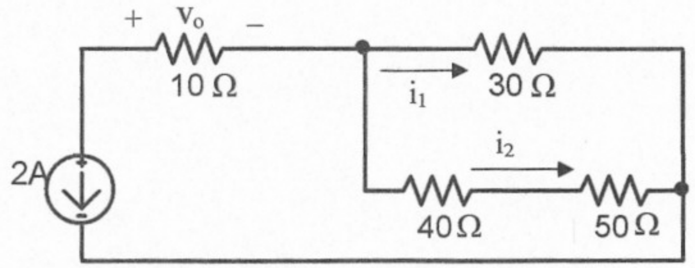
UNIVERSITY OF UTAH
ELECTRICAL AND COMPUTER ENGINEERING DEPARTMENT

ECE 1270 HOMEWORK #1 Solution Summer 2007

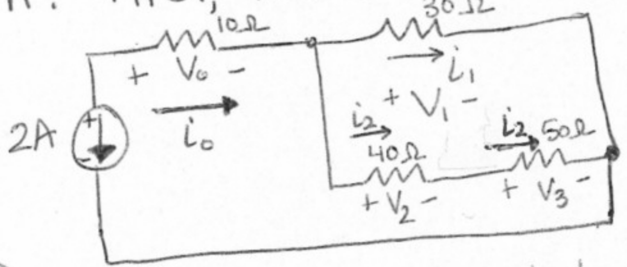
1.




(a) Calculate $i_1$, $i_2$, and $v_o$.
(b) Find the power dissipated for every component including the current source.

step1

Sol'n: First, label all resistors to have current and voltage




Step2

Next write eq. for wanted unknowns:

- Ohm's law ⇒ ① $V_o = i_o(10)$
  ② $V_1 = i_1(30)$
  ③ $V_2 = i_2(40)$
  ④ $V_3 = i_2(50)$
- V loop equation ⇒ (remember to avoid taking a V loop with the current source in it)
  ⑤ $+V_3 + V_2 - V_1 = 0$
- I sum equation ⇒ ⑥ $-i_o + i_1 + i_2 = 0$
- Since only one current can flow in a branch ⇒

$$i_o = -2A$$

$$\therefore\ V_o = -2(10) = \boxed{-20\,V}$$

#1 (cont.)

- Need to solve for $i_1$ and $i_2$. Knowing $i_o$, eq. ⑥ is

⑦ $i_1 + i_2 = -2A$

→ Need another eq. with just $i_1$ and $i_2$ in it ⇒

- Use ⑤ with ②, ③ and ④ in it:

⑧ $i_2(50) + i_2(40) - i_1(30) = 0$

- We now have 2 eq. and 2 unknowns →
  - eq. → ⑦ and ⑧
  - unknowns → $i_1, i_2$

$$i_1 = (-2 - i_2)$$

$$i_2(90) - 30(-2 - i_2) = 0$$

$$i_2(90) + 30 i_2 + 60 = 0$$

$$i_2(120) = -60$$

$$\therefore \quad i_2 = -\frac{60}{120} = \boxed{-\frac{1}{2} A}$$

$$i_1 = (-2 - i_2) = -2 - \tfrac{1}{2} = \boxed{-1\tfrac{1}{2} A}$$

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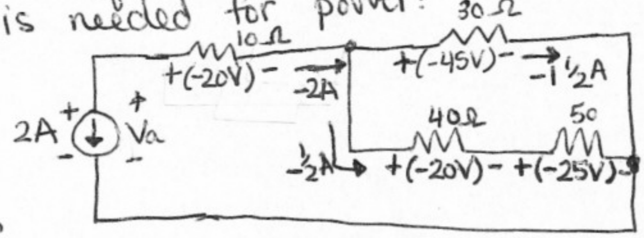
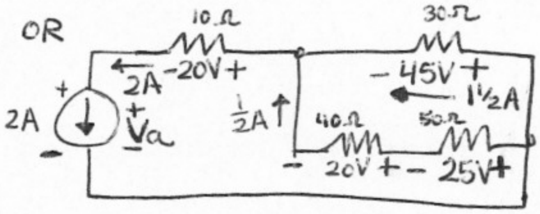
From eq ①, ②, ③, and ④ we know all V's across R's. The voltage across the 2A is needed for power:




OR




$$+V_a + 20 + 45 = 0$$

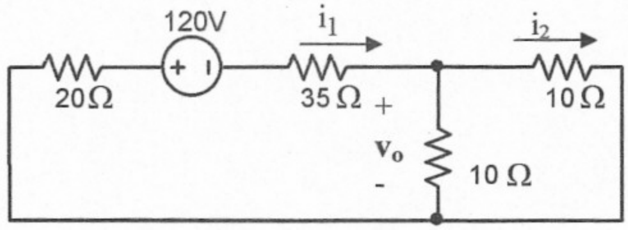
$$V_a = -65V$$

power

| | absorbed | delivered |
|---|---|---|
| 2A src. | | $-(65)(2) = -130W$ |
| 10Ω | $+20(2) = 40W$ | |
| 30Ω | $45(1\tfrac{1}{2}) = 67.5W$ | |
| 40Ω | $(20)(.5) = 10W$ | |
| 50Ω | $25(.5) = 12.5W$ | |
| Total | $+130W$ | $-130W$ |

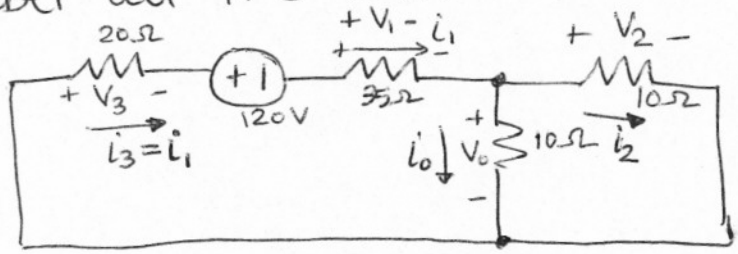
delivered = absorbed

2.




