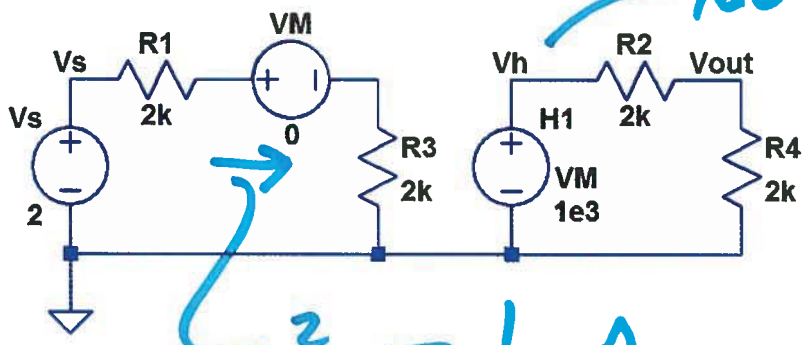
7)

Quiz #7 EE 220 Fall 2016 Name:_____

Closed book and notes.

Show your work for credit!

1. Find Vout in the following circuit. Note that H1 is a current-controlled voltage source (CCVS) also known as a current-dependent voltage source. (5 points)



$10^3 \cdot \frac{1}{2}\,mA$

$10^3 \cdot \frac{1}{2} \cdot 10^{-3}$

$= \frac{1}{2}\,V$

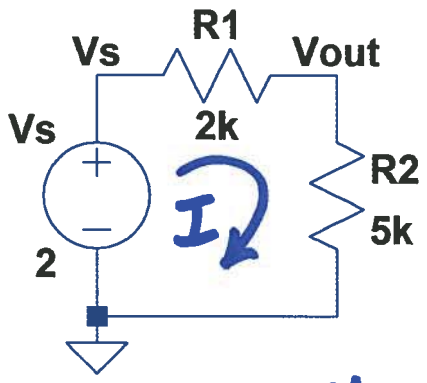
$\frac{2}{4k} = \frac{1}{2}\,mA$

$V_{OUT} = \frac{1}{4}\,V$

8)

Quiz #8 EE 220 Fall 2016 Name:_____
Closed book and notes.
Show your work for credit!

1. Find the voltage across R1. As always, show your work for credit. (3 points)



$I = \frac{2}{7K}$

V_{drop} across R_1

$= R_1 \cdot I$

$= 2k \cdot \frac{2}{7k}$

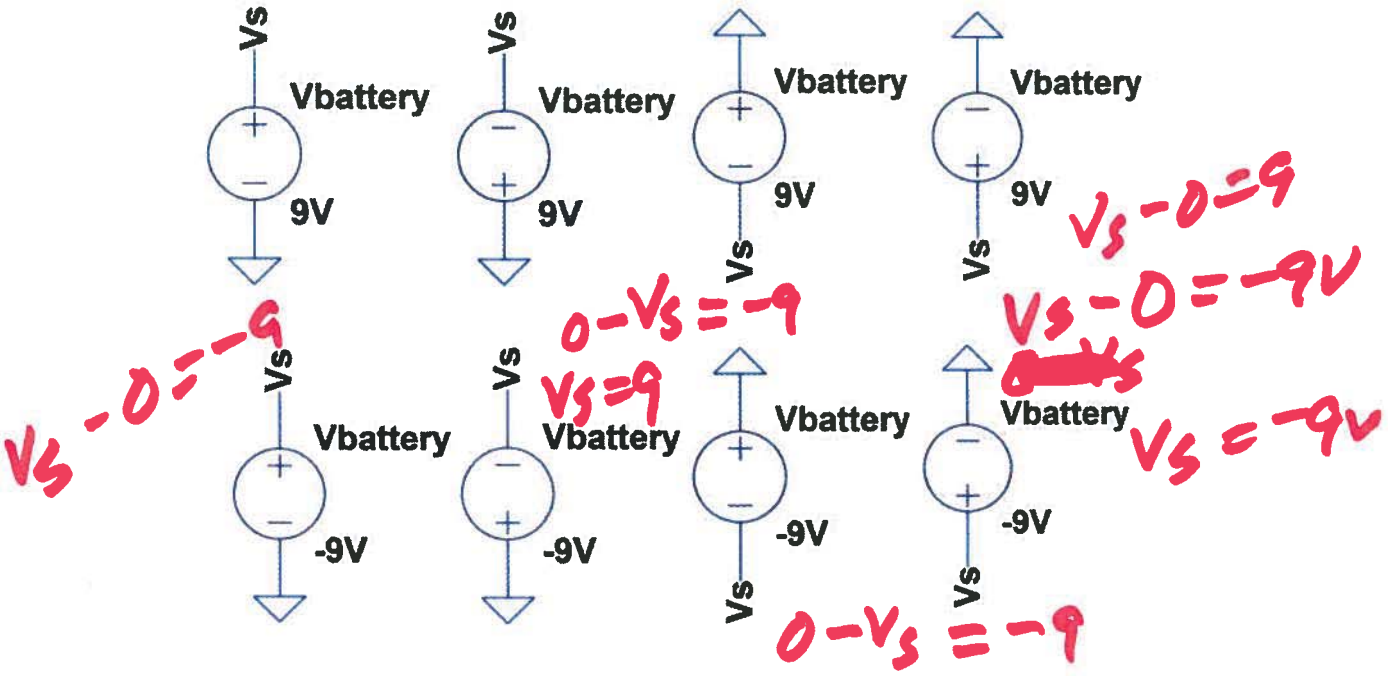
$= \frac{4}{7} V$

9)

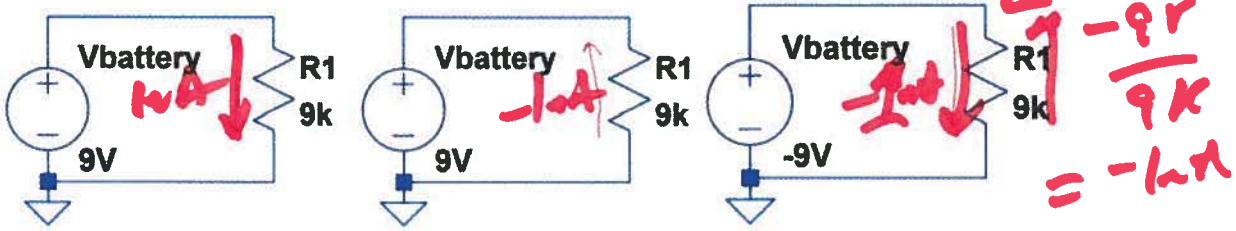
H.W. #1 EE 220 Fall 2016

Show your work for credit!

