Electron Flow and Resistance: Ohm's (Ω) and Kirchoff's Laws

Session 1c of Basic Electricity
A Fairfield University E-Course
Powered by LearnLinc

Basic Electricity

Two Sections

- Electron Flow and Resistance
  - 5 on-line sessions
  - Lab
- Inductance and Capacitance
  - 5 on-line sessions
  - Lab

Mastery Test, Part 1

Basic Electricity (Continued)

- Text: "Electricity One-Seven," Harry Mileaf, Prentice-Hall, 1996, ISBN 0-13-889585-6 (Covers several Modules and more)
- References:
  - "Digital Mini Test: Principles of Electricity Lessons One and Two," SNET Home Study Coordinator, (203) 771-5400
  - Electronics Tutorial (Thanks to Alex Pounds at alex_tb@hotmail.com)
  - Electronics Tutorial (Thanks to Mark Sokos at sokos@desupernet.net)

Section 1:
Electron Flow and Resistance

- 0BJECTIVES: This section introduces five basic electrical concepts as well as the underlying atomic structure of electrical materials.
  - Conductance(G),
  - Resistance (R),
  - Current (I),
  - Power (P), and
  - Electromotive force (E) or voltage (V).

Section 1 Schedule:

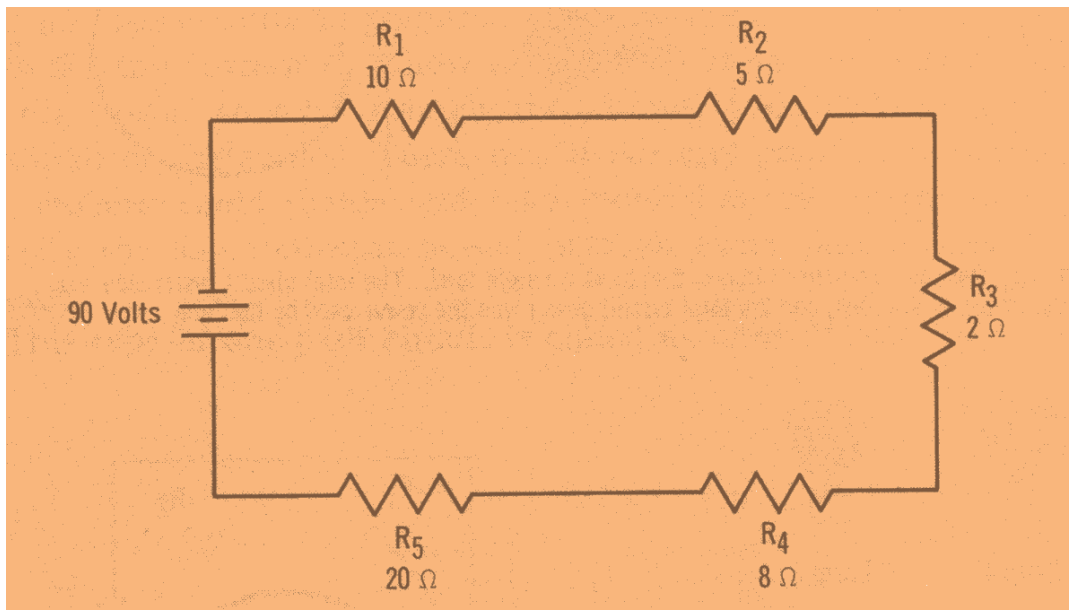
Session a – 03/04	Atoms, Charge and Current	Text 1.1 – 1.39
03/06 & 03/08 were Math Tutorials	Conductivity (G), Electric Fields and Electromotive Force (EMF)	Text 1.40 – 1.68
Session b – 03/11	Resistance (R), Conductance (G), Ohms Law (Ω) & Power (Watts)	Text 2.1 – 2.52
Session c – 03/13 (lab - 03/16, sat.)	**Resistors in Series and Parallel and Working with Equations**	**Text 2.53 – 2.98**
Session d – 03/18	Series / Parallel Simplification Kirchoff, Thevenin & Norton	2.99 – 2.115 2.116 – 2.133
Session e – 03/20	Review: The Water Model	1.42, 1.63, 2.5, 2.129 Sokos

