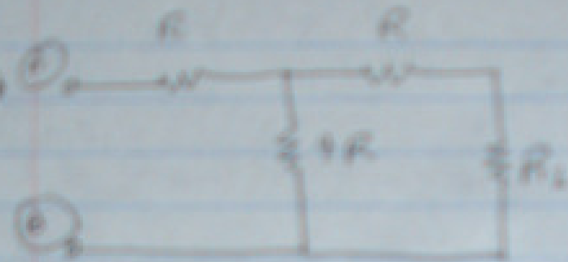
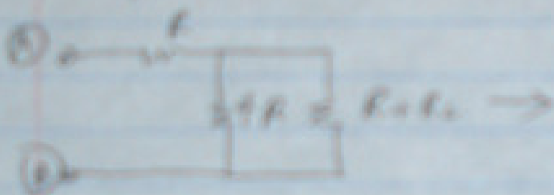
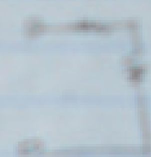
2.53



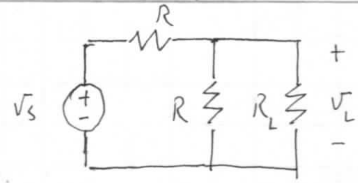
$$\frac{(4R)(R+R_L)}{4R+(R+R_L)}$$

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

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

$$\boxed{R_L = 3R}$$

**2/41**



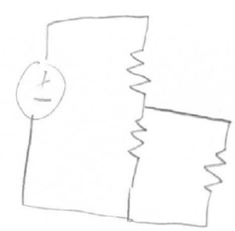

$$v_L = v_s \times \frac{(R \parallel R_L)}{R + (R \parallel R_L)}$$

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

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

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

**2.44**



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

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

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

$$5 = \left(\frac{1000R_x}{1000R_x + 5\times10^6 + 4000R_x - R_x^2}\right) 24$$

$$-5R_x^2 + 25000R_x + 25\times10^6 = 24000R_x$$

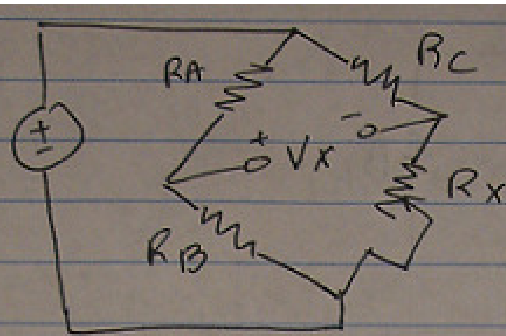
$$R_x^2 - 5000R_x - 5\times10^6 = -4800R_x$$

$$R_x^2 - 200R_x - 5\times10^6 = 0$$

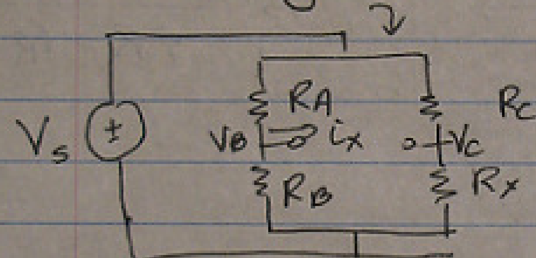
$$\boxed{R_x = 2338\,\Omega}$$

4996 (5000)
−2338
2662

2.46




Redrawing




for $i_x = 0$ and $V_x = 0$ $V_B = V_C$

using voltage division

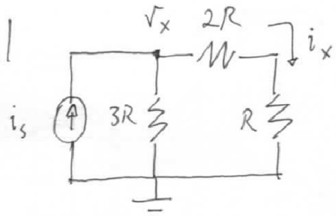
$$V_B = V_C$$

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

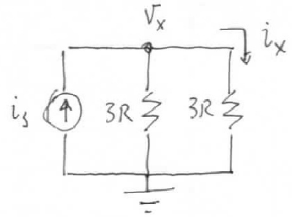
$$\frac{R_B \, (R_X + R_C)}{(R_A + R_B)} = R_X$$

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

2/51




=




← Figure 2

from fig. 2

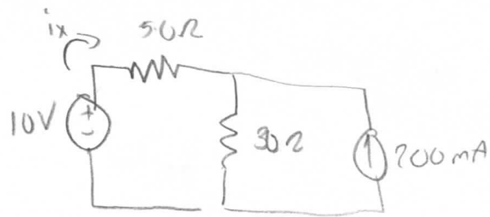
$$\Rightarrow \quad i_x = \frac{i_s}{2}$$ //

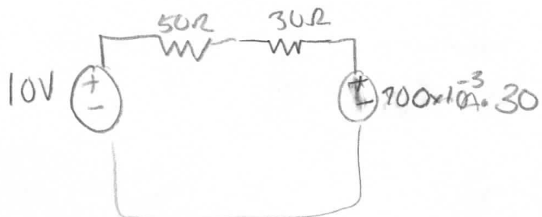
(This is a simple current division)

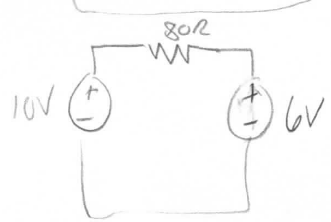
$$v_x = 3 R i_x$$

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

2.55



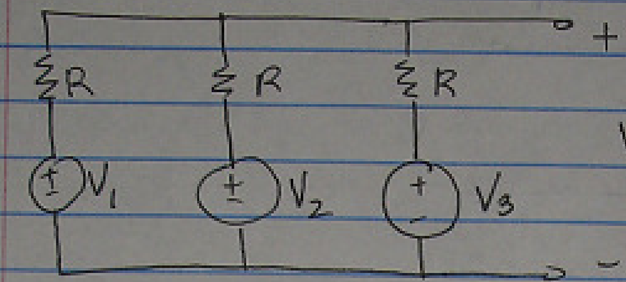




$4V = 80\Omega\, I$ (4/80)

