EECS16A 5D

* Discussion checkoff

Skills

- Identify nodes & branches in ckts
- How to apply passive sign convention
- Redraw circuits

Analysis (solving for voltages & currents)

- NVA
- Superposition
- Equivalence
  - ↳ Thevenin/Norton (source-resistor) (ckts)
  - ↳ Resistors/Capacitors
- Charge sharing algorithms

Equations

- KCL, KVL
- Golden rules
- I-V relation
  - ↳ C ($i_c = C\frac{dv_c}{dt}$)
  - ↳ R (Ohm's law)
- Power $P = IV$
- Constitutive eq: $R = \rho\frac{L}{A}$, $C = \varepsilon\frac{A}{d}$

Functional Blocks

- Dividers (V, I), Voltage summer
- Op Amps
  - ↳ inverting amp
  - ↳ non-inverting amp
  - ↳ Unity gain buffer
  - ↳ Transresistance amp

Modeling

Touchscreen
- ↳ R
- ↳ C

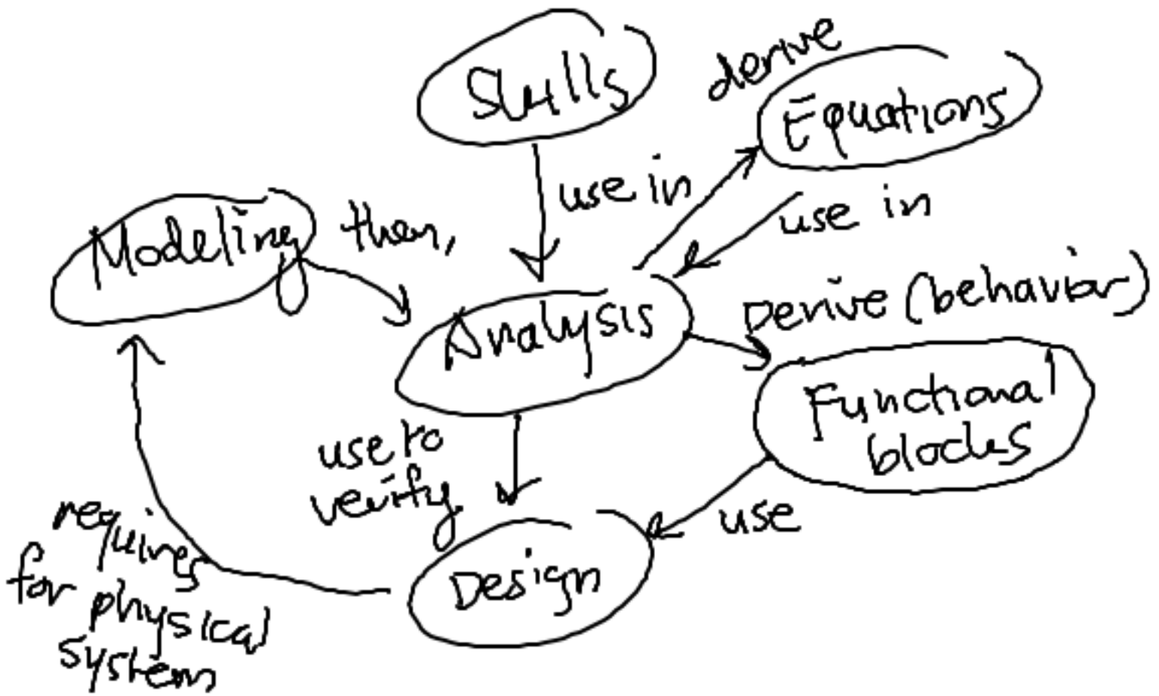
Timer clbt
(Design ex. from lecture)

(charging cap triggers) event

Design

Procedure
- ↳ Specification (words) goal in
- ↳ Strategy (abstracting goal as block diagram + math)
- ↳ Implementation (drawing ckts)
- ↳ verification (analyzing to check)

