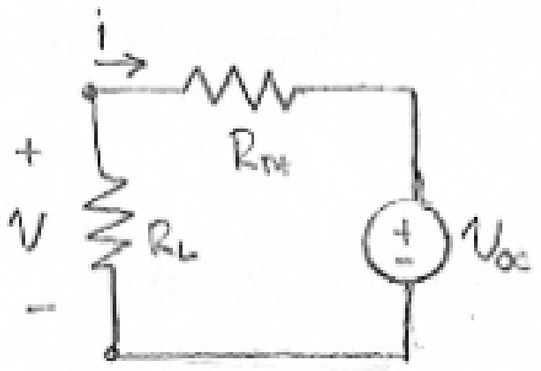
# ECE 201 HW 14 Solutions

1) a) $i = v/R_L$

1) $i = \frac{8V}{32\Omega} = \boxed{\frac{1}{4}A}$

2) $i = \frac{7V}{-21\Omega} = \boxed{-\frac{1}{3}A}$

b)




$v = iR_{TH} + V_{oc}$

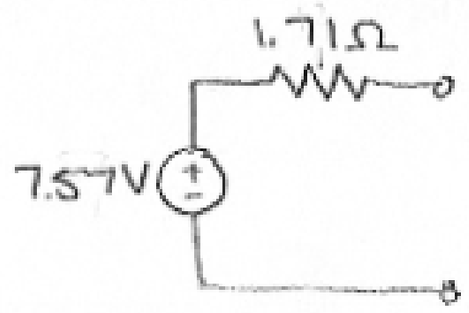
① $8 = (\frac{1}{4})R_{TH} + V_{oc}$

② $7 = (-\frac{1}{3})R_{TH} + V_{oc}$

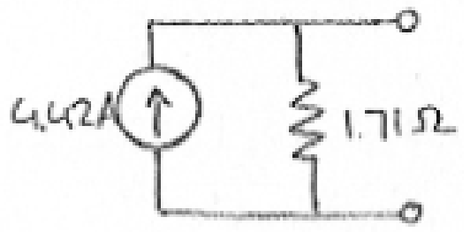
$$\begin{bmatrix} 1/4 & 1 \\ -1/3 & 1 \end{bmatrix} \begin{bmatrix} R_{TH} \\ V_{oc} \end{bmatrix} = \begin{bmatrix} 8 \\ 7 \end{bmatrix}$$

$V_{oc} = \frac{53}{7}$ $R_{TH} = \frac{12}{7}$

$= 7.57V$ $= 1.71\Omega$



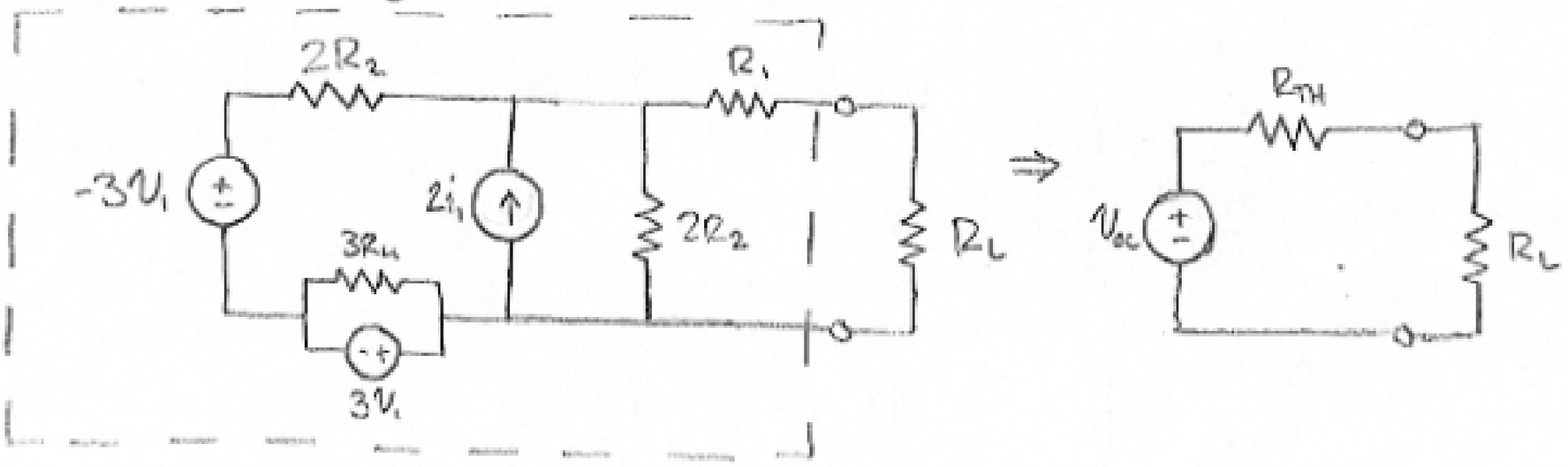

c) $i_{sc} = \frac{V_{oc}}{R_{TH}} = \frac{\frac{53}{7}}{\frac{12}{7}} = \frac{53}{12} = 4.42\,A$



