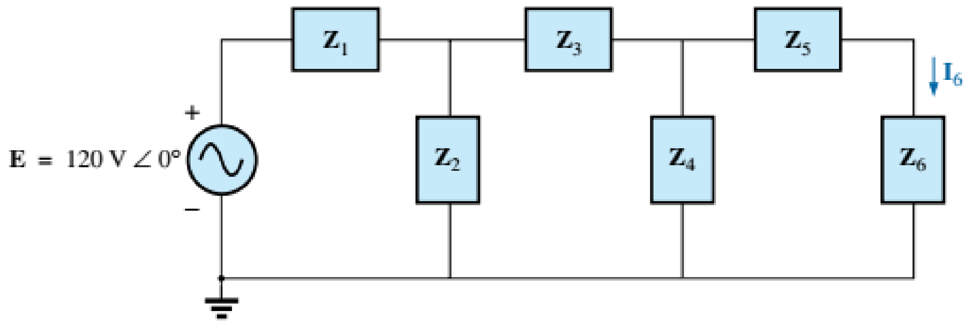
Ladder Networks and Grounding

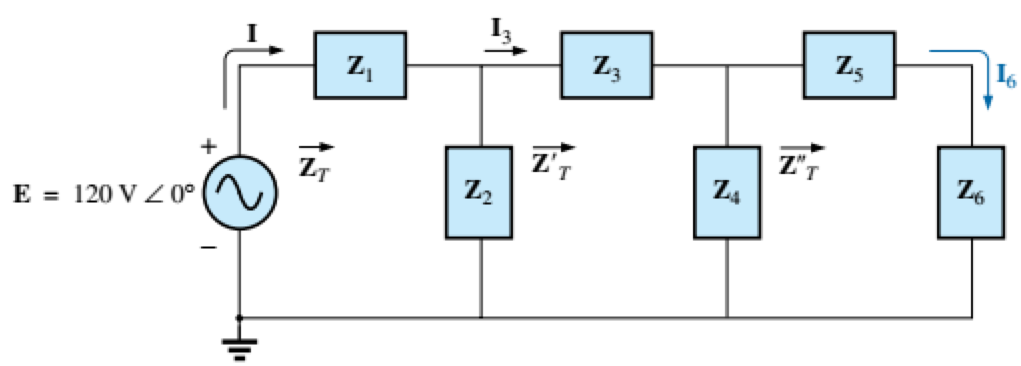
- Ladder Networks
  - Approach from Wednesday
  - Current divider reminder
  - **In class problem**
- Grounding
  - Intro
  - Lab equipment example
  - AC line example

Ladder Networks – One Approach (same as in DC Circuits)

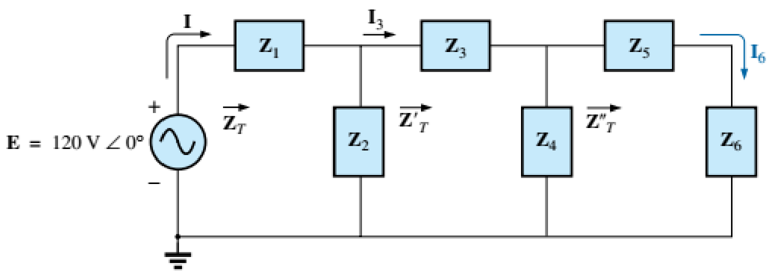


A specific series-parallel configuration

Analyze by:
- Collapse the circuit from the far end
- Find the source current
- Expand the circuit again, finding voltages or currents along the way
    - Successive application of voltage or current divider



Ladder Networks – One Approach



Finding **ZT**

$$\mathbf{Z''}_T = \mathbf{Z}_5 + \mathbf{Z}_6$$

and
$$\mathbf{Z'}_T = \mathbf{Z}_3 + \mathbf{Z}_4 \| \mathbf{Z''}_T$$

with
$$\mathbf{Z}_T = \mathbf{Z}_1 + \mathbf{Z}_2 \| \mathbf{Z'}_T$$

Finding **I**

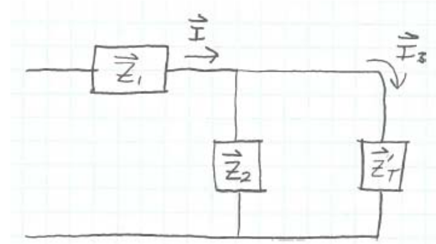
$$\mathbf{I} = \frac{\mathbf{E}}{\mathbf{Z}_T}$$

