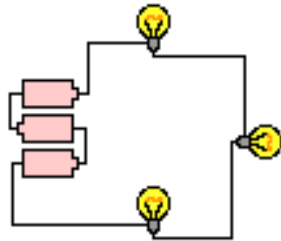
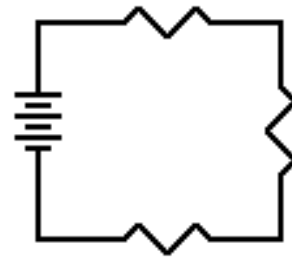


# Series Circuits

Drawing of Circuit

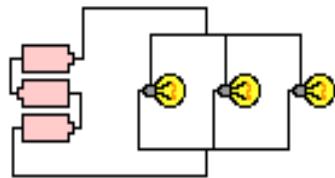


Schematic Diagram of Circuit

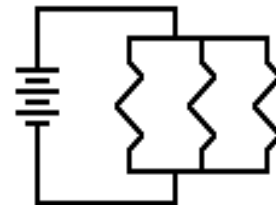


# Parallel Circuits

Drawing of Circuit

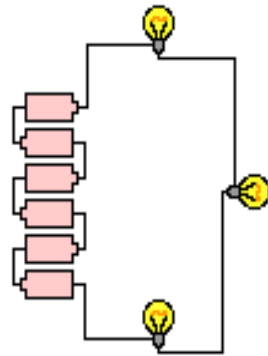


Schematic Diagram of Circuit

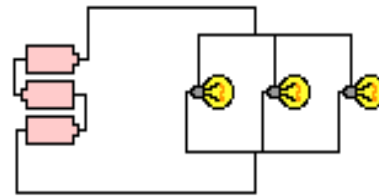


# Series and Parallel Circuits

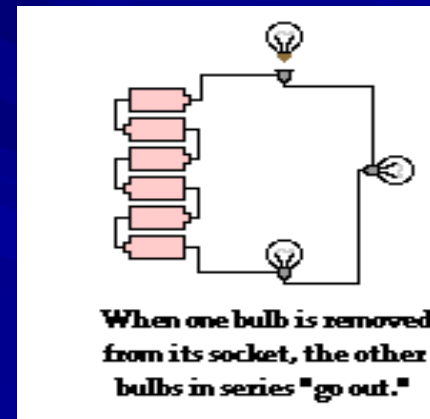
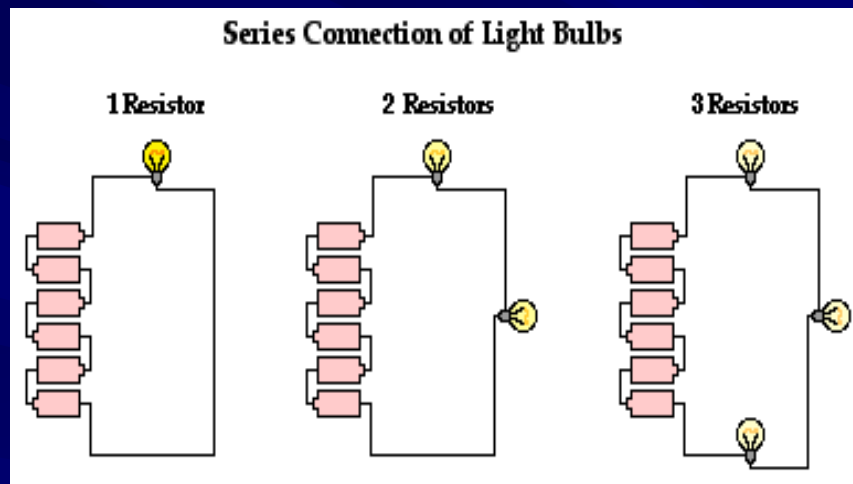
Series Connection