① Calculate $i_1$, $i_2$, and $v_o$.

• Label all R's with an I and V




• Note that only 1 current can be in a branch ⇒
∴ $(i_1 = i_3)$

② • Ohm's Law:

$V_3 = i_1(20)$

$V_1 = i_1(35)$

$V_o = i_o(10)$

$V_2 = i_2(10)$

③ V loops ⇒

$+V_o - V_2 = 0 \Rightarrow V_o = V_2$

$+V_o + V_1 + V_3 + 120 = 0$

④ current Sum ⇒

$-i_1 + i_o + i_2 = 0$

• Now we need to get eq. with the same variables.

→ Replacing $V_2$ with $V_o$ ⇒ From ohm's Laws:

$V_o = i_o(10)$ and $V_o = i_2(10)$

∴ $i_o(10) = i_2(10)$ so $i_o = i_2$ ⑤

→ Replacing $V_o, V_1, V_3$ to be interms of $i_o$ and $i_1$ gives another eq.

$i_o(10) + i_1(35) + i_1(20) + 120 = 0$

$i_o(10) + i_1(55) + 120 = 0$ ⑥

• Using ④, ⑤, and ⑥ {put ⑤ into ④ and solve for $i_1$}

$-i_1 + 2i_o = 0 \Rightarrow i_1 = 2i_o$ { now put this eq. into ④}

$-2i_o + 2i_o = 0$ (See what happens when you put into the wrong eq. → No sol.) → put into ⑥

#2 (Cont.)

$i_1 = 2i_o \qquad i_o = i_2$

6

$i_o(10) + 2i_o(55) + 120 = 0$

$120(i_o) = -120/120$

$i_o = \boxed{-1A}$

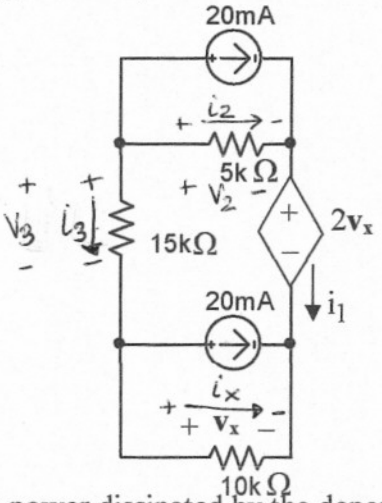
$i_o = i_2 = \boxed{-1A}$

$i_1 = 2i_o = \boxed{-2A}$

$V_o = i_o(10) = \boxed{-10V}$

$2i_3 + 10m = i_x$

3. ① Label all R's with a current and a Voltage.




Find $v_x$, $i_1$, and the power dissipated by the dependent source.

2. a. Write Ohm's Law eq:

① $V_x = i_x(10K)$

② $V_3 = i_3(15K)$

③ $V_2 = (5K)i_2$

b. V loop eq's: (avoid taking loop through I src's)

④ $+V_3 - V_2 - 2V_x + V_x = 0$

c. I summation:

⑤ $i_3 + i_2 + 20m = 0$

⑥ $-i_3 + 20m + i_x = 0$

Eq. ⑥ and ⑤ contain 3 unknown's. Using these 2 and rewriting ④ in terms of $i_2$, $i_3$, and $i_x$ gives 3rd eq:

⑦ $i_3(15K) - i_2(5K) - 2i_x(10K) + i_x(10K) = 0$

$i_3(15K) - i_x(10K) = i_2(5K)$

⑧ $i_3(3) - i_x(2) = i_2 \Rightarrow$ Plug this into ⑤:

$i_3 + [i_3(3) - i_x(2)] + 20m = 0$

$4i_3 + 20m = 2i_x$

$2i_3 + 10m = i_x$

#3 (cont.)

⑨ $2i_3 + 10m = i_x \Rightarrow$ plug into ⑥

$$-i_3 + 20m + 2i_3 + 10m = 0$$

$$i_3 + 30m = 0$$

$$i_3 = \underline{-30m\ A} \Rightarrow \text{plug back into ⑨}$$

$$2(-30m) + 10m = i_x$$

$$\therefore \quad i_x = \underline{-50m\ A} \Rightarrow \text{use to find } V_x \text{ ①}$$

$$V_x = i_x(10K) = -50m(10K) = \boxed{-500\ V}$$

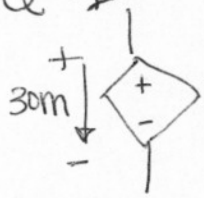
To find $i_1 \Rightarrow$ use current summation

$$-i_1 - 20m - i_x = 0$$

$$i_1 = -20m - (-50m) = \boxed{+30mA}$$

- power for dependent source $\Rightarrow$

$$P = i_1(2V_x)$$




$2V_x = 2(-500) = -1{,}000V$

$$\text{power} = -(30m)(1{,}000)$$

$$\text{power} = \boxed{-30\ W}$$