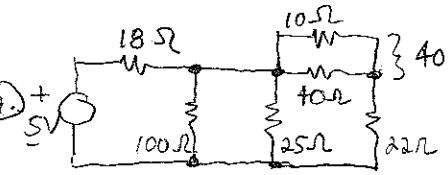
3.6, 4.14, 4.18a
4.36, 4.42a, 4.50, 4.54

Engineering 11
Electrical Circuit Analysis
Assignment 2 Solutions

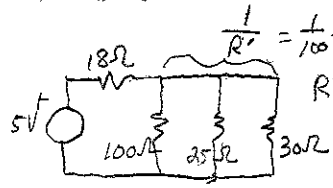
2005
LAM

(1) (3.6) (a)



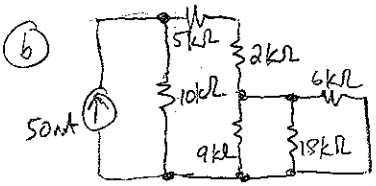
$40 \| 10 = \frac{40(10)}{40+10} = 8\Omega$

8Ω in series w/ 22Ω = 30Ω

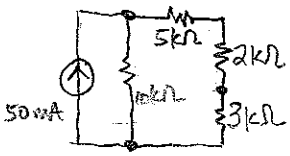


$\frac{1}{R'} = \frac{1}{100} + \frac{1}{25} + \frac{1}{30} \Rightarrow R' = 12\Omega$

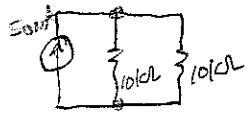
(b)

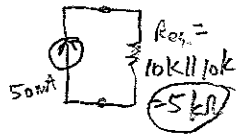


6k || 18k || 9k = 3k

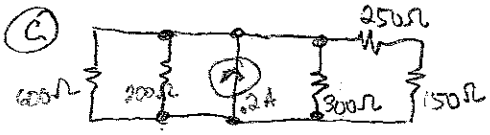


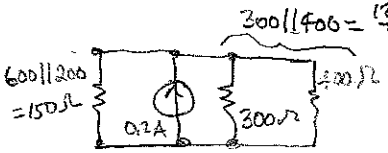
In series, 5k + 2k + 3k = 10kΩ



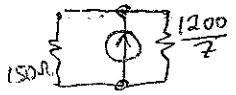


(c)

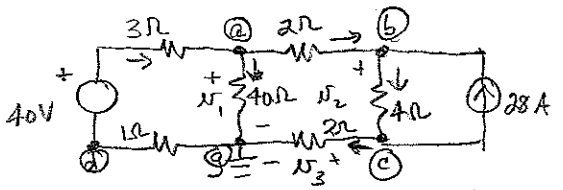




Note: all in parallel



(2) (4.14) (a) Find v_1, v_2, v_3 using node voltage method



$$\sum_a i = 0 = \frac{(40+v_2)-v_1}{3} - \frac{v_1-0}{40} - \frac{(v_1-v_2)}{2}$$

$$\sum_b i = 0 = \frac{v_1-v_2}{2} - \frac{v_2-v_3}{4} + 28$$

$$\sum_c i = 0 = \frac{v_2-v_3}{4} - \frac{v_3}{2} - 28$$

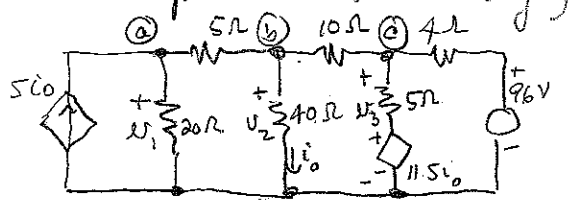
$$\sum_g i = 0 = \frac{v_2-0}{1} + \frac{v_1}{40} + \frac{v_3}{2}$$

$v_a = v_1$, $v_b = v_2$, $v_c = v_3$

Using MATLAB, $\boxed{v_1 = 60\text{V},\ v_2 = 73\text{V},\ v_3 = -13\text{V}}$

(b) $P_{28A} = v_{28A} \cdot i_{28A} = (v_3 - v_2)(28) = (-86)(28) = -2408$ W (power delivered since neg.)

(3.) (4.18a) Find $v_1, v_2, \& v_3$.



$$\sum_a i = 0 = 5i_0 - \frac{v_1}{20} - \frac{(v_1-v_2)}{5}$$

$$\sum_b i = 0 = \frac{(v_1-v_2)}{5} - \frac{v_2}{40} - \frac{(v_2-v_3)}{10}$$

$$\sum_c i = 0 = \frac{(v_2-v_3)}{10} - \frac{(v_3-96)}{4} - \frac{(v_3-11.5i_0)}{5}$$

