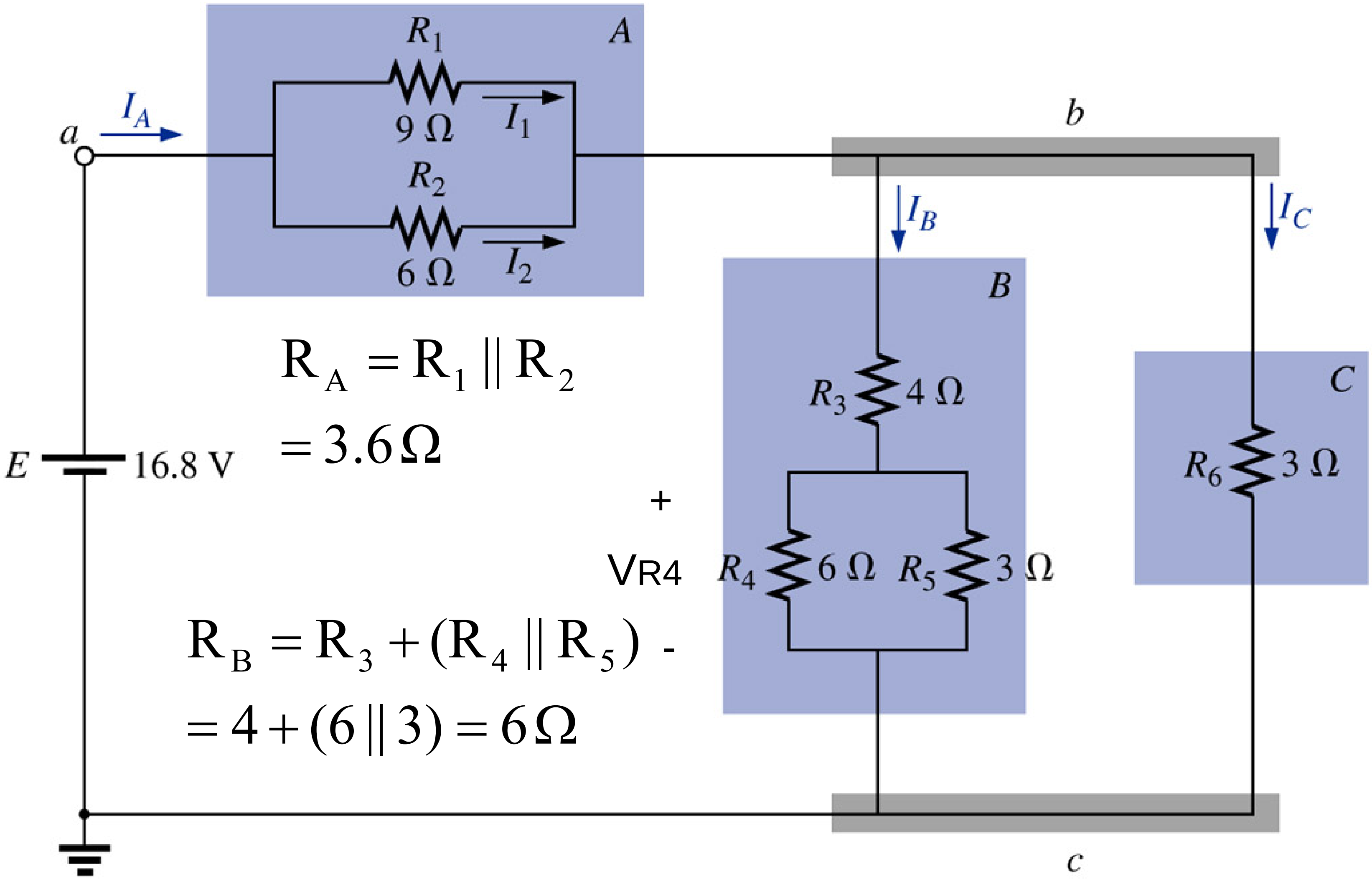
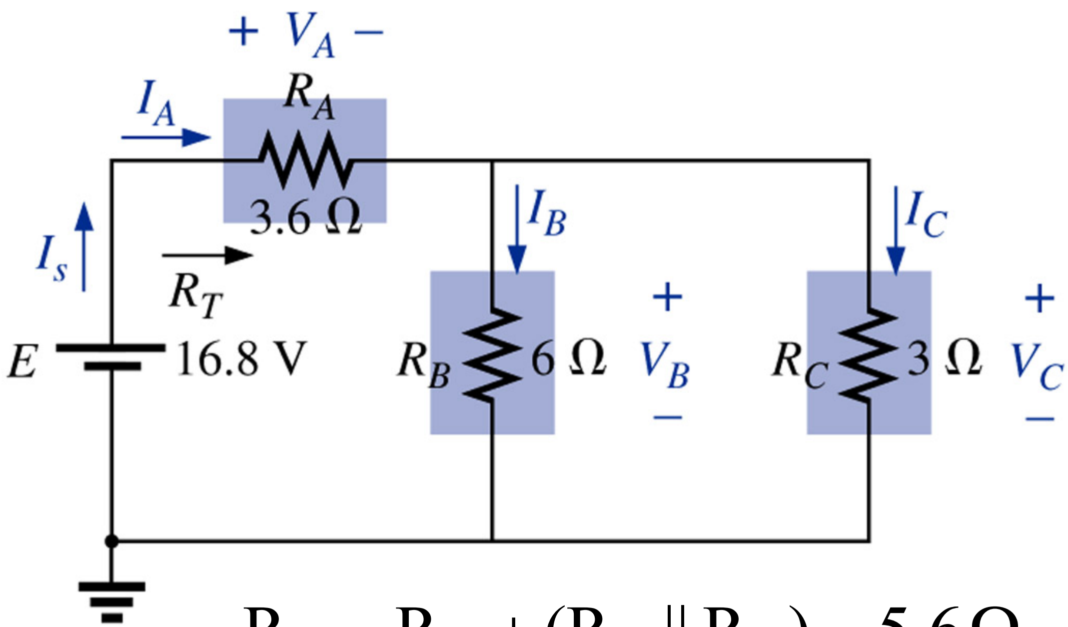
Breakout #1 – Find I_1, I_B, I_C, V_{R4}



