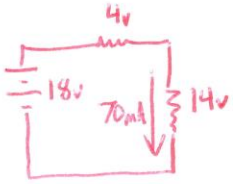
Midterm 2
Principles of Computer Engineering I

NAME:

STUDENT ID: Key

1. (6 pts - Maximum Power Transfer) If the voltage at the source terminals of a power supply is 18v without load, and with a load, that voltage drops to 14v when 70mA are sourced.

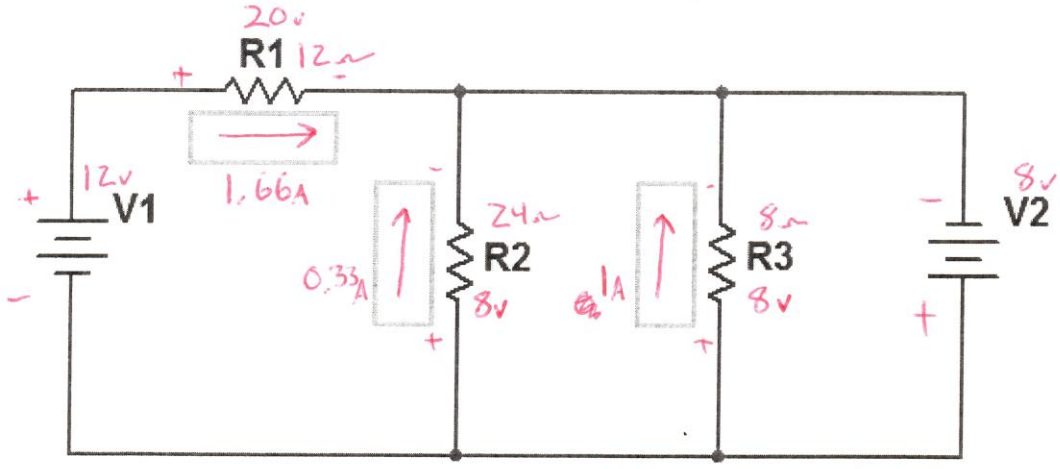


(3pt) What is the Internal Resistance of the Voltage Source? 57.143Ω

(3pt) What new load resistance would you pick in order to transfer max power?

57.143Ω

2. (10.5pts - Superposition) For the circuit below use Superposition to determine the Current Magnitude/Direction and Voltage for each component..



$R_1 = 12\Omega$, $R_2 = 24\Omega$, $R_3 = 8\Omega$, $V_1 = 12v$, $V_2 = 8v$

(1.5pt) Draw an arrow in each of the provided boxes to signify the conventional current direction of each component.

(2pt) I_{R1}: 1.66A

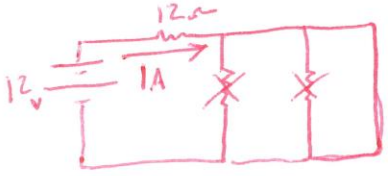
(1pt) V_{R1}: 20v

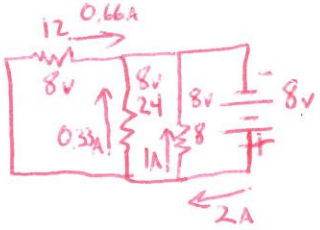
(2pt) I_{R2}: 0.33A

(1pt) V_{R2}: 8v

(2pt) I_{R3}: 1A

(1pt) V_{R3}: 8v

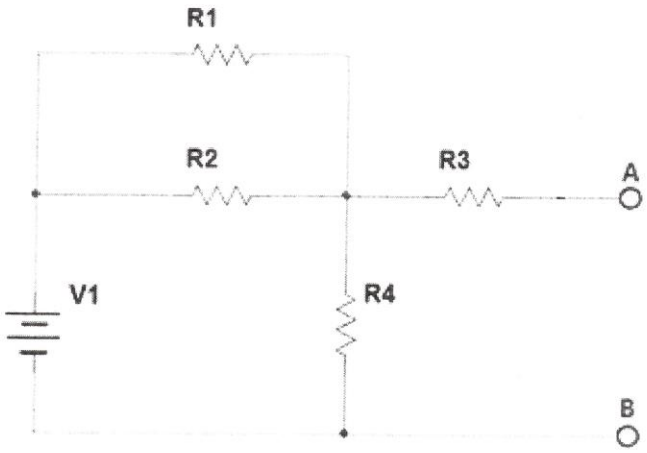




16.5

Midterm 2
Principles of Computer Engineering I

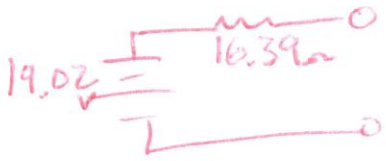
5. (12pts) For the following circuit, derive the Thevenin equivalent circuit.
V1 = 30 v, R1 = 30 ohm, R2 = 9 ohm, R3 = 12 ohm, R4 = 12 ohm



