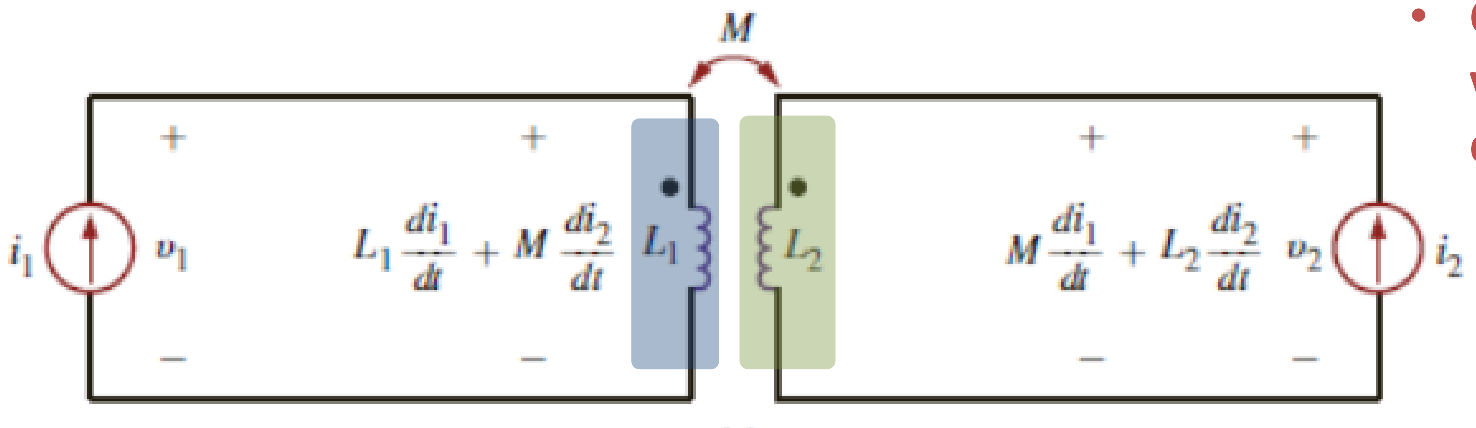
Last Lecture → Magnetically Coupled Coils

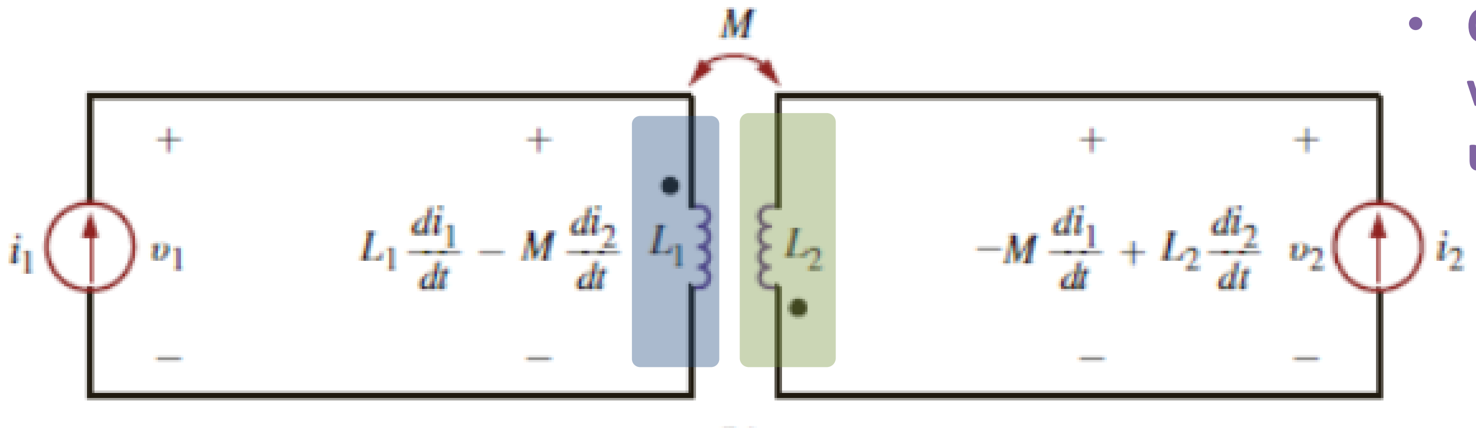


(a)

