

$$R_{ab} = R + \frac{4R(R+R_L)}{5R+R_L}$$

$$R_L = R + \frac{4R^2 + 4RR_L}{5R+R_L}$$

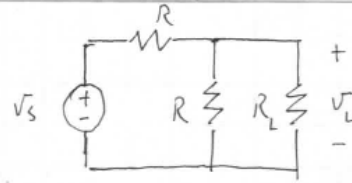
$$R_L = 3R$$

2/41 $V_L = V_s \times \frac{(R \parallel R_L)}{R + (R \parallel R_L)}$

$$= V_s \times \frac{R R_L}{R(R + R_L) + R R_L}$$

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

$$= V_s \frac{R_L}{R + 2R_L} //$$

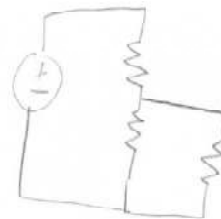


2.44

$$5V = \left(\frac{R_x \parallel 1k\Omega}{R_x \parallel 1k\Omega + \frac{1}{4}R_x} \right) 24$$

$$\frac{1000R_x}{1000 + R_x} + 5000 - R_x$$

$$\frac{1000R_x + (5000 - R_x)(1000 + R_x)}{1000 + R_x}$$



$$5 = \left(\frac{1000R_x}{1000R_x + 5 \times 10^6 + 4000R_x - R_x^2} \right) 24$$

$$-5R_x^2 + 25R_x + 25 \times 10^6 = 24000R_x$$

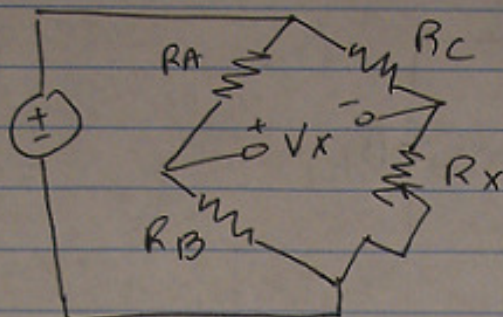
$$R_x^2 - 5000R_x - 5 \times 10^6 = -4800R_x$$

$$R_x^2 - 2800R_x - 5 \times 10^6 = 0$$

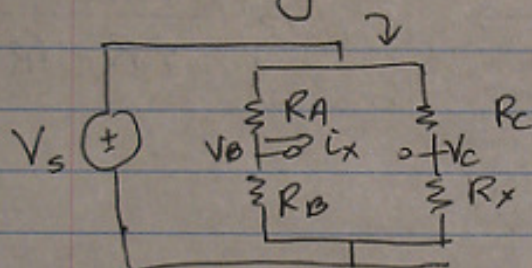
$$R_x = 2338 \Omega$$

$$\begin{array}{r} 4200 \\ -2338 \\ \hline 2662 \end{array}$$

2.46



Redrawing



$$\text{for } i_X = 0 \text{ and } V_X = 0 \quad V_B = V_C$$

using voltage division

$$V_B = V_C$$

$$\frac{R_B}{R_A + R_B} V_s = \frac{R_X}{R_X + R_C} V_s$$

$$\frac{R_B (R_X + R_C)}{(R_A + R_B)} = R_X$$

$$R_X = \frac{R_C R_B}{R_A}$$

2/51

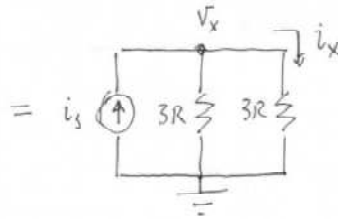
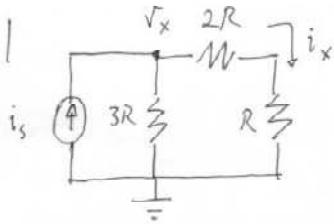


Figure 2

from fig. 2

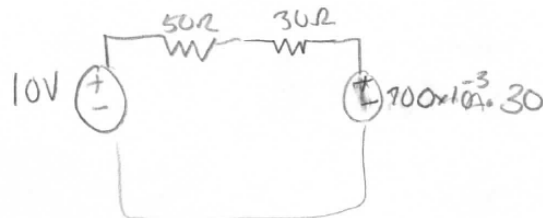
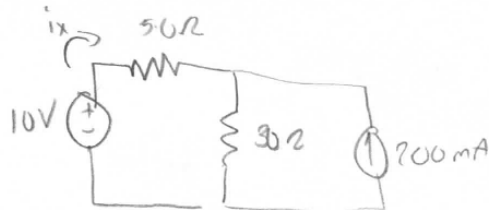
$$\Rightarrow i_x = \frac{i_s}{2}$$