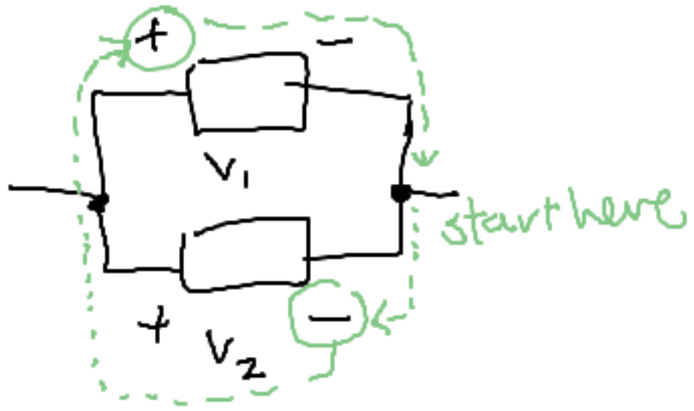
composition & loading
& how to identify loading



Problems

- Noise filtering
- Audio to speaker

1 (a)

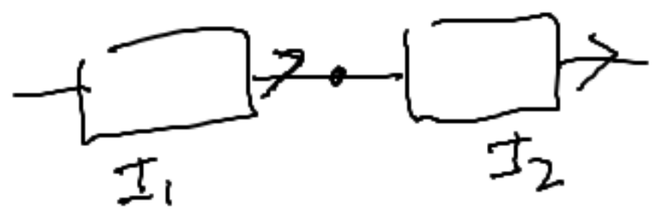


KVL: $-V_2 + V_1 = 0$

$V_1 = V_2$

Whenever in parallel, same branch voltage (assuming same labeling)

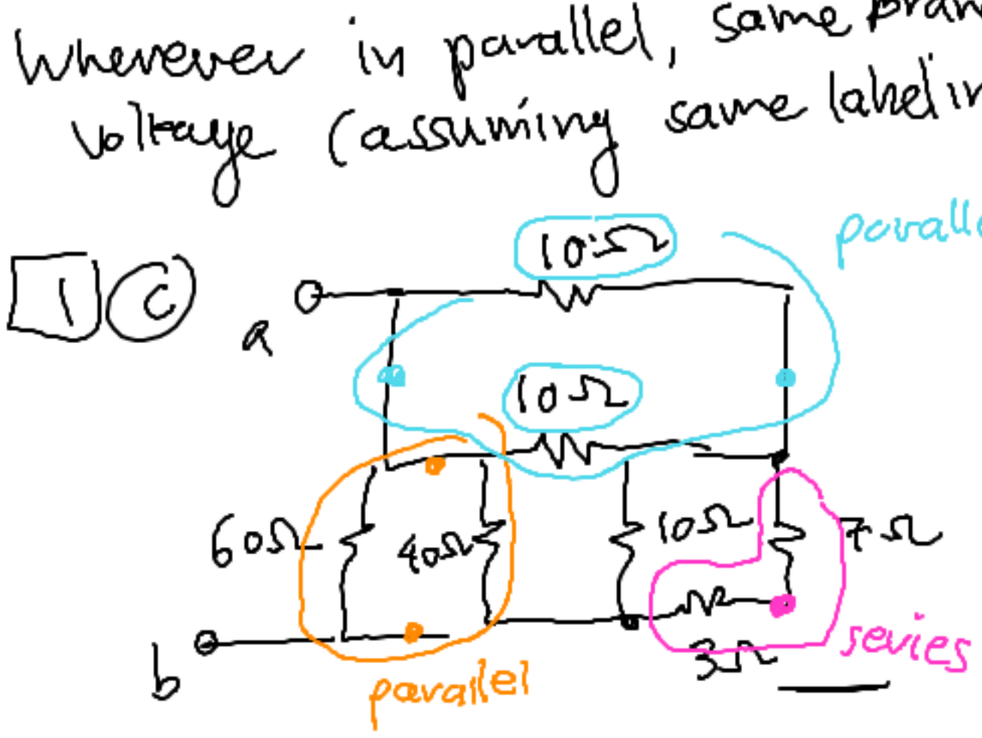
1 (b)

