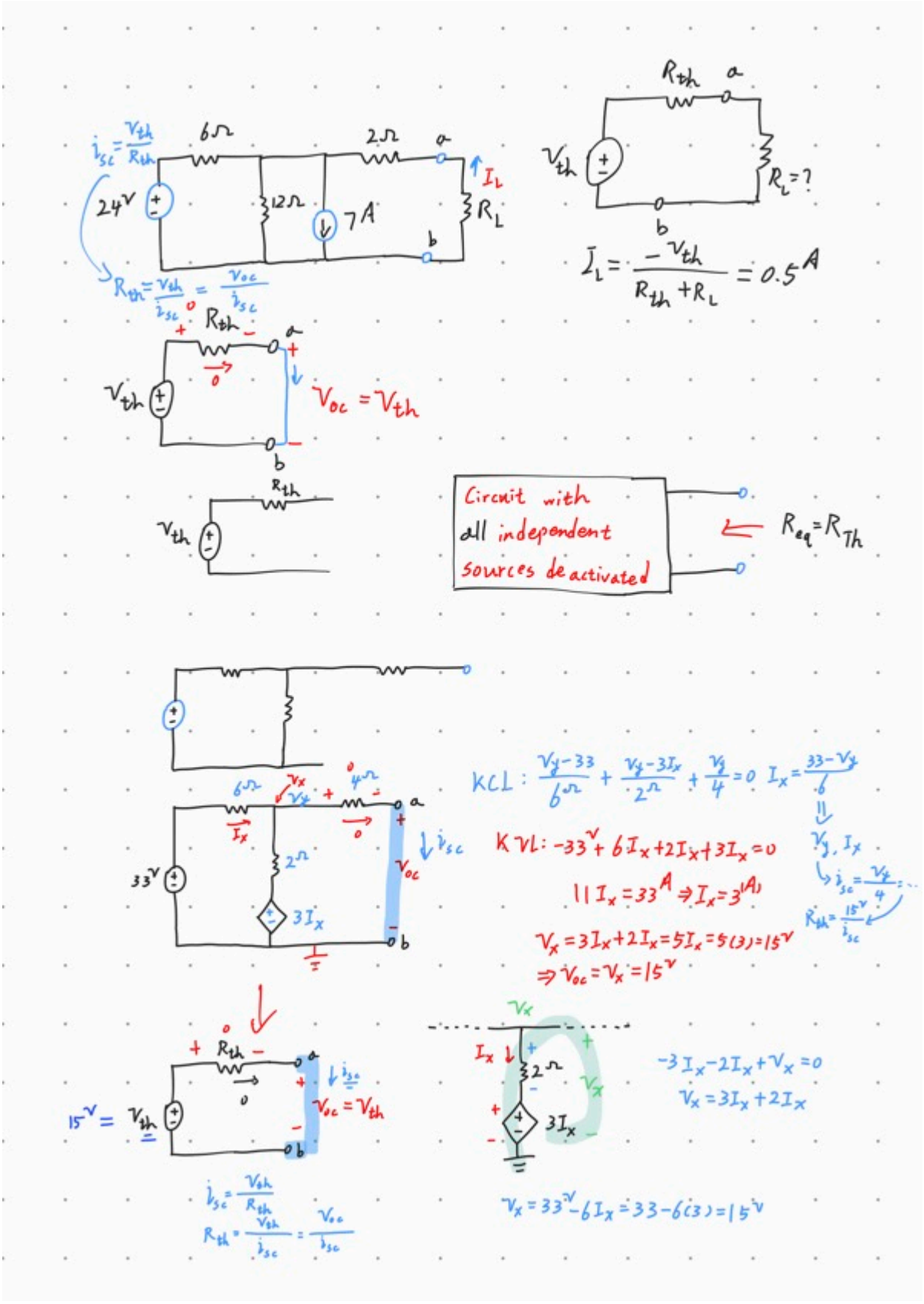
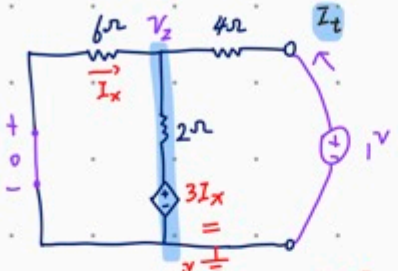
Lecture 7


$i_{sc} = \frac{V_{th}}{R_{th}}$
6Ω
2Ω
a
24V
12Ω
7A
I_L
R_L
b
$R_{th} = \frac{V_{th}}{i_{sc}} = \frac{V_{oc}}{i_{sc}}$
R_{th}
V_{th}
$V_{oc} = V_{th}$
R_{th} a
V_{th}
$R_L = ?$
b
$I_L = \frac{-V_{th}}{R_{th} + R_L} = 0.5^A$
Circuit with all independent sources deactivated
$R_{eq} = R_{Th}$
6Ω
V_x
V_y
4Ω
a
I_x
2Ω
i_{sc}
V_{oc}
33V
$3I_x$
b
KCL: $\frac{V_y - 33}{6\Omega} + \frac{V_y - 3I_x}{2\Omega} + \frac{V_y}{4} = 0$ $I_x = \frac{33 - V_y}{6}$
KVL: $-33^V + 6I_x + 2I_x + 3I_x = 0$
$11 I_x = 33^A \Rightarrow I_x = 3^{(A)}$
$V_x = 3I_x + 2I_x = 5I_x = 5(3) = 15^V$
$\Rightarrow V_{oc} = V_x = 15^V$
V_y, I_x
$i_{sc} = \frac{V_y}{4} = \ldots$
$R_{th} = \frac{15^V}{i_{sc}}$
$15^V = V_{th}$
$V_{oc} = V_{th}$
$i_{sc} = \frac{V_{th}}{R_{th}}$
$R_{th} = \frac{V_{th}}{i_{sc}} = \frac{V_{oc}}{i_{sc}}$
V_x
I_x
2Ω
$3I_x$
$-3I_x - 2I_x + V_x = 0$
$V_x = 3I_x + 2I_x$
$V_x = 33^V - 6I_x = 33 - 6(3) = 15^V$