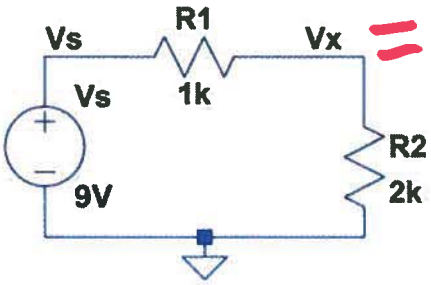
1. What is the voltage, Vs, in each of the following circuits? It's okay to simply write your answer next to each Vs in the schematics. (0.5 points each)



2. What is the current flowing in the following circuits? Give answers for the current flowing in the directions indicated on each schematic. (3 points)



3. Find the voltages Vs, Vx, and the voltages across both R1 and R2. Find the current flowing in the circuit. Verify your answers with LTspice. (6 points)



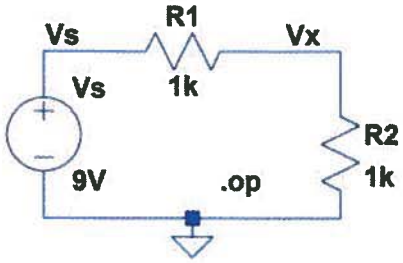
$= 9 \cdot \frac{2k}{2k+1k} = 6V$

10)

H.W. #2 EE 220 Fall 2016

Show your work for credit!

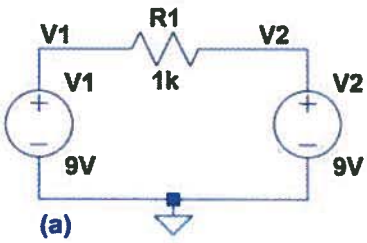
1. Write a text file containing the LTspice netlist for the following circuit. Verify that the simulation results match your hand calculations. (3 points)

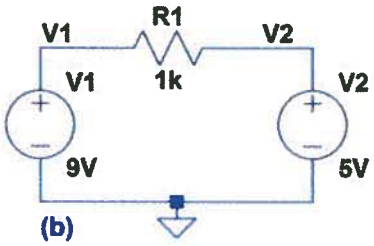


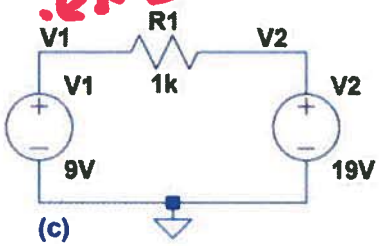
comment
Vs Vs 0 DC 9
R1 Vs Vx 1K
R2 Vx 0 1K

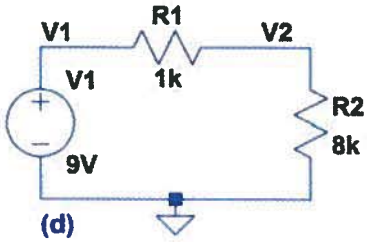
2. Find the voltages and currents in each of the following circuits. Verify your answers with LTspice. (9 points)

