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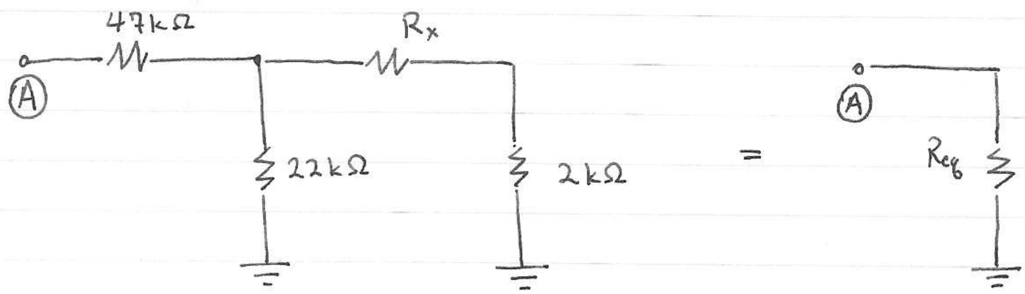

$((R_x \oplus 2k\Omega) \,||\, 22k\Omega) \oplus 47k\Omega$

$$R_{eq} = 47 + \frac{22 \cdot (R_x + 2)}{22 + R_x + 2} = 60 \quad k\Omega$$

$$\frac{22(R_x + 2)}{22 + R_x + 2} = 13$$

$$22R_x + 44 = 286 + 13R_x + 26$$

$$9R_x = 268$$

$$\boxed{R_x \approx 29.8\ k\Omega}$$

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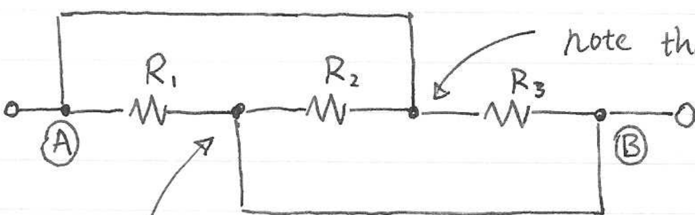
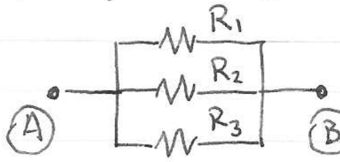


note that this is node A!

Note that this is node B!

R_1, R_2, and R_3 are each connected to both nodes A & B



$\boxed{R_{eq} = \frac{R}{3}}$ (since $R_1 = R_2 = R_3 = R$)

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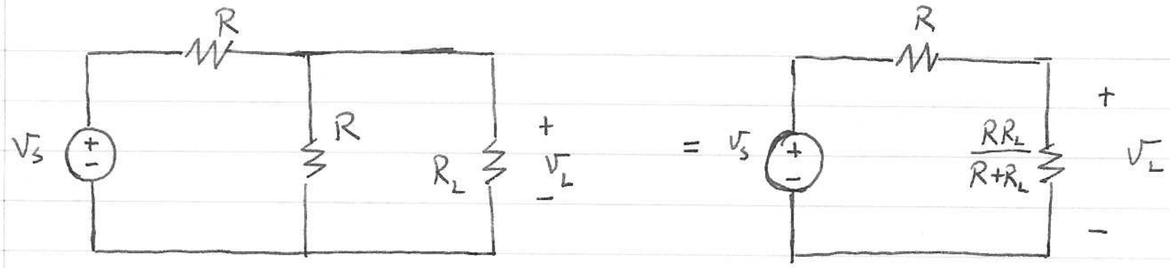