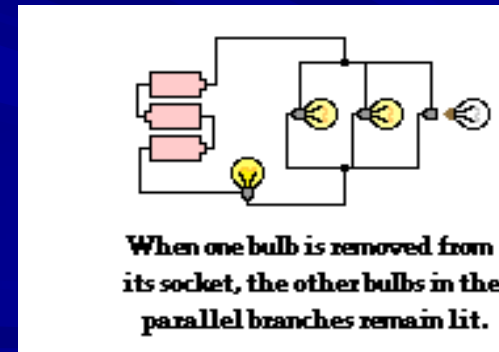
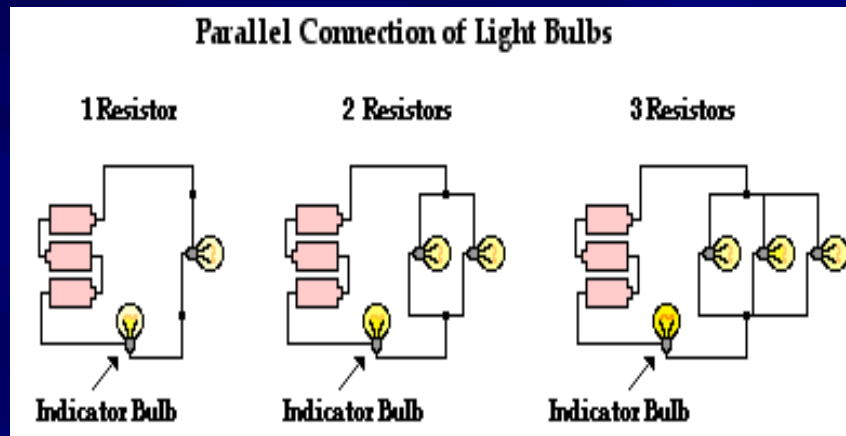
Parallel Connection