Current Divider (special case of 2 impedances)

$$\mathbf{I}_3 = \frac{\mathbf{Z}_2\mathbf{I}}{\mathbf{Z}_2 + \mathbf{Z'}_T}$$

$$\mathbf{I}_6 = \frac{\mathbf{Z}_4\mathbf{I}_3}{\mathbf{Z}_4 + \mathbf{Z''}_T}$$

Development of **I3** (special case equation)



GENERAL FORM:

$$\vec{I}_x = \vec{I}_T \left(\frac{\vec{Z}_T}{\vec{Z}_x} \right)$$

HERE:

$$\vec{I}_3 = \vec{I} \left(\frac{\vec{Z'}_T // \vec{Z}_2}{\vec{Z'}_T} \right)$$

BUT $\quad \vec{Z'}_T // \vec{Z}_2 = \dfrac{\vec{Z'}_T \cdot \vec{Z}_2}{\vec{Z'}_T + \vec{Z}_2}$

$$\therefore \vec{I}_3 = \vec{I} \left(\frac{\vec{Z'}_T \cdot \vec{Z}_2}{\vec{Z'}_T + \vec{Z}_2} \right) \left(\frac{1}{\vec{Z'}_T} \right)$$

$$\vec{I}_3 = \vec{I} \; \frac{\vec{Z}_2}{\vec{Z'}_T + \vec{Z}_2}$$

Ladder Networks – ICP (partial HW problem)

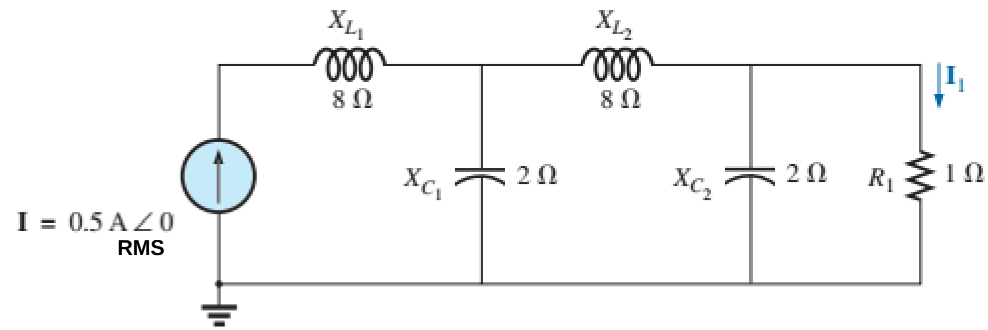
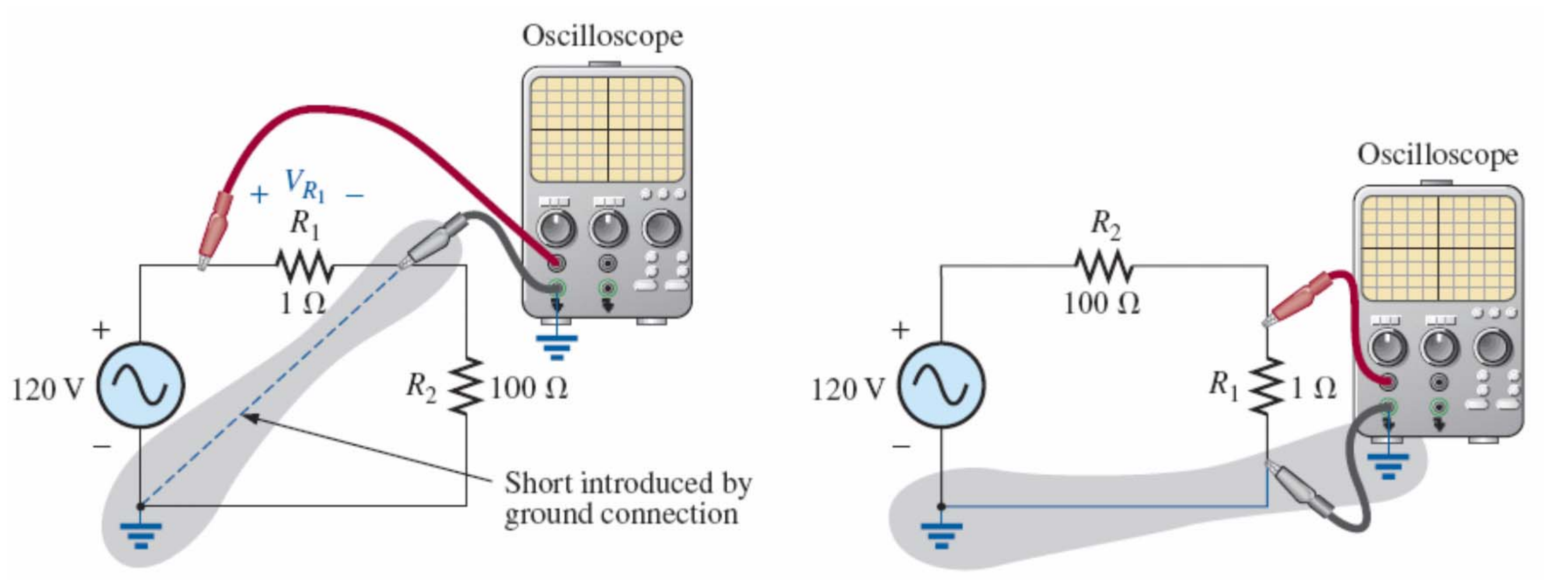