Session 1b Review

- Circuits
  - Open
  - Closed
- Switches
- Direct Current (DC) vs. Alternating Current (AC)
- Conductors
- Resistors and the Color Code
- Power (Voltage * Current)

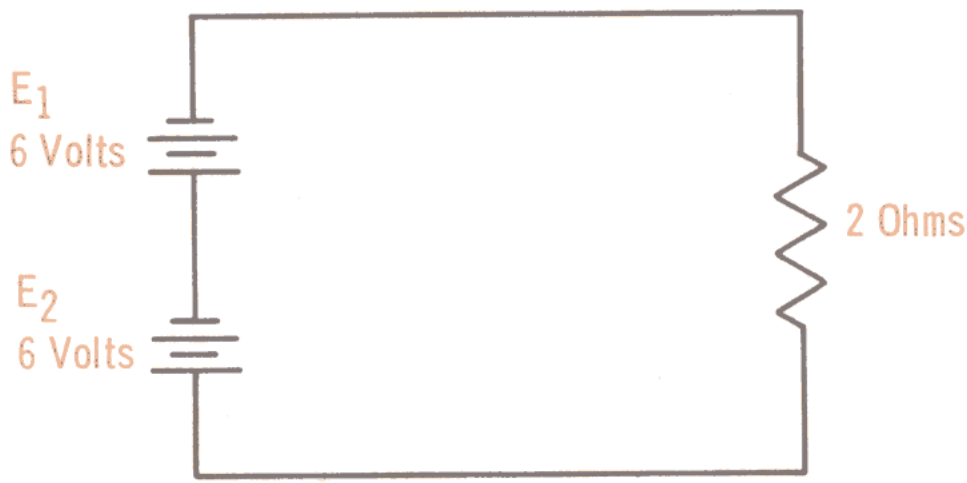
Resistors in Series

- The same current passes through each series resistor
- The voltage "divides" among the resistors
- $90=I*(10+5+2+8+20)$
- $R_{total}= 10+5+2+8+20$
- $R_{total}= 45$
- **Series resistors add**



Voltage Sources in Series

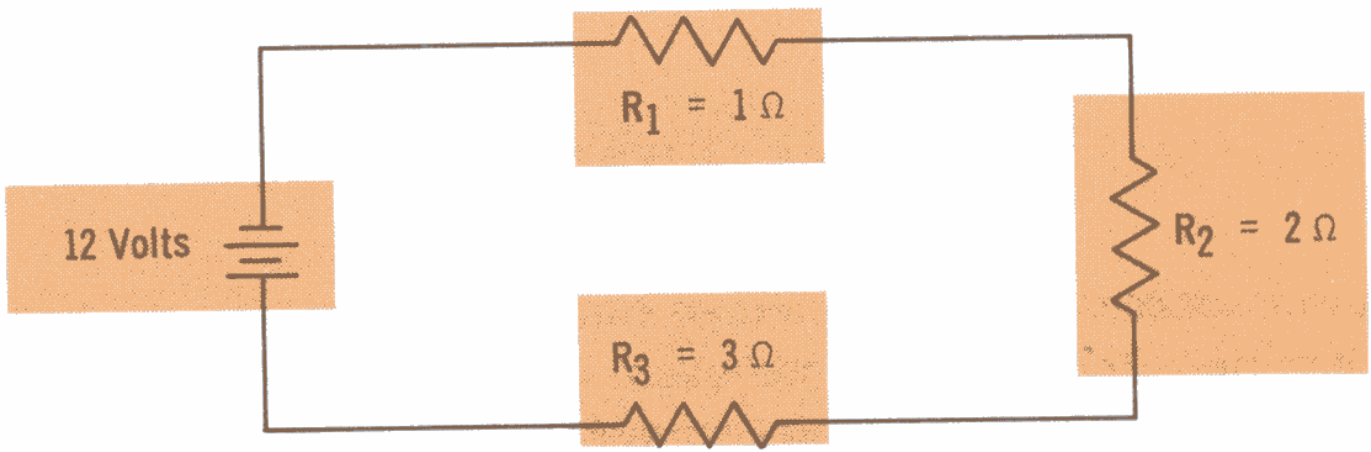
- Series voltages add (watch the ± signs)



