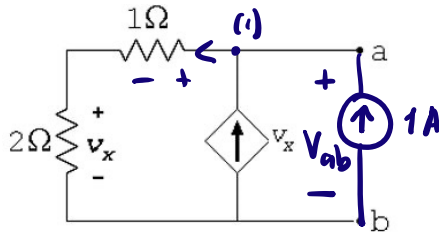


- **Example #11:** Obtain  $V_T, I_N, R_T$  for the following circuit



no independent sources  $\Rightarrow V_T$  and  $I_N = 0$

Get  $R_T$ :

$$\text{KCL @ (i): } 1 + V_x = I_{2\Omega} = \frac{V_x}{2} \Rightarrow V_x = -2V$$

$$\text{KVL outer loop: } -V_x - V_{1\Omega} + V_{ab} = 0$$

$$-V_x - 1 \cdot \left(\frac{V_x}{2}\right) + V_{ab} = 0$$

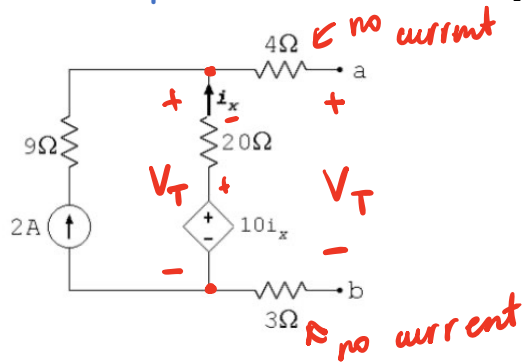
$$V_{ab} = \frac{3}{2} V_x = -3V \Rightarrow$$

$$\boxed{R_T = -3\Omega}$$

$R_T$  can be negative  
if the circuit has dependent  
sources

$R_T$  is always positive if no  
dependent sources

- **Example #12:** Obtain  $V_T$ ,  $I_N$ ,  $R_T$  for the following circuit



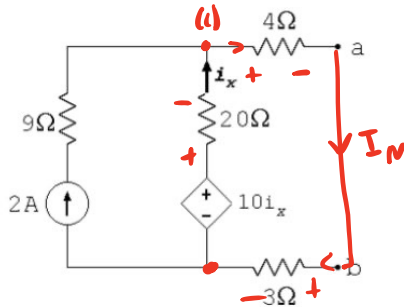
$$V_T = ?$$

$$V_T = -i_x \cdot 20 + 10i_x = -10i_x$$

$$i_x = -2A$$

$$V_T = 20V$$

- Example #12-cont: Obtain  $V_T, I_N, R_T$  for the following circuit



$I_N$  - ?

KVL @ right loop:

$$-10i_x + 20i_x + 4 \cdot I_N + 3 \cdot I_N = 0$$

↑

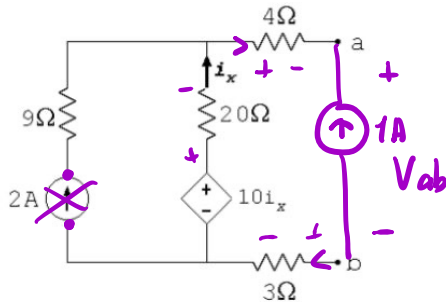
KCL @ (1):  $i_x = I_N - 2$

$$I_N = \frac{20}{17} \text{ A}$$

$$i_x = -\frac{14}{17} \text{ A} \text{ - is not the same!}$$

$$R_T = \frac{V_T}{I_N} = \frac{20}{20/17} = 17 \Omega$$

- Example #12-cont: Obtain  $V_T, I_N, R_T$  for the following circuit



$R_T$  - ? First: source suppression!

$$\text{KVL: } -10i_x + 20i_x + 4i_x + V_{ab} + 3i_x = 0$$

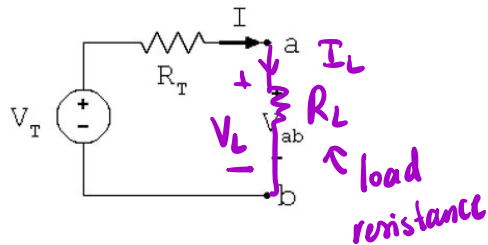
$$i_x = -1A$$

Solving...

$$V_{ab} = 17V \Rightarrow R_T = 17\Omega$$

- Available power

- What is the maximum power a load can get from a circuit?



What  $R_L$  to choose to get max power?

$$P_L = \frac{V_L^2}{R_L} = \frac{1}{R_L} \cdot \left( V_T \left( \frac{R_L}{R_L + R_T} \right) \right)^2 =$$

$$= V_T^2 \frac{R_L}{(R_L + R_T)^2}$$



maximize  $P_L$  over  $R_L \Rightarrow \boxed{R_L = R_T}$

↑  
the best matched load choice!

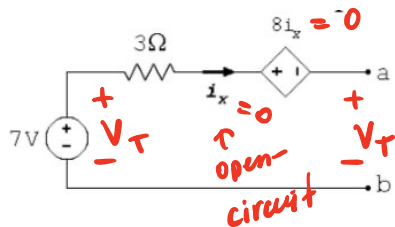
$$P_{\max} = P_a = \frac{V_T^2}{4R_T}$$

↑ available power

← only get this much if  $R_L = R_T$

Only if  $R_T > 0$  !

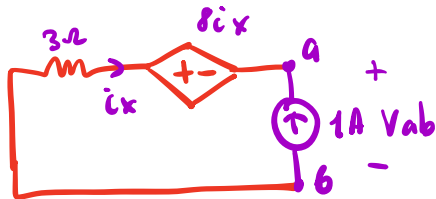
- **Example #13:** Obtain the available power,  $P_a$  for the following circuit



$$P_a = \frac{V_T^2}{4R_T}$$

$$V_T = 7V$$

For  $R_T$ , let's do  
test signal method:



$$i_x = -1A$$