FIG. 17.54

Find: The voltage across L_2, the current through C_2 (not $\mathbf{I}_1$) and the average power delivered to the circuit by the source

Remember: Develop a strategy 1st and at least one check-point BEFORE starting the problem.

Grounding – In The Lab



(a) (b)

What will the O'Scope read?
Is it the correct value?

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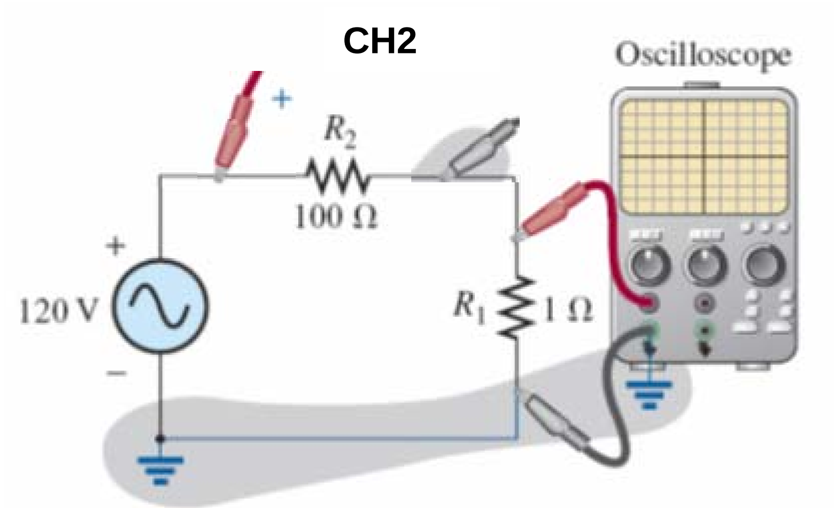
across

What will the O'Scope read?
Is it the correct value?

Grounding – In The Lab



What will the O'Scope read?
CH1 and CH2?
Are these the correct measurements?