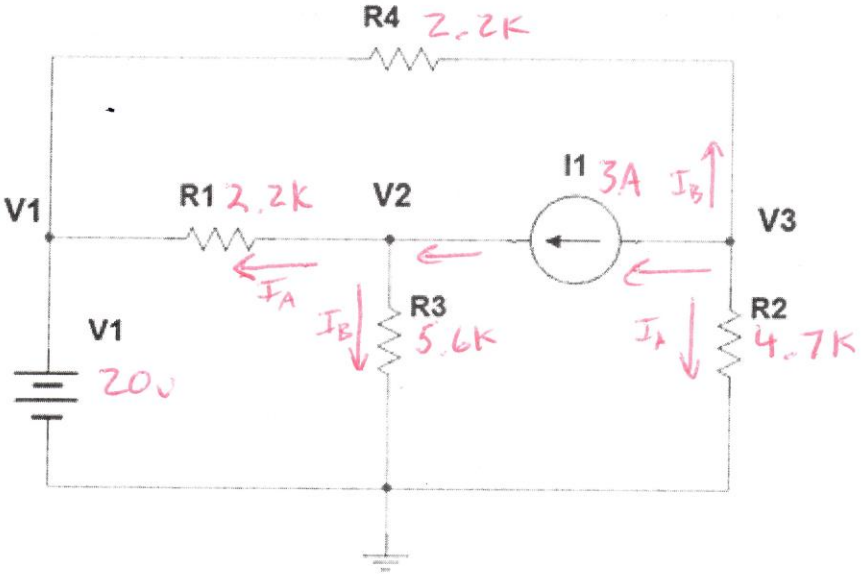
(3pt) R_{TH}: 16.39 Ω

(6pt) V_{TH}: 19.02 V

(2pt) Draw the Thevenin Equivalent Circuit (include all values).



6. (12pt Nodal Analysis) Solve the circuit below using Nodal Analysis. The Reference node and the 3 nodes to solve for have already been placed for you.



R1 = 2.2KΩ, R2 = 4.7KΩ, R3 = 5.6KΩ, R4 = 2.2KΩ, I1 = 3A, V1 = 20v

(2pt) Node 1 Equation: $V_1 = 20v$

(2pt) Node 2 Equation: $I_A + I_B = 3A$ $I_A = \frac{V_2 - V_1}{2.2K}$ $I_B = \frac{V_2}{5.6K}$

$\frac{V_2 - V_1}{2.2K} + \frac{V_2}{5.6K} = 3A$

(2pt) Node 3 Equation: $3A + I_A + I_B = 0$ $I_A = \frac{V_3}{4.7K}$ $I_B = \frac{V_3 - V_1}{2.2K}$

