

# ENG2200

## Electric Circuits

### Chapter 3

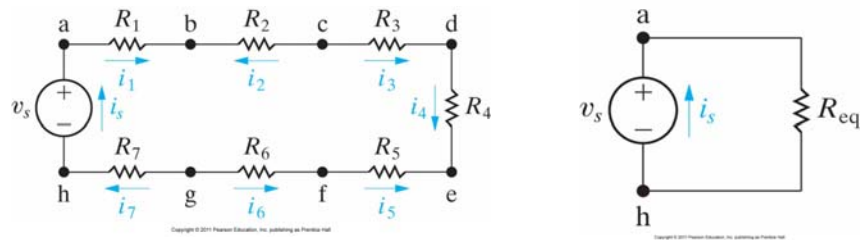
#### Simple Resistive Circuits

### Chapter 3

- Resistance in series and parallel
- Voltage and current dividers
- Measuring voltage, current, and resistance
- Delta-to-Wye ( $\Delta$  to Y)

## Resistance in Series

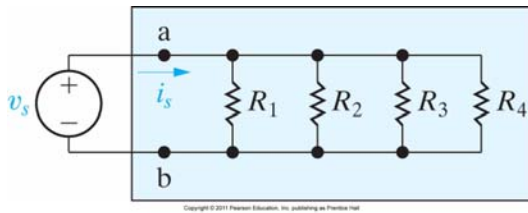
- Two or more resistors are connected *in series* if they carry the same current
- $R_{eq} = R_1 + R_2 + \dots + R_n$



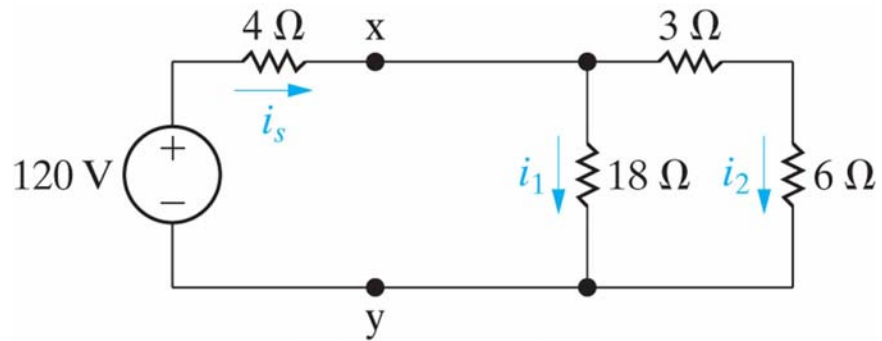
## Resistors in parallel.

- Two, or more, resistors are connected in parallel if they have the same voltage.

$$\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \frac{1}{R_4} \quad (\text{use conductance})$$



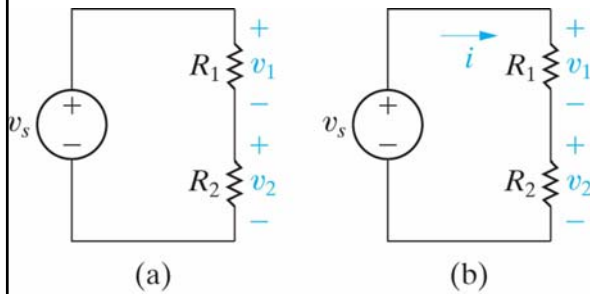
Find  $i_s$ ,  $i_1$ , and  $i_2$



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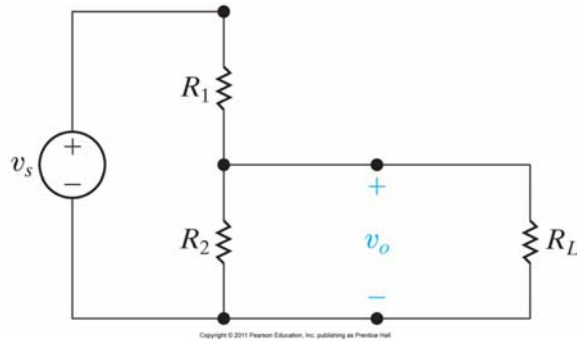
### Voltage Divider

What is  $v_1$  and  $v_2$  relative to  $v_s$ ?