Grounding – Electrical Outlets

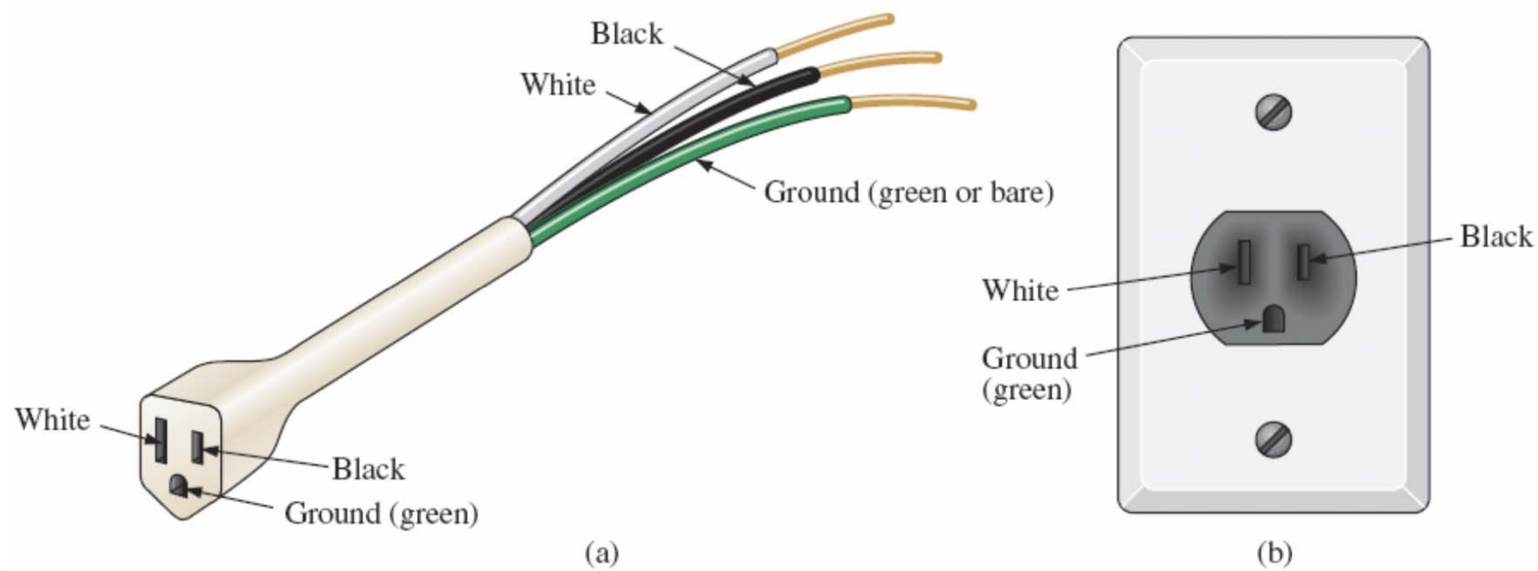
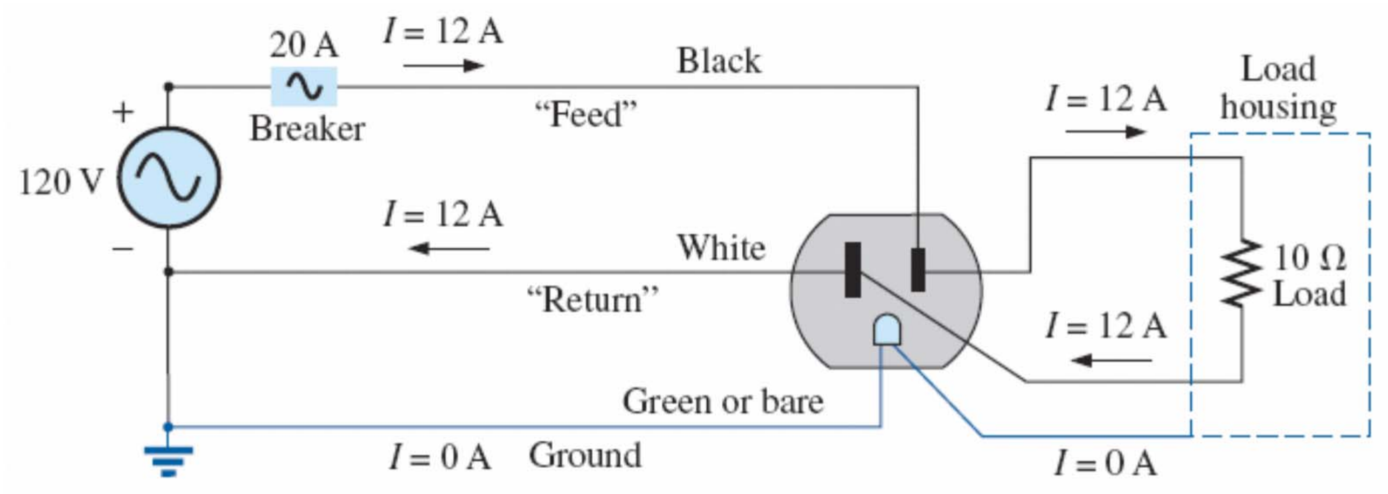