By voltage division: $V_L = \dfrac{V_s \times \left(\dfrac{R R_L}{R+R_L}\right)}{R + \dfrac{R R_L}{R+R_L}}$

$$= \frac{V_s R R_L}{R^2 + 2RR_L}$$

$$\boxed{V_L = \frac{V_s R_L}{R + 2R_L}}$$

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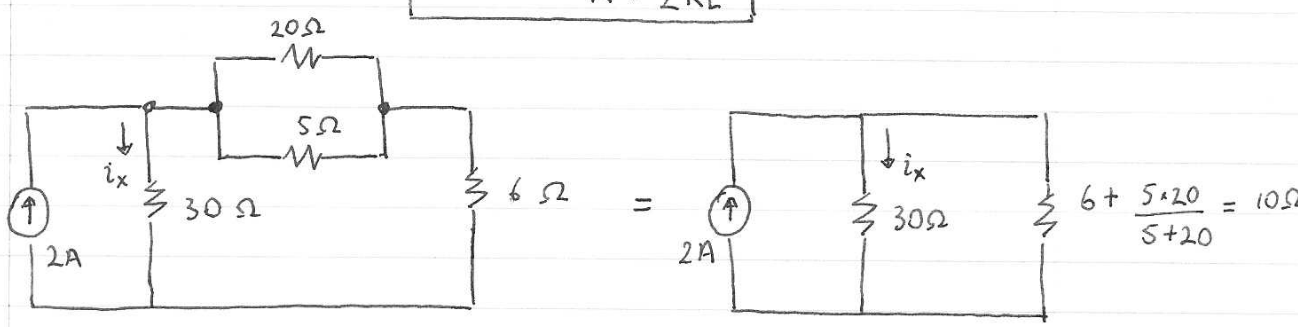

Current division: $i_x = 2A \times \dfrac{10}{10+30}$

$$\boxed{i_x = \tfrac{1}{2} A}$$

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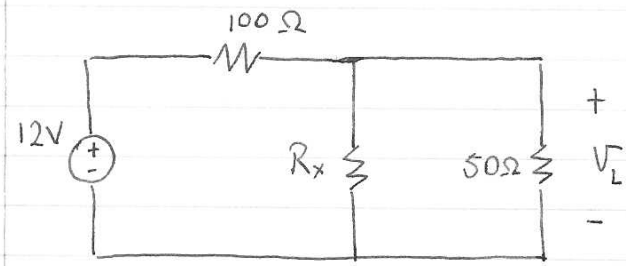

$R_x \geq 0$

It is impossible to choose R_x ST $V_L = 6\text{ V}$

Proof

V_L is the voltage drop across the equivalent resistance obtained by combining R_x & the 50 Ω resistor in parallel,

$$R_{eq} = \frac{50 R_x}{50 + R_x} \quad \text{where } 0 \leq R_x$$

$R_{eq} < 50 \quad \forall R_x \geq 0$

Assume $V_L = 6\text{ V}$

$\Rightarrow R_{eq} = 100\,\Omega$ Contradiction!

$\therefore$ no $R_x \geq 0$ can be chosen ST $V_L = 6\text{ V}$ ∎

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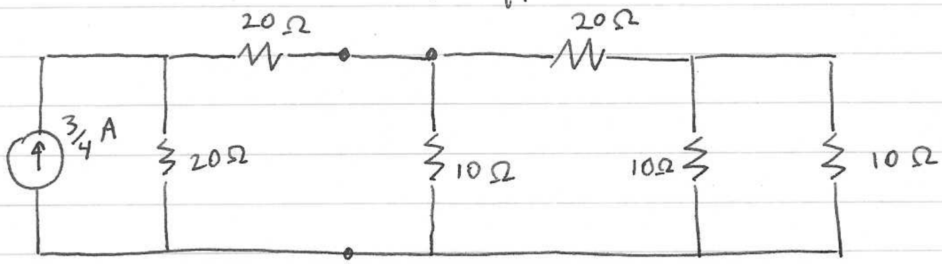
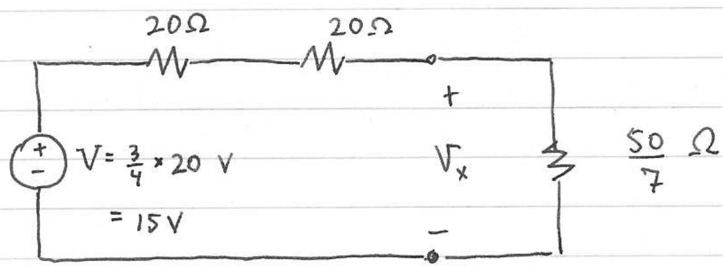


