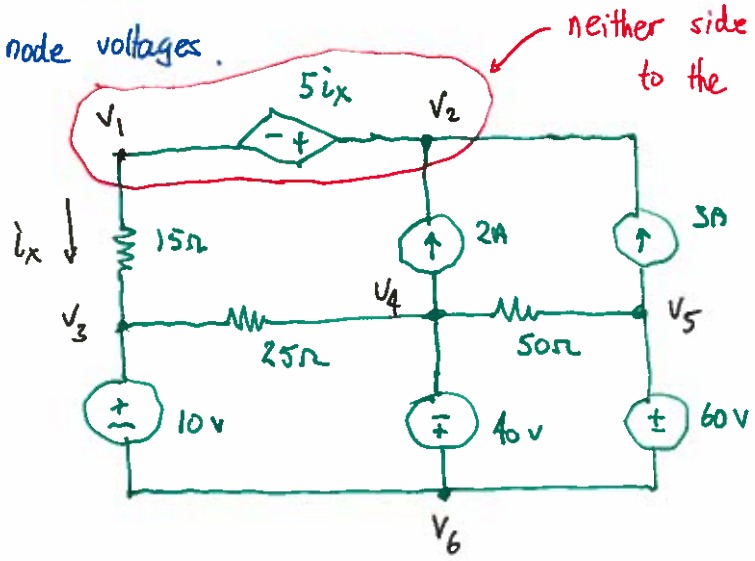
Monday, February 22, 2016

2007 midterm

Find node voltages.



Choices for reference node.

reference	V_3	V_4	V_5	V_6 ✓
V_6	10	-40	60	0
V_3	0	-50	50	-10
V_4	50	0	100	40
V_5	-50	-100	0	-60

(V_1, V_2 supernode)

Choose V_6 as reference

remember! current terms only!

Supernode: $\frac{V_1 - V_3}{15} - 2 - 3 = 0$

$V_1 - 10 - 5 \times 15 = 0$

$V_1 = 85$ V.

Supernode dependence: $V_2 - V_1 = 5i_x$

and where $i_x = \frac{V_1 - V_3}{15} = \frac{85-10}{15} = 5$ A

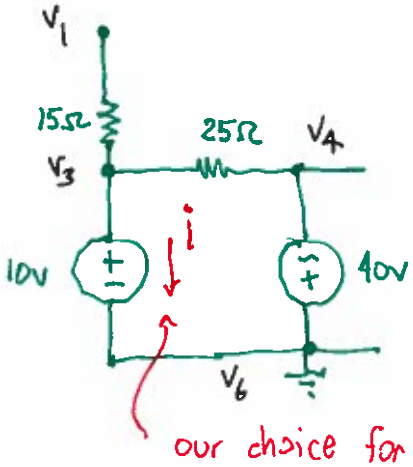
so $V_2 - V_1 = 5(5)$

$V_2 = V_1 + 25 = 110$ V.

Power in dependent source: $p = vi = (5i_x)(i_x)$

$= 125\ W$ (absorbing)

Power in the 10 V source.



Node 3:

$$\frac{V_3 - V_1}{15} + \frac{V_3 - V_4}{25} + i = 0$$

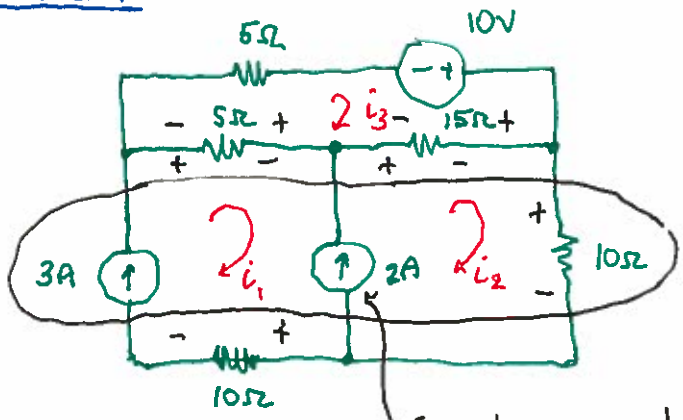
$$\frac{10 - 85}{15} + \frac{10 - (-40)}{25} + i = 0$$

$$-5 + 2 + i = 0$$

$$i = 3\ A$$

power: $p = vi = 10 \times 3 = 30\ W$ (absorbing)

2012 midterm



What happens if we try to write a supermesh equation here?

$$5(i_1 - i_3) + 15(i_2 - i_3) + 10i_2 + 10i_1 + ? = 0$$

↑ unknown voltage on current source - and it's not 3!

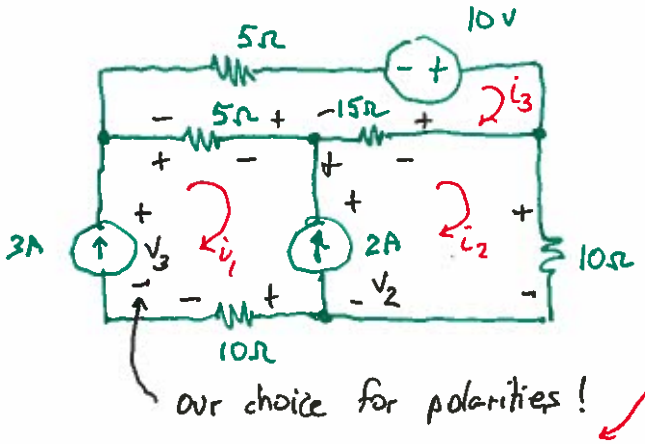
Instead, we know $i_1 = 3A$. And we still use the supermesh dependence equation.

$$i_2 - i_1 = 2$$
$$i_2 = 2 + i_1 = 5\,A$$

Now mesh 3: $5(i_3 - i_1) + 5i_3 - 10 + 15(i_3 - i_2) = 0$

$$25i_3 - 5i_1 - 15i_2 = 10$$
$$25i_3 - 5(3) - 15(5) = 10$$
$$25i_3 = 100$$
$$i_3 = 4\,A.$$

Find power in current sources.



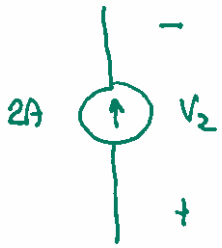
Mesh 2 equation: $15(i_2 - i_3) + 10i_2 - V_2 = 0$

$$15(5-4) + 10(5) = V_2$$
$$V_2 = 65\,V$$

Power in 2A source

$$p = -iv$$
$$= -2 \times 65$$
$$= -130\,W$$

Choosing opposite polarity for V_2



Mesh 2: $15(i_2 - i_3) + 10i_2 + V_2 = 0$

$$15 \times 1 + 10 \times 5 = -V_2$$
$$V_2 = -65\,V$$

Power: $p = vi = (-65) \times 2 = -130\,W.$ Same!