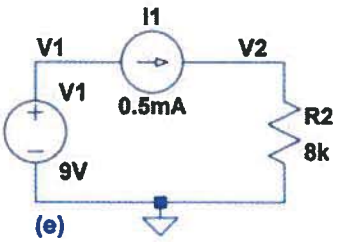
.op
.end

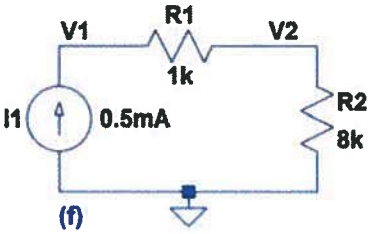


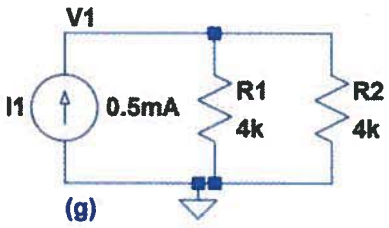


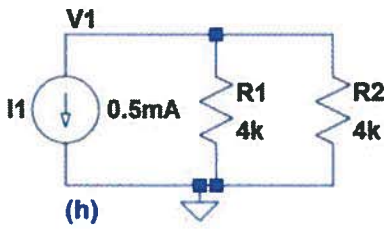


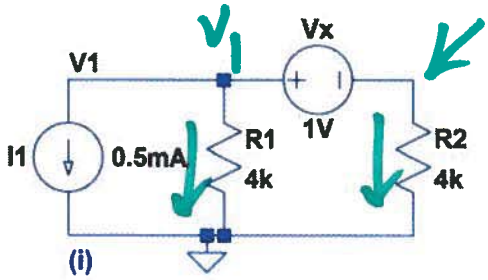












V_1

$KV_1 - 1$

$0.5mA + \frac{V_1}{4K}$

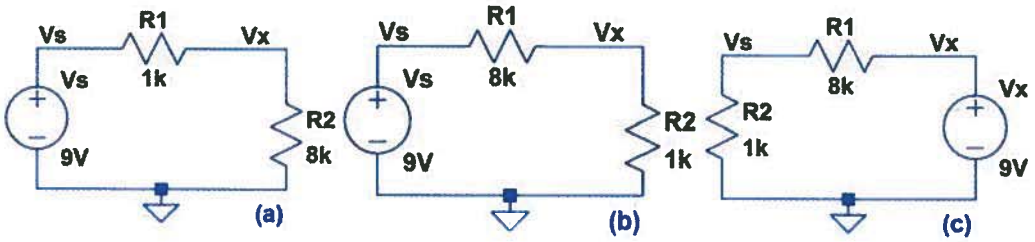
$+ \frac{V_1 - 1}{4K} = 0$

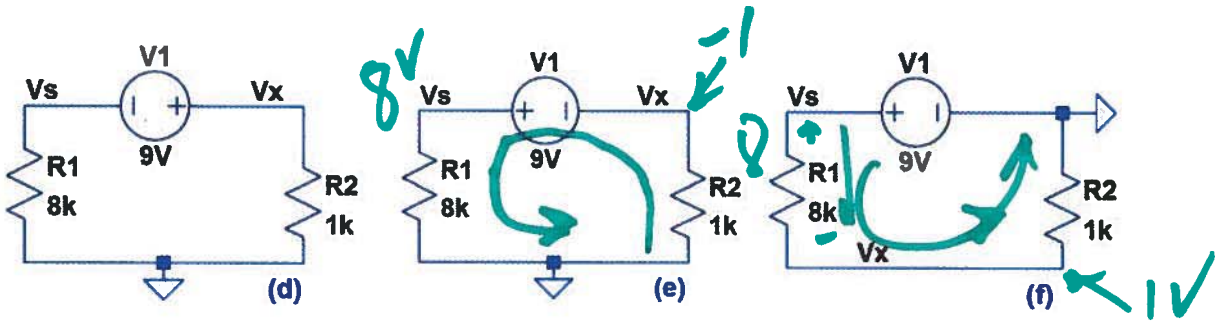
11)

H.W. #3 EE 220 Fall 2016

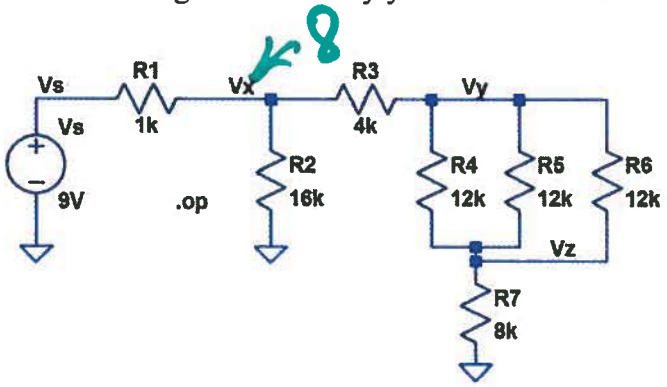
Show your work for credit!

1. Find the voltages Vx and Vs in each of the following circuits. Verify your hand calculations using LTspice. (6 points)

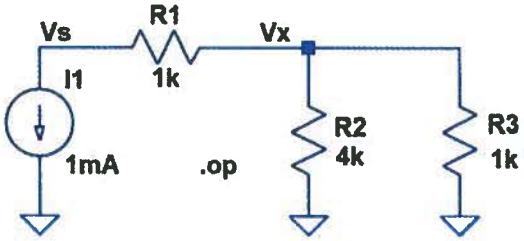




2. Find the voltages in the following circuit. Verify your hand calculations using LTspice. (6 points)



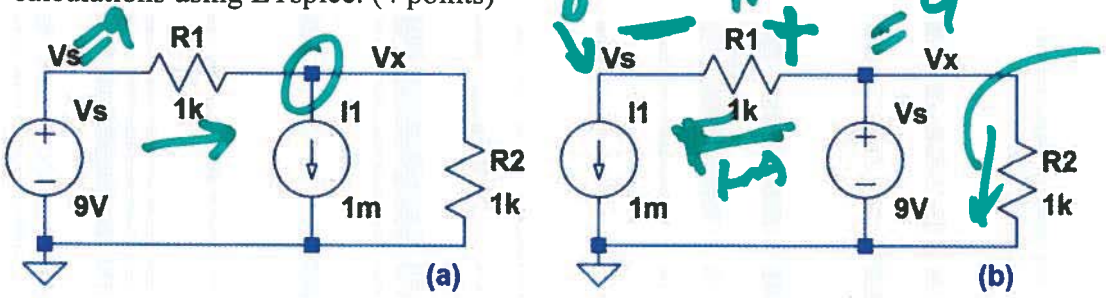
3. Show how to derive the voltage divider equation and the current divider equation for a two resistor circuit. Ensure your derivation includes the two schematics you are using. Provide an example for each derivation. (4 points)
4. Calculate Vs, Vx, and the current that flows in R2 and R3. Verify your hand calculations using LTspice. (4 points)



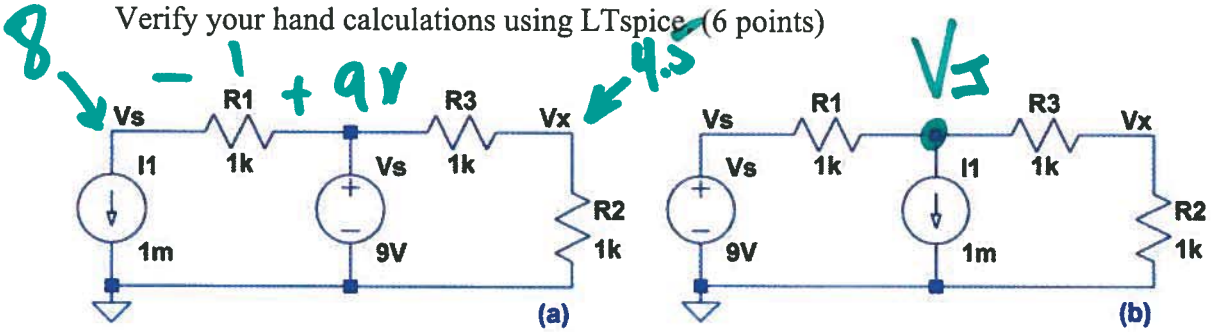
H.W. #4 EE 220 Fall 2016

Show your work for credit!