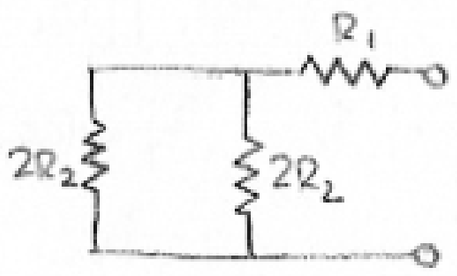

d) $R_L = R_{TH} = \boxed{1.71\Omega}$

e) $P = \frac{V_{oc}^2}{4R_{TH}} = \frac{(7.57V)^2}{4(1.71\Omega)} = \boxed{8.38W}$

2) a) Rearrange circuit into:




$R_{TH} = R_{eq}$ of boxed circuit with independent sources off

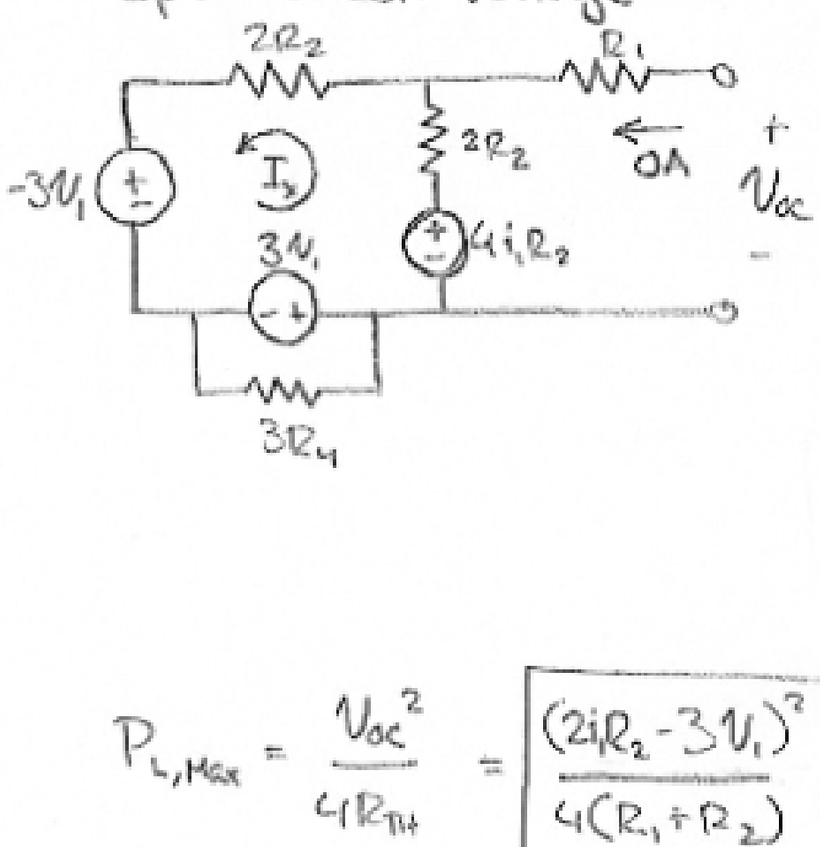



$$R_{TH} = R_{eq} = R_1 + ((2R_2)^{-1} + (2R_2)^{-1})^{-1}$$
$$= R_1 + R_2$$

$R_L = R_{TH}$ for maximum power

$$= \boxed{R_1 + R_2}$$

b) After current to voltage source transformation, we find the open circuit voltage




$$3V_1 + 3V_1 + 4i_1R_2 - 2R_2I_x - 2R_2I_x = 0$$
$$4R_2I_x = 6V_1 + 4i_1R_2$$
$$I_x = \frac{3V_1 + 2i_1R_2}{2R_2}$$

$$V_{oc} = 4i_1R_2 - 2R_2I_x$$
$$= 4i_1R_2 - 3V_1 - 2i_1R_2$$
$$= 2i_1R_2 - 3V_1$$

$$P_{L,max} = \frac{V_{oc}^2}{4R_{TH}} = \boxed{\frac{(2i_1R_2 - 3V_1)^2}{4(R_1 + R_2)}}$$

3) a) $V_{AB} = i_s R_{TH} + V_{oc}$

$V_{AB} = i_s\, 9 + (V_1 + V_2)$

$\boxed{R_{TH} = 9}$

b) $\boxed{V_{oc} = V_1 + V_2}$

c) $i_{sc} = \dfrac{V_{oc}}{R_{TH}}$

$= \boxed{\dfrac{V_1 + V_2}{R_{TH}}}$

d) $R_L = R_{TH}$

$= \boxed{9}$

e) $P_{L,Max} = \dfrac{V_{oc}^2}{4\, R_{TH}}$

$= \boxed{\dfrac{(V_1 + V_2)^2}{4g}}$