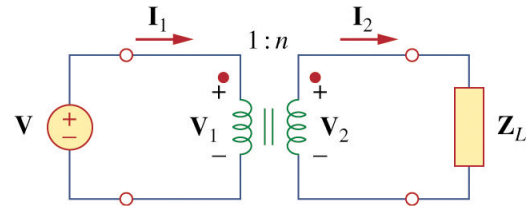
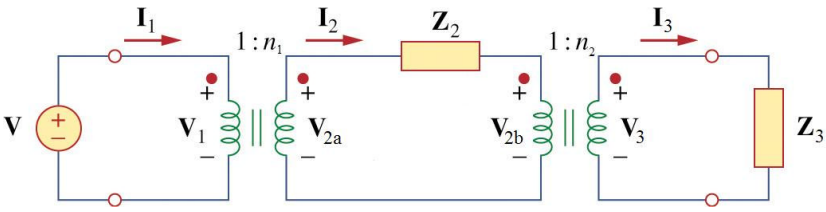
Lesson 26: Transformers 2

Transformer summary

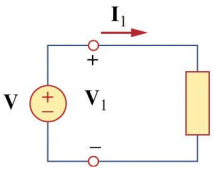


Multiple transformers

How do we handle multiple transformers?

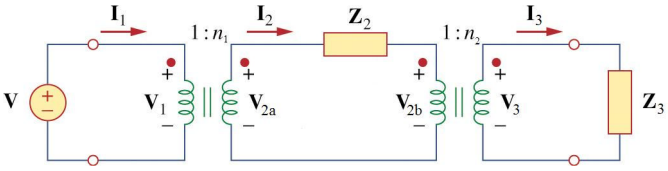


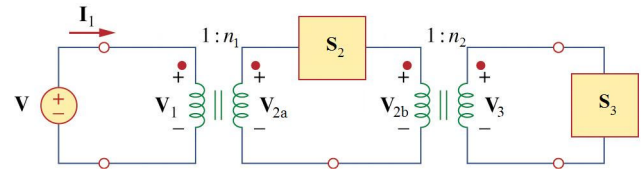
Using reflected impedance, collapse the circuit from right to left.



Multiple transformers and power

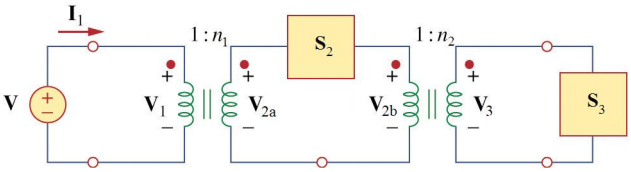
How do calculate the complex power for loads $\mathbf{Z}_2$ and $\mathbf{Z}_3$?

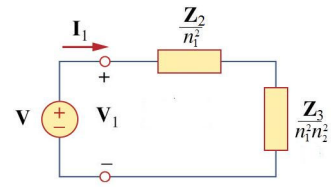




Previously we determined that $\mathbf{Z} = \frac{1}{n_1^2}\left(\mathbf{Z}_2 + \frac{\mathbf{Z}_3}{n_2^2}\right) =$

Redrawing the circuit, we see that $\mathbf{S}_1$ and $\mathbf{S}_2$ are the same power to the reflected versions of $\mathbf{Z}_2$ and $\mathbf{Z}_3$.





Transformer applications

We have discussed the use of transformers in power transmission.

- Transformer efficiencies of 95% are common and 99% is achievable.

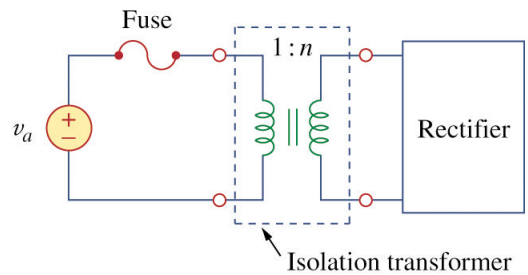
Other important applications of transformers are

- Electrical isolation
- Impedance matching
- Frequency selective circuits

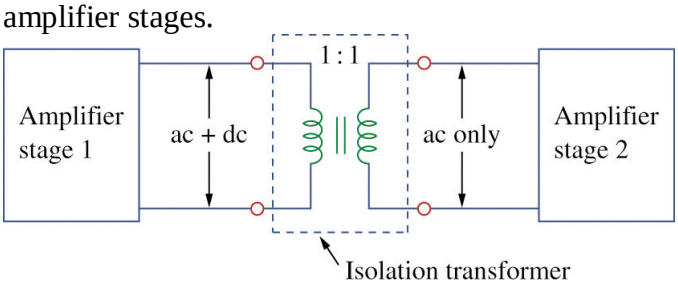
Electrical isolation

Electrical isolation exists between devices when there is no physical connection between them. Transformers are used in power supplies that convert ac to dc.