- Current enters the dotted terminal → voltage at coupled coil is positive at the dotted terminal

$$V_1 = jX_{L1}I_1 + jX_{LM}I_2$$

$$V_2 = jX_{L2}I_2 + jX_{LM}I_1$$



(b)

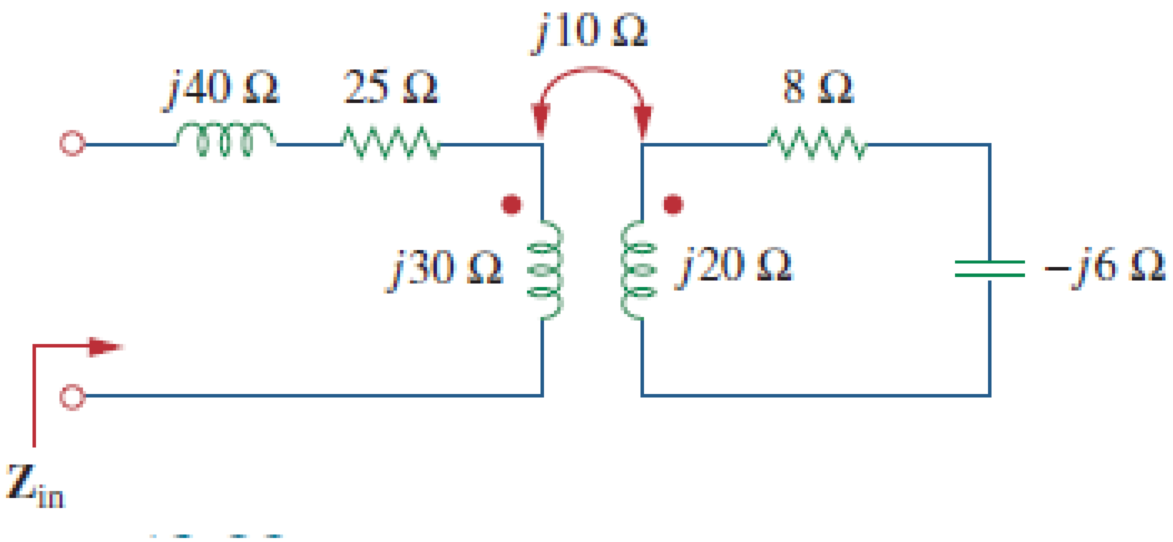
- Current enters the undotted terminal → voltage at coupled coil is positive at the undotted terminal

$$V_1 = jX_{L1}I_1 - jX_{LM}I_2$$

$$V_2 = jX_{L2}I_2 - jX_{LM}I_1$$

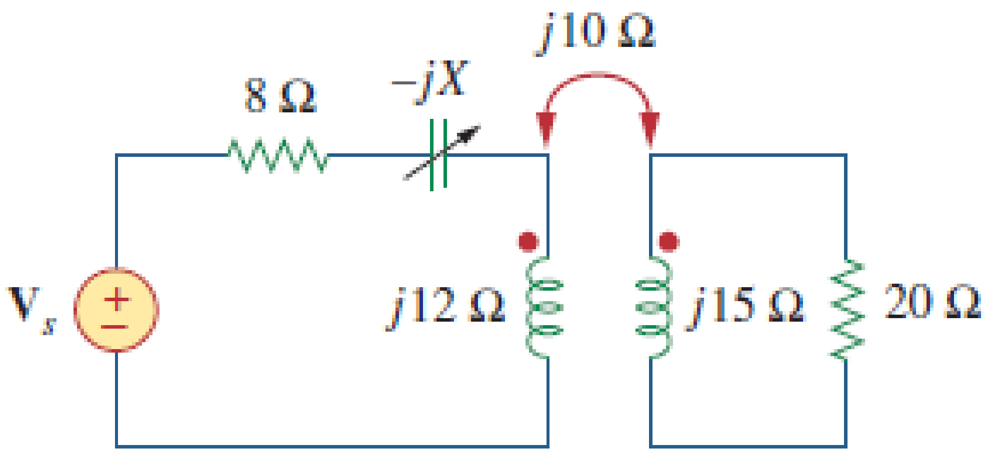
Problem

Find the input impedance of the circuit using the concept of the reflected impedance.

