

Homework II

Ch. 2: 42, 43, 45, 49, 51, 52, 56

Ch. 3: 37, 38, 41

P. 2.42 Find v_L in terms of i_s , R , & R_L

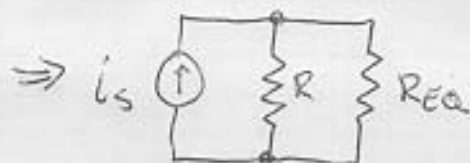
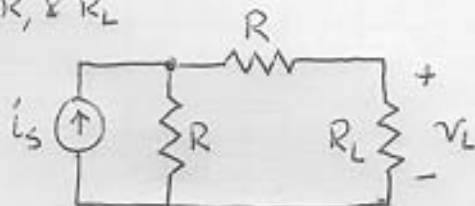
$$R_{eq} = R + R_L$$

current division

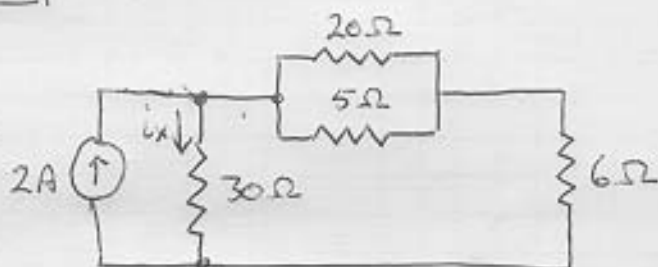
$$i_L = \frac{R}{R + (R + R_L)} i_s$$

$$v_L = i_L R_L$$

$$v_L = \frac{R R_L}{2R + R_L} i_s$$



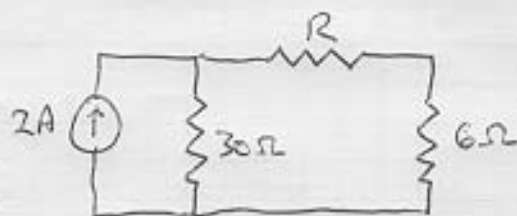
P. 2.43 Find i_x



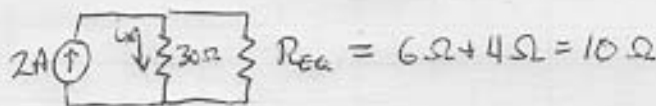
current division

$$i_x = \frac{10}{10 + 30} (2A)$$

$$i_x = 0.5 A$$



$$R = \frac{(20)(5)}{20 + 5} \Omega = 4 \Omega$$



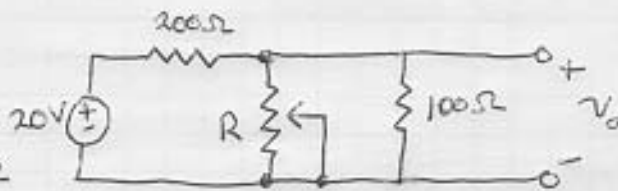
P. 2.45 Find range of v_o

$$R_{eq} = \frac{R(100)}{R + 100} \quad 0 \Omega \leq R_{eq} \leq 50 \Omega$$

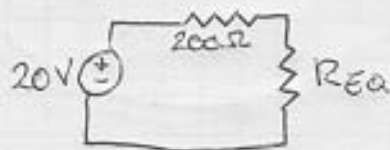
voltage division

$$v_o = \frac{R_{eq}}{200 + R_{eq}} (20V)$$

$$0V \leq v_o \leq 4V$$



$$0 \leq R \leq 100 \Omega$$



P.2.49 Select R_x such that $v_L = 3V$

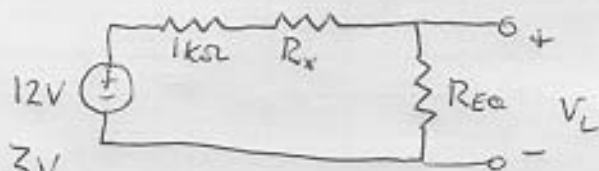
$$R_{Eq} = \frac{(1)(1)}{1+1} k\Omega$$

$$= 500 \Omega$$