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## The effect of loading

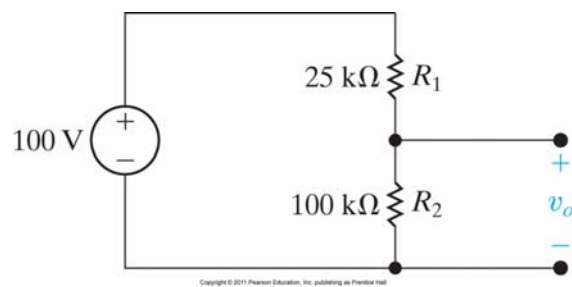


## The effect of loading

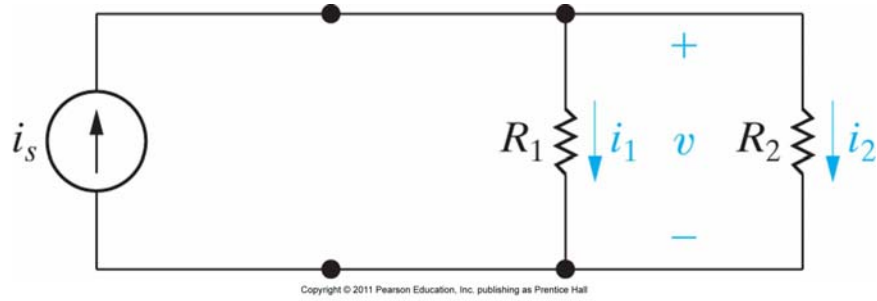
Find  $v_o$

What if the load is  $10\Omega$

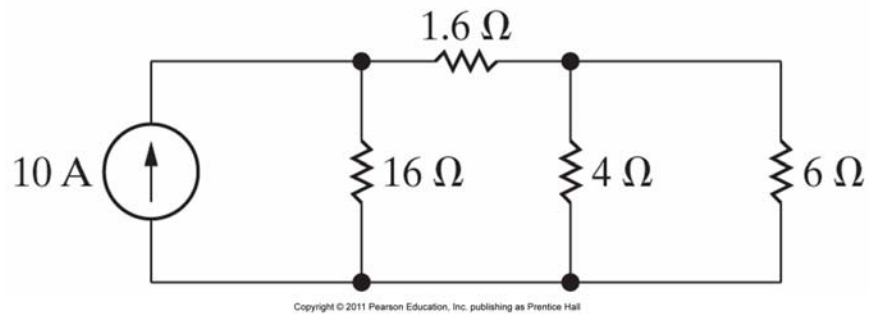
What is the load id  $10\text{ M}\Omega$



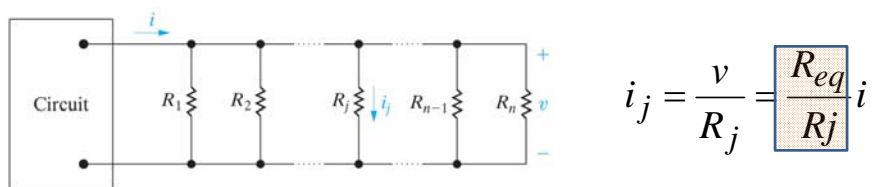
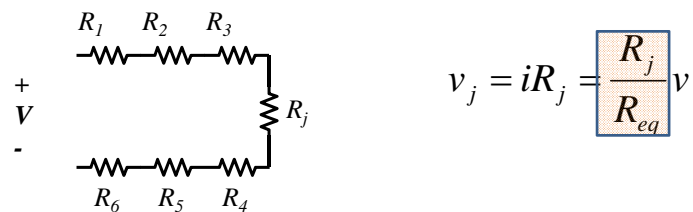
Find  $i_1$  and  $i_2$  in terms of  $i_s$



Find the power dissipated in the  $6\ \Omega$  resistor



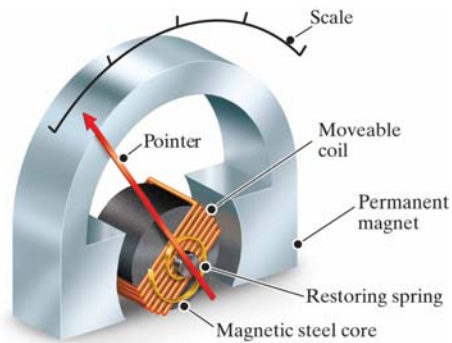
## Voltage and current dividers



## Measuring Voltage and Current

- Voltmeter is an instrument to measure voltage across a load
  - In parallel with the load
  - Ideal resistance of  $\infty$
- Ammeter is an instrument to measure current in a load
  - In series with the load
  - Ideal resistance of 0