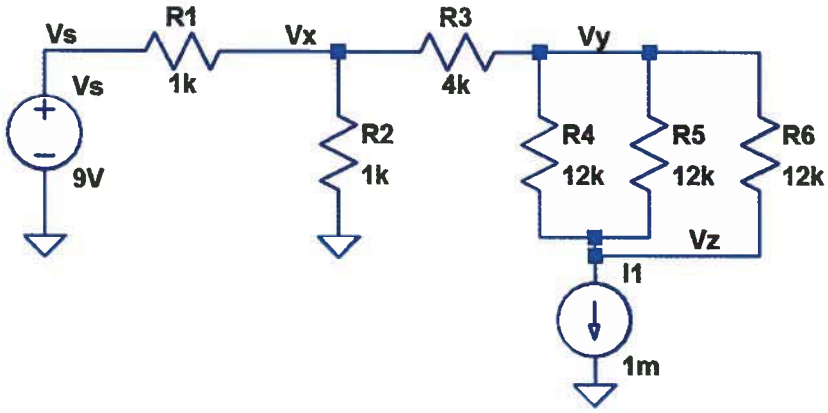
1. Find the voltages Vx and Vs in each of the following circuits. Verify your hand calculations using LTspice. (4 points)



2. Find the voltages Vx and Vs and the current through Vs in each of the following circuits. Verify your hand calculations using LTspice. (6 points)



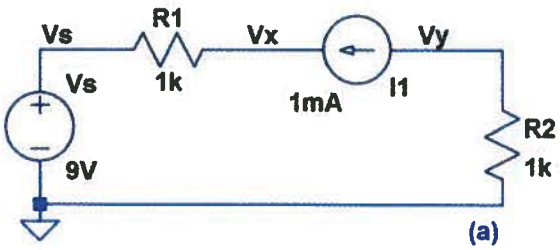
3. Find the voltages in the following circuit. Verify your hand calculations using LTspice. (6 points)

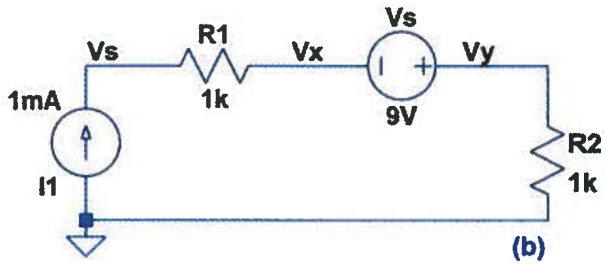


H.W. #5 EE 220 Fall 2016

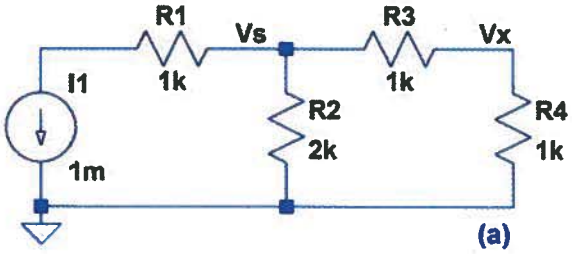
Show your work for credit!

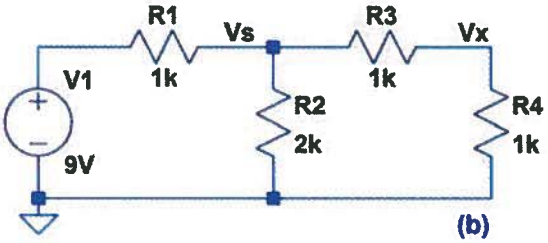
1. Find the voltages Vx and Vy in each of the following circuits. Verify your hand calculations using LTspice. (4 points)



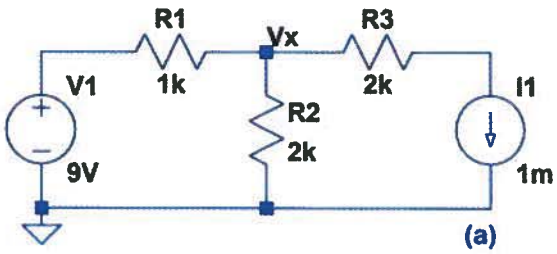


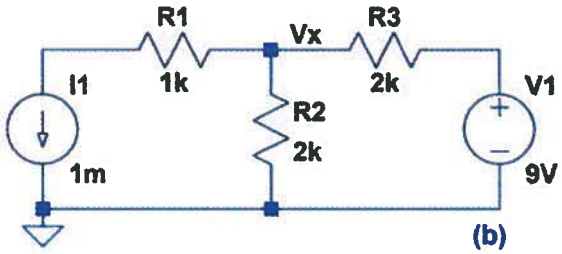
2. Find the voltages Vs and Vx and the current through R2 in each of the following circuits. Verify your hand calculations using LTspice. (6 points)

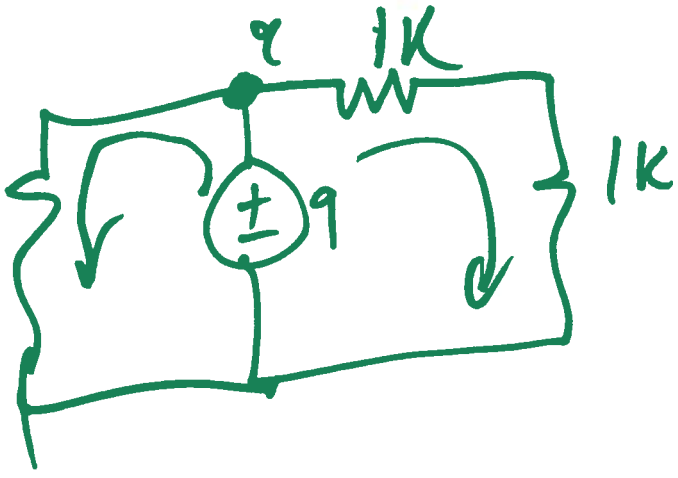




3. **Using superposition** show how to find Vx in the following circuits. Verify your hand calculations using LTspice. (6 points)





