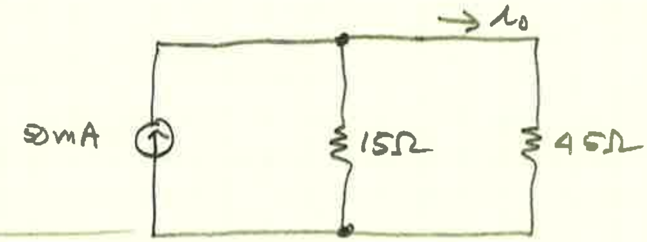
% error = $\left(\frac{\text{measured value}}{\text{true value}} - 1\right) \times 100$

ammeter resistance = 0.1 Ω

an ammeter is used to measure i_o. Find % error.



- FIND true value of i_o

using current divider,

$$i_o = \frac{50mA(15)}{15+45} = 12.5\,mA$$

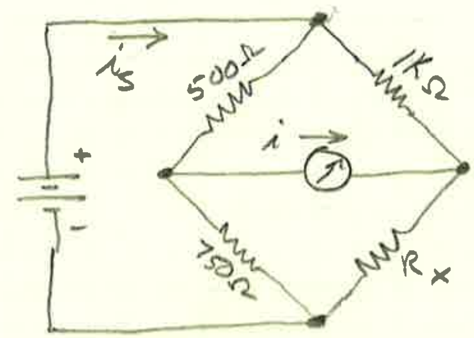
- Find measured value

$$i_o = \frac{(50mA)(15)}{15+45+.1} = 12.4792\,mA$$

$$\%\ \text{error} = \left(\frac{12.4792}{12.5} - 1\right) \times 100 = \boxed{-0.166\ \%}$$

The Bridge circuit is balanced ($i=0$) when $R_1 = 500\,\Omega$, $R_2 = 1000\,\Omega$, $R_3 = 750\,\Omega$

$V = 24V$



a) find R_x

$$\frac{500}{750} = \frac{1K}{R_x}$$

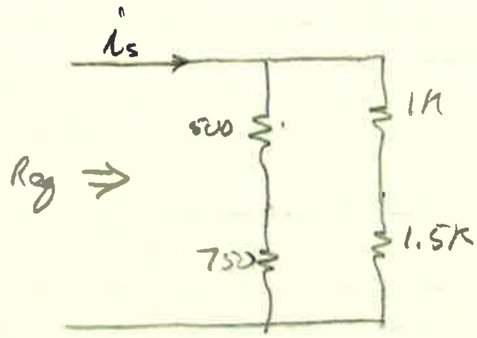
$$\boxed{R_x = 1.5K\Omega}$$

b) find i_s

First, find R_{eq}

$$R_{eq} = \frac{(1250)(2.5K)}{1250 + 2.5K} = 833\,\Omega$$

$$i_s = \frac{24}{833} = \boxed{28.8\text{ mA} = i_s}$$

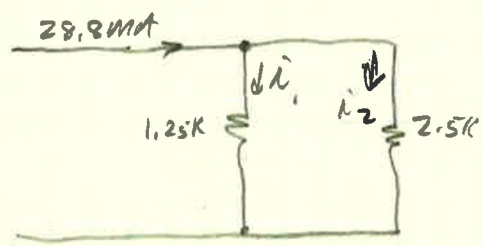


c) which resistor absorbs most power?
d) " " " least " ?

using current divider,

$$i_1 = \frac{(28.8\text{mA})(2.5K)}{1.25K + 2.5K} = 19.2\text{ mA}$$

$$i_2 = \frac{(28.8\text{mA})(1.25K)}{(1.25K + 2.5K)} = 9.6\text{ mA}$$



$P_{500} = i^2 R = 184\text{ mW}$

$P_{750} = i^2 R = 276\text{ mW}$ ← most

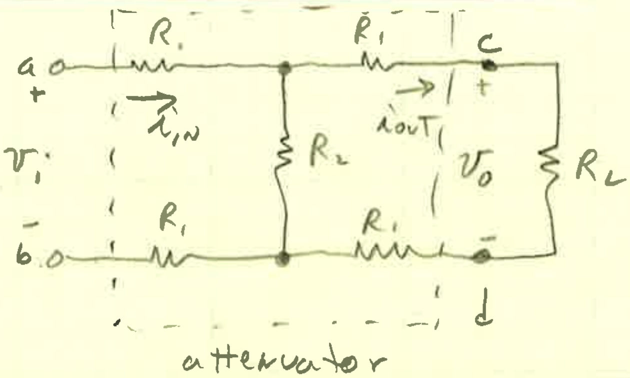
$P_{1K} = i^2 R = 92.2\text{ mW}$ ← least

$P_{1.5K} = i^2 R = 230\text{ mW}$

a) Show that if $R_{ab} = R_L$ then

$R_L^2 = 4R_1(R_1+R_2)$ and

$\dfrac{v_o}{v_i} = \dfrac{R_2}{2R_1 + R_2 + R_L}$



$R_{ab} = 2R_1 + R_2 \| (R_1 + R_1 + R_L)$

$= 2R_1 + \dfrac{R_2(R_2 + R_1 + R_L)}{2R_1 + R_2 + R_L}$

But $R_{ab} = R_L$ so $R_L = 2R_1 + \dfrac{R_2(2R_1 + R_L)}{2R_1 + R_2 + R_L}$

$R_L(2R_1 + R_2 + R_L) = 2R_1(2R_1 + R_2 + R_L) + R_2(2R_1 + R_L)$ ✓

$R_L^2 = 4R_1^2 + 2R_1R_2 + \cancel{2R_1R_L} + 2R_1R_2 + \cancel{R_2R_L} - \cancel{2R_1R_L} - \cancel{R_2R_L}$