voltage division

$$v_L = \frac{R_{Eq}}{1k\Omega + R_x + R_{Eq}} (12V) = 3V$$



solve for R_x

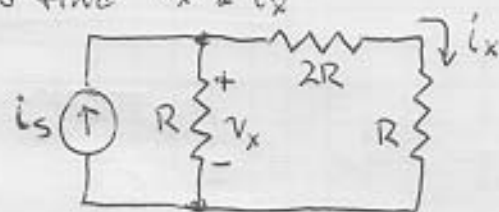
$$R_x = \frac{(R_{Eq})(12V)}{(3V)} - 1k\Omega - R_{Eq}$$

$$R_x = 500 \Omega$$

P.2.51 Use circuit reduction to find v_x & i_x

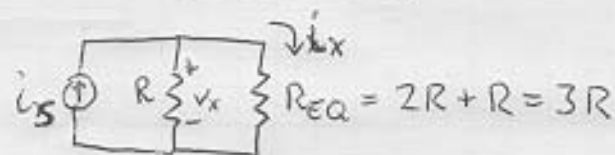
current division

$$i_x = \frac{R}{R+3R} i_s = \left[\frac{i_s}{4} \right]$$



$$v_x = R(i_s - i_x)$$

$$= R\left(i_s - \frac{i_s}{4}\right)$$



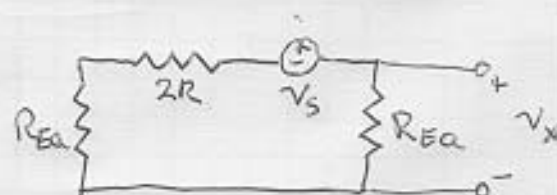
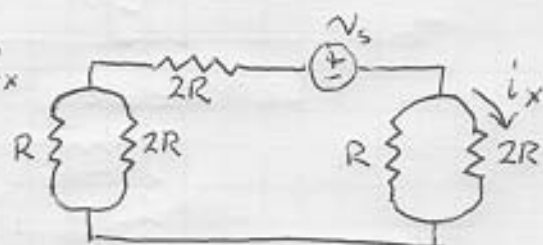
$$v_x = \frac{3}{4} i_s R$$

P.2.52 Use circuit reduction to find i_x

$$R_{Eq} = \frac{(2R)(R)}{2R+R} = \frac{2}{3} R$$

$$v_x = \frac{\left(\frac{2}{3}R\right)}{\left(\frac{10}{3}R\right)} v_s = \frac{v_s}{5}$$

$$i_x = \frac{v_x}{2R} = \left[\frac{v_s}{10R} \right]$$

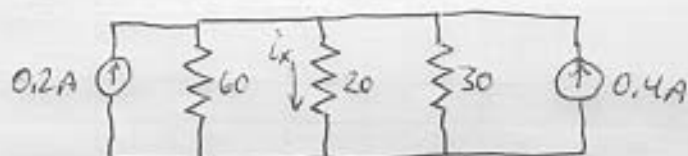
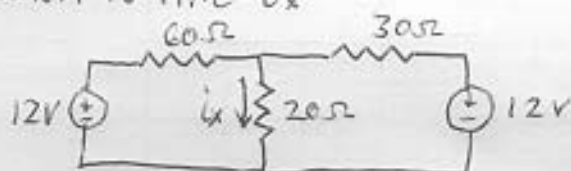


P.2.56 Use source transformation to find i_x

current division

$$i_x = \frac{\left(\frac{1}{20}\right)}{\frac{1}{60} + \frac{1}{30} + \frac{1}{20}} (0.6A)$$