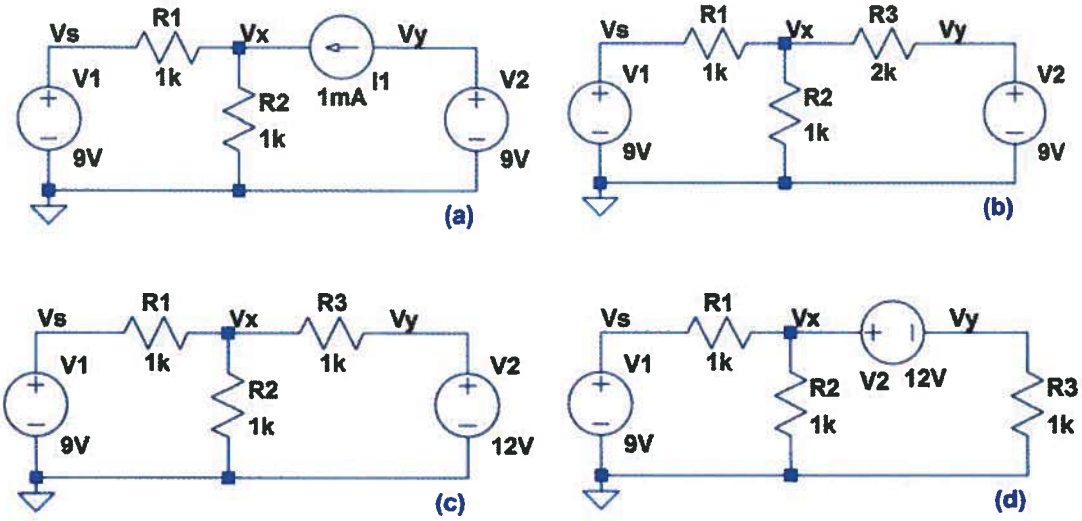


14)

H.W. #6 EE 220 Fall 2016

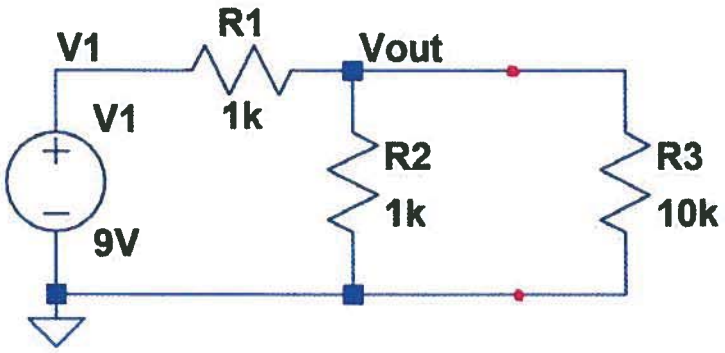
Show your work for credit!

1. Find the voltages and currents in each of the following circuits **using mesh analysis.** Verify your hand calculations using LTspice. (8 points)



2. Repeat problem 1, but no need to repeat the LTspice simulations, **using superposition.** (8 points)

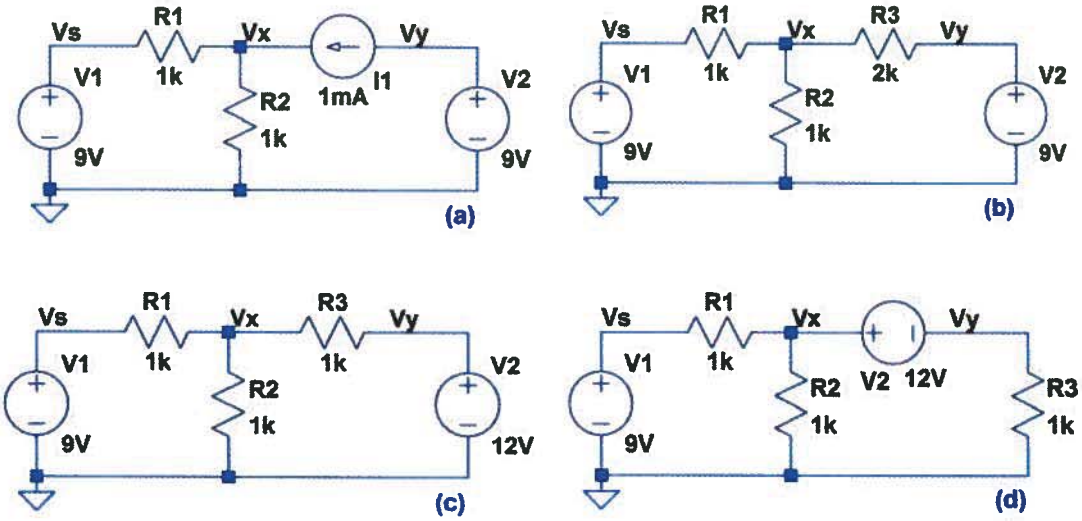
3. Find the Thevenin and Norton equivalent circuits for the circuitry to the left of the two terminals marked with red dots below. Show that Vout is the same for: 1) the circuit seen below, 2) the Thevenin equivalent circuit connected to R3 and 3) the Norton equivalent circuit connected to R3. Verify your answers with three LTspice simulations. (3 points)



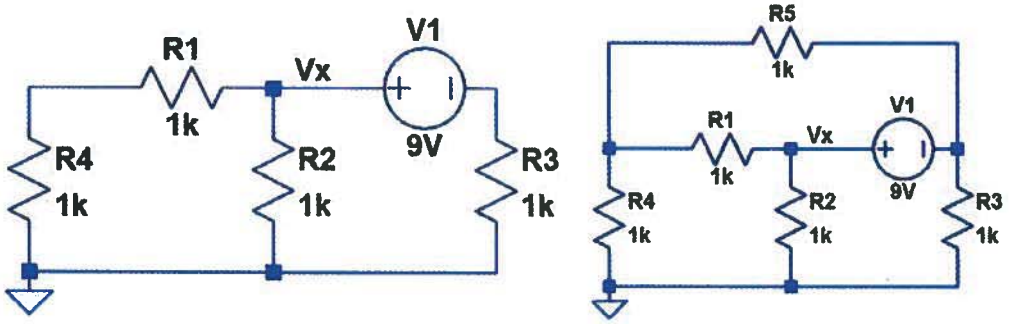
H.W. #7 EE 220 Fall 2016

Show your work for credit!

