ESE 271 First Exam Name:

Fall, 2003 ID Number:

Do not place your answers on this front page.

Each problem is worth 25 points.

Prob. 1:

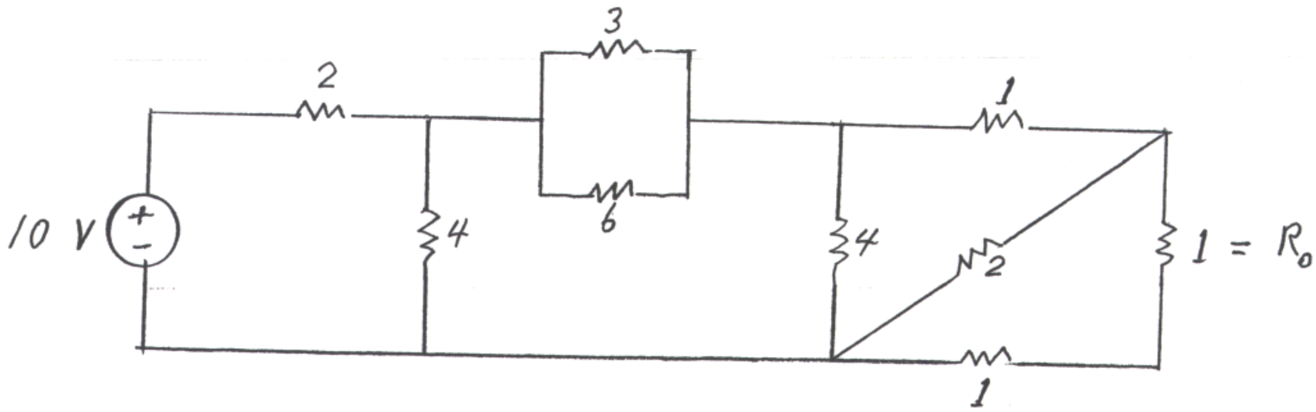
Prob. 2:

Prob. 3:

Prob. 4:

Prob. 1:

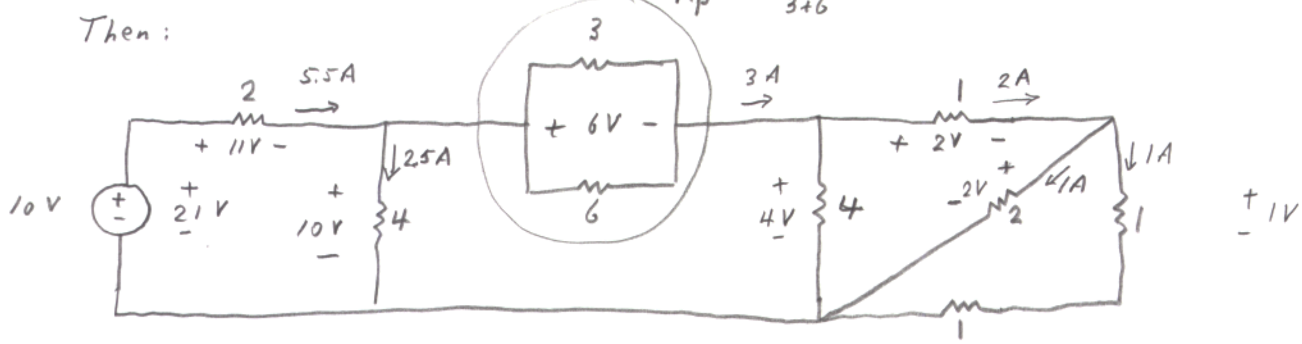
Find the power dissipated in the resistor R_o. All resistance values are in ohms.



