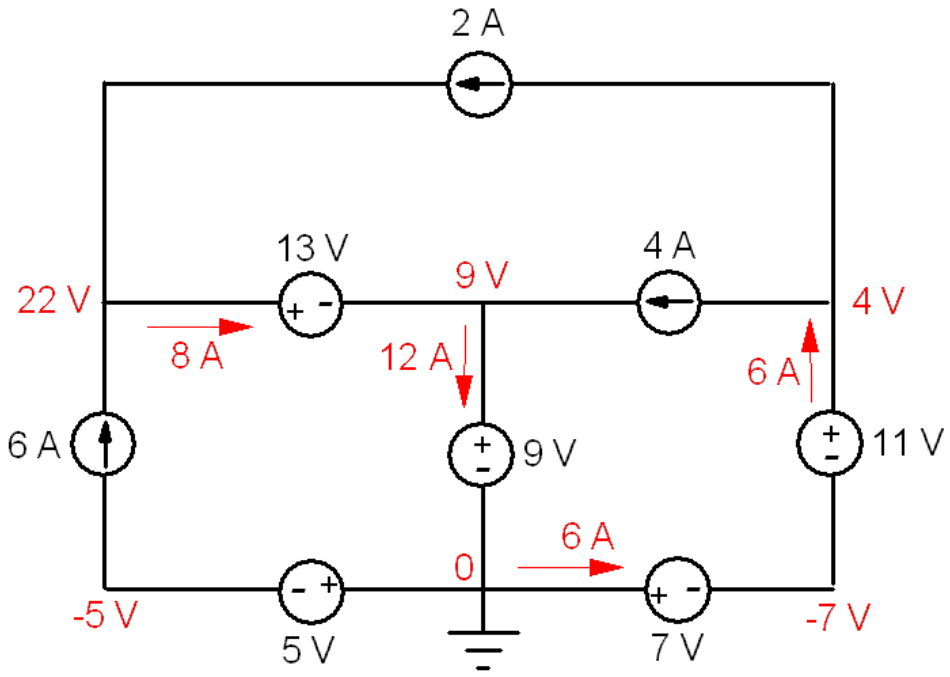
ECE 35 Midterm (Spring 2017) **Name/pid_____**

(3 problems, 10 pts each)

1. For the circuit below, calculate the power supplied or absorbed (specify one) by each of the eight sources.



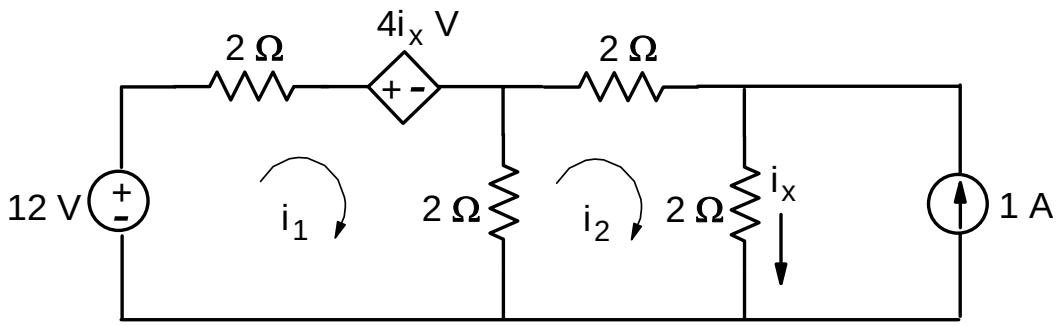
Solution:

Apply KCL and KVL to come up with all the voltages and currents as shown in red.

- 2 A current source: Supplies 2x(22 – 4) = 36 W.
- 4A current source: Supplies 4x(9 – 4) = 20 W.
- 6A current source: Supplies 6x(22 + 5) = 162 W.
- 5 V voltage source: Absorbs 5x6 = 30 W.
- 7 V voltage source: Absorbs 7x6 = 42 W.
- 9 V voltage source: Absorbs 9x12 = 108 W.
- 11 V voltage source: Supplies 11x6 = 66 W.
- 13 V voltage source: Absorbs 13x8 = 104 W.

Total power absorbed =	30 + 42 + 108 + 104 =	284 W.
Total power supplied =	36 + 20 + 162 + 66 =	284 W.