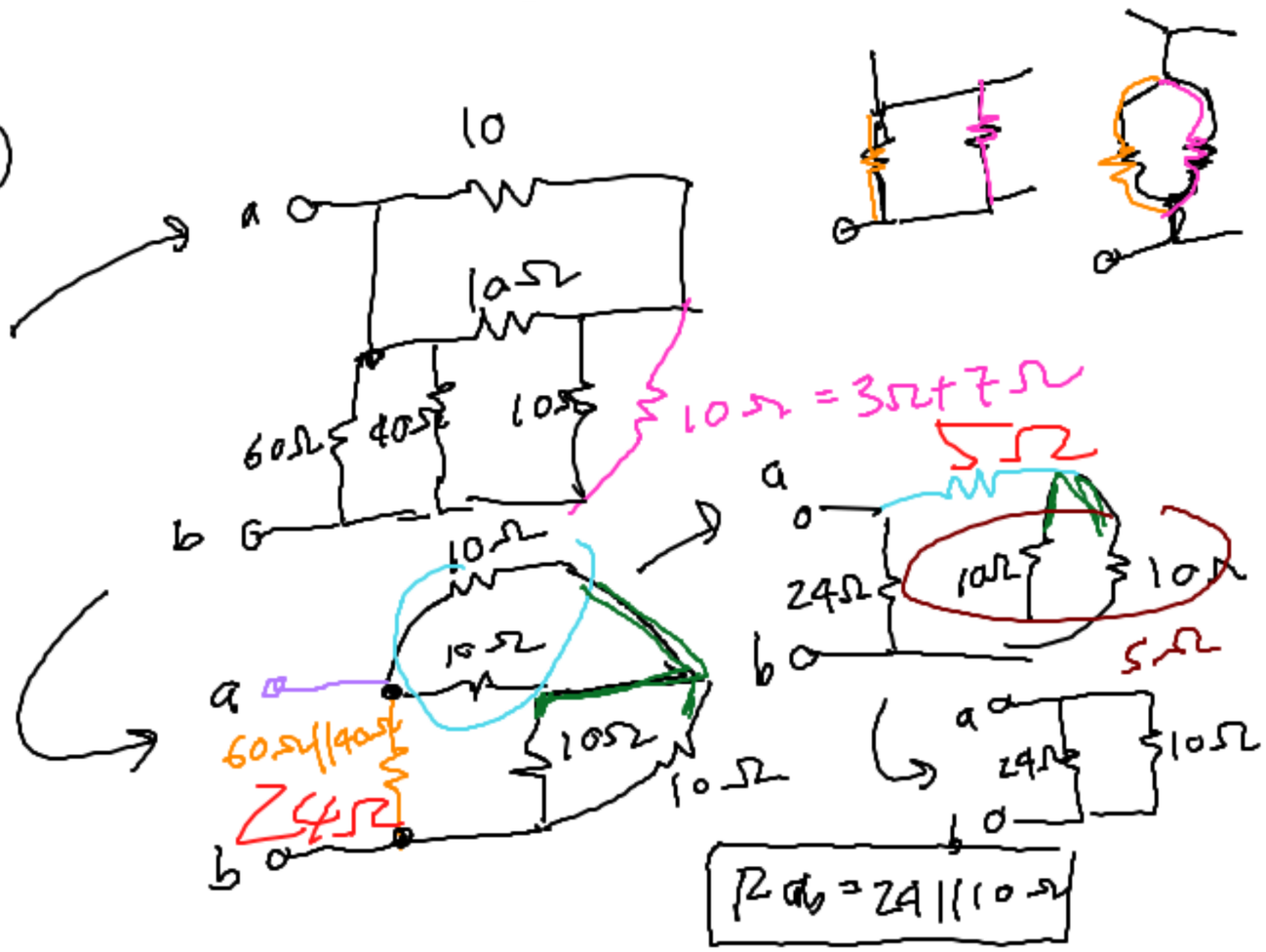


KCL: $I_1 = I_2$

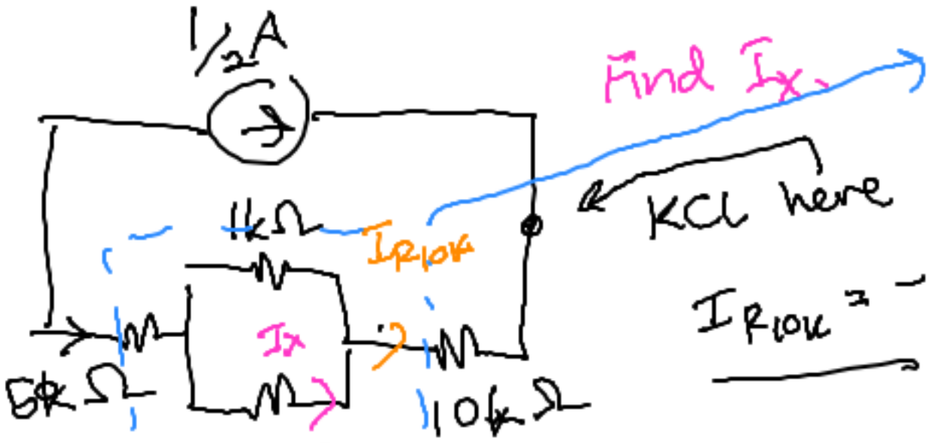
Whenever in series, same current (branch)

1 (c)





1 ④



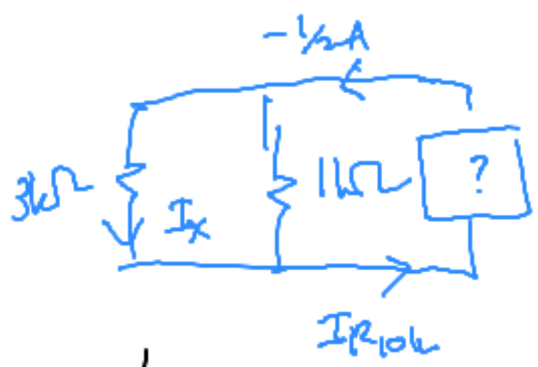
$I_{R10k} = -1/2A$

Options:

- $I_x = -\frac{3}{4} I_{R10k}$? X
- $I_x = -\frac{1}{4} I_S$? ✓
- $I_x = -\frac{1}{8} A$? ✓
- $I_x = \frac{3}{8} A$ X

$I_{R_1} = \frac{R_2}{R_1 + R_2} I_S$

The current direction for I_x is opposite to the one assumed in the derivation → negate