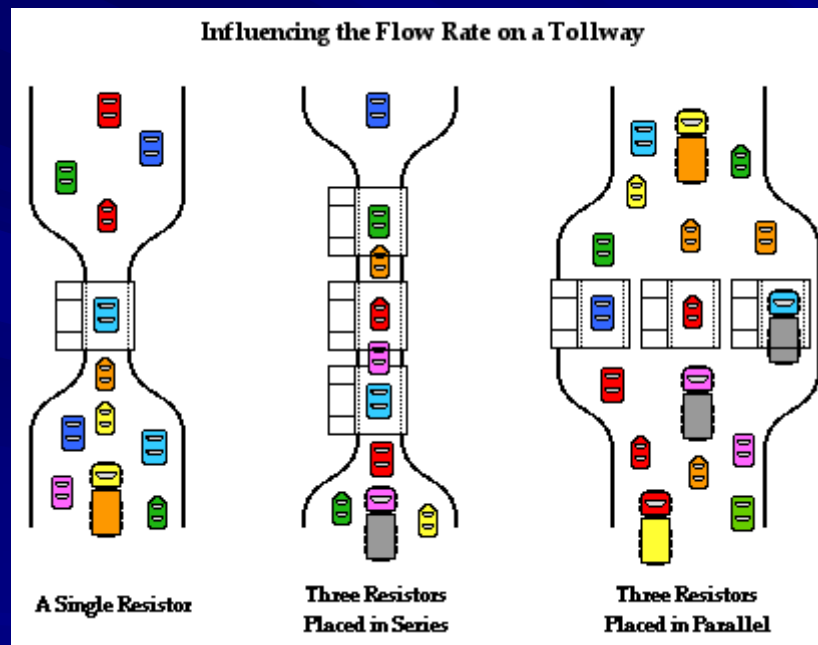
# Series Circuits



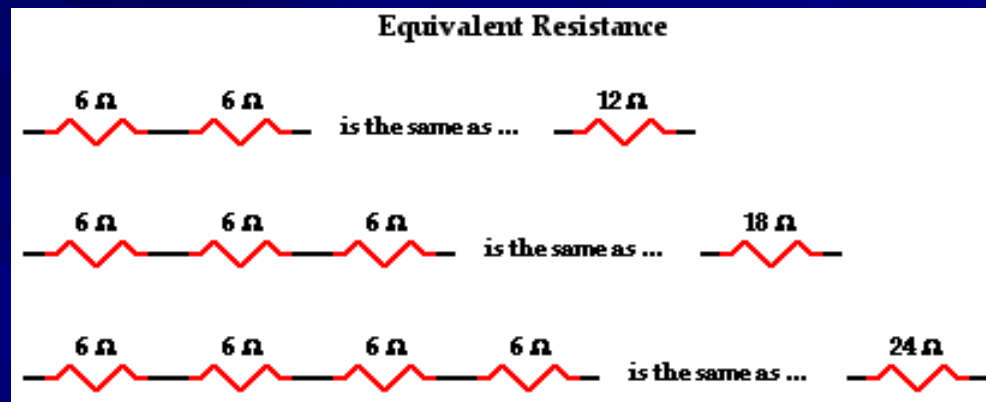
# Parallel Circuits



# Total Resistance and Current Flow



# Equivalent Resistance Series Circuit

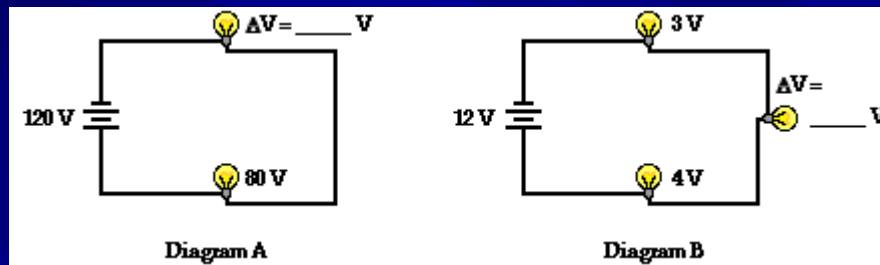


$$R_{eq} = R_1 + R_2 + R_3 + \dots$$

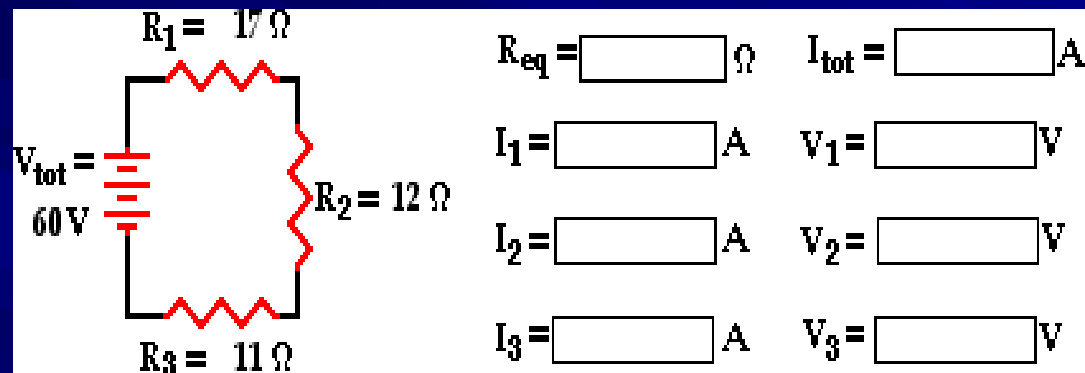
$$I_{battery} = I_1 = I_2 = I_3 = \dots$$

# Voltage Drop

$$V_{\text{battery}} = V_1 + V_2 + V_3 + \dots$$



# Mathematical Analysis of Series Circuits



# Mathematical Analysis of Series Circuits

$$R_{eq} = R_1 + R_2 + R_3 = 17 + 12 + 11 = 40$$

$$I_{tot} = V_{battery} / R_{eq} = (60 \text{ V}) / (40 \text{ }) = 1.5 \text{ amp}$$