R = 5 Ω

R = 25 Ω

$$R = \frac{10 \times 25}{10+25} = \frac{50}{7}\ \Omega$$



$$V_x = (15\text{ V}) \times \frac{50/7}{40 + 50/7} = \boxed{2.27\text{ V}}$$

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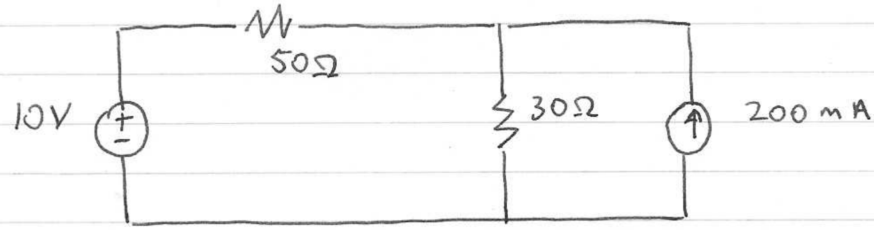

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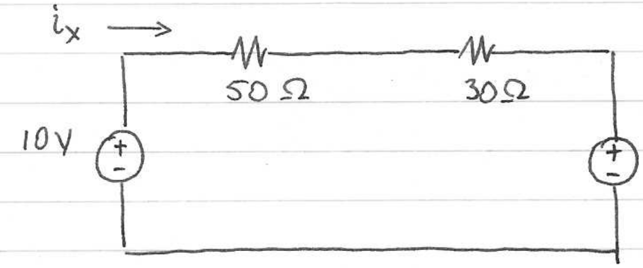

$V = (.2A)(30\Omega)$
$= 6V$

KVL

$-10 + i_x(80) + 6 = 0$

$\boxed{i_x = 50mA}$

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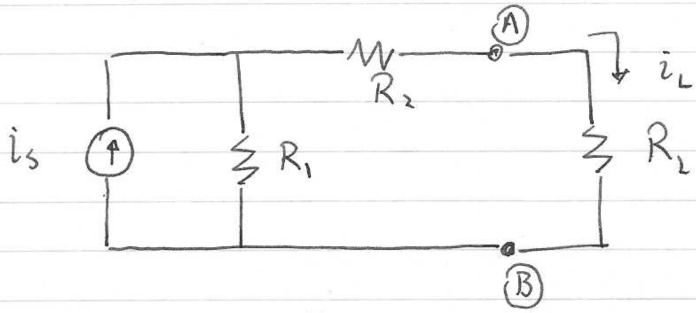

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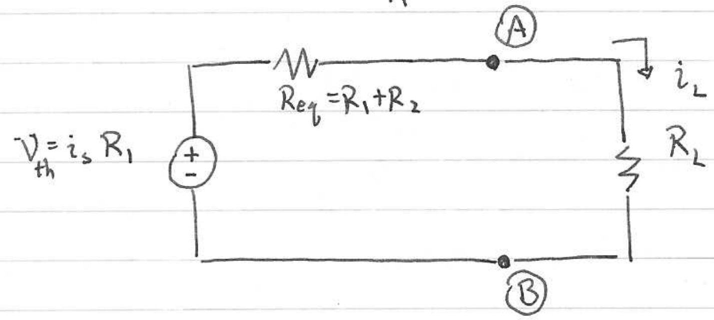