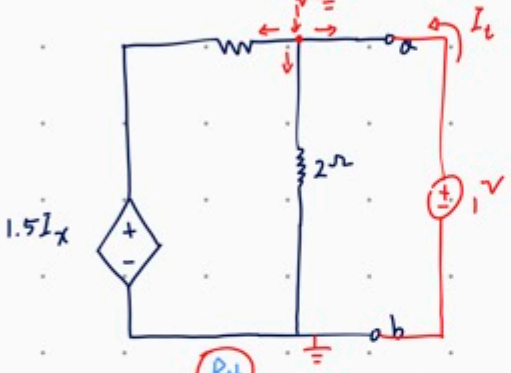


KCL: $\begin{cases} \frac{V_x}{6} + \frac{V_x - 3I_x}{2} + \frac{V_x - 1}{4\Omega} = 0 \\ I_x = \frac{-V_x}{6} \end{cases}$

$\Rightarrow V_x = \dots$

$I_t = \frac{1 - V_x}{4\Omega} = \dots$

$R_{th} = \frac{1^V}{I_t} = \dots$



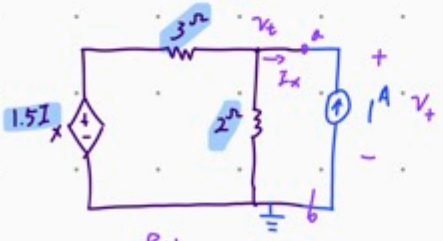
KCL: $\frac{1.}{2\Omega} + \frac{1 - 1.5I_x}{3\Omega} + I_x = 0$

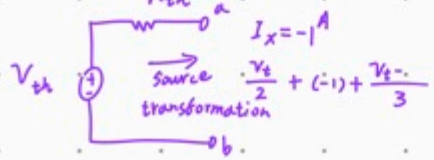
$\Rightarrow I_x = \dots$

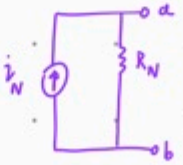
$I_t = -I_x = \dots$

$R_{th} = \frac{1^V}{I_t} = 0.6\Omega$

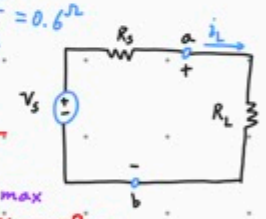
$R_{th} = \frac{V_{oc}}{i_{sc}} = \frac{0}{0}$







$i_N = \frac{V_{th}}{R_{th}} = \frac{V}{\quad}$



$P_L = V_L \cdot i_L$

$R_L = ?$ $P_L = P_{L,max}$

1) $R_L \to 0 \Rightarrow V_L = 0 \Rightarrow P_L = 0$

2) $R_L \to \infty \Rightarrow i_L = 0 \Rightarrow P_L = 0$

X. 3) Neither

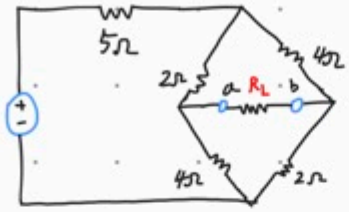
$V_L = \frac{R_L}{R_L + R_s} V_s$

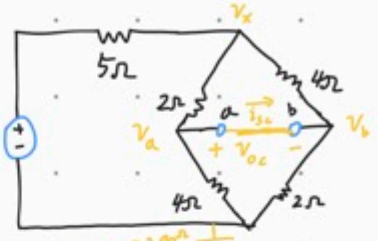
$i_L = \frac{V_s}{R_L + R_s}$

$P_L = V_L \cdot i_L = \frac{R_L}{(R_L + R_s)^2} V_s^2$

$\frac{\partial P_L}{\partial R_L} = \frac{V_s^2 (R_s + R_L)^2 - 2(R_L + R_s) R_L V_s^2}{(R_L + R_s)^4} = 0$

$$(R_S+R_L)^2-2(R_L+R_S)R_L=0$$
$$R_S^2+R_L^2+2R_S$$





$$\frac{V_x-16}{5}+\frac{V_x}{2+4}+\frac{V_x}{4+2}=0$$
$$\Rightarrow V_x=6^V$$

$$V_{oc}=V_a-V_b \qquad V_a=\frac{4\Omega}{2^\Omega+4^\Omega}V_x$$
$$V_b=\frac{2^\Omega}{2^\Omega+4^\Omega}V_x \xrightarrow{V_x=6^V} =2^V$$
$$V_{oc}=V_a-V_b=4-2=2^V=V_{th}$$