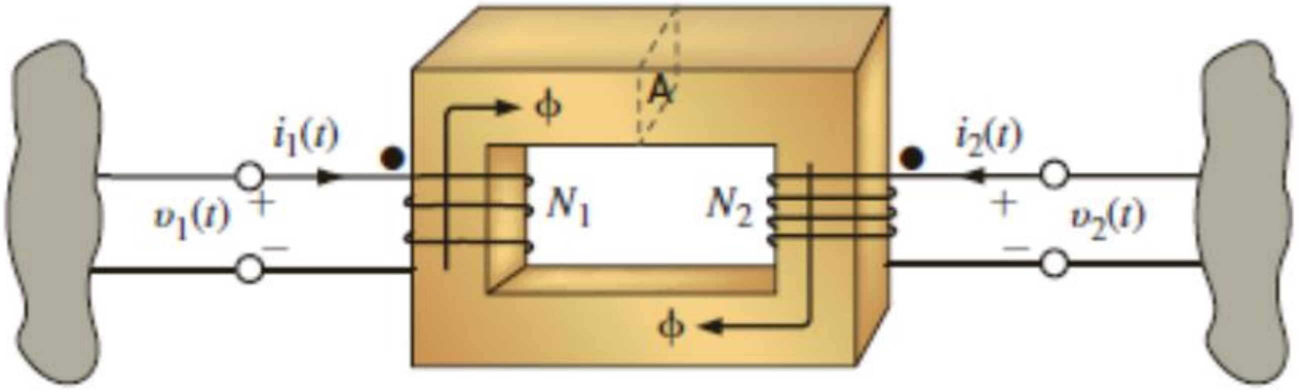


Problem

Find the value of X that will give the maximum power transfer to the 20Ω load.



The Ideal Transformer

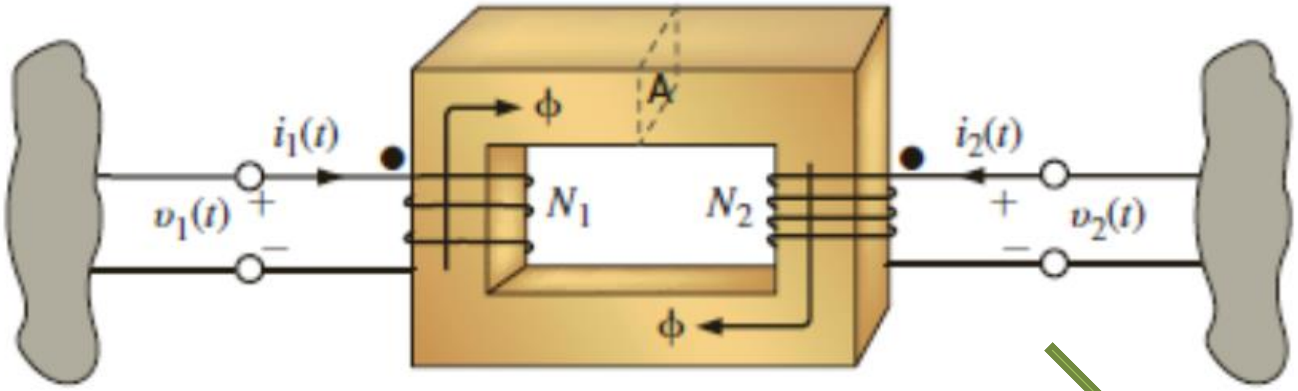


$$\lambda_1 = N_1 \cdot \phi \qquad \lambda_2 = N_2 \cdot \phi$$

$$v_1 = \frac{d\lambda_1}{dt} = N_1 \frac{d\phi}{dt} \qquad v_2 = \frac{d\lambda_2}{dt} = N_2 \frac{d\phi}{dt}$$