$$R_A = R_1 \| R_2$$
$$= 3.6\Omega$$

$$R_B = R_3 + (R_4 \| R_5)$$
$$= 4 + (6 \| 3) = 6\Omega$$

Breakout #1 – Find I1, IB, IC, VR4



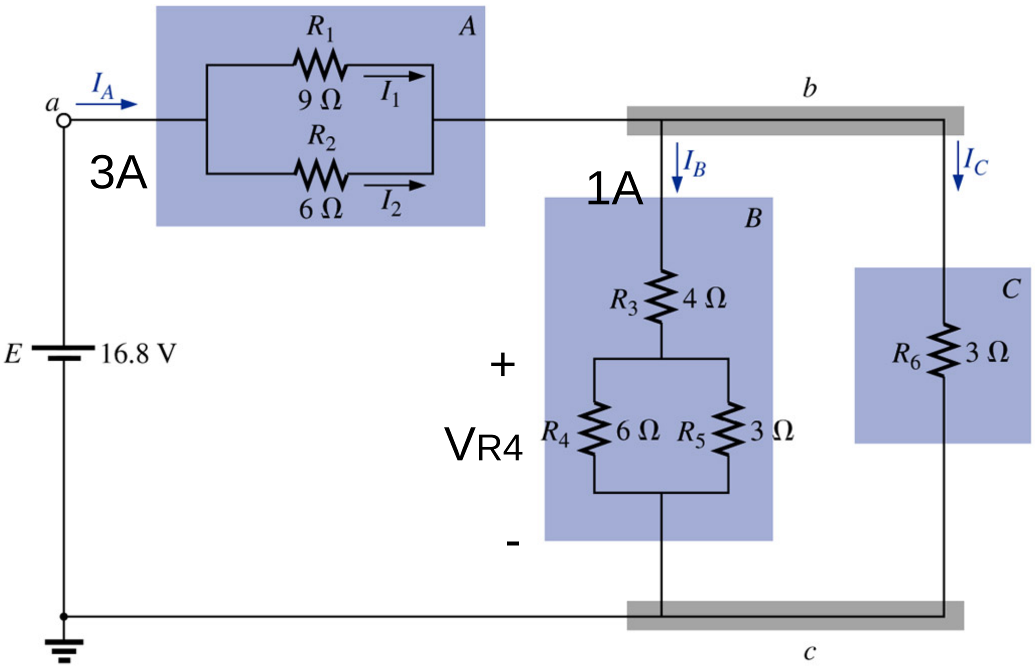
$$I_C = I_A - I_B$$
$$= 2\,A$$

$$R_T = R_A + (R_B \,\|\, R_C) = 5.6\,\Omega$$

$$I_S = I_A = \frac{E}{R_T} = \frac{16.8\,V}{5.6\,\Omega} = 3\,A$$

$$I_B = I_A \frac{R_B \,\|\, R_C}{R_B} = 3\,A \frac{2\,\Omega}{6\,\Omega} = 1\,A$$

