Access/use of any calculating devices other than those approved for this test are forbidden. Use of writings, papers, communications devices or other assistance, including communicating with other students or looking at anyone else's papers are forbidden during this test. All are cheating. Do not use your own scrap paper. If any is needed, it will be supplied. Do not communicate with other students until they have submitted your tests and have left the room.

By signing below, I certify that:

I am the person whose name appears of this test.
I am currently registered in this course.
I understand all the class policies, both those in the syllabus and stated here.
I understand that all acts of cheating or other misconduct will be subject to disciplinary action.

Signature: ______________________

Student Name: ______________________
(printed)

Date: ______________________

Lab Section: ______________________

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This area to be filled in by the grading TAs only
1. Use superposition to find \( I_x \) in the circuit below.

Your work should clearly show the use of superposition or no credit will be given.

\[ I_x = \frac{3}{70} = 0.043A \]

Kill 1V + -2V sources:

\[ I_{x1} = \frac{3}{70} = 0.043A \]

Kill 3V + -2V sources:

\[ I_{x2} = \frac{-1}{25.95} = -0.039A \]

Kill 3V + 4V sources:

\[ I_{x3} = \frac{-2}{40} = -0.05 \]

\[ I_x = 0.043 - 0.039 - 0.05 = -0.046A \]

\[ \frac{3K \cdot V_x}{6000} \]

\[ \frac{4V}{4K} \]

\[ \frac{3K}{4K} \]

\[ \frac{0.001}{1mA} \]

\[ V_x = \frac{V_x + 3}{4000} \]

\[ -\frac{(V_x - 3)}{4000} + \frac{V_x}{6000} + 0.001 = 0 \]

\[ -3V_x + 9 + 2V_x + 12 = 0 \]

\[ V_x = -21 \]

\[ V_x = 21 \]

\[ \boxed{R_N = \frac{V_x}{0.001}} = 21000 \Omega \]

Find Isc:

\[ \boxed{Isc = \frac{4}{7000} = 571 \mu A} \]
3. [20] Use source transformation to change the circuit to the left of the terminals to a single series loop that includes \( R_L \) and a Thevenin equiv. circuit. Then, with that circuit...
   a) If \( R_L = 1.4 \Omega \), how much power is dissipated by \( R_L \)?
   b) What is the maximum power that can be delivered to \( R_L \)?

\[
\begin{align*}
I &= \frac{140}{1.6 + 1.4} = \frac{140}{3} = 46.67 \\
P_{RL} &= (46.67)^2 \times 1.4 = 3049.38 \text{W}
\end{align*}
\]

b) Max pwr to \( R_L \) occurs when \( R_L = 1.6 \Omega \)

\[
P_{\text{max}} = \left( \frac{140}{3.2} \right)^2 \times 1.6 = 3062.5
\]
4. [30] For the circuit below, find \( i_x + v_0 \). Assume an ideal opamp.

Hint: Use KCL analysis.

\[
\text{For } v_2 \text{ we have: } \quad 6 \left( \frac{909.1}{10909.1} \right) = 0.5 \text{V} \quad \text{thus } v_1 \text{ also } = 0.5 \text{V}
\]

\[
\text{KCL } @ v_1: \quad \frac{1 - 0.15}{2000} + \frac{0.5 - 0.5}{2000} - \frac{0.5 - v_0}{10000} = 0
\]

\[
5 - 2.5 - 0.5 + v_0 = 0
\]

\[
v_0 = -2
\]

\[
i_x = \frac{v_1 - v_0}{10000} = \frac{0.5 - (-2)}{10000} = \frac{0.5 + 2}{10000} = 25 \mu A
\]