$= 4R_1^2 + 4R_1R_2$

$\boxed{R_L^2 = 4R_1(R_1 + R_2)}$ ✓

when $R_{ab} = R_L$, $i_{IN} = \dfrac{v_i}{R_L}$

using a current divider, $i_{out} = \dfrac{i_{IN}(R_2)}{R_2 + 2R_1 + R_L}$

$V_o = i_{OUT} R_L = \dfrac{v_i(R_2)(R_L)}{R_L(R_2 + 2R_1 + R_L)}$

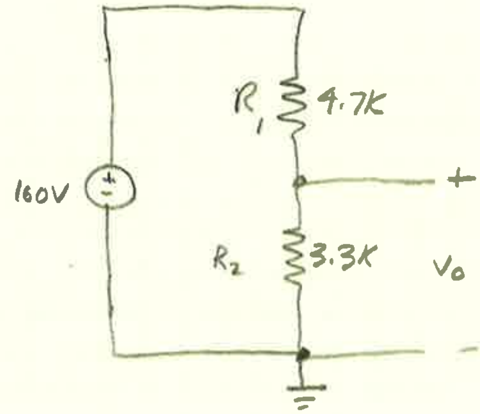
$\boxed{\text{or } \dfrac{V_o}{V_i} = \dfrac{R_2}{2R_1 + R_2 + R_L}}$ ✓

b) Select R_1 & R_2 so $R_{ab} = R_L = 300\,\Omega$ and $\dfrac{V_o}{V_i} = 0.5$

$0.5 = \dfrac{R_2}{2R_1 + R_2 + 300}$ $\qquad 300^2 = 4R_1(R_1 + R_2)$

Solving these 2 equations; $\boxed{R_1 = 50\,\Omega \quad R_2 = 400\,\Omega}$

3.12 | Nilsson 10th



a) FIND V_o

- assume Reference at Bottom of circuit

using Voltage divider,

$$V_o = \frac{160v(R_2)}{R_1+R_2}$$

$$\boxed{V_o = 66\,V}$$

b) $P_{R_1} = \frac{V^2}{R} = \frac{(160-66)^2}{4.7K} = \boxed{1.88\,W}$

$P_{R_2} = \frac{(66)^2}{3.3K} = \boxed{1.32W}$

c) assume only .5W resistors available + V_o is the Same as part a. Find the smallest value of R_1 + R_2

For R_2, $P_{R_2} = \frac{V^2}{R_2} \Rightarrow 0.5 = \frac{(66)^2}{R_2} \Rightarrow \boxed{R_2 = 8.71k\Omega}$

For R_1, $P_{r_1} = \frac{(160-66)^2}{R_1} \Rightarrow 0.5 = \frac{(94)^2}{R_1} \Rightarrow \boxed{R_1 = 17.67K\Omega}$

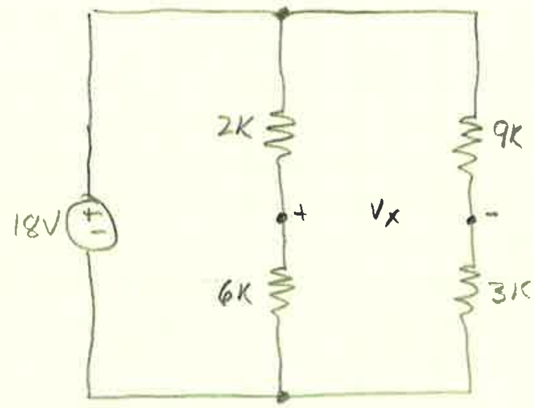
a) find v_x

For left branch:

$$V_{x+} = \frac{18(6K)}{6K+2K} = 13.5V$$

$$V_{x-} = \frac{18(3K)}{9K+3K} = 4.5V$$

$$V_x = V_{x+} - (V_{x-}) = \boxed{9.0V}$$



b) Replace the 18V source with a general source V_S.
Find V_x in terms of V_S.

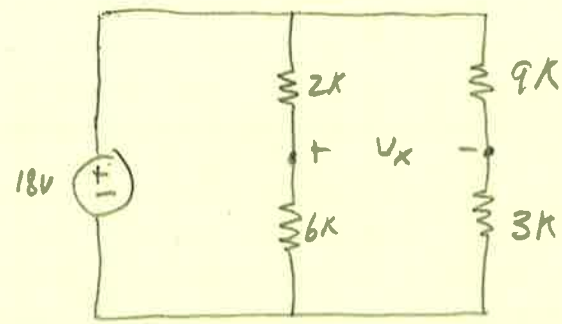
$$V_{x+} = \frac{V_S(6K)}{6K+2K} = \frac{3}{4}V_S$$

$$V_{x-} = \frac{V_S(3K)}{9K+3K} = \frac{1}{4}V_S$$

$$V_x = V_{x+} - V_{x-} = \boxed{\frac{1}{2}V_S}$$

3.27 | Nilsson 9^{th}

a) Find V_x
b) Replace the 18V source with V_s. Find v_x as a function of V_s.



a) using a voltage Divider,

$$V_{x+} = \frac{18(6k)}{2K+6K} = 13.5V$$

$$V_{x-} = \frac{18(3K)}{9K+3K} = 4.5V$$

$$\boxed{V_x = V_{x+} - V_{x-} = 9V}$$

b) $$v_{x+} = \frac{V_s(6k)}{2K+68} = 0.75V_s$$

$$v_{x-} = \frac{V_s(9K)}{9K+3K} = 0.25V_s$$

$$\boxed{V_x = V_{x+} - V_{x-} = 0.5V_s}$$