Assume 1 V on R_o

$$R_p = \frac{3 \times 6}{3+6} = 2\ \Omega$$

Then:

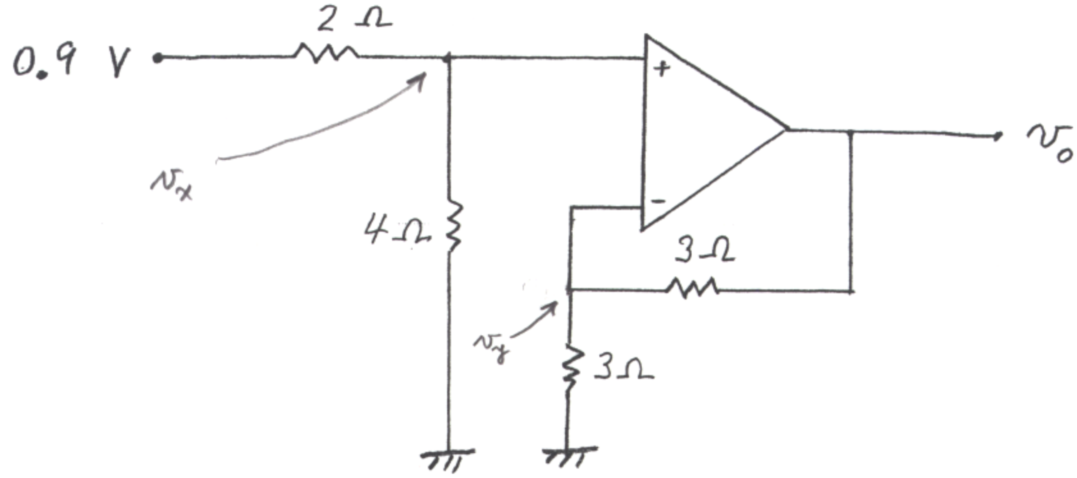


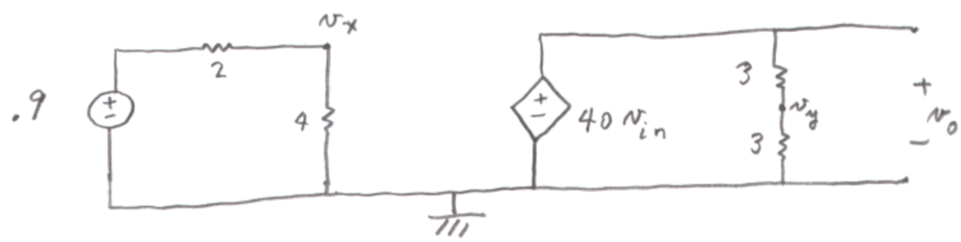
So V on R_o $= \frac{10}{21} = .4762$

So, $P_{\text{on } R_o} = \frac{(.4762)^2}{1} = .2267\ W$

Prob. 2:

The op-amp has the parameters $A = 40$, $R_{in} = \infty$, and $R_o = 0$. Find v_o (Do <u>not</u> use the most ideal op amp model with the virtual-open virtual-short on its in put.)





$$v_{in} = v_x - v_y = .9 \times \frac{4}{6} - \frac{v_o}{2} = .6 - \frac{v_o}{2}$$

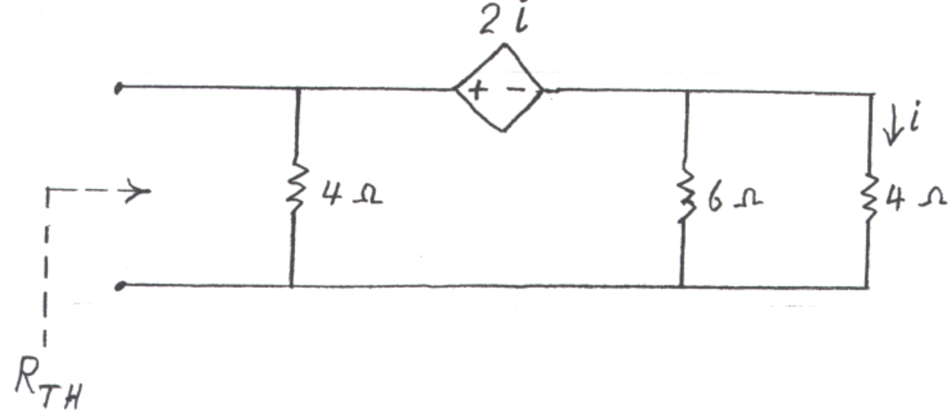
$$v_o = 40\, v_{in} = 40\left(.6 - \frac{v_o}{2}\right)$$

