**Problem 3.88** In the circuit of Fig. P3.88, what value of $R_s$ would result in maximum power transfer to the 10-Ω load resistor?

![Figure P3.88: Circuit for Problem 3.88.](image)

**Solution:** Maximum power transfer to $R_L$ occurs when all of the 2 A flows through $R_L$, requiring $R_s$ to be $\infty$. 
Problem 3.85  The circuit shown in Fig. P3.85 is connected to a variable load $R_L$ through a resistor $R_s$. Choose $R_s$ so that $I_L$ never exceeds 4 mA, regardless of the value of $R_L$. Given that choice, what is the maximum power that $R_L$ can extract from the circuit?

![Circuit Diagram](image)

**Solution:** We should start by finding the Thévenin equivalent of the circuit to the left of $(a,b)$. Simple source-transformation steps lead to:

![Transformed Circuit Diagram](image)

To satisfy the stated condition, we need to choose $R_s$ such that $I_L = 4$ mA when $R_L = 0$. That is

$$I_L = 4 \text{ mA} = \frac{10}{2k + R_s},$$

which leads to $R_s = 0.5 \text{ k}\Omega$.

For maximum power transfer by $R_L$, it should be equal to:

$$R_L = 2 \text{ k}\Omega + R_s = 2.5 \text{ k}\Omega$$

$$I_L = \frac{10}{5k} = 2 \text{ mA}$$

$$P_{\text{max}} = I_L^2R_L = (2 \times 10^{-3})^2 \times 2.5 \times 10^3 = 10 \text{ (mW)}.$$
Problem 3.86  In the circuit shown in Fig. P3.86, a potentiometer is connected across the load resistor $R_L$. The total resistance of the potentiometer is $R = R_1 + R_2 = 5 \, \text{k} \Omega$.

(a) Obtain an expression for the power $P_L$ dissipated in $R_L$ for any value of $R_1$.

(b) Plot $P_L$ versus $R_1$ over the full range made possible by the potentiometer’s wiper.

Solution:

(a) 

\[
\frac{V - 12}{2k} + \frac{V}{1k} + \frac{V}{R_1} = 0
\]

\[V = \frac{12R_1}{3R_1 + 2}, \quad \text{with } R_1 \text{ measured in } \text{k} \Omega.
\]

\[P_L = \frac{V^2}{R_L} = \frac{V^2}{1k} = \left(\frac{12R_1}{3R_1 + 2}\right)^2 \times 10^{-3}
\]

(b) 

$P_L$ (mW) versus $R_1$ (kΩ) graph