## D'Arsonval meter movement.



- When current flows in the coil, it creates a torque that rotates the pointer.
- A meter is rated at 50mV and 1mA means when the coil is carrying 1mA there is a voltage drop of 50mV and the pointer full scale
- To use it as an ammeter, a parallel resistor is used
- To use it as voltmeter, a serial resistor is used

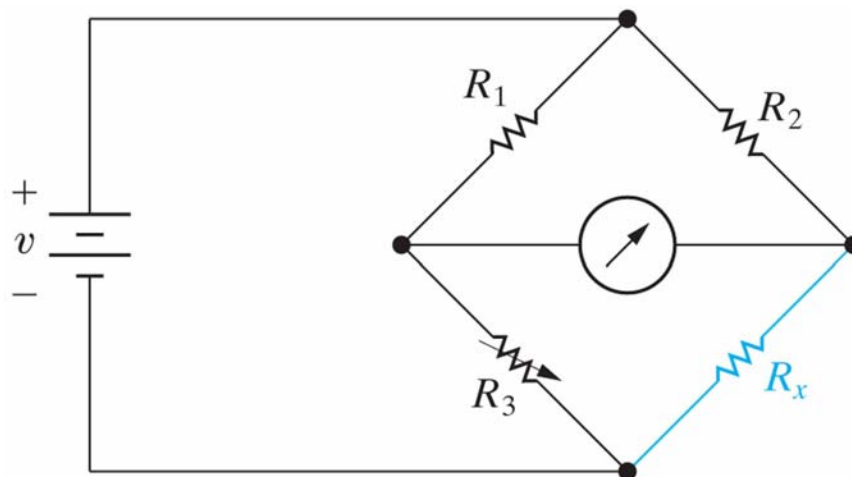
## Example

- A 50 mV, 1 mA d'Arsonval movement is used as ammeter with a full scale of 10mA
- What is  $R_A$ ?
- What measurement will result to if used to measure current in a  $100\Omega$  R with 1V across

### Example

- A 50 mV, 1 mA d'Arsonval movement is used as ammeter with a full scale of 150 V
- What is  $R_v$ ?
- What measurement will result to if used to measure voltage across 75 k $\Omega$  R in series with 15 K $\Omega$  with  $v = 60V$

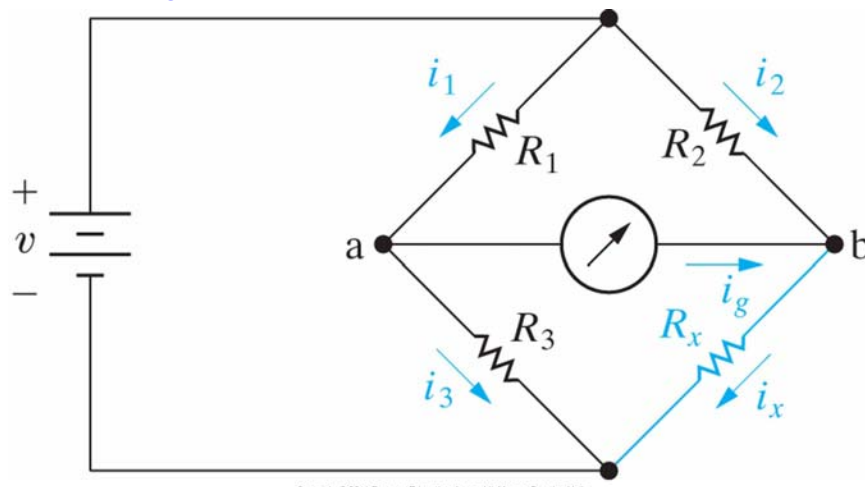
**Figure 3.26** The Wheatstone bridge circuit.