$$v_o\left(1 + \frac{40}{2}\right) = 24$$

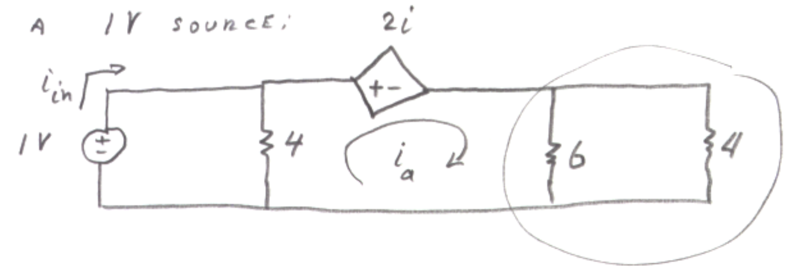
$$v_o = \frac{24}{21} = \frac{8}{7} = 1.143$$

Prob. 3:

Find the input resistance R_{TH}.



APPLY A 1V SOURCE:



$R_p = \frac{6 \times 4}{6+4} = 2.4$

KVL AROUND i_a MESH:

$$-1 + 2i + 2.4\, i_a = 0$$

BUT $i = \frac{6}{6+4} i_a = .6\, i_a$

$$-1 + 1.2\, i_a + 2.4\, i_a = 0$$

$$i_a = \frac{1}{3.6}$$

So, $i_{in} = .25 + \frac{1}{3.6} = .5277$

So, $R_{TH} = \frac{1}{.5277} = 1.8947$

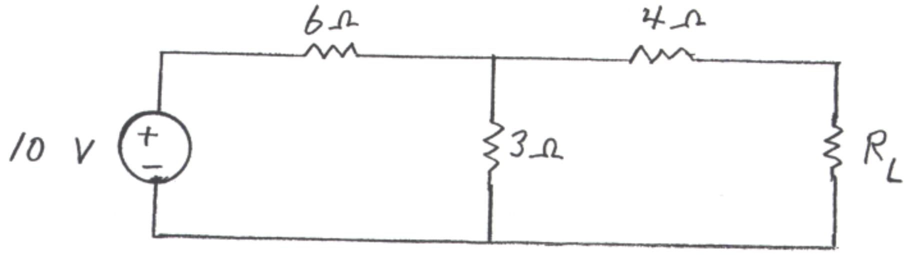
ANOTHER WAY: APPLY A 1 V SOURCE AND DO A NODAL ANALYSIS TO GET i_{in}.

ANOTHER WAY: APPLY A 1A SOURCE AND DO A MESH ANALYSIS TO GET v_{in}.

ANOTHER WAY: APPLY A 1A SOURCE AND DO A NODAL ANALYSIS TO GET v_{in}.

Prob. 4:

Find the value of R_L for which the power dissipated in R_L will be a maximum. Then, find the value of that maximum power.

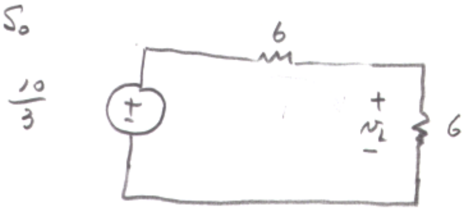


GET R_{TH} TO THE LEFT OF R_L (SHORT THE 10 V SOURCE)

$$R_{TH} = \frac{6 \times 3}{6+3} + 4 = 6\ \Omega.$$ So, $\underline{R_L = R_{TH} = 6\ \Omega}$

ALSO $$V_{oc} = 10 \times \frac{3}{3+6} = \frac{30}{9} = 3.333$$

So



$$v_L = \frac{1}{2} \times \frac{10}{3} = \frac{10}{6}$$

$$P_{MAX} = \frac{v_L^2}{R_{TH}} = \left(\frac{10}{6}\right)^2 \frac{1}{6} = \frac{100}{6^3} = \underline{.4629\ W}$$