Breakout #1 – Find I_1, I_B, I_C, V_{R4}



$$V_{R4} = I_B \cdot (R_4 \| R_5)$$

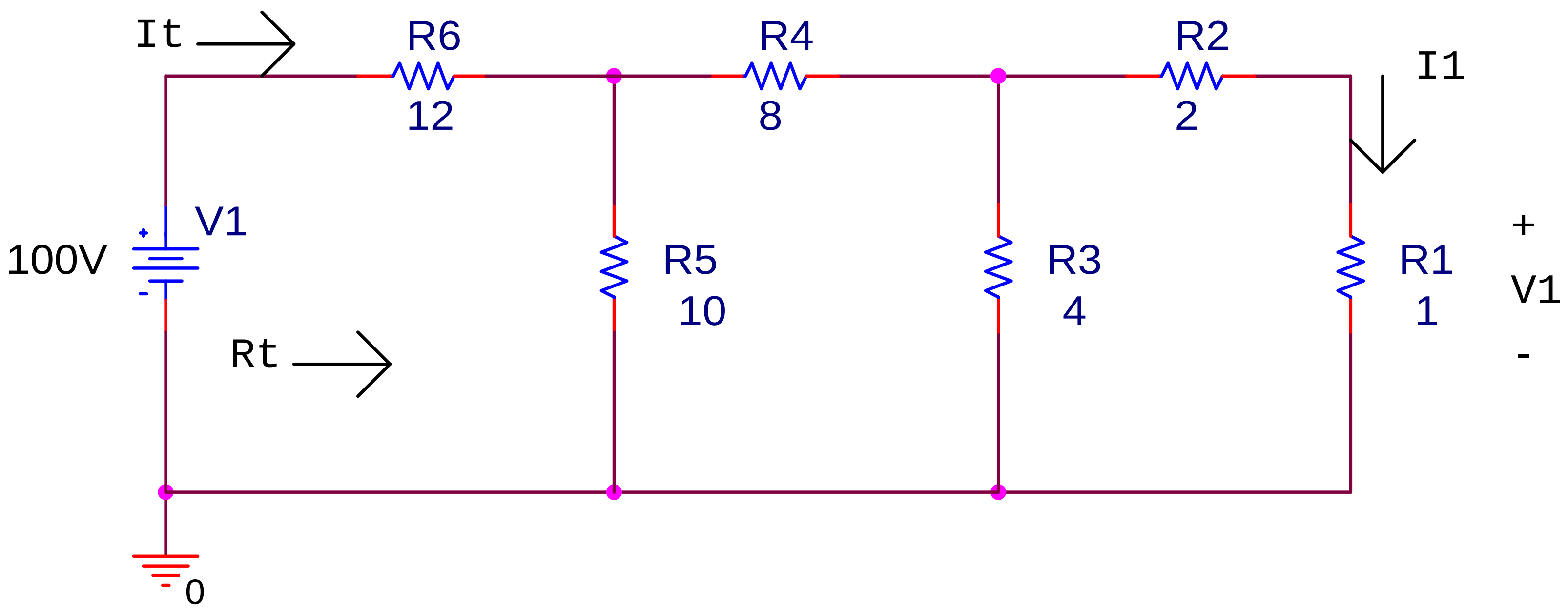
$$V_{R4} = 1\,A \cdot 2\,\Omega$$

$$= 2\,V$$

$$I_1 = I_A \frac{R_A}{R_1} = 3\,A \frac{3.6\,\Omega}{9\,\Omega} = 1.2\,A$$

Breakout #2 – Ladder Network

- Find V_1 and I_1
  - Hint: Start by finding Rt

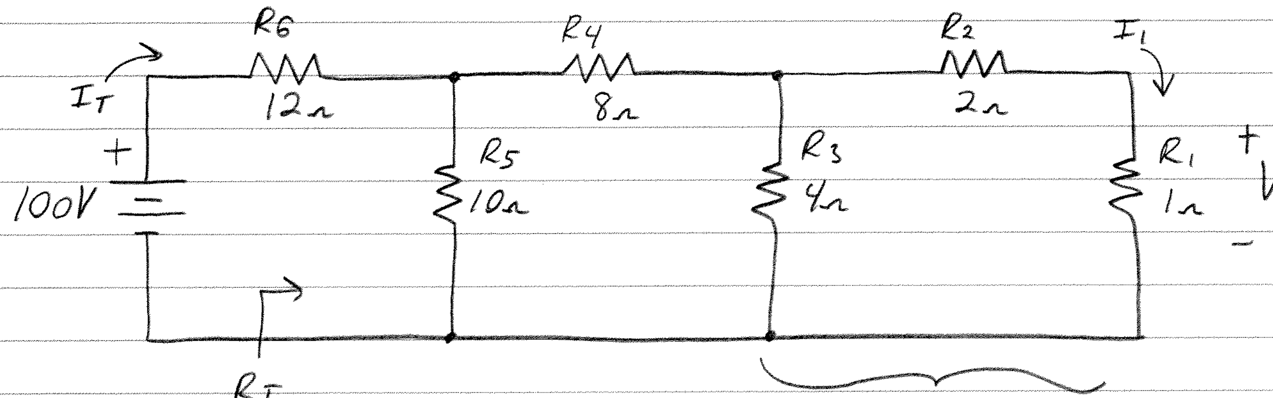


7.3 LADDER NETWORKS

↖ SPECIFIC CASE OF SERIES-PARALLEL NETWORKS, EASILY RECOGNIZED

METHOD 1: REDUCE THE NETWORK + FIND R_T, I_T. THEN WORK BACK INTO THE NETWORK TO FIND THE UNKNOWN(S).

(EXAMPLE) FIND V_1 + I_1:

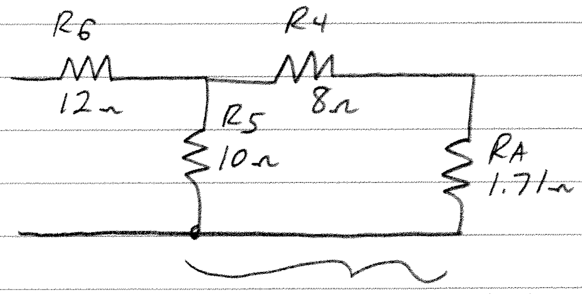


$$\underbrace{R_3 \,//\, (R_2 + R_1)}$$

$$4\Omega \,//\, 3\Omega$$

$$\underline{R_A = 1.71\,\Omega}$$

REDRAW:

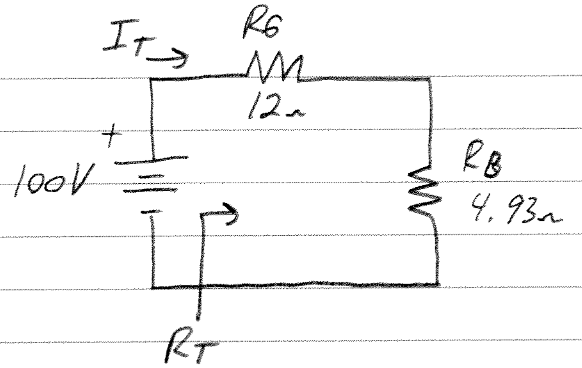


$$R_B = R_5 \,//\, (R_4 + R_A)$$

$$= 10\Omega \,//\, 9.71\Omega$$

$$\underline{R_B = 4.93\,\Omega}$$

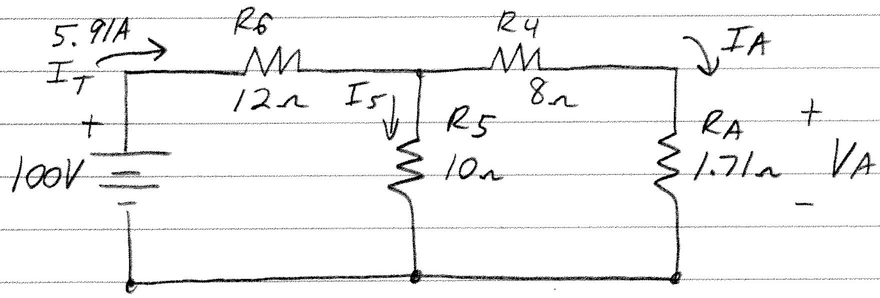
REDRAW:



$$\underline{R_T = 16.93\,\Omega}$$

$$I_T = \frac{100V}{R_T} = \frac{100V}{16.93\,\Omega} = \underline{5.91A}$$

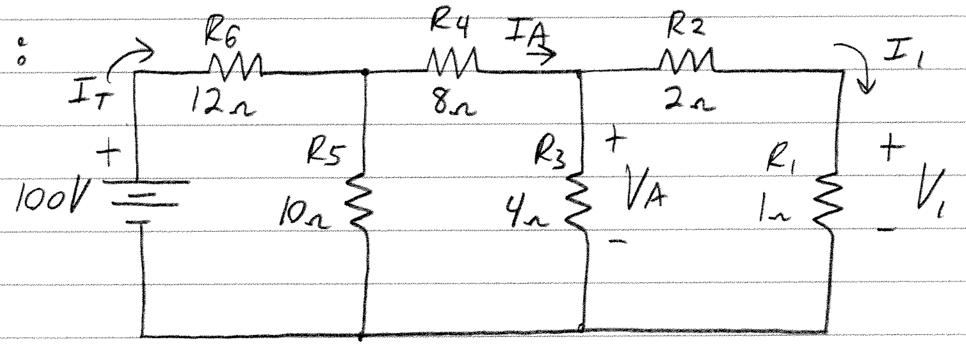
BACK TO PREVIOUS CIRCUIT (WORKING TOWARDS R_1 PARAM.):



$$I_A = I_T\left(\frac{R_5}{R_5 + (R_4 + R_A)}\right) = 5.91A\left(\frac{10}{10 + 9.71}\right) = \underline{3A}$$