Adding up Total Power

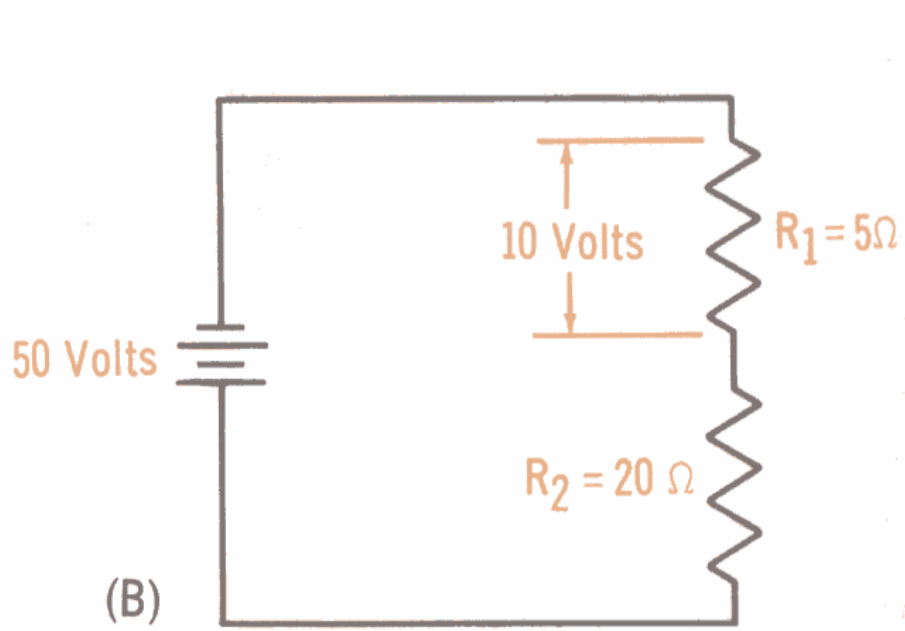
- $P = P_1 + P_2 + P_3$
- $12 = I*1 + I*2 + I*3$
- $12 = I*(1+2+3)$
- $12 = 6*I$