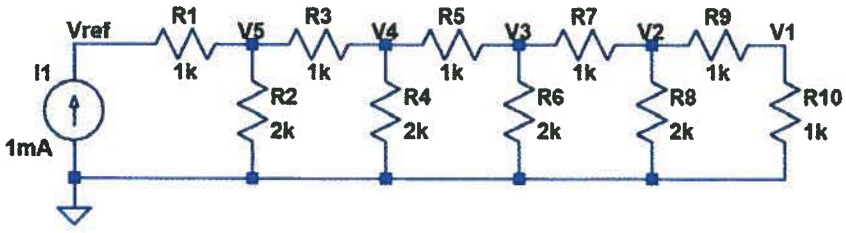
1. In problem 1 from HW#6, circuits seen below, find the Thevenin and Norton equivalent circuits between Vx and ground with R2 removed. Show that when you connect R2 to the Thevenin and Norton equivalents that you get the same value for Vx. Verify your hand calculations using LTspice. (8 points)



2. Determine the currents and voltages in the following circuit using mesh analysis. Verify your hand calculations using LTspice. (4 points)



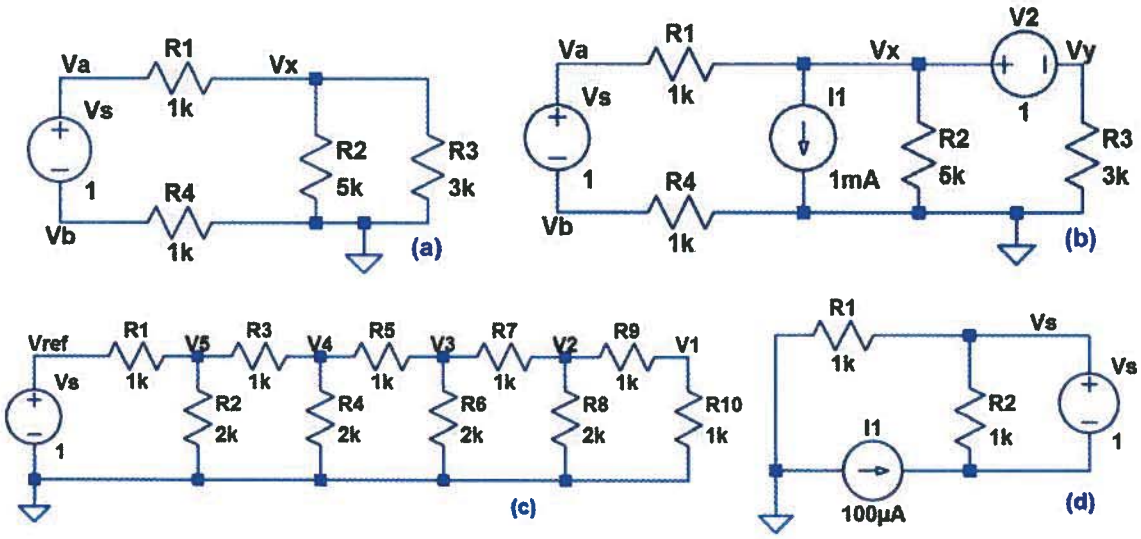
3. Find all voltages in the following circuit. Verify your hand calculations using LTspice. As always, show your work for credit. (2 points)



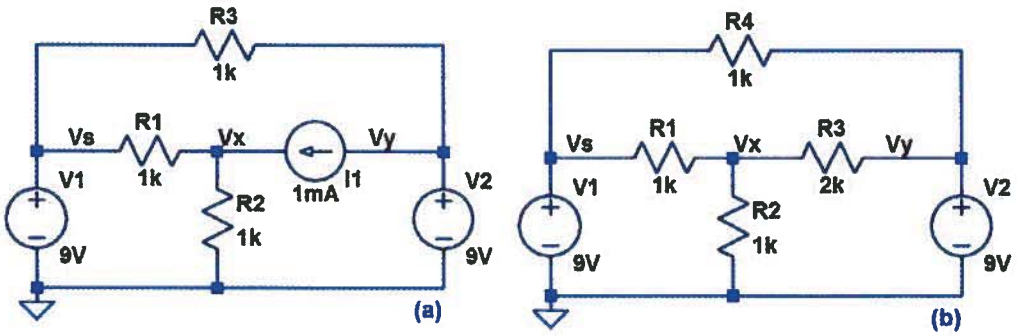
H.W. #8 EE 220 Fall 2016

Show your work for credit!

1. Find the voltages in the following circuits using any method you would like. Verify your hand calculations using LTspice. (4 points)



2. Determine the currents and voltages in the following circuits using superposition and mesh analysis. Verify your hand calculations using LTspice. (6 points)

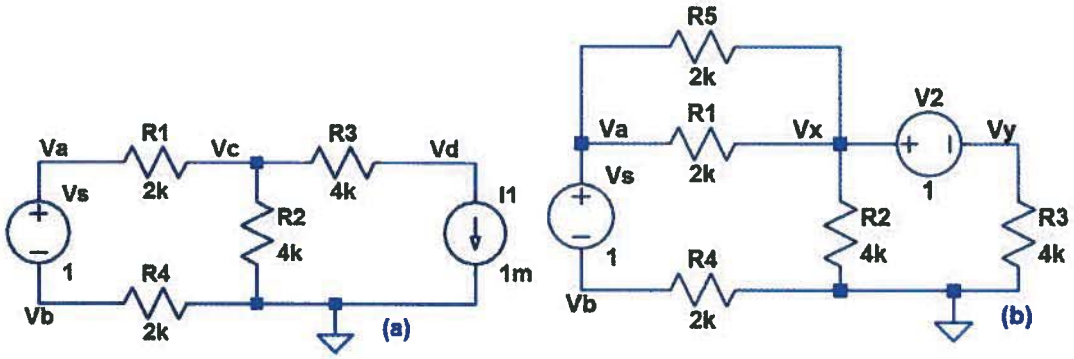


3. For the circuits in problem 2 find the Thevenin and Norton equivalent circuits from Vx to ground without R2 in the circuit. Show, with R2 back in the circuit, that you get the same value for Vx that you calculated in problem 2. Verify your Thevenin and Norton circuits are correct using LTspice. (4 points)

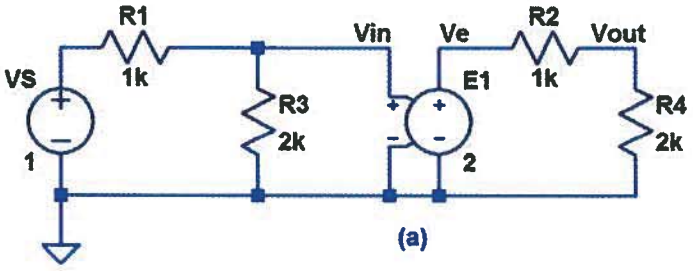
H.W. #9 EE 220 Fall 2016

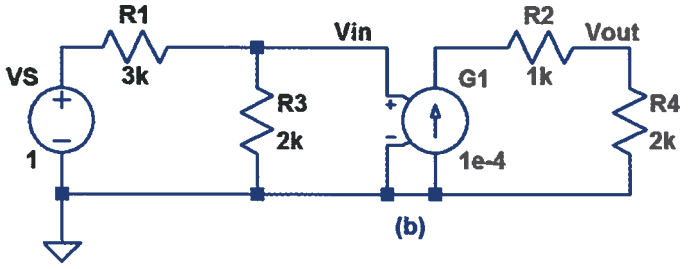
Show your work for credit!