↳ $I_x = \frac{3}{4}(-1/2A)$ X

Why? other resistor

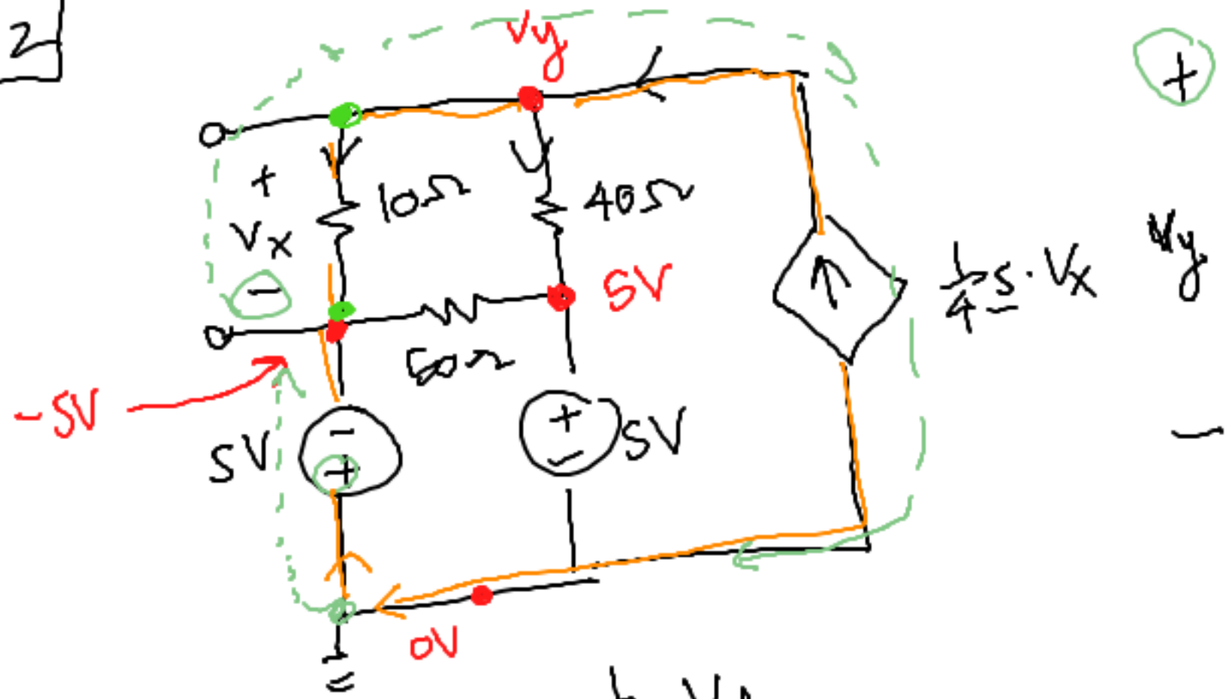
$I_x = \frac{1\Omega}{3k\Omega + 1k\Omega}(-1/2A)$

$= -\frac{1}{8} A$

Reminder: intuitive check

→ Current takes path of least resistance

2



Find V_x & V_y

KCL @ node V_y

$$\rightarrow \frac{1}{4\Omega} V_x = \frac{V_y - 5V}{40\Omega} + \frac{V_y - (-5V)}{10\Omega}$$

$$10V_x = V_y - 5V + 4V_y + 20V$$

$$\sum V_x = V_y + 5V$$

$$10V_y + 50V = 5V_y + 15V$$

$$5V_y = -35V$$

$$\boxed{V_y = -7V}$$

$$\boxed{V_x = (-7V) + 5V = -2V}$$

$$\begin{cases} \rightarrow & \boxed{V_x = V_y - (-5V)} \quad (10\Omega \text{ Branch}) \\ \rightarrow & +5V - V_x + V_y = 0 \quad (\text{KVL path}) \end{cases}$$

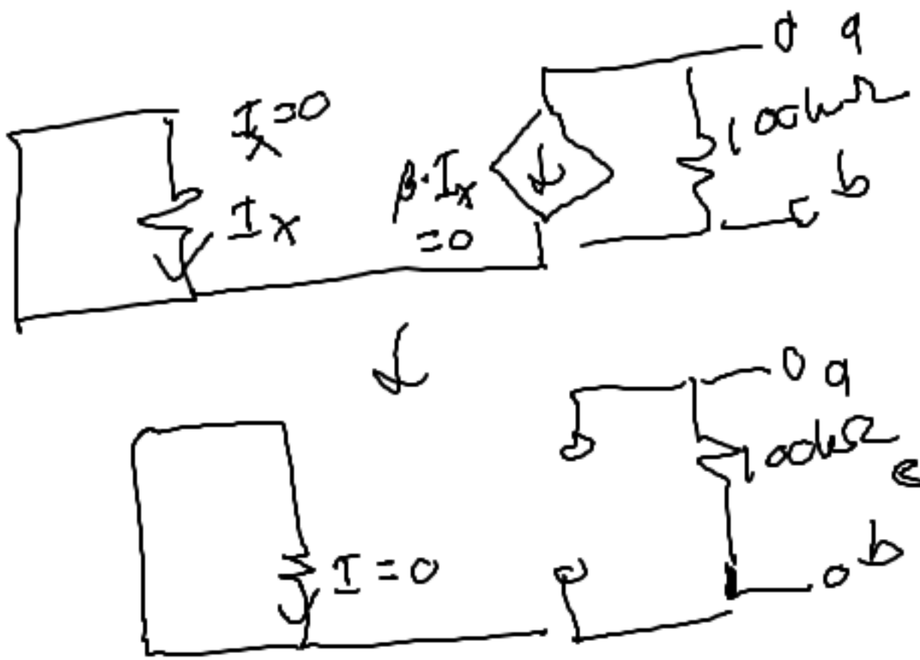
Can always use NVA + KVL eqns to solve. Superposition works too (is essentially NVA)