- $I=2$ amps
- $P_n = I * V_n = I^2 * R_n$
- $P = 2^2*(1+2+3)$
- $P = 24$ watts

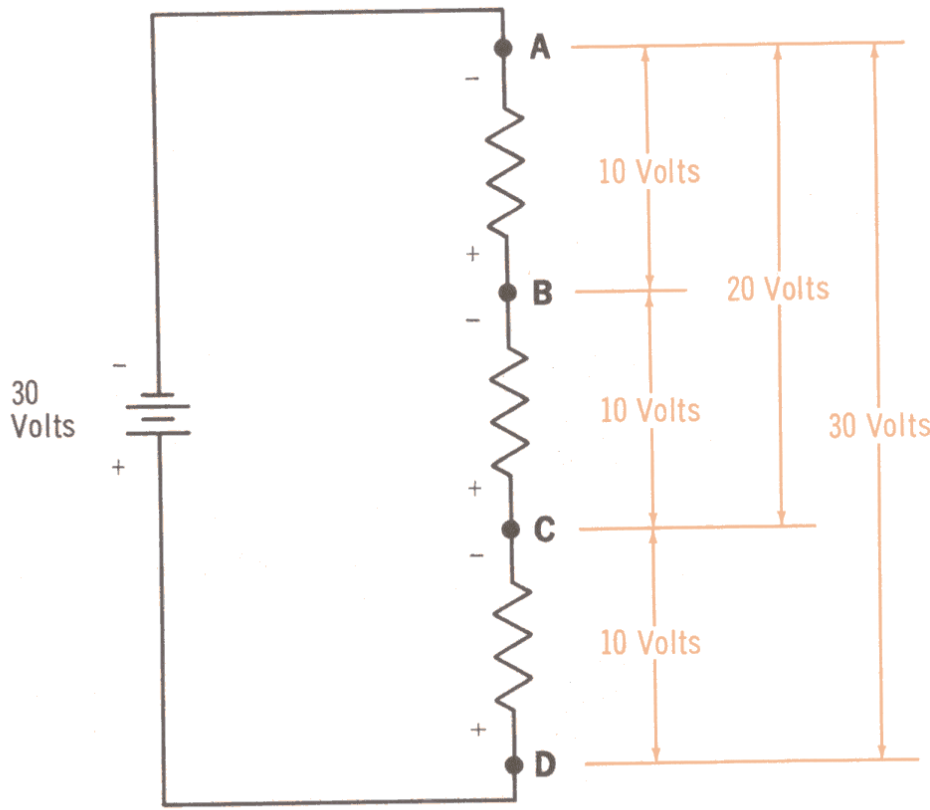


Voltage Drops

- R_{total} = 25Ω
- I=50/25=2 amps
- V_1=2*5=10 volts
- V_2=2*20
  =40 volts
- **The voltage drops add to 50**



Voltage is Relative
(reference point / ground)

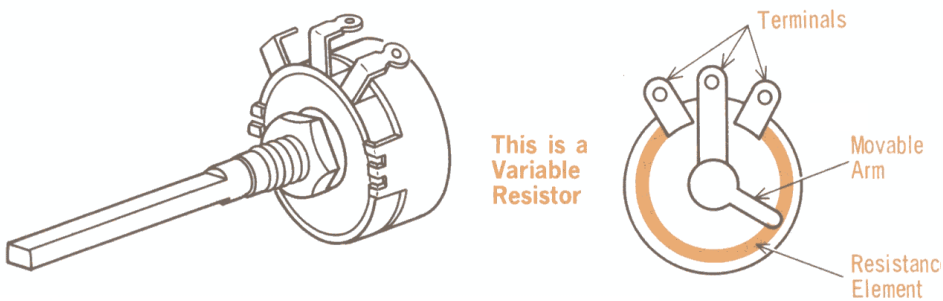


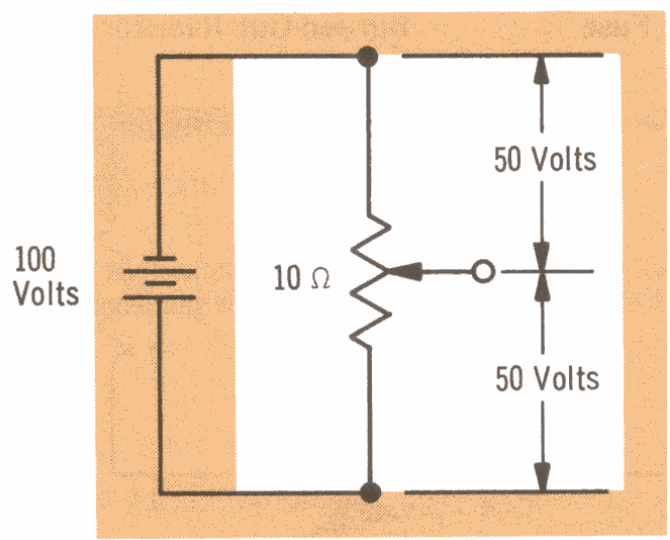
A voltage exists between two points. These points must be specified before you can determine the voltage

A point is positive or negative only in relation to another point. Very often, a point is positive with respect to one point, and at the same time, negative with respect to another

Potentiometers

- A variable resistor (Rheostat)
- 3 terminals
  - Top to bottom, fixed resistance
  - Wiper arm, variable resistance





Potentiometer
(continued)

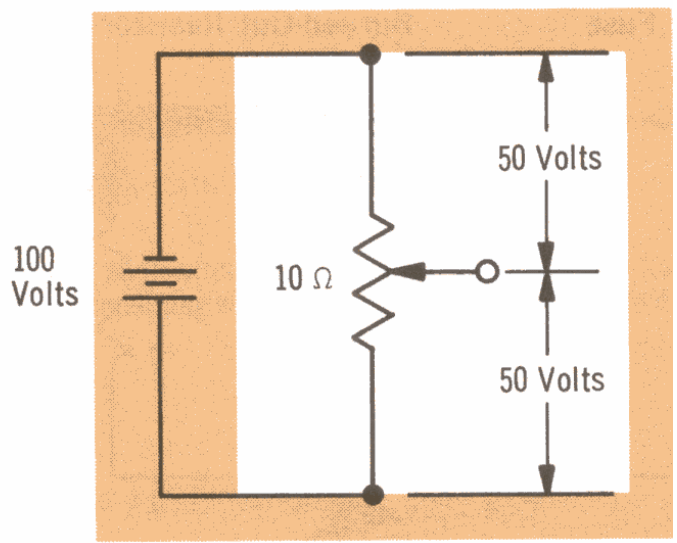
- Effectively two variable resistors in series
  - Always add to same total resistance
  - Forms an adjustable "Voltage Divider"
- Voltage divider

