Problem 3.30: Find v_1 & v_2

$150\Omega \| 75\Omega = 50\Omega$

$90\Omega \| 90\Omega = 45\Omega$

$$\frac{45\Omega}{45\Omega + 90\Omega} \cdot 3V = 1V$$

$$v_1 = 1V \cdot \frac{50\Omega}{50\Omega + 40\Omega} \approx 0.556V$$

$$v_2 = 1V \cdot \frac{30\Omega}{30\Omega + 60\Omega} \approx 0.333V$$

Problem 3.32: Find v_x

$v_x = v_2 - v_1$

$v_2 = 45V \cdot \frac{20k\Omega}{25k\Omega} = 36V$

$v_1 = 45V \cdot \frac{90k\Omega}{150k\Omega} = 27V$

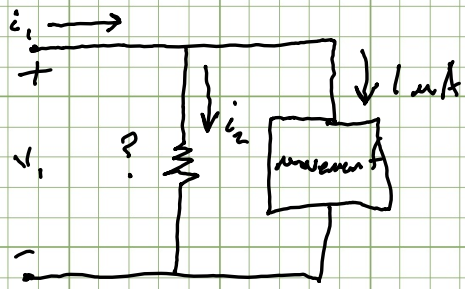
$v_x = 9V$

$$v_x = v_s\left(\frac{4}{5} - \frac{3}{5}\right) = v_s\frac{1}{5}$$

Problem 3.33:

A shunt resistor and a 50 mV, 1 mA d'Arsonval movement are used to build a 5 A ammeter.

A resistance of 20 mΩ is placed across the terminals of the ammeter. What's the new full-scale range?



$i_1 = 5A \qquad i_2 = 4999\ mA$

$v_1 = 50\ mV \qquad \frac{50\ mV}{4999\ mA} \approx 10\ m\Omega$

$20\ m\Omega \,//\, 10\ m\Omega = 6.\overline{6}\ m\Omega$

$$\text{Full-scale} = 1mA + \frac{50mV}{6.\overline{6}m\Omega} = \underline{\underline{7.5\ A}}$$

Problem 3.37: Find R_v for each of the following full-scale readings: 50 V, 5 V, 250 mV, 25 mV

$$1\,mA = \frac{(50V - 20mV)}{R_v} \Rightarrow R_v = 49,980\,\Omega$$

$$1\,mA = \frac{(5V - 20mV)}{R_v} \Rightarrow R_v = 4,980\,\Omega$$

$$1\,mA = \frac{(250mV - 20mV)}{R_v} \Rightarrow R_v = 230\,\Omega$$

$$1\,mA = \frac{(25mV - 20mV)}{R_v} \Rightarrow R_v = 5\,\Omega$$

Problem 3.51: Bridge circuit has 21 V dc.

Bridge is balanced when $R_1 = 800\ \Omega$

$R_2 = 1200\ \Omega$

$R_3 = 600\ \Omega$

a) What is R_x?

b) How much current is supplied?

c) Which resistor absorbs the most power? How much?

d) Which absorbs the least? How much?

$$R_x = R_2 \cdot \frac{R_3}{R_1} = 900\ \Omega$$

$$\frac{21\ V}{R_{eq}} \qquad R_{eq} = R_1 / R_2 + R_3 / R_x$$

$$= 840\ \Omega$$

$$= 25\ mA$$

$$V_g = 21V \cdot \frac{R_x}{R_x + R_2} = 9V \rightarrow \text{Voltage over } R_x \text{ \& } R_3$$

$12V \rightarrow$ Voltage over R_1 & R_2

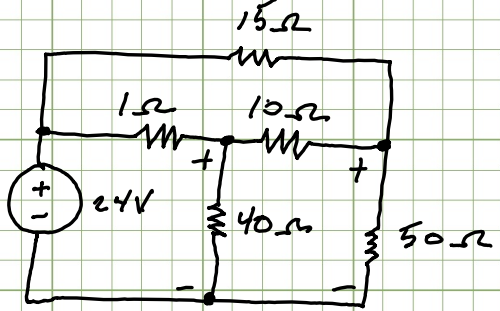
$$\frac{9V^2}{600\ \Omega} = 0.135\ W \qquad \frac{12V^2}{800\ \Omega} = 0.180\ W$$