$$\therefore V_A = I_A R_A = (3A)(1.71\Omega) = \underline{5.13V}$$

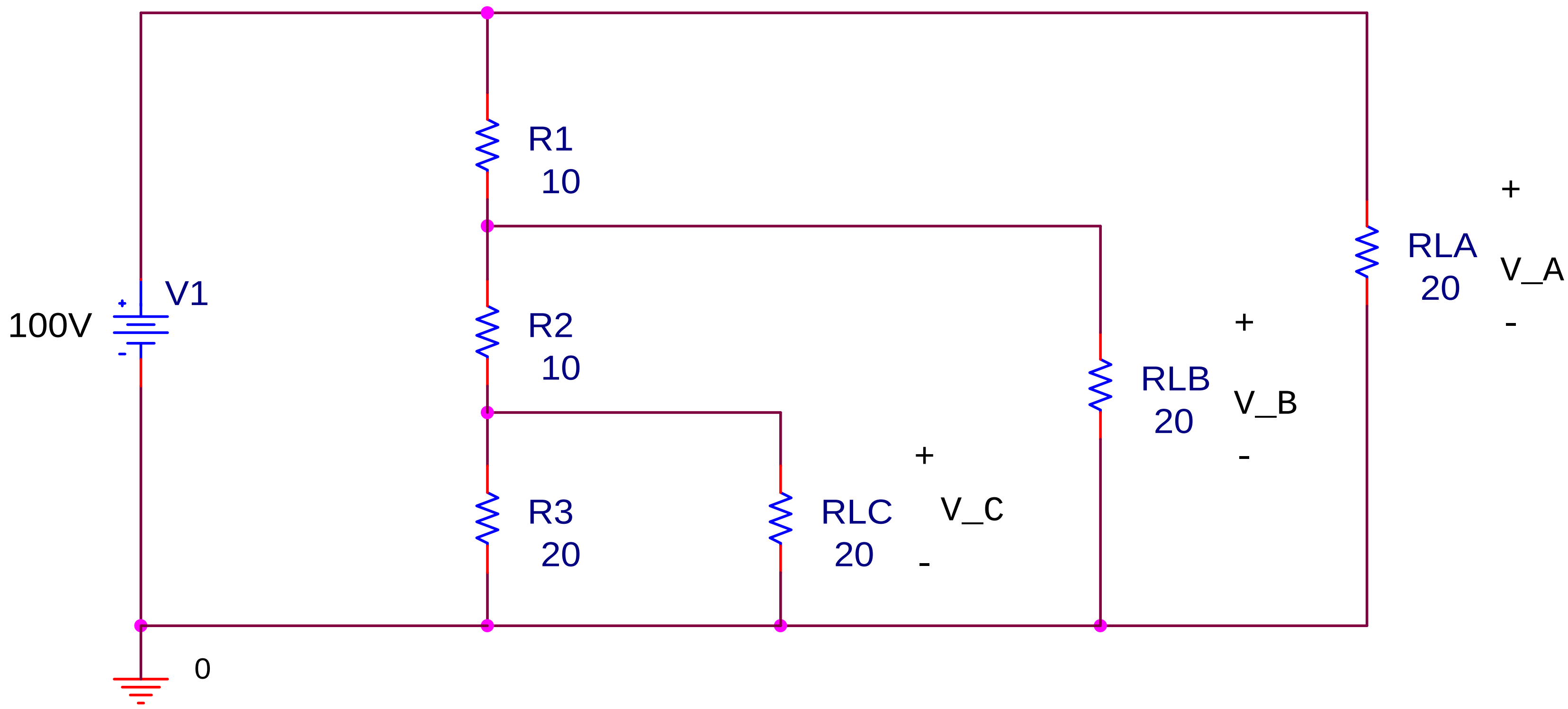
EXPAND R_A:



$$V_1 = V_A \frac{R_1}{R_1 + R_2} = 5.13V\left(\frac{1}{3}\right) = \boxed{1.71V}$$

Breakout #3 – Voltage Divider Supply

- Find V_B and V_C



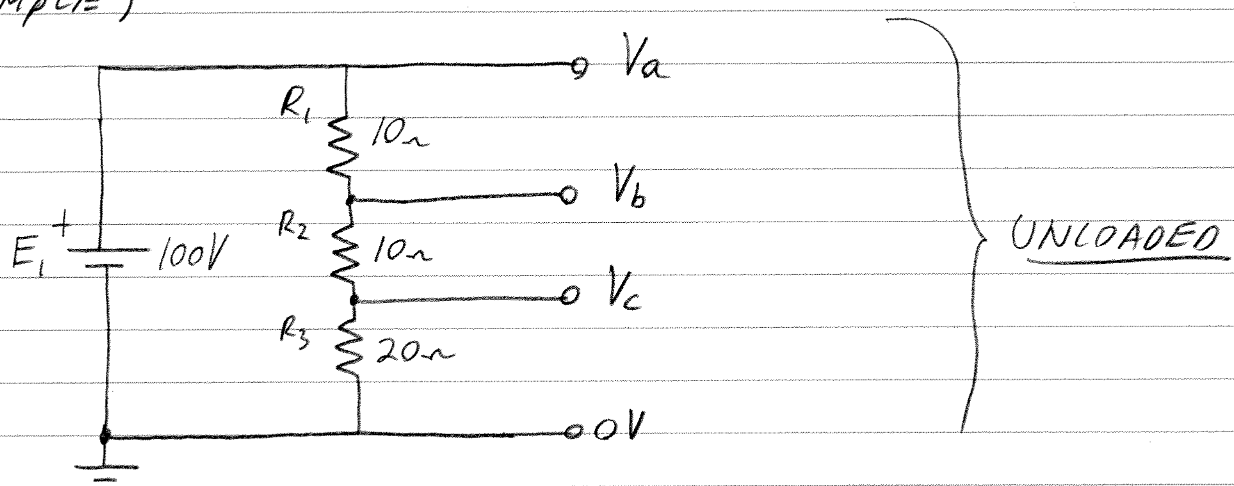
$$I_1 = I_A\left(\frac{R_3}{R_3+R_2+R_1}\right) = 3A\left(\frac{4}{4+2+1}\right) = \boxed{1.71\,A}$$