$I = V/(R_1+R_2)$

$V_{out} = I^* R_2$

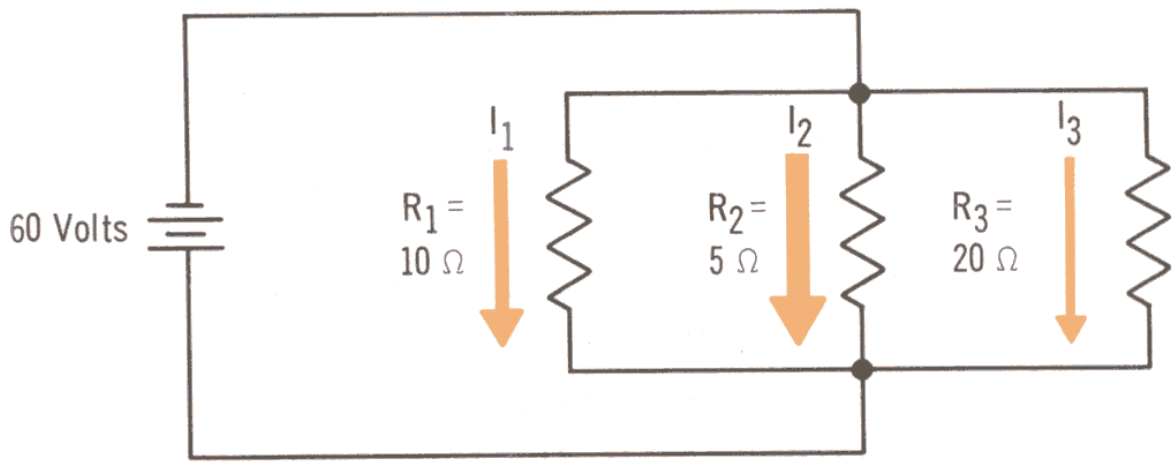
$V_{out} = R_2 * V/(R_1+R_2)$

$V_{out} / V = R_2 /(R_1+R_2)$



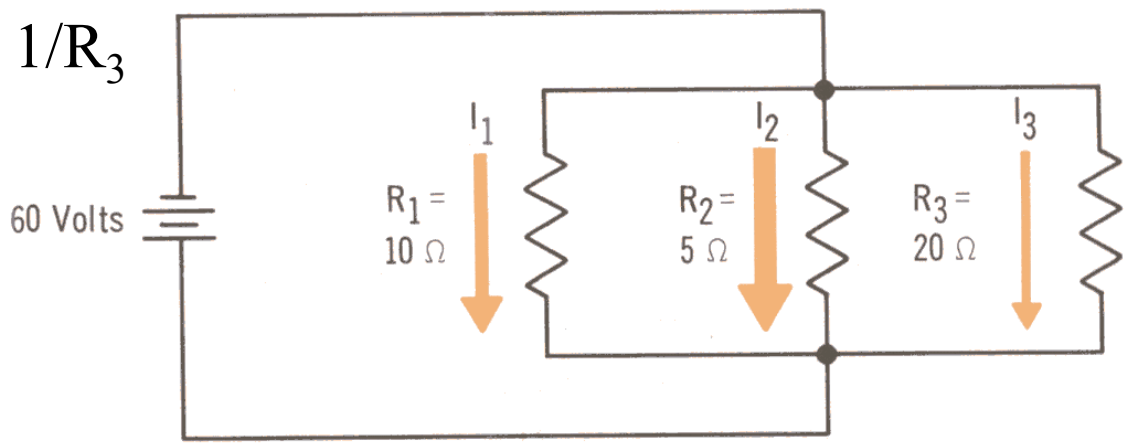
Parallel Resistors

- The same voltage is across each parallel resistor
- The current "divides" among the resistors
- $I_1 = 60/10$
  $= 6$ amps
- $I_2 = 60/5$
  $= 12$ amps
- $I_3 = 60/20$
  $= 3$ amps
- $I_{total} = 6+12+3$
- $I_{total} = 21$ amps