$$I_{battery} = I_1 = I_2 = I_3 = 1.5 \text{ amp}$$

# Mathematical Analysis of Series Circuits

$$V_1 = I_1 \cdot R_1$$

$$V_1 = (1.5 \text{ A}) \cdot (17 \Omega)$$

$$V_1 = 25.5 \text{ V}$$

$$V_2 = I_2 \cdot R_2$$

$$V_2 = (1.5 \text{ A}) \cdot (12 \Omega)$$

$$V_2 = 18 \text{ V}$$

$$V_3 = I_3 \cdot R_3$$

$$V_3 = (1.5 \text{ A}) \cdot (11 \Omega)$$

$$V_3 = 16.5 \text{ V}$$

# Check Your Answers

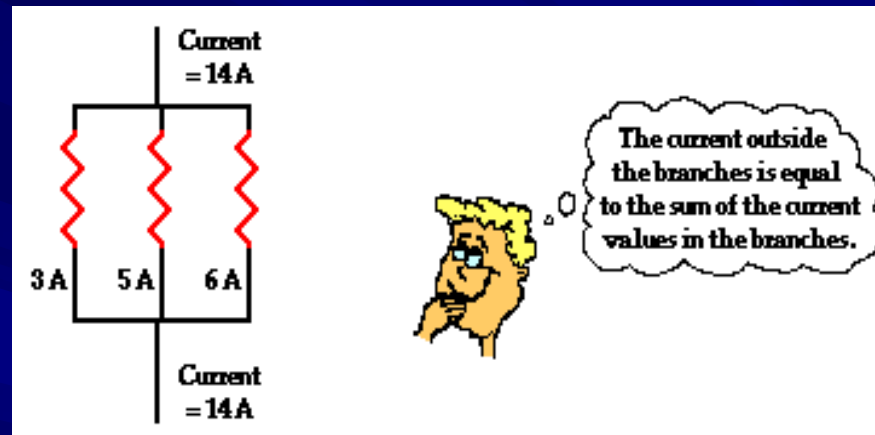
Is  $V_{\text{battery}} = V_1 + V_2 + V_3$  ?

Is  $60 \text{ V} = 25.5 \text{ V} + 18 \text{ V} + 16.5 \text{ V}$  ?

Is  $60 \text{ V} = 60 \text{ V}$  ?

Yes!!