$3A + \frac{V_3}{4.7K} + \frac{V_3 - V_1}{2.2K} = 0$

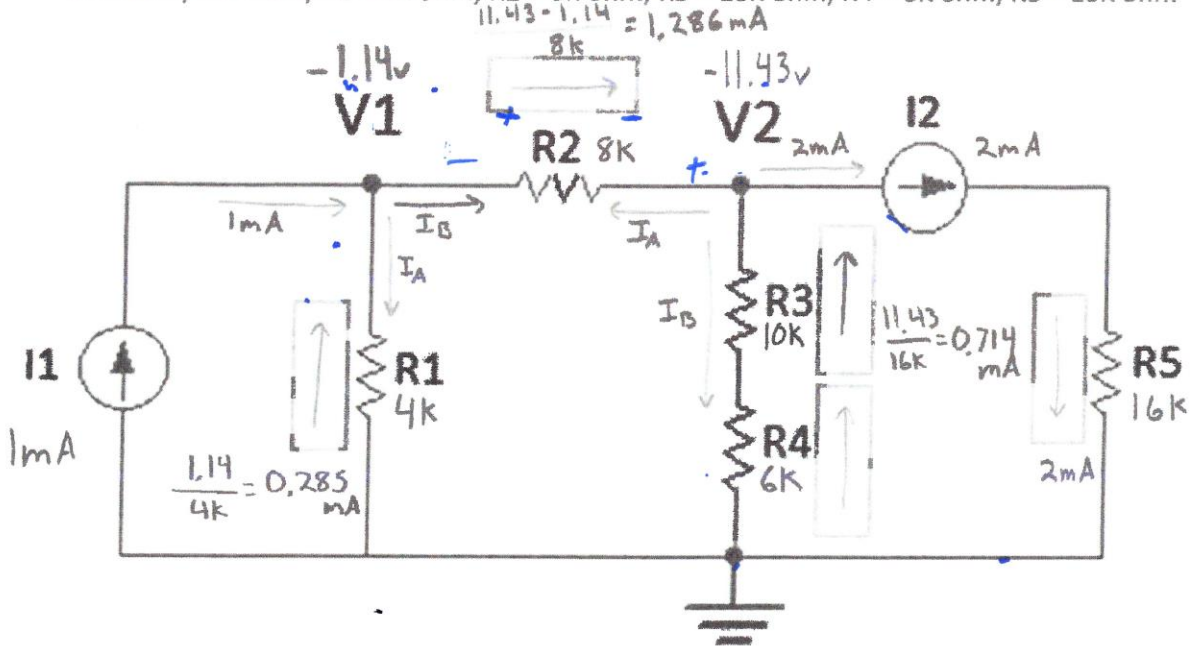
(6pt) Solve the system of 3 equations for V1, V2, and V3.

V1: 20 V V2: 4752.8 V V3: -4482 V

Midterm 2
Principles of Computer Engineering I

1. (13 pts Nodal Analysis) Solve the circuit below using Nodal Analysis. The Reference node and the 3 nodes to solve for have already been placed for you. 15.5

I1 = 1mA, I2 = 2mA, R1 = 4K ohm, R2 = 8K ohm, R3 = 10K ohm, R4 = 6K ohm, R5 = 16K ohm



(2pts) Node 1 Equation: $1mA = I_A + I_B$

$I_A = \frac{V_1}{4K}$ I_B $\frac{V_1 - V_2}{8K}$

$1mA = \frac{V_1}{4K} + \frac{V_1 - V_2}{8K}$

(2pts) Node 2 Equation: $I_A + I_B + 2mA = 0$

$I_A = \frac{V_2 - V_1}{8K}$ $I_B = \frac{V_2}{16K}$

$\frac{V_2 - V_1}{8K} + \frac{V_2}{16K} + 2mA = 0$

(4pts) Solve the system of 2 equations for V1, V2

V1 = -1.14 v V2 = -11.43 v

(7.5pts) Use your solution to calculate the current through each component. Use the provided boxes to Draw an arrow for <u>each</u> resistor on the above schematic to signify "Actual" Current Direction and list the currents below