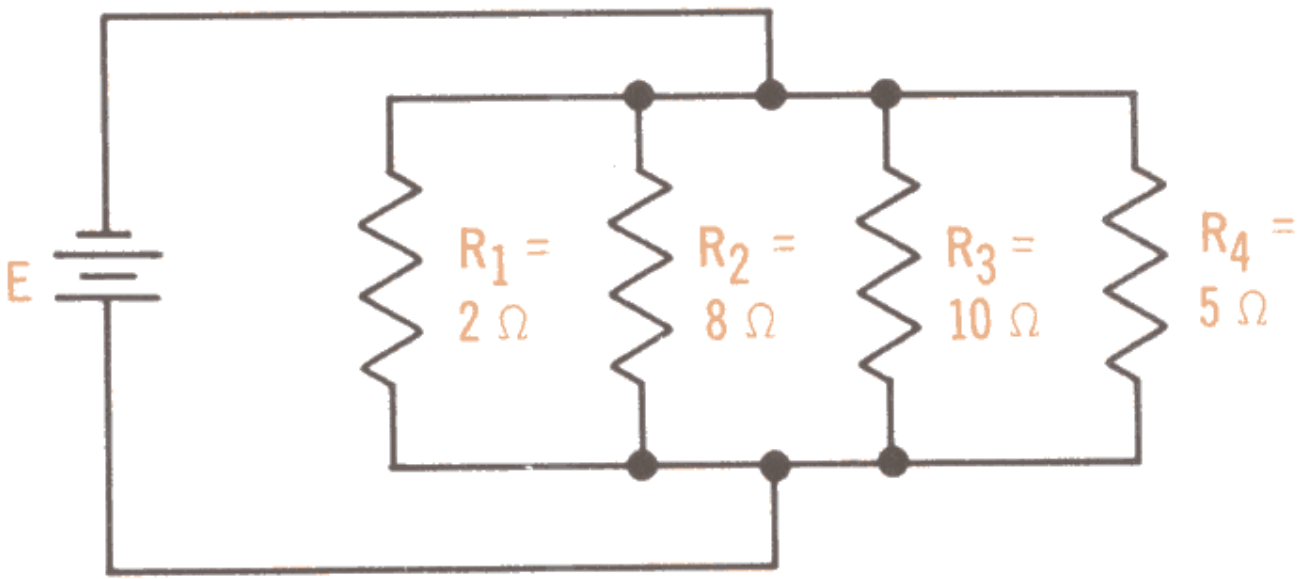


Adding Resistors in Parallel

- $V = I_{total} * R_{total}$ or $R_{total} = V / I_{total}$
- $I_{total} = V/R_1 + V/R_2 + V/R_3$
- $R_{total} = 1/(1/R_1 + 1/R_2 + 1/R_3)$
- $1 / R_{total} = 1/R_1 + 1/R_2 + 1/R_3$

