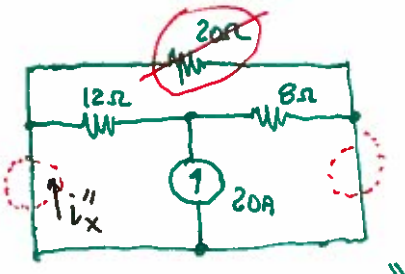
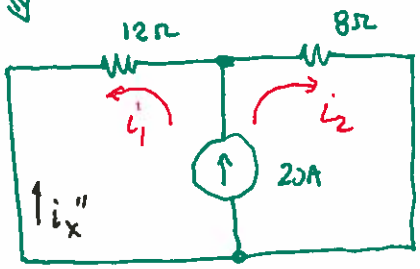
Friday, February 26, 2016





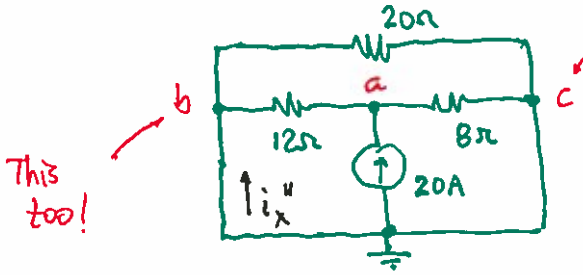
Current divider

$$i_1 = \frac{8}{8+12} \times 20 = 8A$$

and $i_x'' = -i_1$, so

$$\boxed{i_x'' = -8}$$

Clearly, short-circuits can cause much confusion. Let's reattempt this without taking special notice.



Note: $V_b = V_c = 0$

Node a: $$-20 + \frac{V_a}{12} + \frac{V_a}{8} = 0$$

so $V_a = 96$ V.

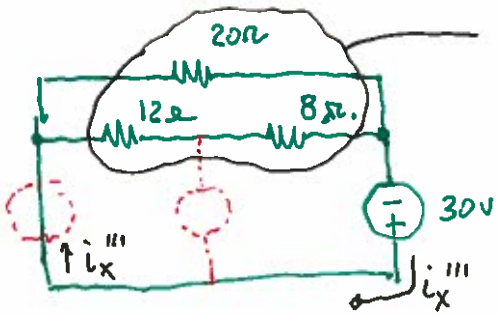
To solve for i_x'', write node equation at b.

Node b: $$-i_x'' + \frac{V_b - V_a}{12} + \frac{V_b - V_c}{8} = 0$$

$$-i_x'' + \frac{0-96}{12} + \frac{0-0}{20} = 0$$

$$\boxed{i_x'' = -8}$$

(c) 30-volt source by itself



as in (a), 10Ω

$$i_x''' = \frac{30V}{10\Omega} = 3A$$

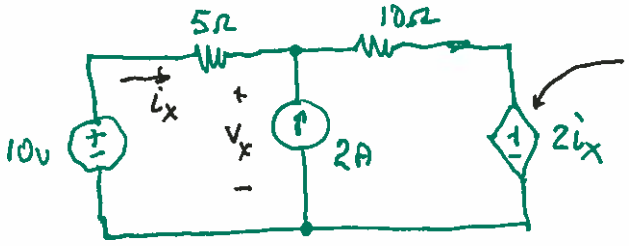
By superposition, $i_x = i_x' + i_x'' + i_x'''$

$= 5 - 8 + 3 = 0$

$$\boxed{i_x = 0}$$

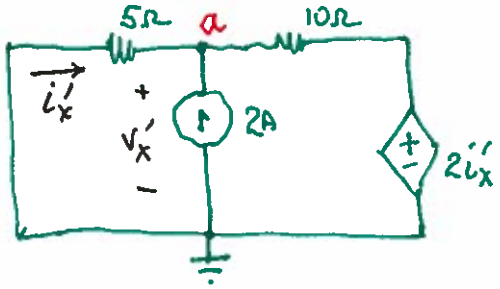
Example 2: With dependent source. Find V_x by superposition

IMPORTANT: only zero the <u>independent</u> sources



dependent sources: if we have them, we have to put up with them!

(a) 2A current source acting alone; find V_x'.



Node a: $\frac{V_a}{5} - 2 + \frac{V_a - 2i_x'}{10} = 0$

($\frac{V_a}{5}$ this is $-i_x'$)

$(\times 10)$ $2V_a - 20 + V_a - 2i_x' = 0$

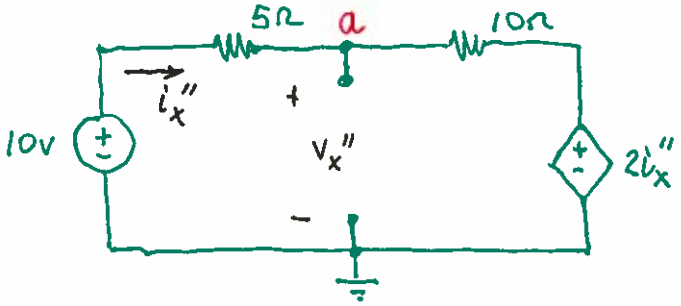
$$3V_a - 2i_x' = 20$$

We know $i_x' = -V_a/5$, so

$$3V_a + \frac{2V_a}{5} = 20 \qquad \therefore \; V_a = 5.88\text{v}$$

so $\boxed{V_x' = 5.88\text{v}}$

(b) Now with the 10v source acting alone



Node a: $\dfrac{V_a - 10}{5} + \dfrac{V_a - 2i_x''}{10} = 0$

Note this is $-i_x''$, so $i_x'' = \dfrac{10 - V_a}{5}$

(×10) $2V_a - 20 + V_a - 2i_x'' = 0$

$$3V_a - 2i_x'' = 20$$

or $3V_a - 2\left(\dfrac{10 - V_a}{5}\right) = 20$

$$3V_a - 4 + \frac{2}{5}V_a = 20$$

$$\therefore \; V_a = 7.06\text{v} \qquad \text{so} \qquad \boxed{V_x'' = 7.06\text{v}}$$

Finally, by superposition

$$V_x = V_x' + V_x'' = 5.88 + 7.06$$

$$\boxed{V_x = 12.94\text{v}}$$

OPERATIONAL AMPLIFIERS

An operational amplifier (op amp) is a complex electronic circuit that implements a voltage-controlled voltage source.

Many important practical engineering examples:

- high-speed video amplifiers
- microelectronic filters (telecommunications – huge industry)
- instrumentation (precision measuring devices)

Invented in 1968. Originally used to perform operations in "analog" computers to perform operations on voltages and currents

- addition
- integration
- multiplication