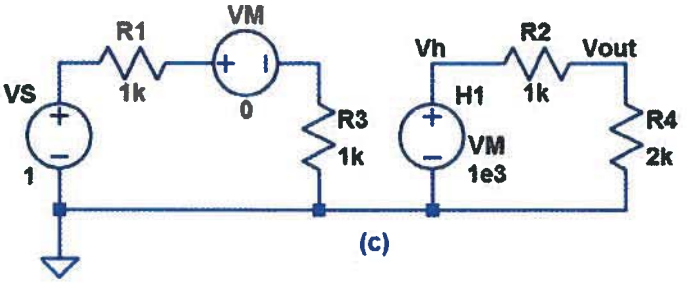
1. Find the voltages and currents in the following two circuits. Verify your hand-calculated answers using LTspice. (4 points)

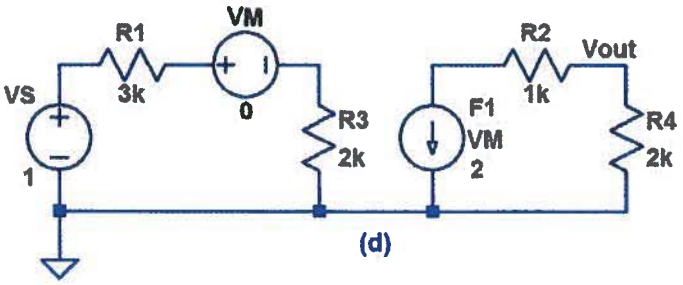


2. Find Vout in each of the following circuits. Verify your hand-calculated answers using LTspice. (8 points)





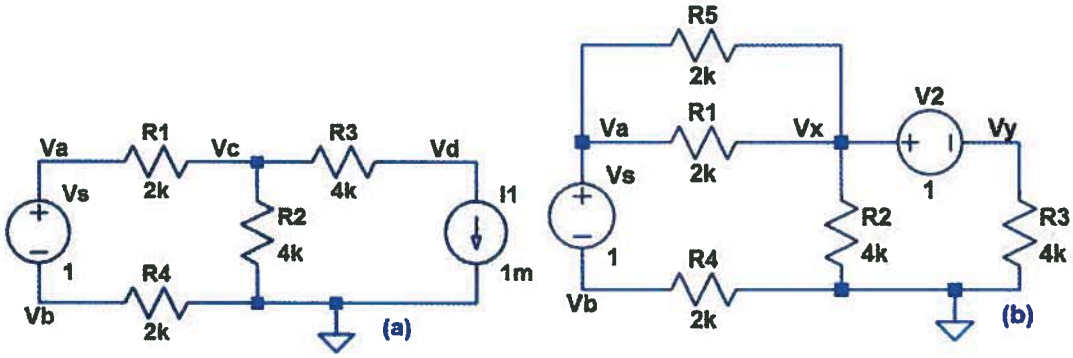




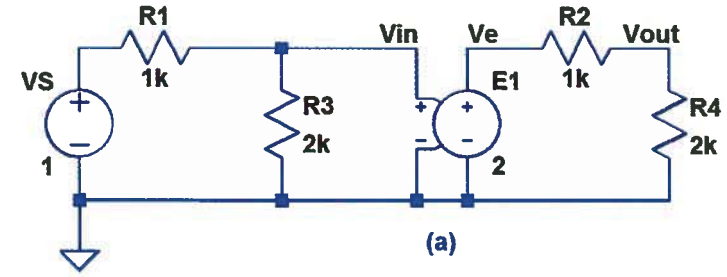
H.W. #10 EE 220 Fall 2016

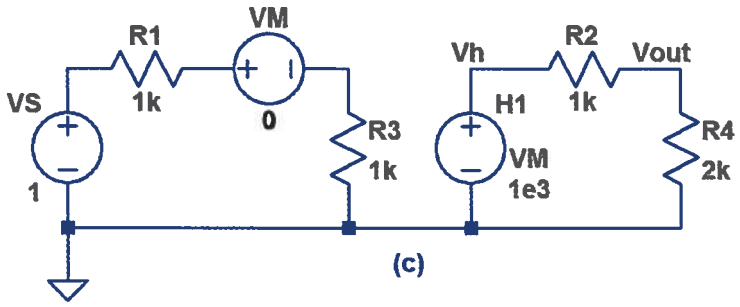
Show your work for credit!

1. The first two circuits from HW#9 are reproduced below. For each circuit calculate the power dissipated by each resistor and the power supplied by each source. No need to repeat finding the currents and voltages from problem 1 in HW#9. Simply list, and use, the results from HW#9 problem 1 in this one. Does the power dissipated by the resistors equal the power supplied by the sources? Do not turn in LTspice results (if you do I will ask the grader to take points off for not following the directions) but feel free to use LTspice to ensure that you did the problem right. (2 points)



2. Find the Thevenin and Norton equivalent circuits (models) at the terminals where R2 is connected (without R2 in the circuit) in the above two circuits. Use LTspice, with R2 back in the circuit and connected to your Thevenin and Norton equivalent circuits, to verify your models are correct. (4 points)
3. Can Thevenin and Norton equivalent circuits be determined for circuits with dependent sources? Why or why not? Using the (a) and (c) circuits from problem 2 in HW#9, pasted below, verify your answer. Assume that you are finding Thevenin and Norton equivalent circuits between Vout and ground, without R4 in the circuit. Verify your answer with LTspice simulations by connecting R4 to your Thevenin/Norton circuits and showing the same output voltage, Vout. (6 points)

