EE100 Fall 2008
Guest Lecture 2: Mesh and Nodal Analysis

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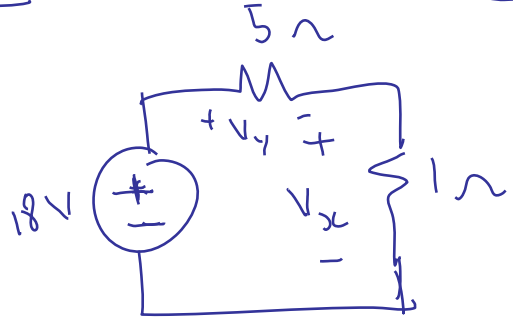
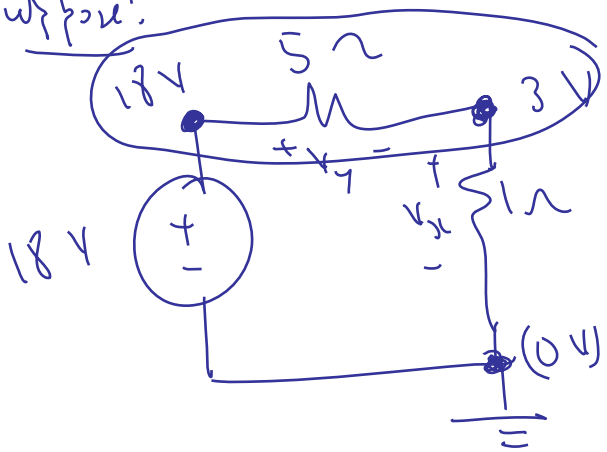
Today: (1) Concept of a ground.

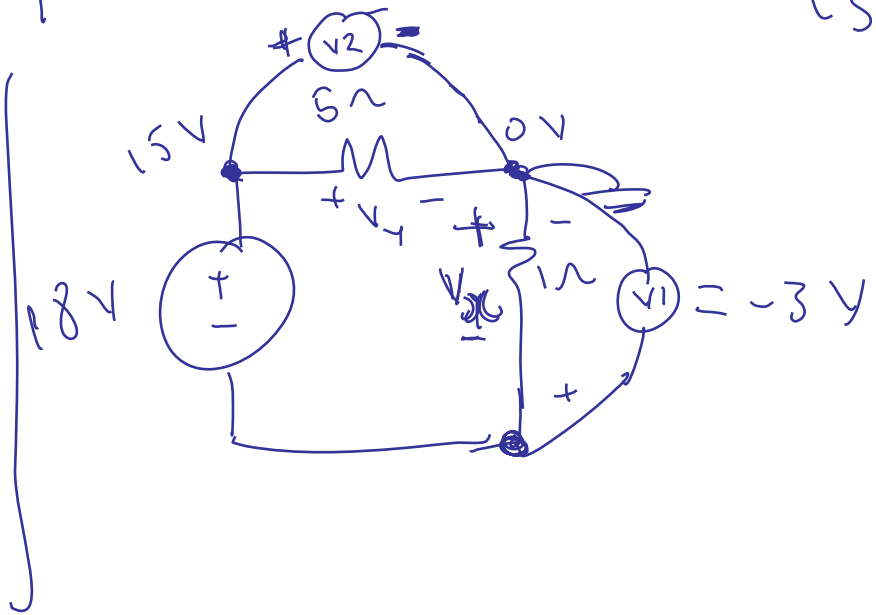


$$V_x = 3\,V = \boxed{(18\,V)\,\frac{1}{(5+1)}} \rightarrow \text{Voltage Divider}$$

$$V_y = 15\,V = 18 - 3 = (18\,V)\left(\frac{5}{5+1}\right)$$

Suppose:

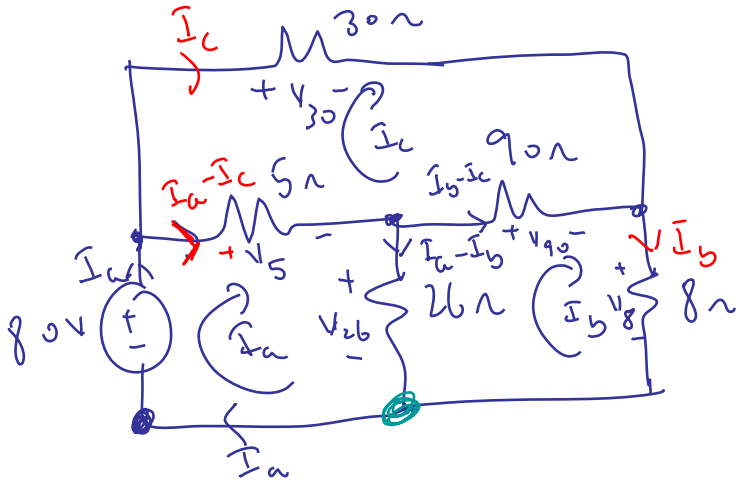




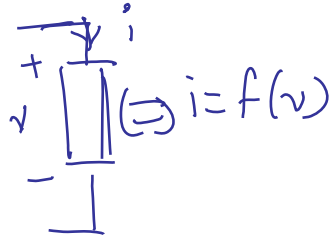
Mesh Analysis: ("Dual" of nodal analysis)

[Reading: Section 4.5 - 4.7 in your book]

Dp. 4.7 on p.107 (a) Find the power delivered by the 80V source to the circuit shown.



Recall: [Sign convention]



Note: (counterclockwise):

loop I_a: $V_{26}+V_5-80=0$

$\Rightarrow +(I_a-I_b)26+(I_a-I_c)5-80=0$

KVL around loop I_a:

$80-V_5-V_{26}=0$ ✓ $\Rightarrow 80-V_5-V_{26}=0$

$-80+V_5+V_{26}=0$ $\Rightarrow$ $80-(I_a-I_c)5-(I_a-I_b)26=0$ — (1)

KVL around loop I_b: $26(I_a-I_b)-90(I_b-I_c)-8I_b=0$ — (2)

KVL around loop I_c: $90(I_b-I_c)+5(I_a-I_c)-30I_c=0$ — (3)

In matrix form:

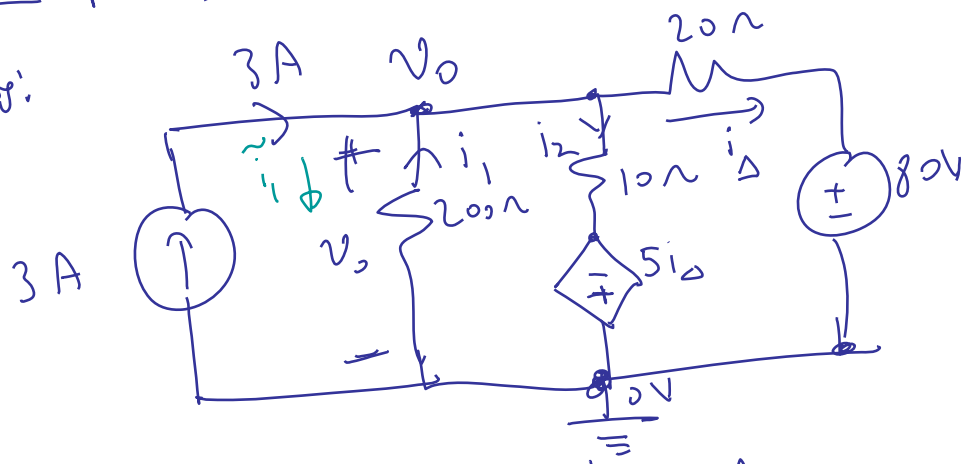
$$\begin{bmatrix} 31 & -26 & -5 \\ 26 & -124 & 90 \\ 5 & 90 & -125 \end{bmatrix} \begin{bmatrix} I_a \\ I_b \\ I_c \end{bmatrix} = \begin{bmatrix} 80 \\ 0 \\ 0 \end{bmatrix}$$

$$\Rightarrow \quad I_a = 5\ A$$
$$I_b = 2.5\ A$$
$$I_c = 2\ A$$

$$P_{supplied} = -(80)(5) = -400\ W$$

$$\boxed{P_{delivered} = 400\ W}$$

p4.17 (p.140) (a) Find v_o in the circuit below using nodal analysis:



Nodal: ① Pick a ground node

② Figure out the number of unknown essential nodes. [Only one: v_o]