(This is a simple current division)

$$v_x = 3R i_x$$

$$= \frac{3}{2} R i_s$$

2.55

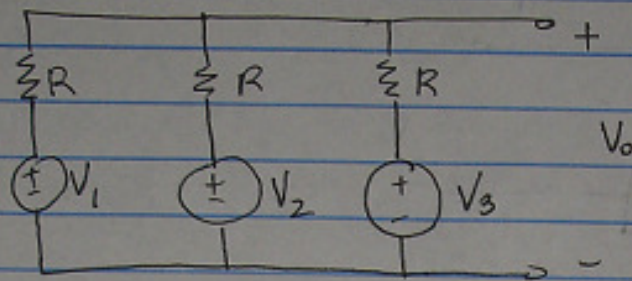


$$4V = 80 \Omega I$$

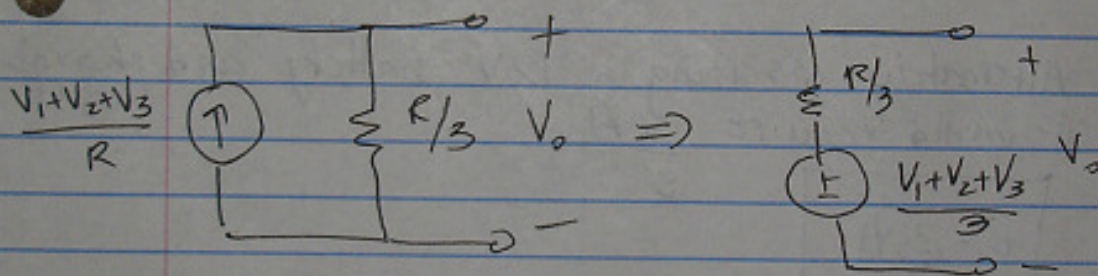
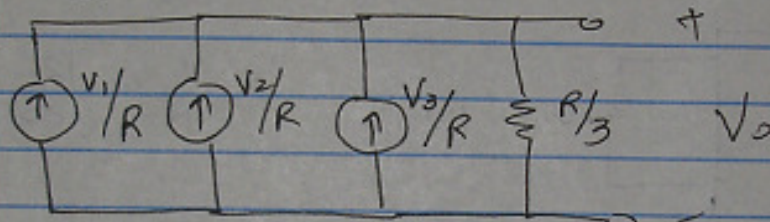
$$I = \frac{4}{80} A$$

$$I = 0.05 A$$

2.57



Using source transformation



$$\therefore \Rightarrow \boxed{V_0 = \frac{V_1 + V_2 + V_3}{3}}$$

3/35a/ OC analysis:

$$V_{oc} = V_{th} = 10 \text{ V} \times \frac{15 \text{ k}\Omega}{10 \text{ k}\Omega + 15 \text{ k}\Omega}$$

$$\therefore V_{th} = 6 \text{ V}$$

SC analysis:

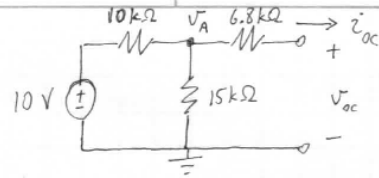
$$V_A' = 10 \text{ V} \times \frac{(6.8 \text{ k}\Omega \parallel 15 \text{ k}\Omega)}{10 \text{ k}\Omega + (6.8 \text{ k}\Omega \parallel 15 \text{ k}\Omega)}$$

$$\approx 3.1875 \text{ V}$$

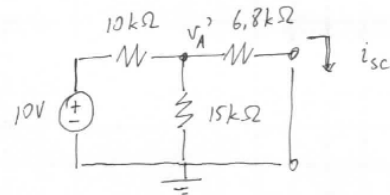
$$\text{also, } V_A' = 6.8 \text{ k}\Omega i_{sc}$$