$$[S] (\text{siemens}) = \left[\frac{1}{\Omega}\right]$$

↳ conductivity

3 Takeaway for equivalence (Thevenin/Norton eq)

- Dependent sources don't always requiring a test source on output
- If dependent source depends on a quantity that goes to zero when independent sources turn off → also turn off dependent source



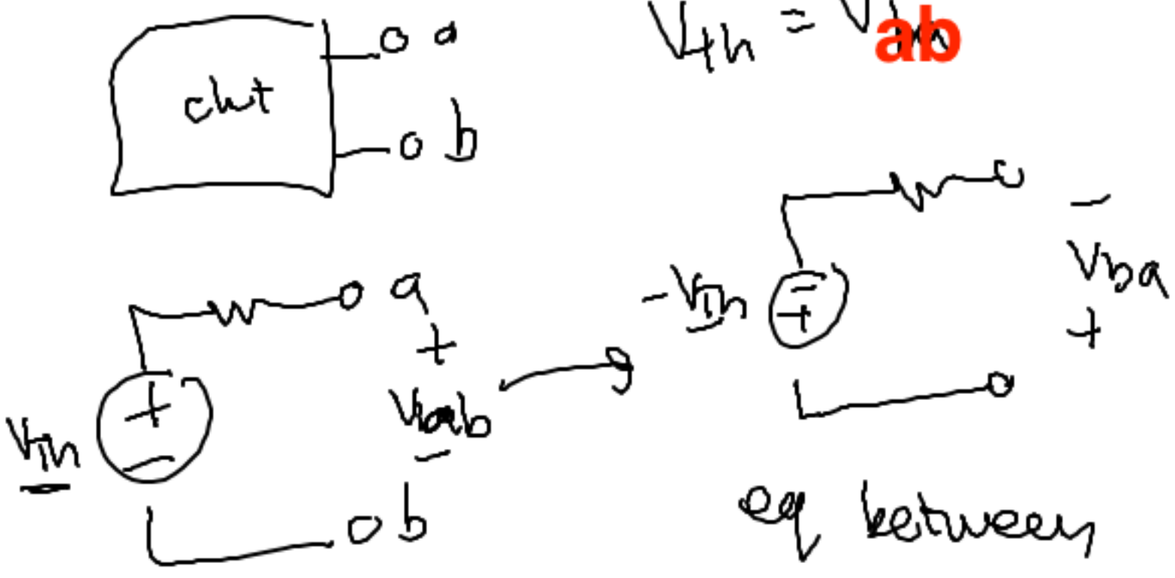
R_{ab} (when sources are off) $= R_{Th} = R_N$

$= 100k\Omega$

Q: When to use NVA vs. Superposition? (Rule for when one is faster?)