IR1 = 0.285 mA IR4 = 0.714 mA

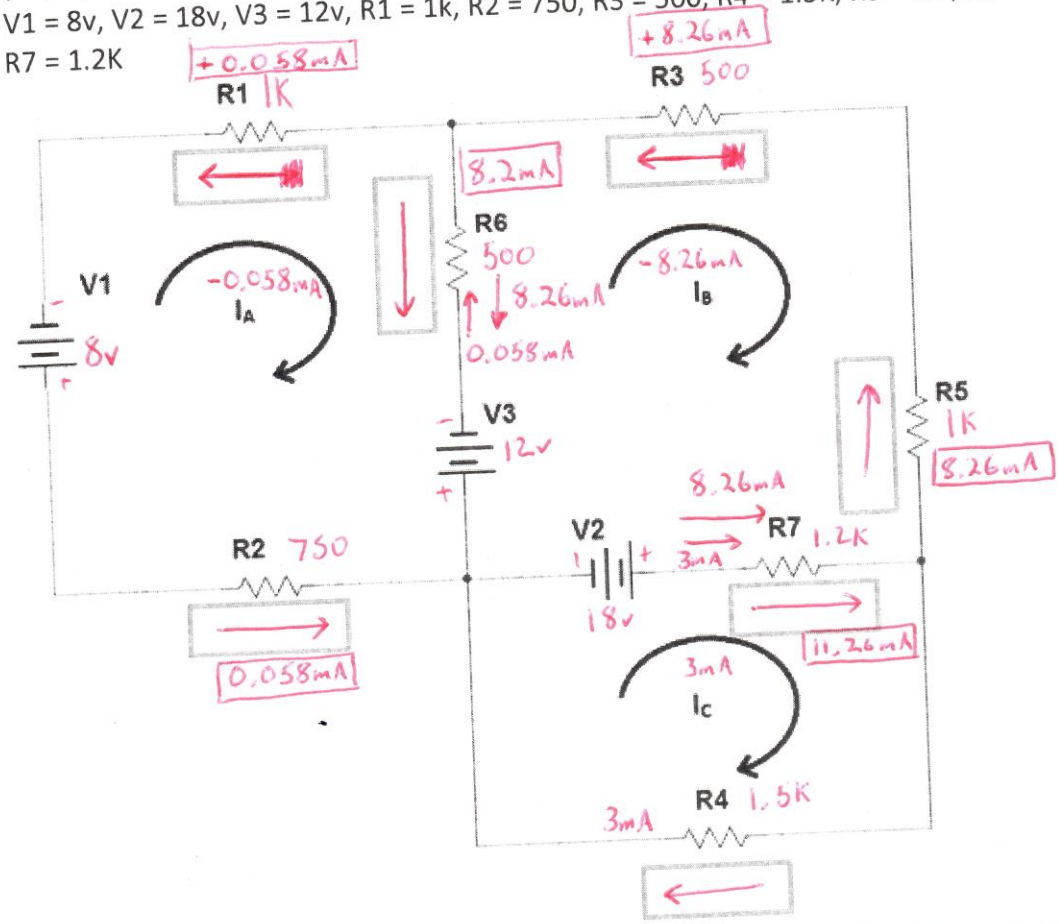
IR2 = 1.286mA IR5 = 2mA

IR3 = 0.714mA

15.5

Midterm 2
Principles of Computer Engineering I

7. (19pts) Use Mesh Analysis to solve the following problem.
V1 = 8v, V2 = 18v, V3 = 12v, R1 = 1k, R2 = 750, R3 = 500, R4 = 1.5K, R5 = 1K , R6 = 500, R7 = 1.2K



(2pts) Equation for Mesh Current I_A: $1K I_A + 500 I_A - 500 I_B - 12v + 750 I_A + 8v = 0$

(2pts) Equation for Mesh Current I_B: $2.25K I_A - 500 I_B = 4v$
$500 I_B + 1K I_B + 1.2K I_B - 1.2K I_C + 18v + 12v + 500 I_B - 500 I_A$
$-500 I_A + 3.2K I_B - 1.2K I_C = -30v$

(2pts) Equation for Mesh Current I_C: $-18v + 1.2K I_C - 1.2K I_B + 1.5K I_C$
$-1.2K I_B + 2.7K I_C = 18v$

(6pts) Mesh Current I_A: -0.058mA Mesh Current I_B: -8.26mA Mesh Current I_C: 3mA

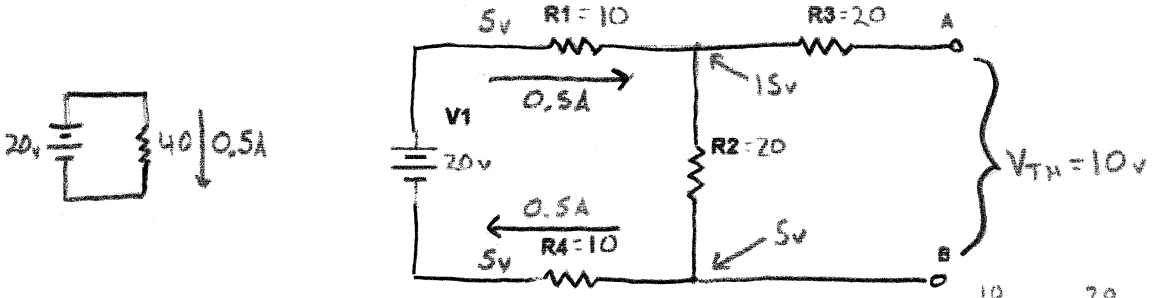
(3.5pts) Use the provided boxes in the circuit to draw an arrow for the "actual" conventional current of each component.

(3.5pts) Fill in the voltages for each component in the table below:

V_{R1} = 0.058v	V_{R5} = 8.26v
V_{R2} = 0.044v	V_{R6} = 4.1v
V_{R3} = 4.13v	V_{R7} = 13.512v

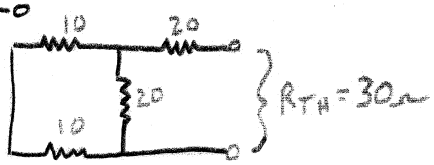
Midterm 2
Principles of Computer Engineering I

3. (12pt) For the following circuit, derive the Thevenin equivalent circuit.