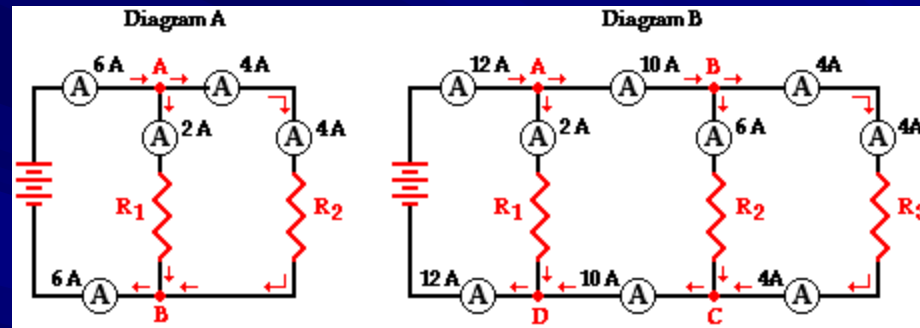
# Current in a Parallel Circuit



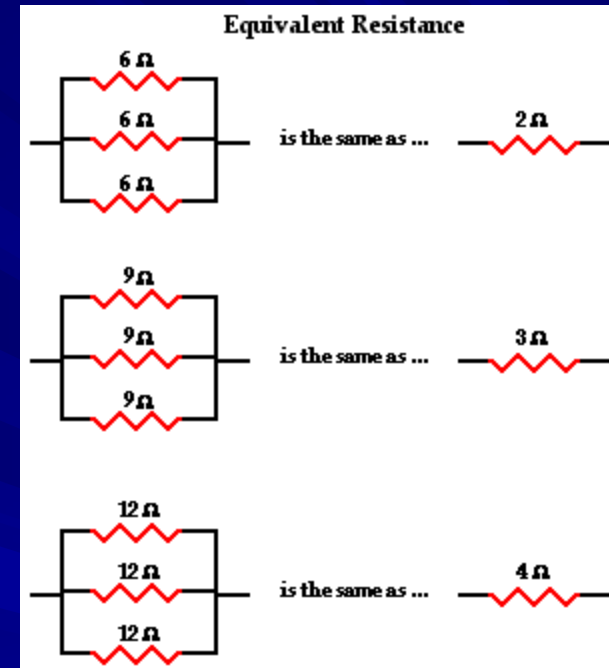
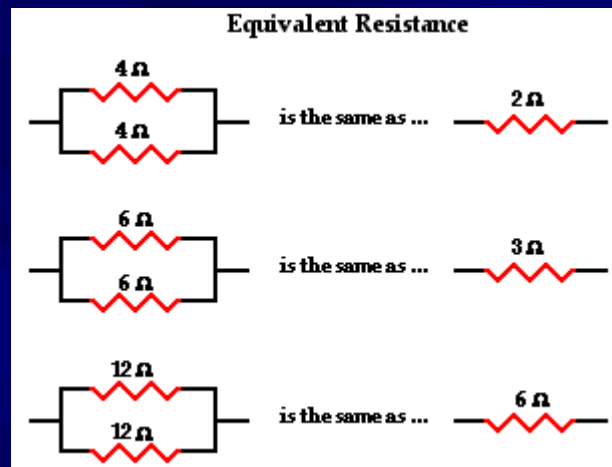
$$I_{\text{total}} = I_1 + I_2 + I_3 + \dots$$

$I_{\text{total}}$  is the total amount of current outside the branches (and through the battery) and  $I_1$ ,  $I_2$ , and  $I_3$  represent the current in the individual branches of the circuit.

# Current in a Parallel Circuit



# Equivalent Resistance in a Parallel Circuit



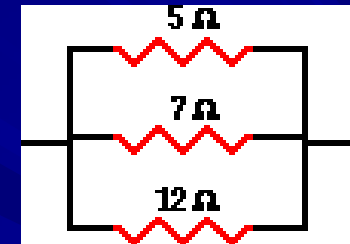
**Equivalent Resistance** of a circuit is the amount of resistance which a single resistor would need in order to equal the overall effect of the collection of resistors which are present in the circuit.

$$1 / R_{eq} = 1 / R_1 + 1 / R_2 + 1 / R_3 + \dots$$

# Equivalent Resistance in a Parallel Circuit

A 5.0  $\Omega$  , 7.0  $\Omega$  , and 12  $\Omega$  resistor are placed in parallel what is the equivalent resistance?

$$1/R_{eq} = 1/R_1 + 1/R_2 + 1/R_3$$



$$1/R_{eq} = 1/(5.0 \text{ } \Omega) + 1/(7.0 \text{ } \Omega) + 1/(12 \text{ } \Omega)$$

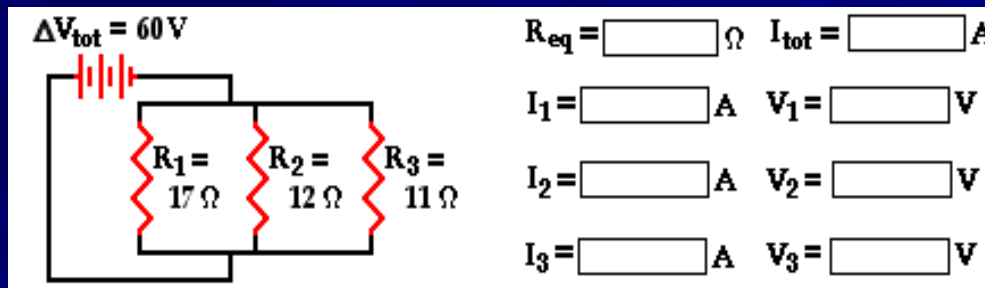
$$R_{eq} = 2.3$$

# Voltage Drops for Parallel Circuits

The total voltage drop in the external circuit is equal to the gain in voltage as a charge passes through the battery (the internal circuit).

