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

$$v(t) \longrightarrow \hat{V}$$

$$L\frac{di}{dt} \longrightarrow j\omega L \hat{I}$$

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

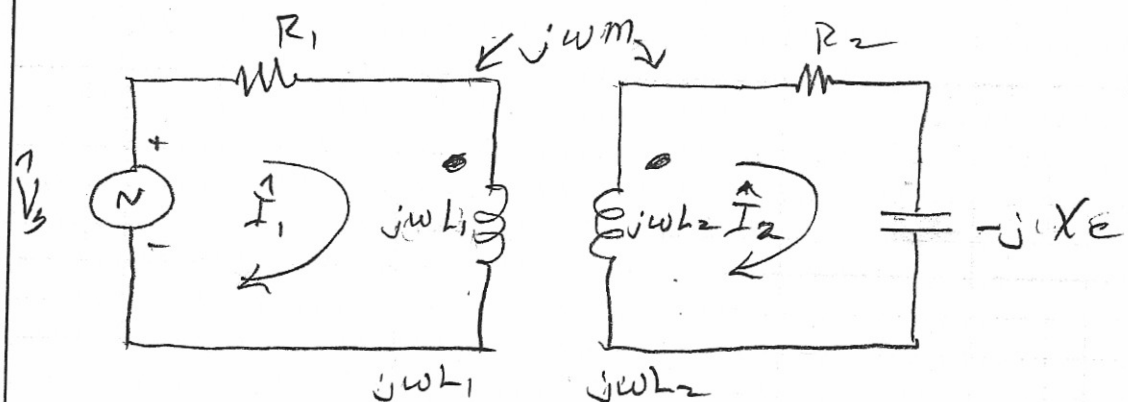


Figure 17.4: A linear transformer with AC circuit conditions.

We can write on the primary side,

$$R_1 \hat{I}_1 + j\omega L_1 \hat{I}_1 - j\omega M \hat{I}_2 = \hat{V}_s$$

or

$$\boxed{(R + j\omega L_1)\hat{I}_1 - j\omega M \hat{I}_2 = \hat{V}_s}$$

and for the secondary

$$j\omega L_2 \hat{I}_2 + R_2 \hat{I}_2 - j\omega M \hat{I}_1 - jX_c \hat{I}_2 = 0$$

or

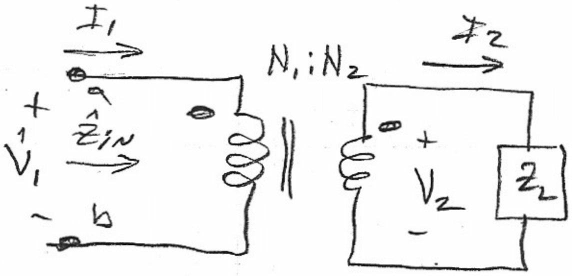
$$\boxed{-j\omega M \hat{I}_1 + (R_2 + j(\omega L_2 - X_c)) = 0}$$

Carrying on with Equation 17.17

$$\hat{S}_1 = \hat{V}_1 \hat{I}_1^* = \frac{\hat{V}_2}{N} \hat{I}_2^* N = \hat{V}_2 \hat{I}_2^* \qquad 17.18$$

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

Consider the following sketch



Let

$$N = \frac{N_2}{N_1}$$

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

$$\hat{V}_1 = \frac{\hat{V}_2}{N} = \frac{Z_L \hat{I}_2}{N} = \frac{Z_L \hat{I}_1}{N N} = \frac{Z_L \hat{I}_1}{N^2}$$

$$\frac{\hat{V}_1}{\hat{I}_1} = Z_{IN} = \frac{Z_L}{N^2} \qquad (17.19)$$

* *

The impedance of the secondary is reflected to the primary as the load impedance divided by N^2. <u>This is important.</u>

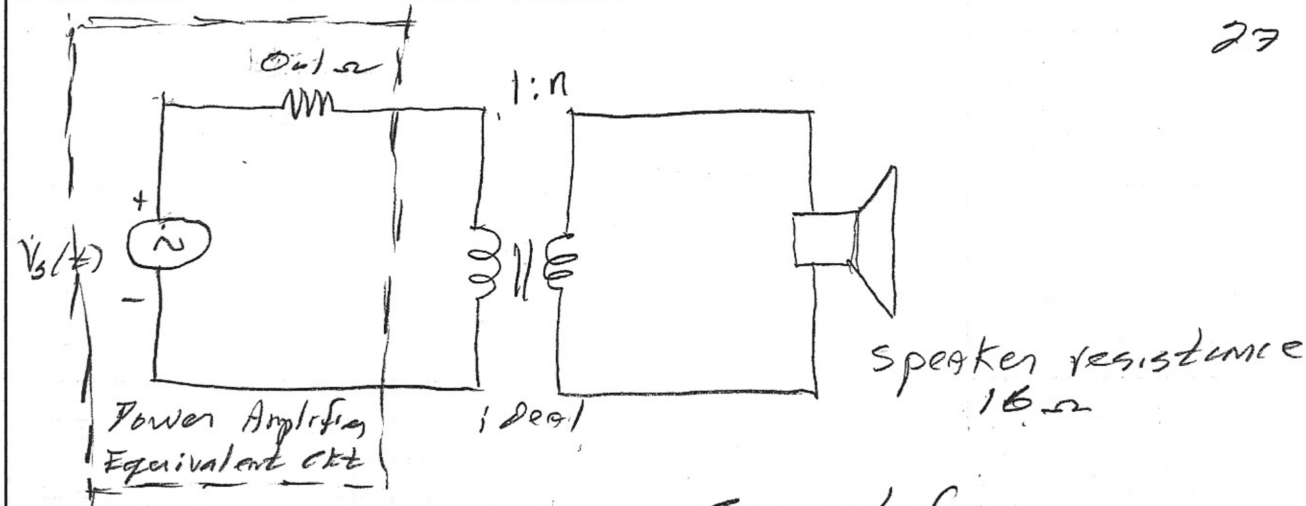


Figure 17.20: Circuit for Example 17.5.

Good power amplifiers are characterized by having very low output resistance. We assume here, 0.1 Ω, which is typical. Find n so that maximum power is transferred to the speaker.

Solution: The resistance reflected is

$$Z_{ref} = \frac{Z_L}{n^2}$$

We want $Z_{ref} = 0.1\Omega$ for maximum power transfer. So

$$n^2 = \frac{Z_L}{Z_{ref}} = \frac{16}{.1} = 160$$

$$n = \sqrt{160} = 12.7 = \frac{N_2}{N_1}$$

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