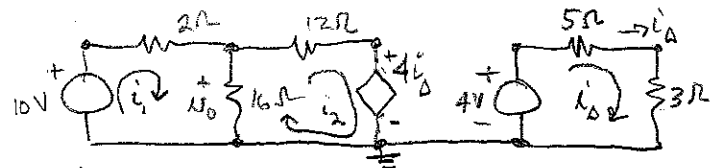
Also need eq for i_0:

$$i_0 = \frac{v_2}{40}$$

Using MATLAB,

$\boxed{v_1 = 156\text{ V},\ v_2 = 120\text{ V},\ v_3 = 78\text{ V}}$

(4.) (4.36) Use mesh current to find v_0.



$$\sum_{\text{loop 1}} v = 0 = 10 - 2i_1 - 16(i_1 - i_2)$$

$$\sum_{\text{loop 2}} v = 0 = 16(i_2 - i_1) + 12i_2 + 4i_\Delta$$

$$\sum_{\text{loop 3}} v = 0 = 4 - 5i_\Delta - 3i_\Delta$$

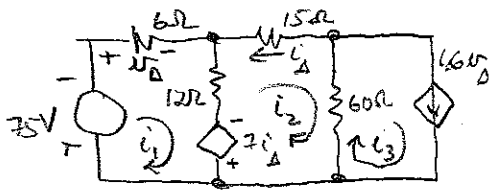
Solve using MATLAB

$\Rightarrow i_1 = 1\text{A},\ i_2 = 0.5\text{A},\ i_\Delta = 0.5\text{A}$

so $\boxed{v_0 = 16(i_1 - i_2) = 8\text{V}}$

(b) Find power delivered by dependent source. $P = (4i_\Delta)(i_2) = 2(\frac{1}{2}) = \boxed{1\text{W absorbed}}$ (or -1 W delivered.)

(5) (4.42) @ Use mesh currents to find which sources are delivering power.



$\sum_1 v = 0 = 75 + 6i_1 + 12(i_1 - i_2) - 7i_\Delta$

$\sum_2 v = 0 = 7i_\Delta + 12(i_2 - i_1) + 15i_2 + 60(i_2 - i_3)$

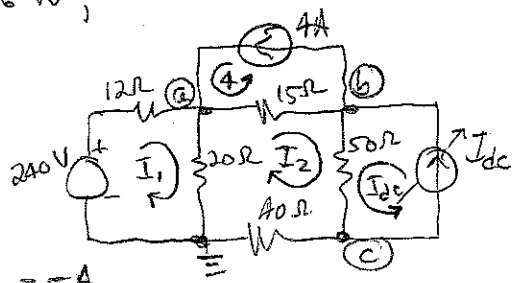
Loop 3: $i_3 = 1.6v_\Delta = 1.6(6i_1) = 9.6i_1$; Dependent Source: $i_\Delta = -i_2$ $\quad i_\Delta = -29.4A$

Solve using MATLAB $\Rightarrow i_1 = 4A$, $i_2 = 29.4A$, $i_3 = 38.4A \Rightarrow v_\Delta = 6i_1 = 24V$

$P_{75V} = 75(4) = 300\,W$, $P_{vccs} = (-540)(16)(24) = -20,736\,W$,

$P_{ccvs} = -7(-29.4)(4 - 29.4) = -5227\,W$

(6) (4.50) Want power delivered by 4A source $\to 0$



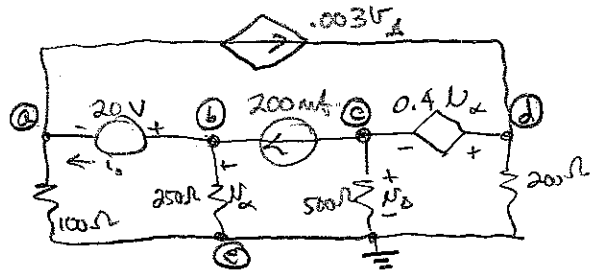
For no power from 4A source, need $v_{ab} = 0 \Rightarrow I_2 = -4A$

Then $\sum_1 v = 0 = 240 - 12I_1 - 20(I_1 - I_2)$ (where $I_2 = -4$) $\Rightarrow I_1 = 5A$

And $\sum_2 v = 0 = 50(I_2 + I_{dc}) + 40I_2 + 20(I_2 - I_1) = 0$ (sub in I_1 & I_2) $\Rightarrow$ $\boxed{I_{dc} = 10.8\,A}$

(7) 4.54 Use node voltage method since dependent sources are given in terms of v's.

(Consider ab & cd as supernodes.)



$\frac{v_a}{100} + \frac{v_b}{250} - 0.2 + .003(v_\Delta = v_c) = 0$

$\frac{v_c}{500} + \frac{v_d}{200} - 0.003v_c + 0.2 = 0$

where $v_b - v_a = 20$

$v_d - v_c = 0.4v_\alpha = 0.4v_b$

$\therefore v_b = 44\,V$; $i_o = 0.2 - \frac{44}{250} = 0.024\,A$

& $\boxed{P_{20V} = 20i_o = 480\,mW \text{ absorbed}}$