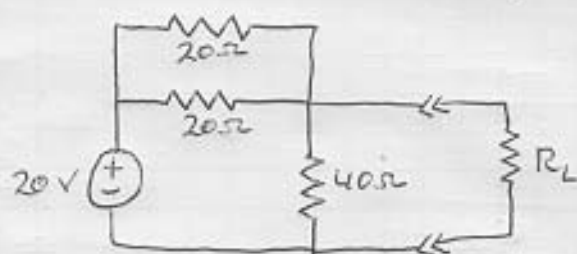
$$i_x = 0.3A$$



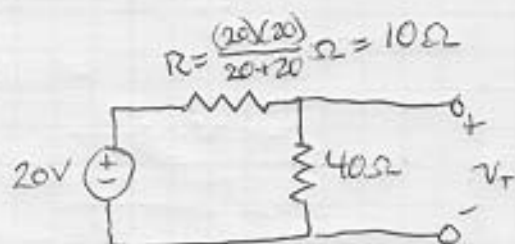
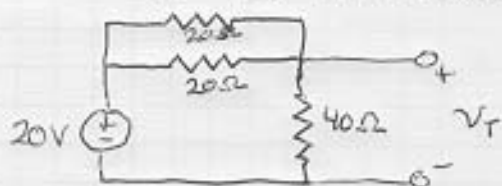
rearrange & add sources



P.3.37 Find Thevenin Equivalent circuit. Find voltage across load when $R_L = 5\Omega, 10\Omega$, and 50Ω



Step 1 - remove load & find voltage between the terminals of the interface.

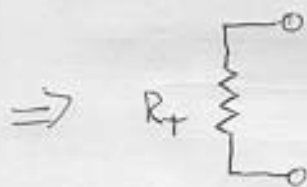
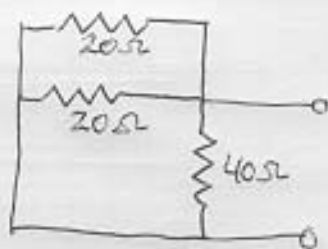


voltage division

$$V_T = \frac{40}{10+40} (20V)$$

$$V_T = 16V$$

Step 2 - Find the equivalent resistance seen by the load, turn off all sources.

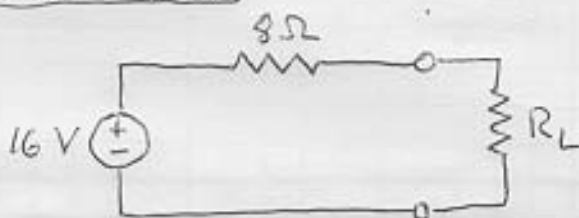


$$\frac{1}{R_T} = \frac{1}{20\Omega} + \frac{1}{20\Omega} + \frac{1}{40\Omega}$$

$$R_T = \frac{(20)(20)(40)}{(20)(20) + (20)(40) + (20)(40)}$$

$$\boxed{R_T = 8\Omega}$$

Thevenin Circuit



When

$$R_L = 5\Omega$$

$$V_L = \frac{5}{8+5} (16V)$$

$$\boxed{V_L = \frac{80}{16} V \approx 6.15V}$$

$$R_L = 10\Omega$$

$$V_L = \frac{10}{8+10} (16V)$$

$$\boxed{V_L = \frac{80}{9} V \approx 8.89V}$$

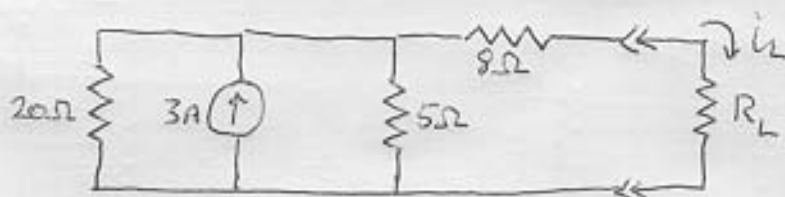
$$R_L = 50\Omega$$

$$V_L = \frac{50}{8+50} (16V)$$

$$\boxed{V_L = \frac{400}{29} V \approx 13.8V}$$

P.3, 38

Find Norton equivalent circuit. Find current through load when $R_L = 6\Omega$, 12Ω , and 60Ω

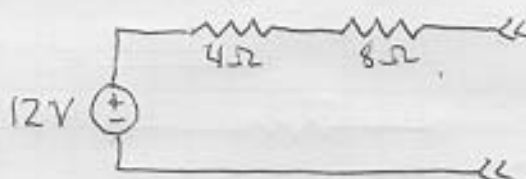


$$20\Omega \parallel 5\Omega$$

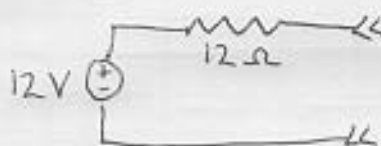


$$\frac{(20)(5)}{20+5} \Omega = 4\Omega$$

Source transformation



$$(3A)(4\Omega) = 12V$$



source transf.

