We next recall that in going from time domain to steady state in AC circuits we use

\[ V(t) \rightarrow \hat{V} \]

\[ \frac{LdI}{dt} \rightarrow j\omega L I \]

In light of this we consider the transformer circuit shown in Figure 17.4.

![Transformer Circuit Diagram]

**Figure 17.4**: A linear transformer with AC circuit conditions.

We can write on the primary side,

\[ R_1 I_1 + j\omega L_1 I_1 - j\omega M I_2 = V_1 \]

or

\[ \sqrt{(R_1 + j\omega L_1) I_1 - j\omega M I_2} = V_1 \]

and for the secondary

\[ j\omega L_2 I_2 + R_2 I_2 - j\omega M I_1 - jX_c I_2 = 0 \]

or

\[ \sqrt{-j\omega M I_1 + (R_2 + j(\omega L_2 - X_c))} = 0 \]
Carrying on with Equation 17.17

\[ Z = V I = \frac{V_2}{I_2} = N = \frac{V_2}{I_2} \]

which shows that the complex power in equals the complex power out as it should be.

Consider the following sketch:

We want to find \( \frac{V_1}{I_1} \) which will be the impedance seen at \( a-b \)

\[ V_1 = \frac{V_2}{N} = \frac{\frac{Z_2}{I_2}}{N} = \frac{Z_2}{I_2} \cdot \frac{I_1}{N} = \frac{Z_2 I_1}{N} \]

\[ \frac{V_1}{I_1} = Z_1 \cdot N = \frac{Z_2}{N^2} \]

(17.19)

The impedance of the secondary is reflected to the primary as the load impedance divided by \( N^2 \). This is important.
Good power amplifiers are characterized by having very low output resistance. We assume here, 0.1Ω, which is typical.

Find n so that maximum power is transferred to the speaker.

**Solution:** The resistance reflected is

\[ Z_{	ext{ref}} = \frac{Z_L}{n^2} \]

We want \( Z_{	ext{ref}} = 0.1Ω \) for maximum power transfer. So

\[ n^2 = \frac{2L}{0.1} = 16 \Rightarrow 160 \]

\[ n = \sqrt{160} = 12.7 = \frac{N_2}{N_1} \]

This does not preclude that \( N_1 \) might be 300 turns and \( N_2 = 12.7 \times 300 = 3810 \) turns.