Note that:

$$I_{sc} = \frac{V_{th}}{R_{eq}}$$

$$\boxed{\begin{aligned} V_{th} &= i_s R_1 \\ R_{eq} &= R_1 + R_2 \\ I_{sc} &= i_s \frac{R_1}{R_1 + R_2} \end{aligned}}$$

(b)

$$i_L = \frac{V_{th}}{R_{eq} + R_L}$$

$$\boxed{i_L = \frac{i_s R_1}{R_1 + R_2 + R_L}}$$

(c)

$$i_L = i_s \times \frac{R_1}{R_1 + (R_2 + R_L)}$$ by current division

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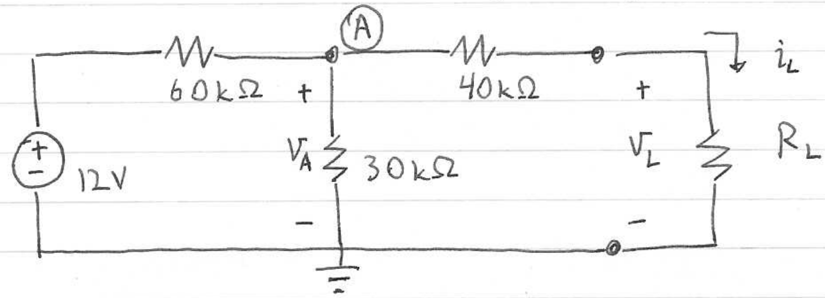

Open Circuit test:

$(R_L \to \infty)$

$$V_L = V_{oc} = 12 \cdot \frac{30}{30+60} \text{ V}$$

$$\boxed{V_{th} = 4\text{V}} \qquad (V_{oc} = V_{th})$$

Short Circuit test:

$(R_L = 0)$

$i_L = i_{sc}$

$$V_A = 12 \cdot \frac{120/7}{60 + 120/7}$$

$$i_{sc} = \frac{V_A}{40}$$

$$\Rightarrow \boxed{I_N = \frac{1}{15} \text{ mA}}$$

$$\boxed{R_{eq} = \frac{V_{th}}{I_N} = 60\text{k}\Omega}$$

$$V_L = V_{th} \cdot \frac{R_L}{60 + R_L} = 4 \cdot \frac{R_L}{60 + R_L}$$

$$P_L = \frac{V_L^2}{R_L} \longrightarrow P_L = \begin{cases} 66.1\ \mu\text{W} & \text{when } R_L = 50\text{k}\Omega \\ 47.3\ \mu\text{W} & \text{when } R_L = 200\text{k}\Omega \end{cases}$$

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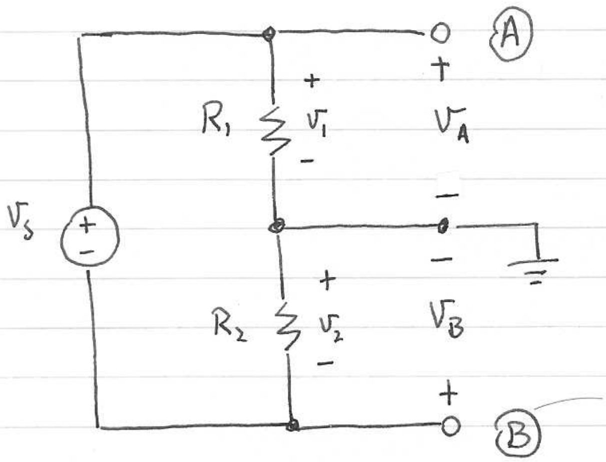

$$v_1 = \frac{v_s R_1}{R_1 + R_2}$$

$$v_A = v_1$$

$$\Rightarrow \boxed{v_A = v_s \frac{R_1}{R_1 + R_2}}$$

$$v_2 = v_s \frac{R_2}{R_1 + R_2}$$

$$v_B = -v_2$$

$$\Rightarrow \boxed{v_B = -v_s \frac{R_2}{R_1 + R_2}}$$