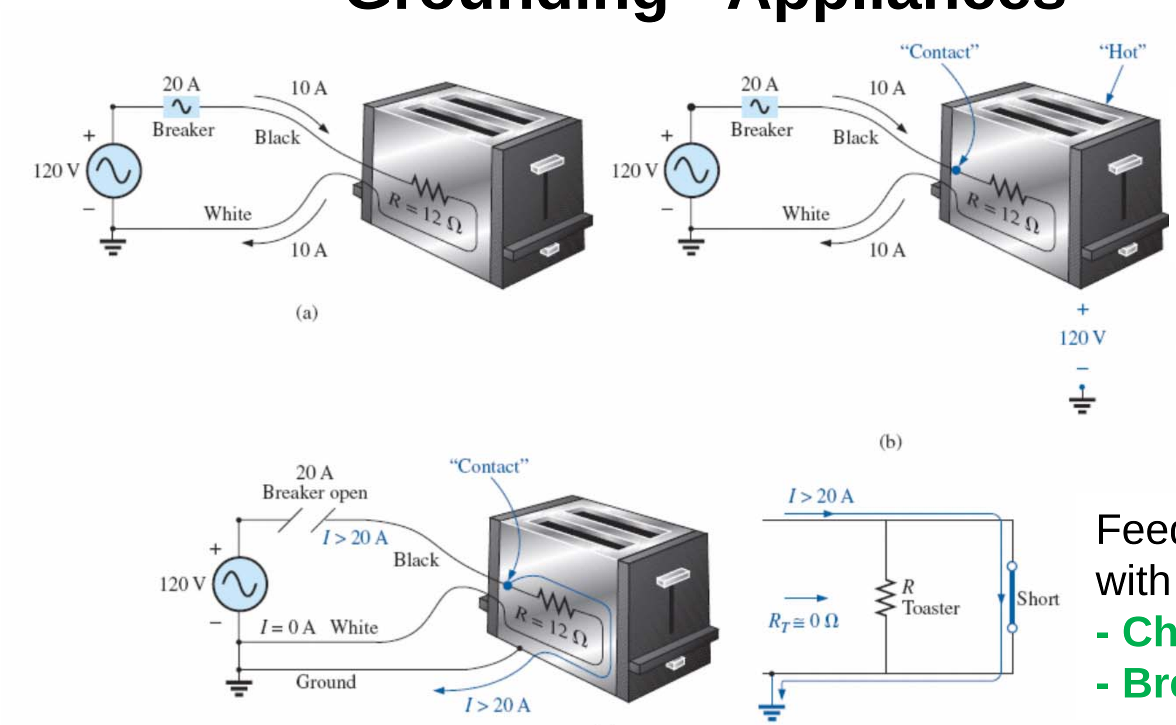
FIG. 17.24 *Three-wire conductors: (a) extension cord; (b) home outlet.*

Grounding – Electrical Outlets



Note:
- No current is meant to flow through the green wire (earth ground)
- Return and ground are connected together

Grounding - Appliances



Feeder makes contact with the chassis
- Chassis is "hot"

Feeder makes contact with the chassis
- Chassis is grounded
- Breaker trips

FIG. 17.26 *Demonstrating the importance of a properly grounded appliance: (a) ungrounded; (b) ungrounded and undesirable contact; (c) grounded appliance with undesirable contact.*