Norton circuit



$$\frac{(12V)}{(12\Omega)} = 1A$$

when

$$R_L = 6\Omega$$

$$i_L = \frac{12}{12+6} (1A) =$$

$$i_L = \frac{2}{3} A \approx 0.67A$$

$$R_L = 12\Omega$$

$$i_L = \frac{12}{12+12} (1A)$$

$$i_L = \frac{1}{2} A = 0.5A$$

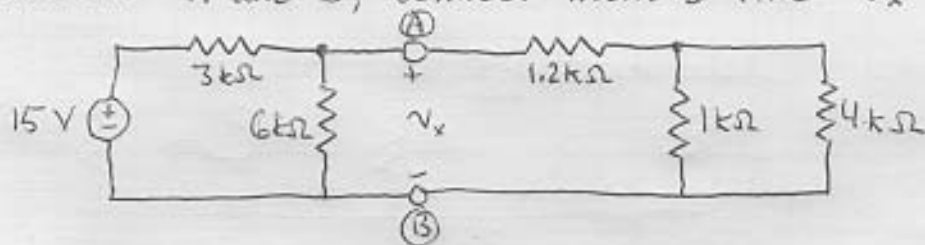
$$R_L = 60\Omega$$

$$i_L = \frac{12}{12+60} (1A)$$

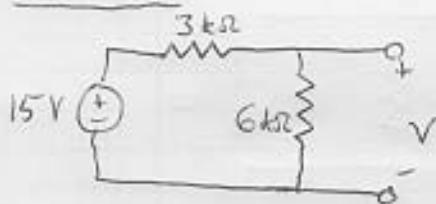
$$i_L = \frac{1}{6} A \approx 0.17A$$

P.3.41

Find Thevenin equivalent circuits on both sides of terminals A and B, connect them & find V_x



left side



Step 1

$$V = \frac{6}{3+6} \times 15$$

$$V = \left(\frac{6k\Omega}{3k\Omega + 6k\Omega} \right) (15V)$$

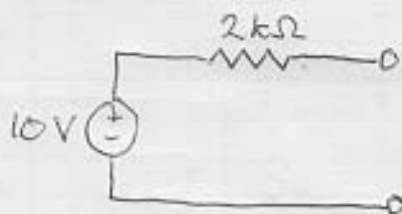
$$V = 10V$$

Step 2

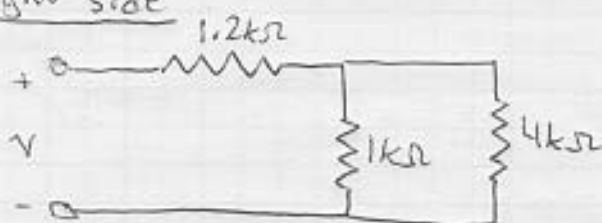


$$R_{EQ} = \frac{(3)(6)}{3+6} k\Omega$$

$$= 2k\Omega$$



right side



Step 1

$$V = 0 \quad (\text{no source})$$

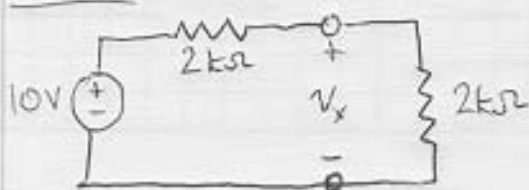
Step 2

$$R_T = 1.2k\Omega + \frac{(1)(4)}{1+4} k\Omega$$

$$= 2k\Omega$$



join



voltage division

$$V_x = \frac{2}{2+2} (10V) = 5V$$