③ KCL @ v_o: $\sum i_{in} = \sum i_{out}$

$\Rightarrow 3 + i_1 = i_2 + i_\Delta$

$\sum i_{in} = \sum i_{out}$

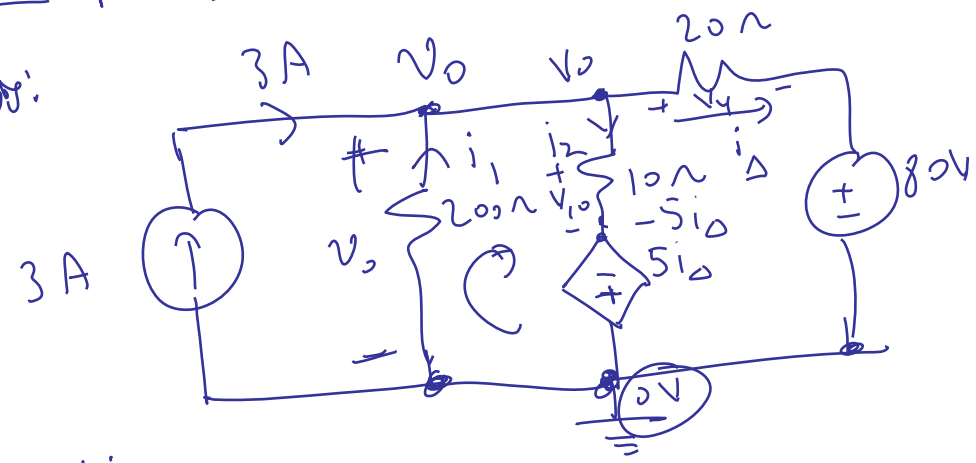
$\Rightarrow 3 = i_1 + i_2 + i_\Delta$

④ Replace unknown currents in KCL eqn. with node voltages

i_1: v_o + − 200Ω i_1 $\Longleftrightarrow$ $i_1 = \frac{-v_o}{200}$

+ v_o − 200Ω i_1 $i_1 = \frac{v_o}{200}$

p4.17 (p.140) (a) Find v_o in the circuit below using nodal analysis.



v_o + i_1 200Ω $\Longleftrightarrow$ $i_1 = \frac{-v_o}{200}$

Recall KCL eqn:

$3 + i_1 = i_2 + i_\Delta$ — (1)

$i_1 = \frac{-v_o}{200}$

$i_2 = \frac{v_{10}}{10}$

v_{10} + i_2 10Ω

KVL: $v_o - v_{10} + 5i_\Delta = 0$

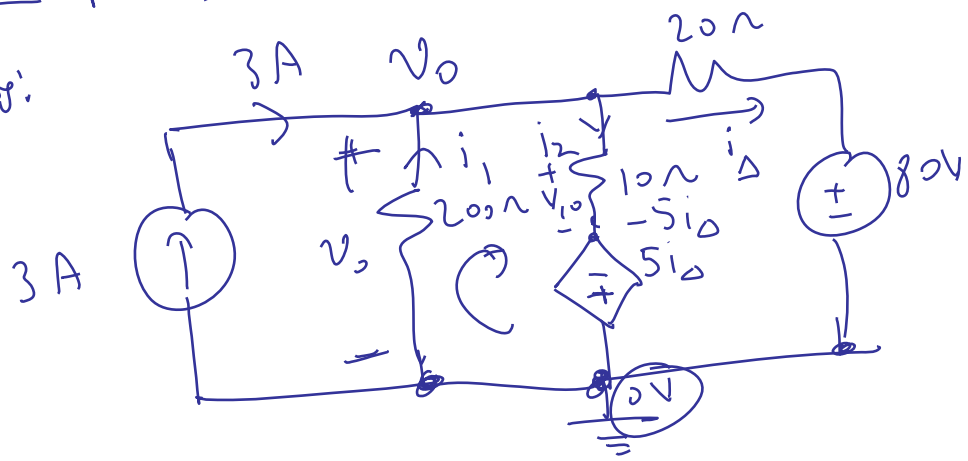
$\Rightarrow v_{10} = v_o + 5i_\Delta$

$\therefore i_2 = \frac{v_o + 5i_\Delta}{10}$

$\therefore$ (1) $\Rightarrow 3 + \left(\frac{-v_o}{200}\right) = \frac{v_o + 5i_\Delta}{10} + i_\Delta$, $i_\Delta = \frac{v_o - 80}{20}$

(constraint eqn.

p4.17 (p.140) (a) Find v_o in the circuit below using nodal analysis.



$$\text{i. } ① \Rightarrow 3 + \left(\frac{-v_o}{20}\right) = \frac{v_o + 5i_\Delta}{10} + i_\Delta, \quad i_\Delta = \frac{v_o - 80}{20}$$

(constraint eqn.)

$$\therefore \quad 3 - \frac{v_o}{20} = \frac{v_o + 5\left(\frac{v_o - 80}{20}\right)}{10} + \frac{v_o - 80}{20}$$

$$\Rightarrow \boxed{v_o = 50\text{ V}}$$

Supernode ($\Rightarrow$ Cutset!)

↓

related