CHECK: $I_1 = \dfrac{V_1}{R_1} = \dfrac{1.71V}{1\Omega} = \underline{1.71A}$ ✓

7.4 Voltage Divider Supply (Loaded & Unloaded)

- Utilize one supply & resistors to provide several output voltages

(Example)



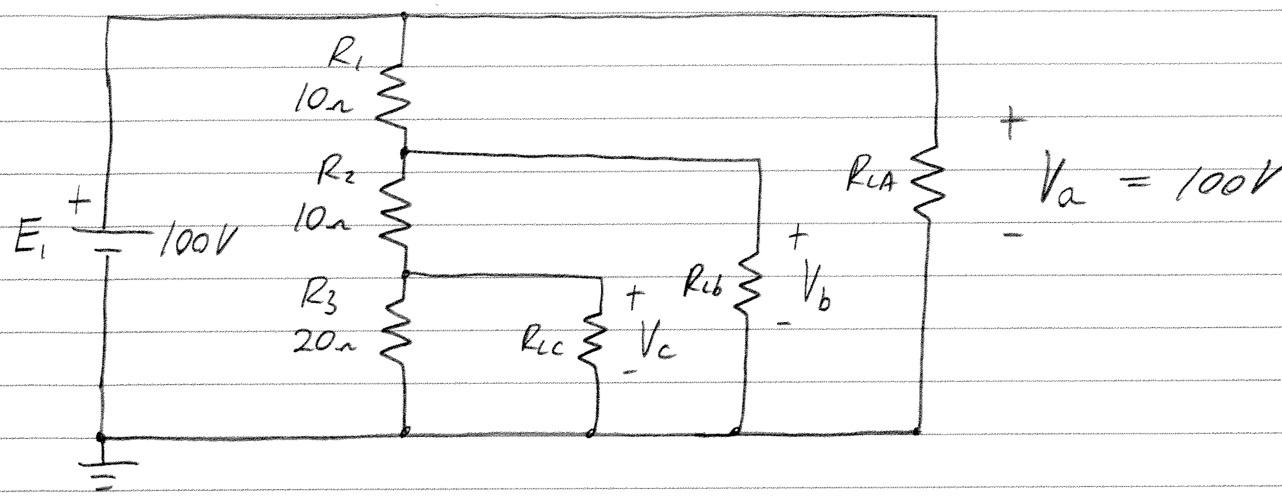
$\underline{\underline{V_a = 100V}}$

$$V_b = 100V\,\frac{(R_2+R_3)}{R_2+R_3+R_1} = 100V\left(\frac{30}{40}\right) = \underline{\underline{75V}}$$

$$V_c = 100V\,\frac{R_3}{R_1+R_2+R_3} = 100V\left(\frac{20}{40}\right) = \underline{\underline{50V}}$$

3 Voltages for the price of one ...
What's the catch?

LOADED VOLTAGE DIVIDER SUPPLY:



$$V_b = \left(\frac{[(R_3 // R_{LC}) + R_2] // R_{Lb}}{[(R_3 // R_{LC}) + R_2] // R_{Lb} + R_1}\right) E_1 \qquad (1)$$

$$V_c = \left(\frac{R_3 // R_{LC}}{R_3 // R_{LC} + R_2}\right) V_b \qquad (2)$$

FOR $R_{Lb} = R_{LC} = 20\Omega$:

$$1 \rightarrow V_b = \left(\frac{[20//20 + 10] // 20}{[20//20 + 10] // 20 + 10}\right) 100V = \left(\frac{20//20}{20//20 + 10}\right) 100V = \left(\frac{10}{10+10}\right) 100V$$

$$\therefore \underline{V_b = 50V} \leftarrow \text{75V UNLOADED}$$

$$2 \rightarrow V_c = \left(\frac{20//20}{20//20 + 10}\right) 50V = \left(\frac{10}{10+10}\right) 50V = \underline{25V} \leftarrow \text{50V UNLOADED}$$