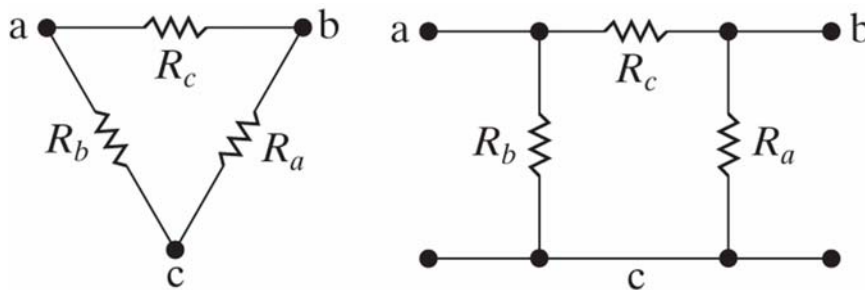
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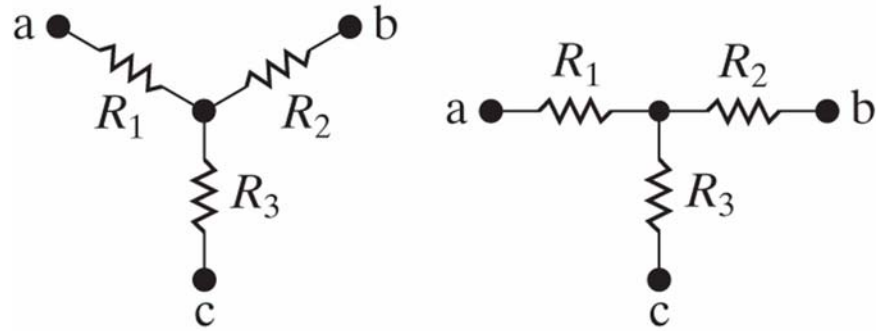
**Figure 3.27** A balanced Wheatstone bridge ( $i_g = 0$ ).