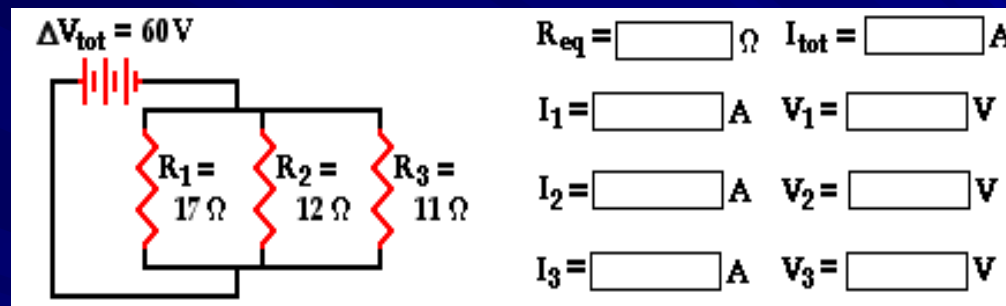
$$V_{\text{battery}} = V_1 = V_2 = V_3 = \dots$$

# Mathematical Analysis of Parallel Circuits



$$\frac{1}{R_{\text{eq}}} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$$
$$\left( \frac{1}{17} \right) + \left( \frac{1}{12} \right) + \left( \frac{1}{11} \right)$$
$$R_{\text{eq}} = 4.29 \Omega$$

# Mathematical Analysis of Parallel Circuits



$$I_{\text{tot}} = V_{\text{battery}} / R_{\text{eq}}$$
$$(60 \text{ V}) / (4.29063 \text{ })$$

$$I_{\text{tot}} = 14.0 \text{ amp}$$

$$V_{\text{battery}} = V_1 = V_2 = V_3 = 60 \text{ V}$$

# Mathematical Analysis of Parallel Circuits

$$I_1 = V_1 / R_1$$

$$I_1 = (60 \text{ V}) / (17 \text{ } )$$

$$I_1 = \mathbf{3.53 \text{ amp}}$$

$$I_2 = V_2 / R_2$$

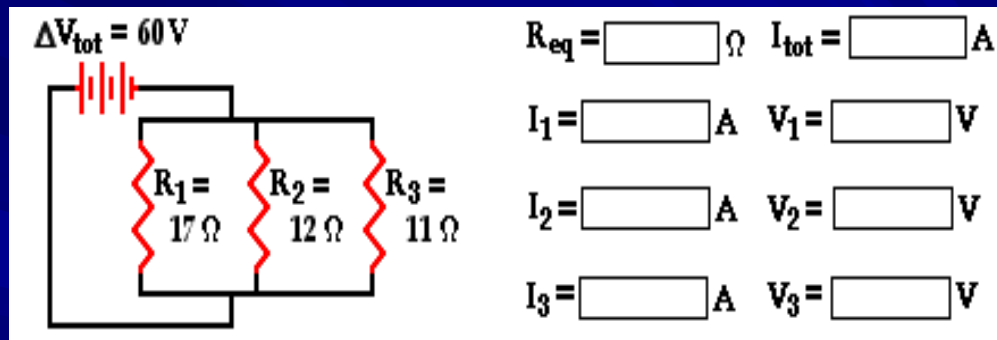
$$I_2 = (60 \text{ V}) / (12 \text{ } )$$

$$I_2 = \mathbf{5.00 \text{ amp}}$$

$$I_3 = V_3 / R_3$$

$$I_3 = (60 \text{ V}) / (11 \text{ } )$$

$$I_3 = \mathbf{5.45 \text{ amp}}$$



# Mathematical Analysis of Parallel Circuits

$$\text{Is } I_{\text{tot}} = I_1 + I_2 + I_3 ?$$

$$\text{Is } 14.0 \text{ amp} = 3.53 \text{ amp} + 5.00 \text{ amp} + 5.45 \text{ amp} ?$$

$$\text{Is } 14.0 \text{ amp} = 13.98 \text{ amp} ?$$

Yes!!

(The 0.02 amp difference is simply rounding error.)