$$\therefore \frac{v_2}{v_1} = \frac{N_2}{N_1}$$

The Ideal Transformer



Assuming an ideal magnetic core with infinite permeability…

$$P_1 + P_2 = 0$$

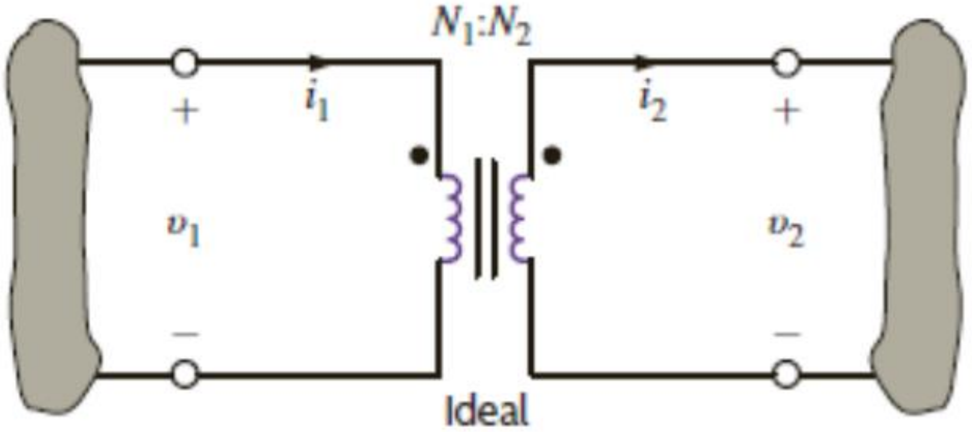
$$v_1 \cdot i_1 + v_1 \cdot \frac{N_2}{N_1} \cdot i_2 = 0$$

$$\therefore \frac{i_2}{i_1} = -\frac{N_1}{N_2}$$

$$\lambda_1 = N_1 \cdot \phi \qquad \lambda_2 = N_2 \cdot \phi$$

$$v_1 = \frac{d\lambda_1}{dt} = N_1 \frac{d\phi}{dt} \qquad v_2 = \frac{d\lambda_2}{dt} = N_2 \frac{d\phi}{dt}$$