$$\therefore i_{sc} \approx 4.69 \times 10^{-4} \text{ A} = i_N$$

$$R_{eq} = \frac{V_{th}}{i_N} = 12.8 \text{ k}\Omega$$



Open Circuit $\Rightarrow i_{oc} = 0, V_{oc} = V_A$



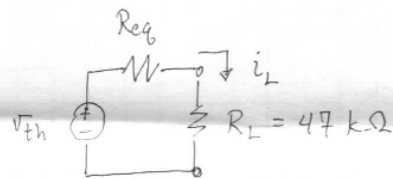
Short Circuit

3/35b/ Subst. the Thevenin Eq. Cct

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

$$= \frac{6}{12.8 + 47} \times 10^{-3} \text{ A}$$

$$i_L \approx .1 \text{ mA}$$



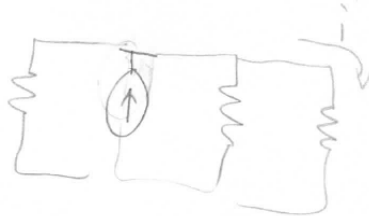
3-38

$$7.5 \times 10^{-3} = \frac{V}{15 \times 10^3} + \frac{V}{5.6 \times 10^3}$$

$$= \frac{5.6 \times 10^3 + 15 \times 10^3}{(15 \times 10^3)(5.6 \times 10^3)} V$$

$$V_{Th} = 10.19V$$

i_{ss}



$$\frac{1}{R_{eq}} = \frac{1}{15} + \frac{1}{5.6} + \frac{1}{8.1}$$

$$R_{eq} = 2.712 k\Omega$$

$$V_{oc} = (7.5 \times 10^{-3}) \left(\frac{5.6 \times 10^3 \cdot 15 \times 10^3}{20.6 \times 10^3} \right)$$

$$V_{oc} = V_{Th} = 10.19$$

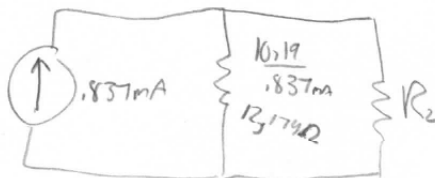
$$V = 7.5 \times 10^{-3} \cdot 2.712 \times 10^3 \Omega$$

$$V = 6.78$$

$$i_{ss} = i_{8.1k\Omega} = \frac{V}{R} = \frac{6.78}{8.1 \times 10^3} = .837mA$$

$$\boxed{I = .837mA}$$

$$\boxed{R_{eq} = 12.174k\Omega}$$



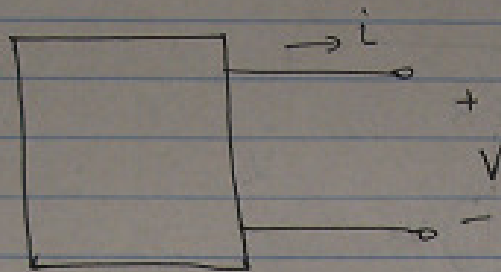
$$\boxed{V_{Th} = 10.19V}$$

$$\text{When } R_L = 4.7k\Omega \quad i = \frac{10.19}{4.7k + 12.17k} = .6mA$$

$$\text{When } R_L = 15k\Omega \quad i = \frac{10.19}{15k + 12.17k} = .37mA$$

$$\text{When } R_L = 60k\Omega \quad i = \frac{10.19}{60k + 12.17k} = .127mA$$

3.42

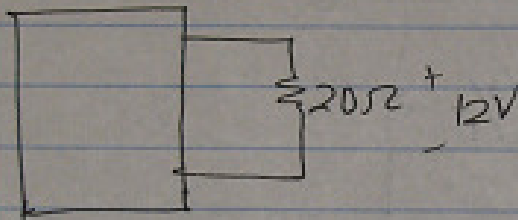


$$i = 1 \text{ A}$$

$$V = 0 \text{ V}$$

$$V = 12 \text{ V}$$

$$R = 20 \Omega$$



$$i = \frac{V}{R} = \frac{12}{20} = \frac{3}{5} \text{ A}$$

Alternately inserting a 12V battery and charging
it would require $\frac{3}{5} \text{ A}$

$$i = \frac{3}{5} \text{ A}$$