2. Solve the circuit below for i_1, i_2, i_x.



Solution:

$$i_x = i_2 + 1$$

KVL, left loop, $12 - 2\,i_1 - 4\,i_x - 2\,(i_1 - i_2) = 0$

KVL, middle loop, $2\,(i_1 - i_2) - 2\,i_2 - 2\,i_x = 0$

Eliminate i_x from the above eqs.,

$$4 - 2\,i_1 - i_2 = 0$$

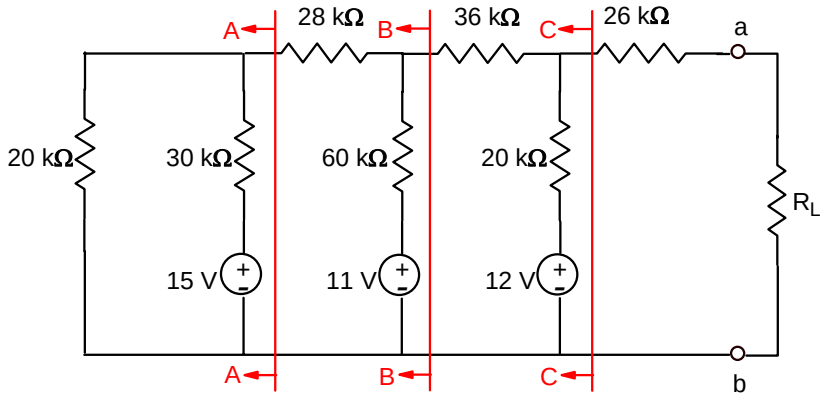
$$i_1 - 3\,i_2 - 1 = 0$$

Solve $i_1 = 13/7$ A

$i_2 = 2/7$ A

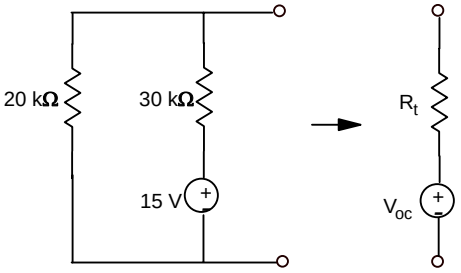
$i_x = 9/7$ A.

3. Find the value of R_L across port (a,b) that maximizes the power absorbed in R_L. How much is the maximum power absorbed?



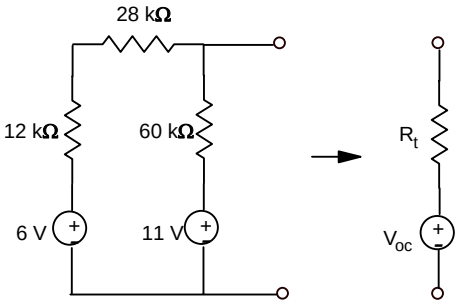
Solution: Apply Thevenin's theorem repeatedly,

AA:



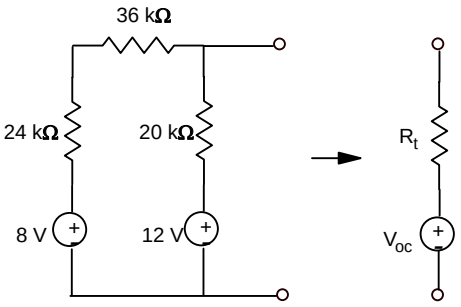
$R_t = 20k//30k = 12k,$
$V_{oc} = 15\times20k/(20k + 30k) = 6$ V.

BB:



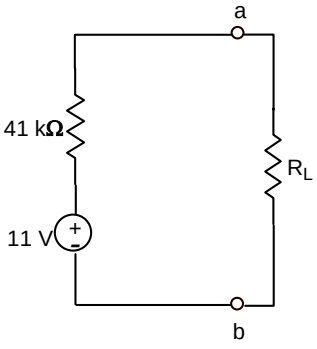
$R_t = (12k + 28k)//60k = 24k,$
$V_{oc} = 11 - 60k\times(11 - 6)/(40k + 60k) = 8$ V.

CC:



$R_t = (24k + 36k)//20k = 15k,$
$V_{oc} = 12 - 20k\times(12 - 8)/(60k + 20k) = 11$ V.

Final circuit:



For maximum power, $R_L = 41\ k\Omega$.
Maximum power = $11^2/(4x41k)$ = 121/164 mW.