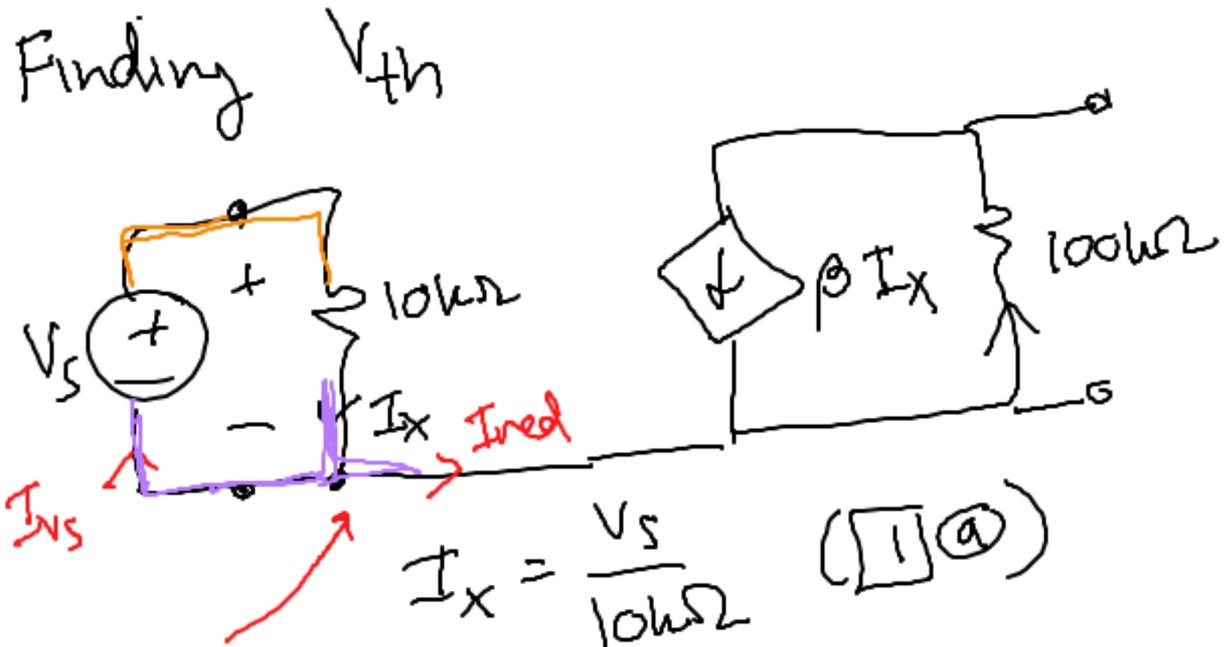
Typically dependent more on which you've practiced or like better.

Q: Thevenin/Norton eq between a-b or b-a?



2 ___ Typically asking about this.

3 Finding V_{th}



Q: any red current?

$$I_x = \frac{V_S}{10k\Omega} \quad (\boxed{1}@)$$

$$V_{OC} = -\beta I_x \cdot 100k\Omega \quad \text{(ohm's law)}$$

$$= -\beta \frac{V_S}{10k\Omega} \cdot 100k\Omega$$

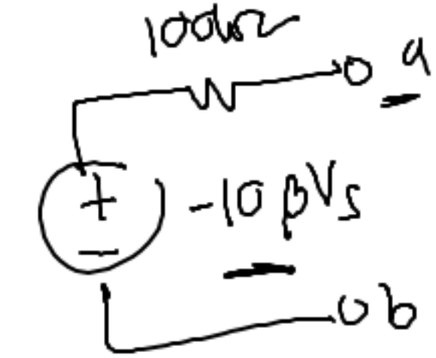
$$= \boxed{-10\beta V_S}$$

N : No

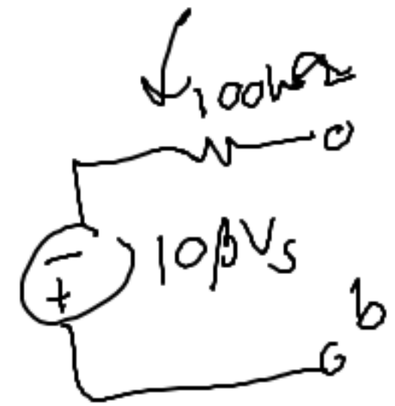
KCL : $I_x = I_{V_S} + I_{red}$

(top) $I_{V_S} = I_x$

$0 = I_{red}$



either or works



Norton eq

$$I_{No} = \frac{V_{th}}{R_{th}} = \frac{-10\beta V_S}{100k\Omega}$$

$$= -\frac{\beta V_S}{10k\Omega}$$