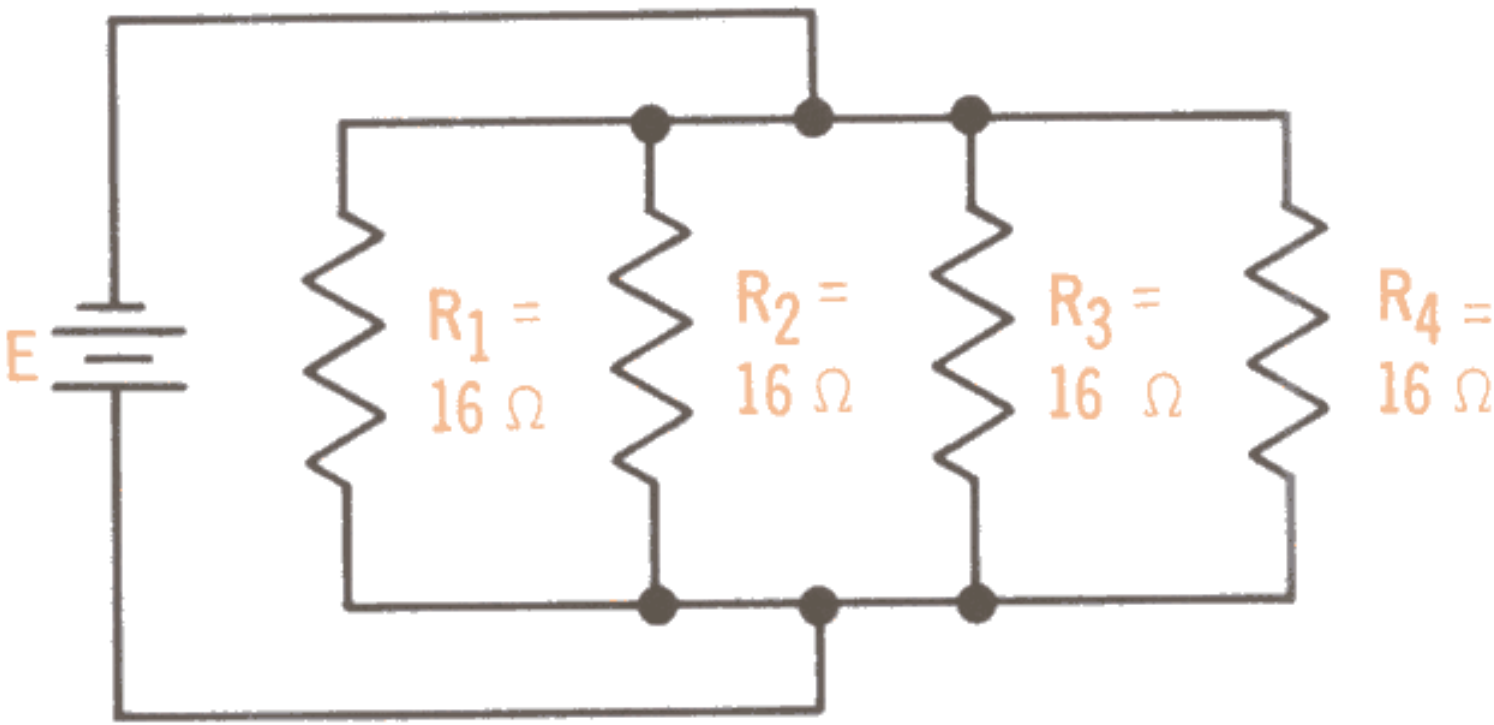


Parallel Practice



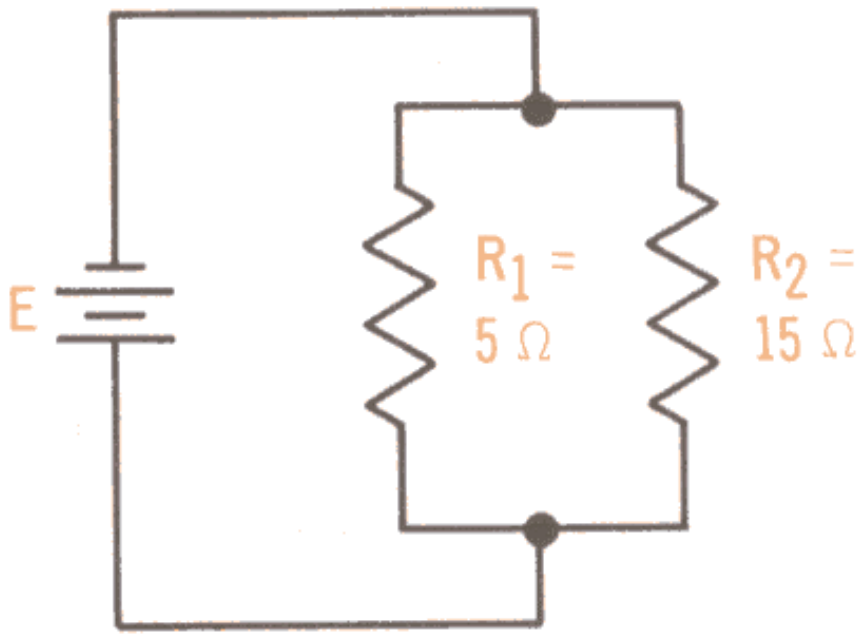
Problem 14

More Parallel Practice



Problem 15

Still more Parallel Practice



Problem 16

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