**Figure 3.29** A  $\Delta$  configuration viewed as a  $\pi$  configuration.

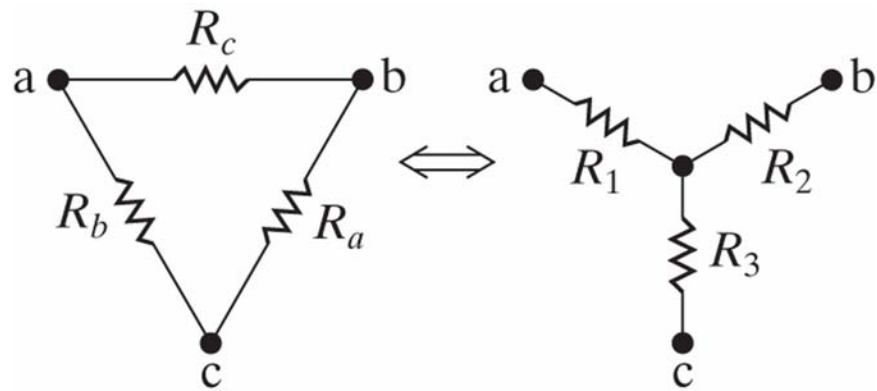


**Figure 3.30** A Y structure viewed as a T structure.

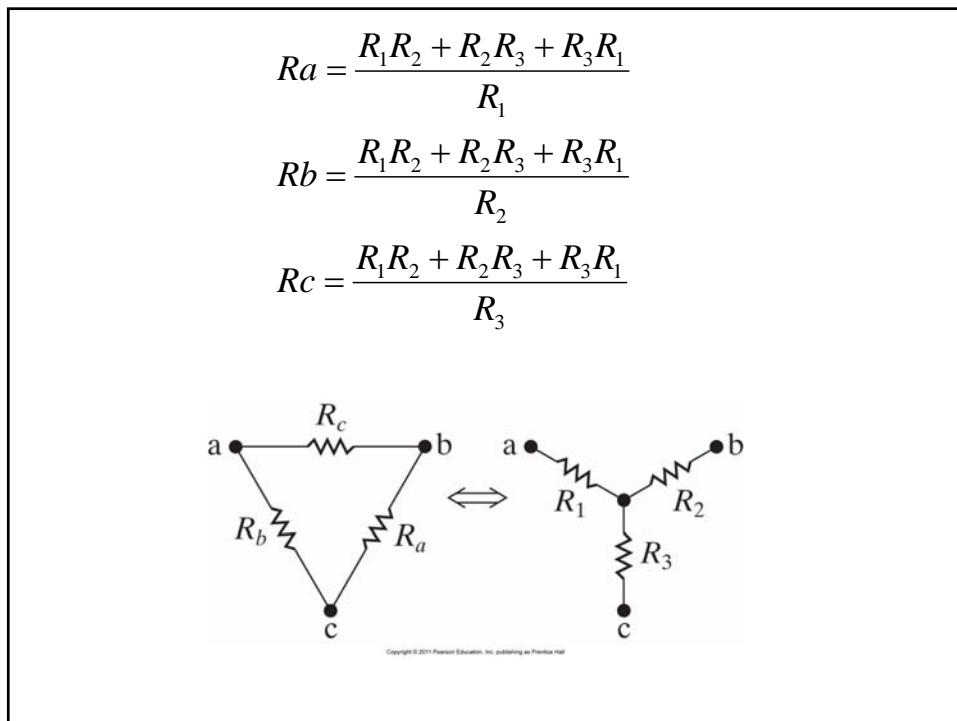
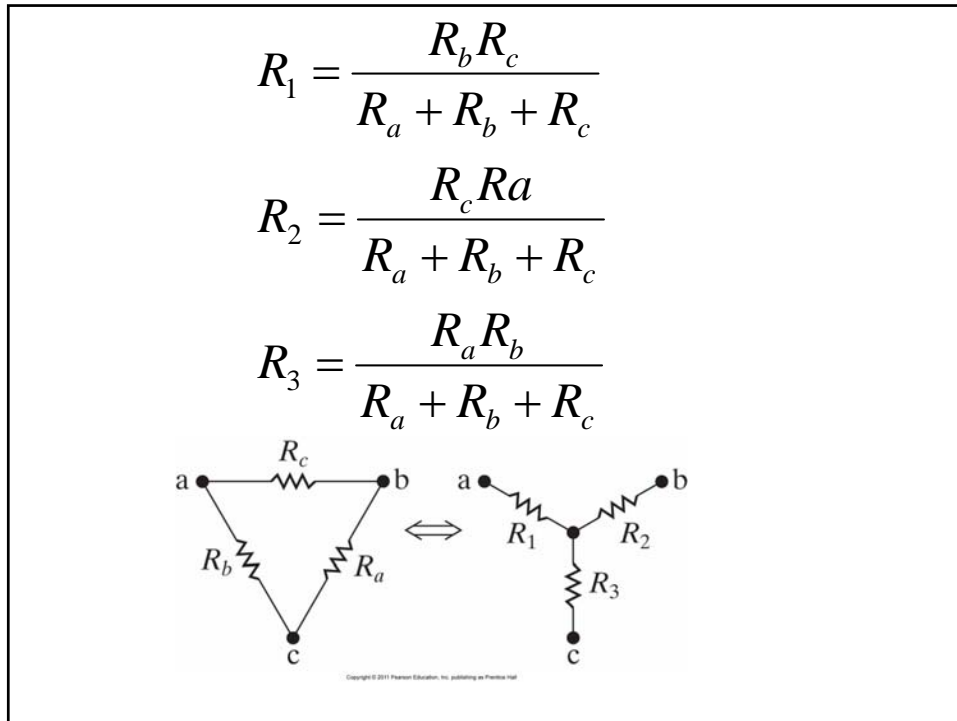


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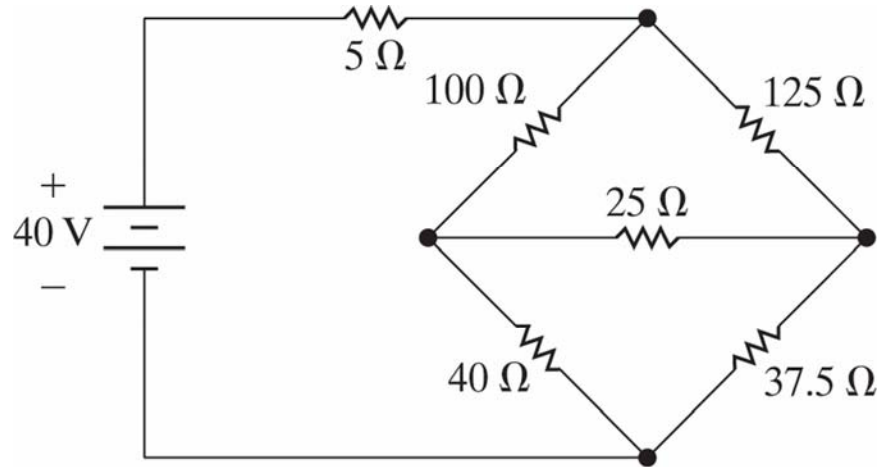
**Figure 3.31** The  $\Delta$ -to-Y transformation.



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**Figure 3.32** The circuit for Example 3.7.



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