- First, they step up/down voltage for the rectifier.
- Second, they provide electrical isolation reducing the risk of shock hazard.

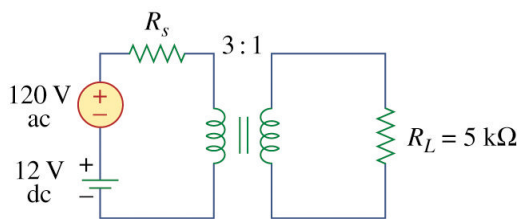


Transformers also provide dc isolation between two amplifier stages.

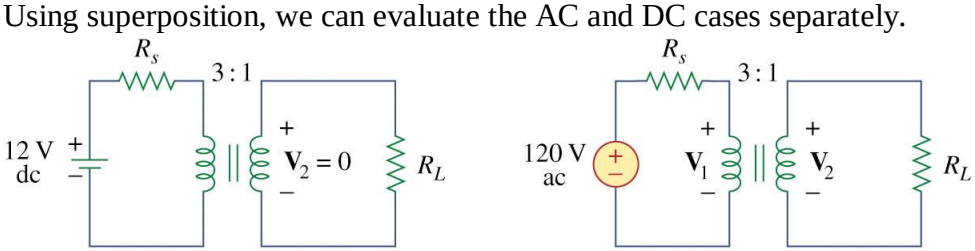


Magnetic coupling does not occur with a dc voltage (no rate of change of voltage means no induced emf)

Consider the following

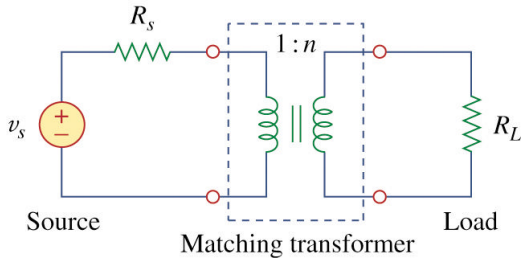


Using superposition, we can evaluate the AC and DC cases separately.



Impedance matching

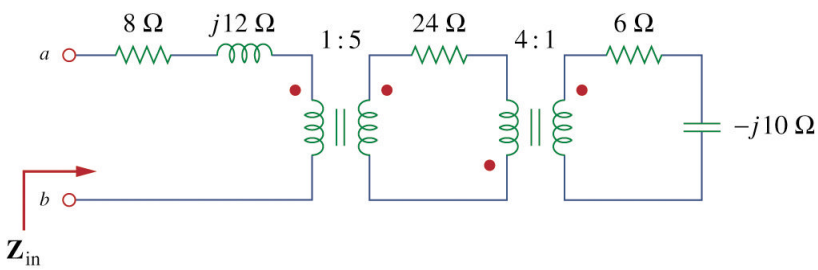
Recall that for maximum power transfer, the load resistance R_L must be matched with the source resistance R_S.



In most cases the two resistances are mot matched, however a transformer can be used to achieve impedance matching.

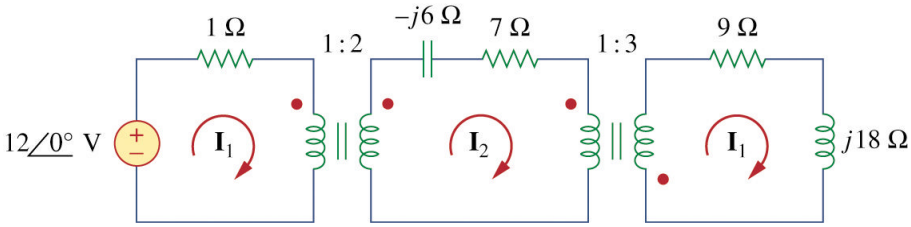
Example Problem 1

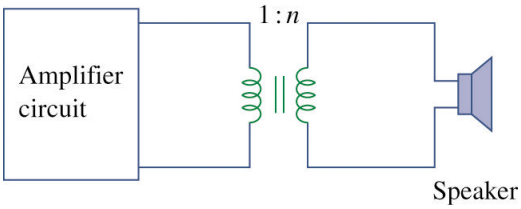
Calculate the input impedance $\mathbf{Z}_{in}$ for the network below.



Example Problem 2

Determine the complex power delivered to each element.



Example Problem 3

A common application of impedance matching transformers is in audio amplifiers. Consider the following case of an amplifier with a Thévenin impedance of 192-Ω. To achieve max power transfer with a 12-Ω speaker, what the required turns ratio of the matching transformer?