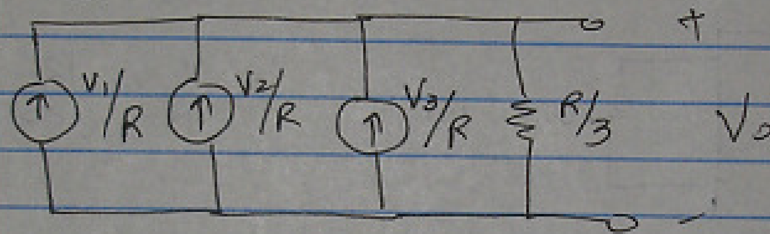
$I = \frac{1}{20} A$

$= .05A$

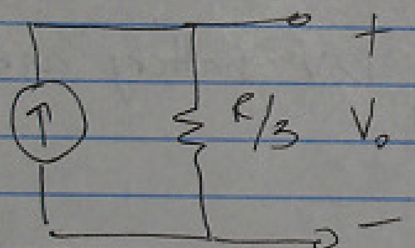
2.57



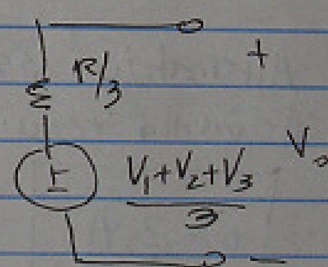

Using source transformation




$\frac{V_1+V_2+V_3}{R}$



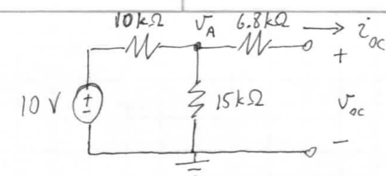

$\Rightarrow$




$\therefore \Rightarrow$

$$\boxed{V_o = \frac{V_1 + V_2 + V_3}{3}}$$

**3/35a** OC analysis:

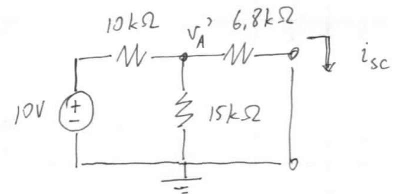



Open Circuit ⇒ $i_{oc} = 0$, $v_{oc} = v_A$

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

$\therefore\ v_{th} = 6\text{ V}$ //

SC analysis:




Short Circuit

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

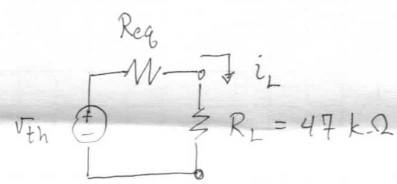
$\approx 3.1875\text{ V}$

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

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

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

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




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

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

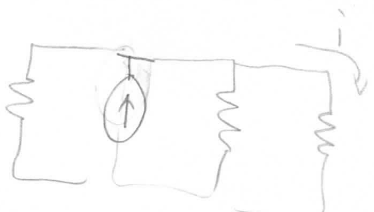
$i_L \approx .1\text{ mA}$ //

3-38

$$7.5\times10^{-3} = \frac{V}{15\times10^3} + \frac{V}{5.6\times10^3}$$
$$= \left(\frac{5.6\times10^3 + 15\times10^3}{(15\times10^3)(5.6\times10^3)}\right) V$$

$V_{TH} = 10.19V$

$i_{ss} =$



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

$R_{eq} = 2.712 k\Omega$

$$V_{oc} = (7.5\times10^{-3})\left(\frac{5.6\times10^3 \cdot 15\times10^3}{20.6\times10^3}\right)$$

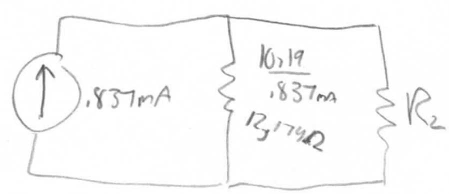
$V_{oc} = V_{TH} = 10.19$

$V = 7.5\times10^{-3} \cdot 2.712\times10^3 \Omega$

$V = 6.78$

$$i_{ss} = i_{8.1k\Omega} = \frac{V}{R} = \frac{6.78}{8.1\times10^3} = .837mA$$

$I = .837mA$
$R_{eq} = 12.174k\Omega$



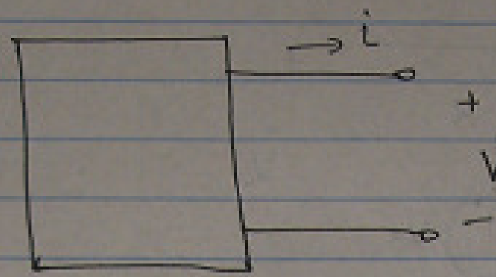

$V_{TH} = 10.19V$

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

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

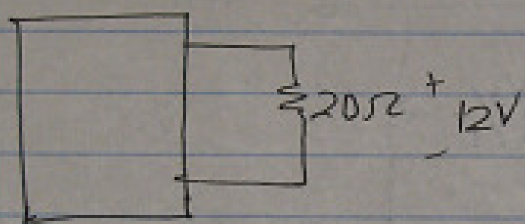
when $R_L = 68k\Omega$ $\quad i = \frac{10.17}{68k + 12.17k} = .127mA$

3.42




$i = 1\,A$ $\quad$ $V = 0V$

$V = 12V$ $\quad$ $R = 20\Omega$




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

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

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