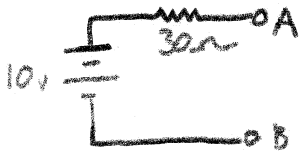


R1 = 10Ω, R2 = 20Ω, R3 = 20Ω, R4 = 10Ω, V1 = 20v

(3pt) R_{th}: 30Ω (6pt) V_{th}: 10v

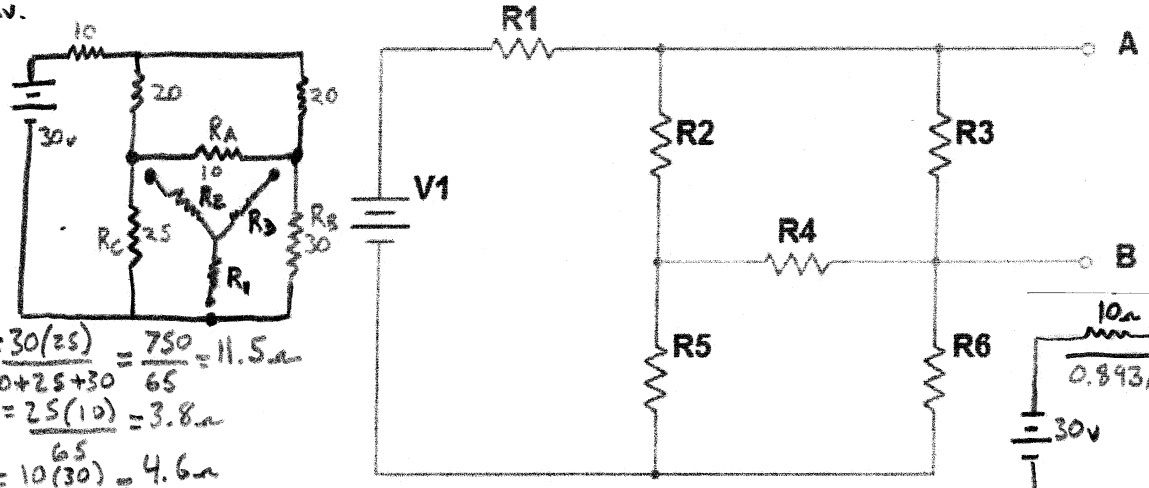


(3pt) Draw the Thevenin Equivalent Circuit (include values for all components).



Delta→Wye Conv.

4. (12pts) For the following circuit, derive the Thevenin equivalent circuit



$R_1 = \frac{30(25)}{10+25+30} = \frac{750}{65} = 11.5\Omega$

$R_2 = \frac{25(10)}{65} = 3.8\Omega$

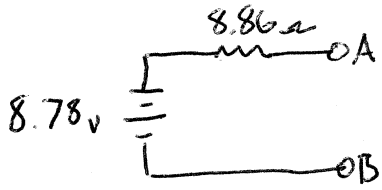
$R_3 = \frac{10(30)}{65} = 4.6\Omega$

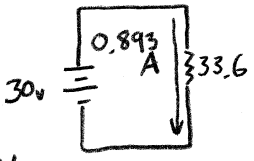
V1 = 30v, R1 = 10Ω, R2 = 20Ω, R3 = 20Ω, R4 = 10Ω, R5 = 25Ω, R6 = 30

(3pt) R_{TH}: 8.86Ω (6pt) V_{TH}: 8.78v

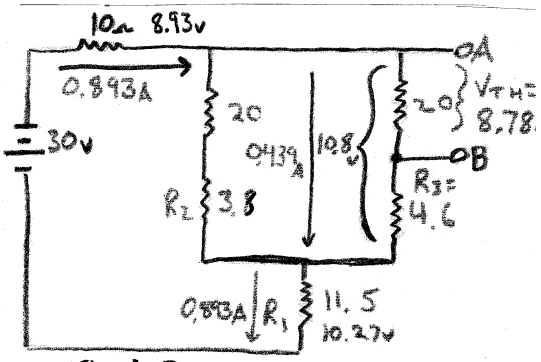
(3pt) Draw the Thevenin Equivalent Circuit (include all values).

Thevenin Equivalent Circuit





Find V_{TH}



Find R_{TH}