$$\therefore \frac{v_2}{v_1} = \frac{N_2}{N_1}$$

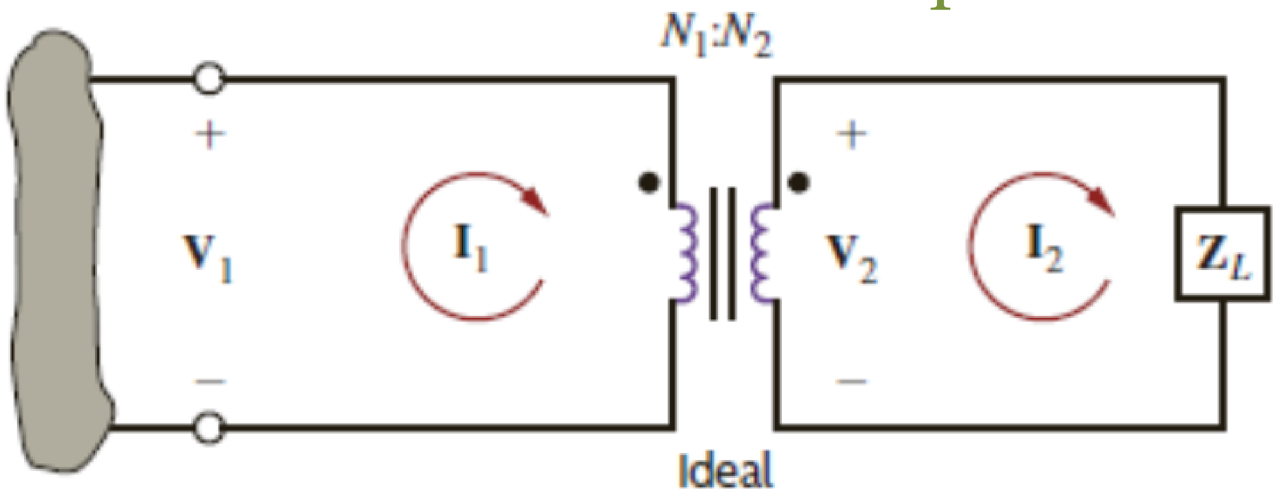


$$\frac{v_2}{v_1} = \frac{N_2}{N_1} \qquad \frac{i_2}{i_1} = \frac{N_1}{N_2}$$

The Ideal Transformer

$$\frac{N_2}{N_1} = n \longrightarrow V_2 = \frac{N_2}{N_1} V_1 = n \cdot V_1$$

$$I_2 = \frac{N_1}{N_2} I_1 = \frac{1}{n} \cdot I_1$$

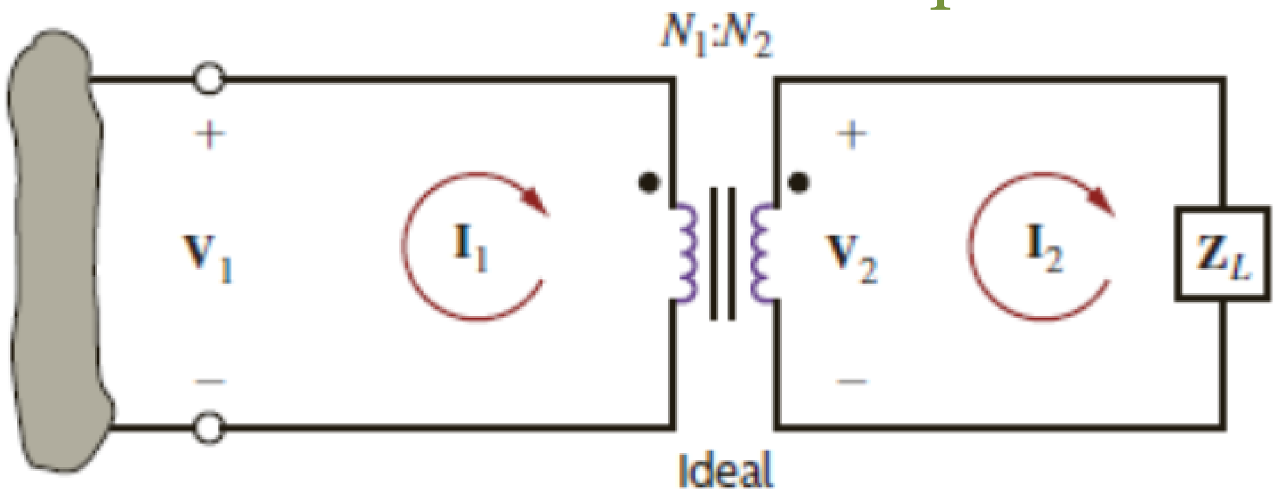


- *If both voltages are referenced positive at the dotted terminals or un-dotted terminals, then $V_2/V_1=N_2/N_1$. If this is not true, then $V_2/V_1=-N_2/N_1$.*
- *If both currents are defined as entering at dotted terminals or un-dotted terminals, then $I_2/I_1=-N_1/N_2$. If this is not true, then $I_2/I_1=N_1/N_2$.*

The Ideal Transformer

$$\frac{N_2}{N_1} = n \longrightarrow V_2 = \frac{N_2}{N_1} V_1 = n \cdot V_1$$

$$I_2 = \frac{N_1}{N_2} I_1 = \frac{1}{n} \cdot I_1$$



$$Z_L = \frac{V_2}{I_2}$$

$$Z_1 = \frac{V_1}{I_1} = \frac{1}{n^2} Z_L$$

- *If both voltages are referenced positive at the dotted terminals or un-dotted terminals, then $V_2/V_1=N_2/N_1$. If this is not true, then $V_2/V_1=-N_2/N_1$.*
- *If both currents are defined as entering at dotted terminals or un-dotted terminals, then $I_2/I_1=-N_1/N_2$. If this is not true, then $I_2/I_1=N_1/N_2$.*