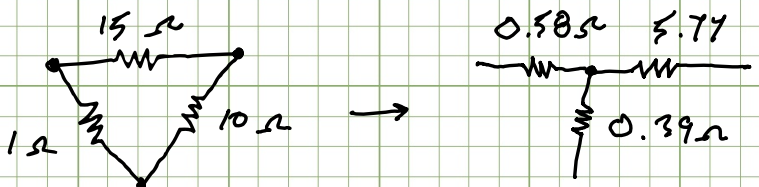
R_1 consumes the most at 180 mW

$\frac{9V^2}{900\Omega} = 0.09W$ $\quad \frac{12V^2}{1200\Omega} = 0.12W$

R_x consumes the least at 90 mW

Problem 3.58: Use a delta-wye transformation to find the voltages V_1 & V_2





$\frac{15\Omega \cdot 10\Omega}{1\Omega+10\Omega+15\Omega} \approx 5.77\Omega$

$\frac{1\Omega \cdot 10\Omega}{1\Omega+10\Omega+15\Omega} \approx 0.39\Omega$

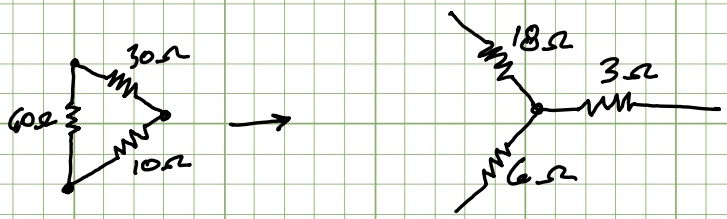
$$\frac{1\Omega \cdot 15\Omega}{1\Omega + 10\Omega + 15\Omega} = 0.58\Omega$$

$$24V - 0.6V = 23.4V$$

$$v_1 = 23.18V$$

$$v_2 = 20.98V$$

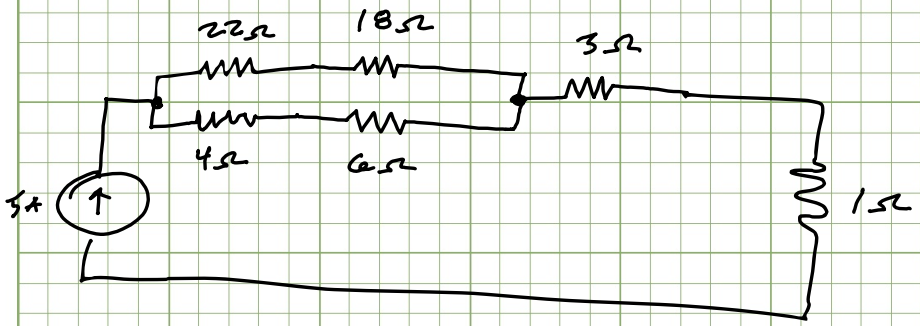
Problem 3.59: Find i_1, i_2, v, and the power supplied.



$$\frac{30\Omega \cdot 10\Omega}{100\Omega} = 3\Omega$$

$$\frac{30\Omega \cdot 60\Omega}{100\Omega} = 18\Omega$$

$$\frac{60\Omega \cdot 10\Omega}{100\Omega} = 6\Omega$$



12Ω

60V

$\text{power} = \frac{60V^2}{12\Omega} = \underline{\underline{300W}}$

$v = \underline{\underline{-6V}}$

$i_1 = \underline{\underline{4A}}$

$\frac{6V}{60\Omega} = 0.1A$ $\quad i_2 = \underline{\underline{3.9A}}$

Problem 3.60: Find i_o & the power dissipated in the 140Ω resistor.

$[([[(8\Omega + 12\Omega) \| 60\Omega] + 20\Omega) \| 140\Omega] + 22\Omega$

$= 50\Omega$

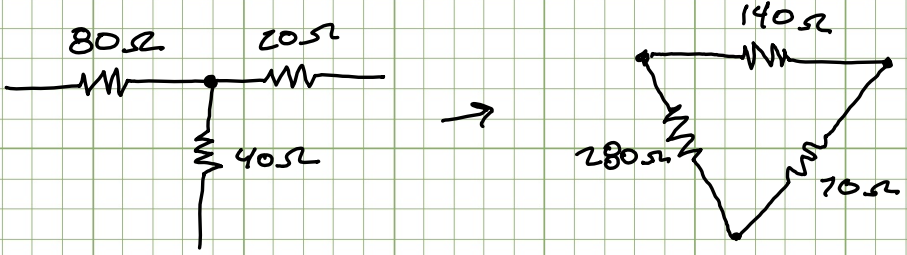
$(50\Omega \| 75\Omega) + 10\Omega = 40\Omega$