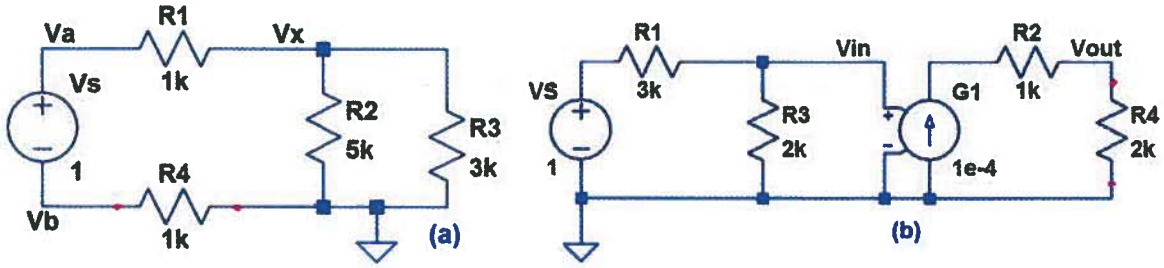




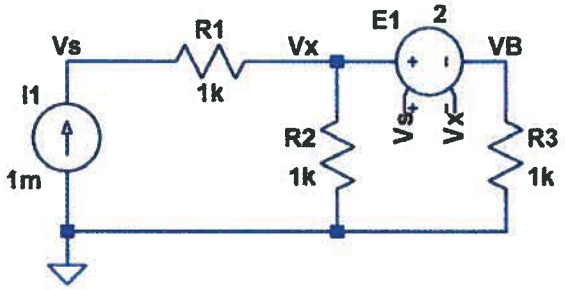
H.W. #11 EE 220 Fall 2016

Show your work for credit!

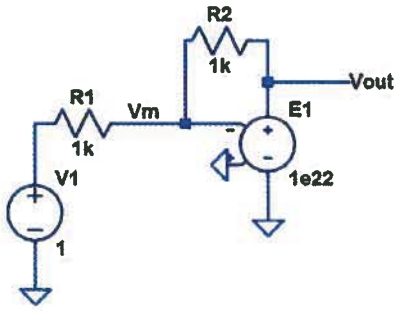
1. Calculate the voltage across R4 in the below circuits. Next find the Thevenin and Norton equivalent circuits at the port indicated by the red dots in the below schematics (this means without R4 in the circuit). Show that your equivalent circuits are correct and then verify with LTspice. (6 points)



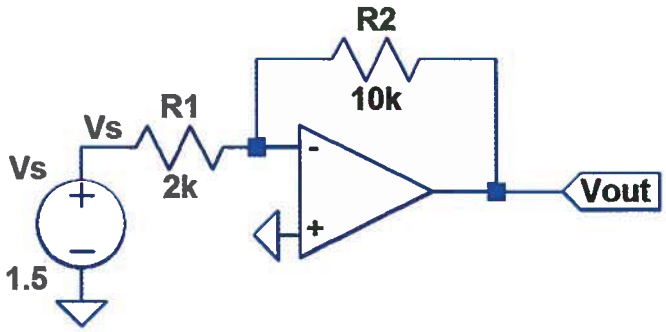
2. Find the voltage VB in the following circuit. Verify your answer with LTpsice. (3 points)



3. Find Vout in the following circuit. For all intents and purposes you can assume the gain of the VCVS is infinite. (3 points)



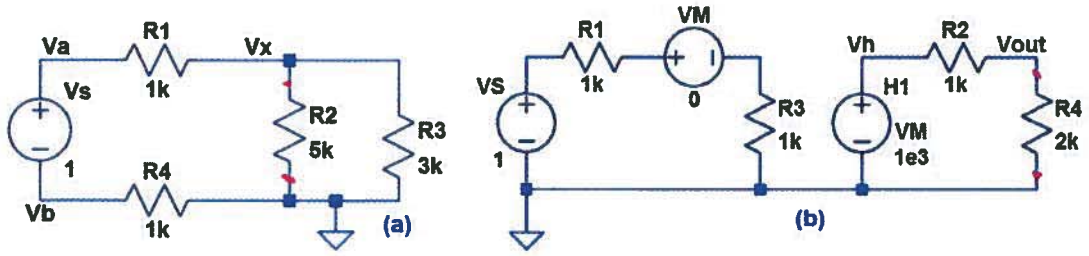
4. Find Vout in the following circuit. Verify your answer with LTspice. As always, show your work for credit. (2 points)



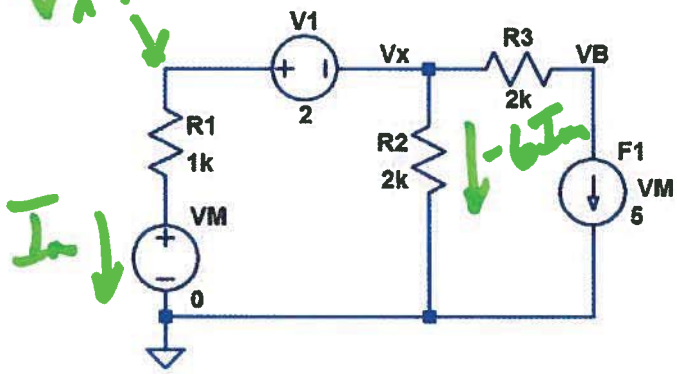
H.W. #12 EE 220 Fall 2016

Show your work for credit!

1. Calculate the voltage across Vx and Vout in the following circuits. Next find the Thevenin and Norton equivalent circuits at the port indicated by the red dots in the below schematics (this means without R2 or R4 in the circuit). Show that your equivalent circuits are correct and then verify with LTspice. (6 points)



2. Calculate VB in the following circuit and then verify your calculation using LTspice. (3 points)



$-6I_m = \frac{V_x}{2k}$

$I_m = \frac{V_x+2}{1k}$

3. Write an equation for Vout as a function of Vin in the following circuits. Plot Vout if Vin varies from -1 to 1 V in each circuit. Verify your answers, including your plots, using a DC sweep in LTspice. (6 points)