$i_o = \frac{180V}{75\Omega} = \underline{\underline{2.4A}}$

$\frac{180V}{50\Omega} = 3.6A$ $\quad 180V - 3.6A \cdot 22\Omega = 100.8V$

$$\frac{100.8\,V^2}{140\,\Omega} \approx 72.6\,W$$

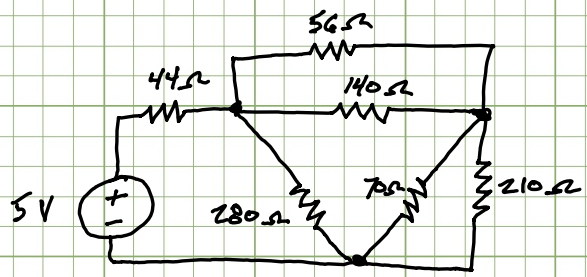
Problem 3.62: Find i_0, i_1, i_2, & the power delivered.



$$\frac{80\,\Omega \cdot 20\,\Omega + 20\,\Omega \cdot 40\,\Omega + 40\,\Omega \cdot 80\,\Omega}{40\,\Omega} = 140\,\Omega$$

$$\frac{5600\,\Omega^2}{20\,\Omega} = 280\,\Omega$$

$$\frac{5600\,\Omega^2}{80\,\Omega} = 70\,\Omega$$



$$\left(70\,\Omega \,/\!/\, 210\,\Omega + 56\,\Omega \,/\!/\, 140\,\Omega\right) \,/\!/\, 280\,\Omega + 44\,\Omega$$

$$92.5\,\Omega \qquad \approx 113.5\,\Omega$$

$$\frac{5V^2}{113.5\Omega} \approx \underline{\underline{220\,mW}}$$

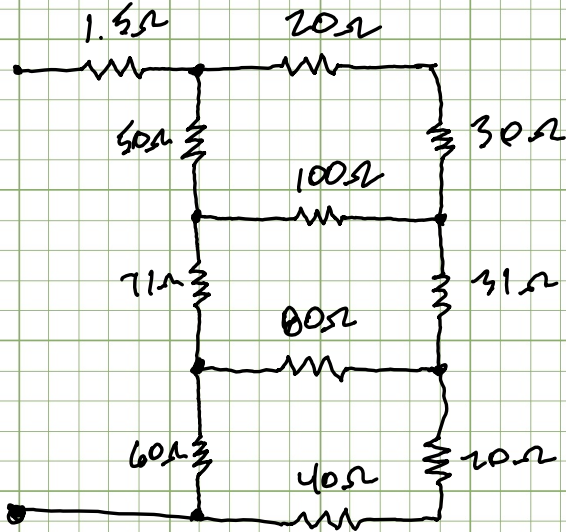
$$\frac{5V}{113.5\Omega} \approx 44\,mA \cdot \frac{280\Omega}{280\Omega + 92.5\Omega} \approx 33\,mA$$

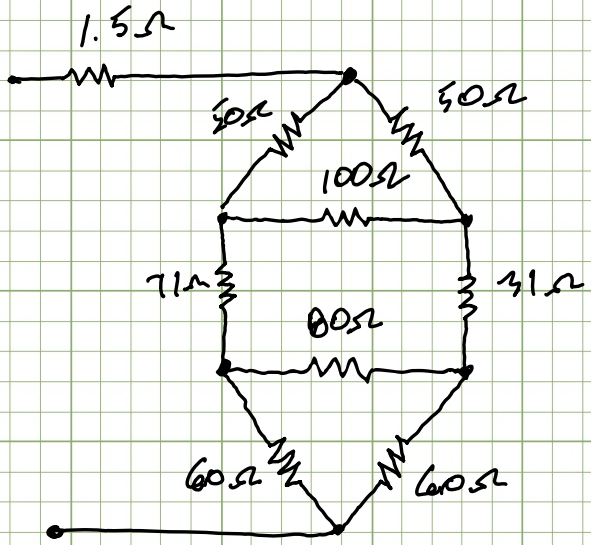
$$33\,mA \cdot \frac{140\Omega}{140\Omega + 56\Omega} \approx \underline{\underline{23.6\,mA = i_1}}$$

$$33\,mA \cdot \frac{70\Omega}{210\Omega + 70\Omega} \approx \underline{\underline{8.25\,mA = i_0}}$$

$$i_2 = 44\,mA - i_0 = \underline{\underline{35.8\,mA = i_2}}$$

Problem 3.63: Find the equivalent resistance.



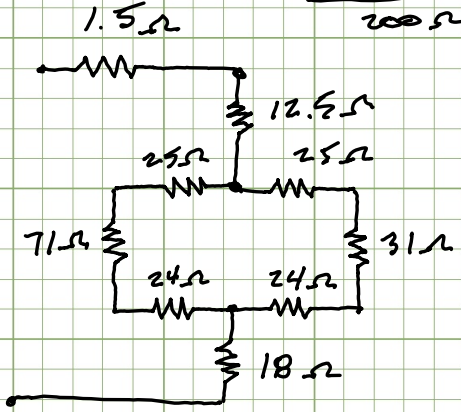


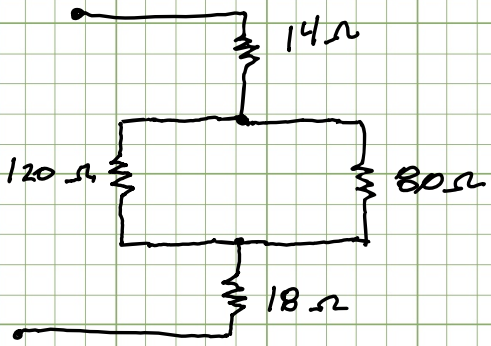
$$\frac{50\Omega \cdot 50\Omega}{200\Omega} = 12.5\Omega$$

$$\frac{100\Omega \cdot 50\Omega}{200\Omega} = 25\Omega$$

$$\frac{80\Omega \cdot 60\Omega}{200\Omega} = 24\Omega$$

$$\frac{60\Omega^2}{200\Omega} = 18\Omega$$

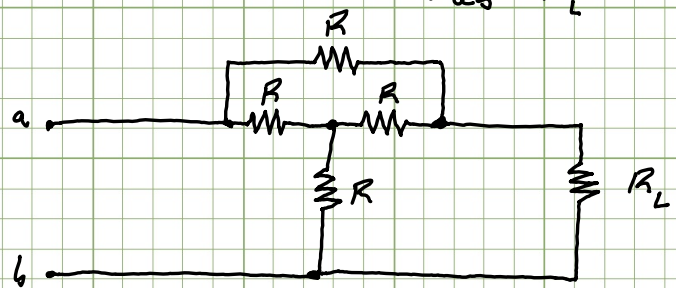


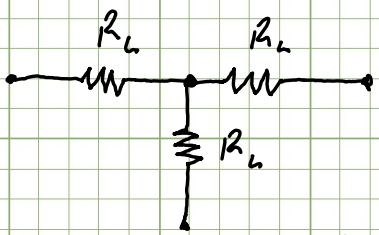


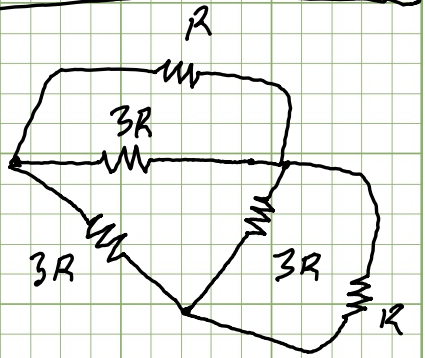
$$48\Omega + 18\Omega + 14\Omega = \underline{\underline{80\Omega}}$$

Problem 3.67: Use a Y-Δ transform to show that

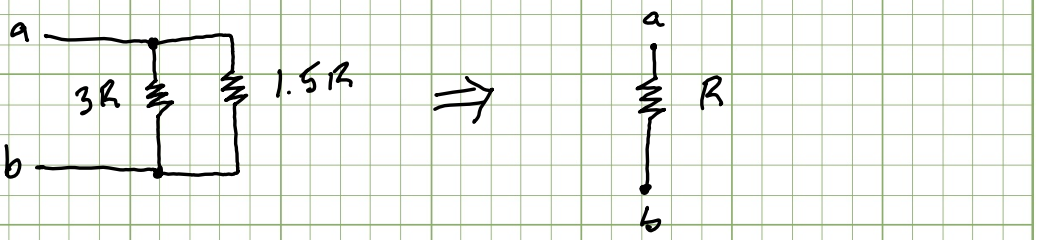
$$R_{ab} = R_L \text{ if } R = R_L$$







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


a
3R
1.5R
b
a
R
b