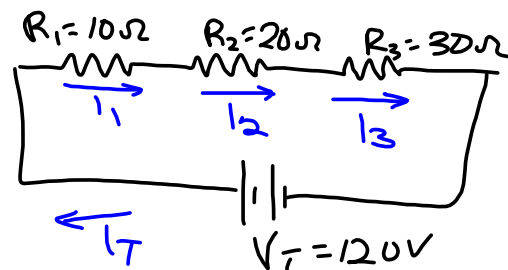


Series Circuit

Characterized by multiple loads, but a single path.

1. By law of conservation of charge

$$I_T = I_1 = I_2 = I_3 = I_i$$



2. By law of conservation of energy

$$V_T = V_1 + V_2 + V_3 = \sum V_i$$

3. Ohm's Law applies to each element of the circuit and the total circuit

$$V_1 = I_1 R_1; V_2 = I_2 R_2; V_3 = I_3 R_3; V_T = I_T R_T; V_i = I_i R_i$$

4. Combining 1-3

$$V_T = V_1 + V_2 + V_3$$

$$I_T R_T = I_1 R_1 + I_2 R_2 + I_3 R_3 \quad \text{but all } I\text{'s are equal}$$

$$R_T = R_1 + R_2 + R_3 = \sum R_i$$

Series Example

$R_1 = 10\Omega$	$I_1 = 2.0A$	$V_1 = 20V$
$R_2 = 20\Omega$	$I_2 = 2.0A$	$V_2 = 40V$
$R_3 = 30\Omega$	$I_3 = 2.0A$	$V_3 = 60V$
$R_T = 60\Omega$	$I_T = 2.0A$	$V_T = 120V$

$$R_T = \sum R_i = 60\Omega$$

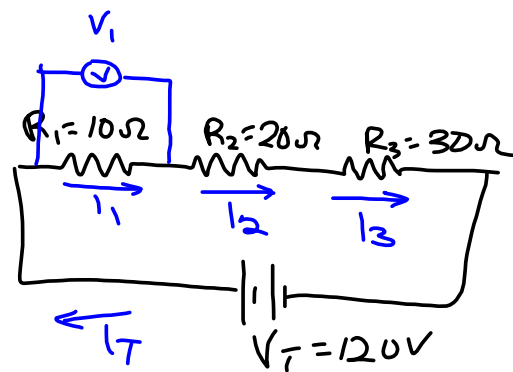
$$I_T = \frac{V_T}{R_T} = 2.0A = I_i$$

$$V_i = I_i R_i$$

$$V_1 = 20V$$

$$V_2 = 40V$$

$$V_3 = 60V$$



Quick Check

$$V_T = \sum V_i ?$$

$$120 = 120 \checkmark$$

Parallel Circuit

Characterized by multiple loads, but only a single load in each path.

1. By law of conservation of charge

$$I_T = I_1 + I_2 + I_3 = \sum I_i$$

2. By law of conservation of energy

$$V_T = V_1 = V_2 = V_3 = V_i$$

3. Ohm's Law

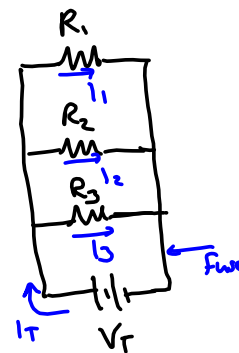
$$V_1 = I_1 R_1; V_2 = I_2 R_2; V_3 = I_3 R_3; V_T = I_T R_T; V_i = I_i R_i$$

4. Combining 1-3

$$I_T = I_1 + I_2 + I_3$$

$$\frac{V_T}{R_T} = \frac{V_1}{R_1} + \frac{V_2}{R_2} + \frac{V_3}{R_3} \quad \text{but all } V\text{'s are equal}$$

$$\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} = \sum \frac{1}{R_i}$$



Parallel Example

$$R_1 = 10\Omega \quad I_1 = 12A \quad V_1 = 120V$$

$$R_2 = 20\Omega \quad I_2 = 6A \quad V_2 = 120V$$

$$R_3 = 30\Omega \quad I_3 = 4A \quad V_3 = 120V$$

$$R_T = 5.45\Omega \quad I_T = 22A \quad V_T = 120V$$

$$V_T = V_i = 120V$$

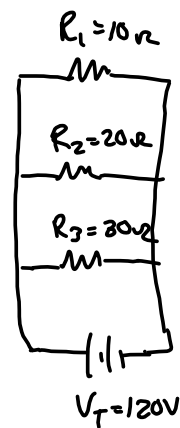
$$I_T = \sum I_i = 22A$$

$$I_i = \frac{V_i}{R_i} \quad I_1 = 12A$$

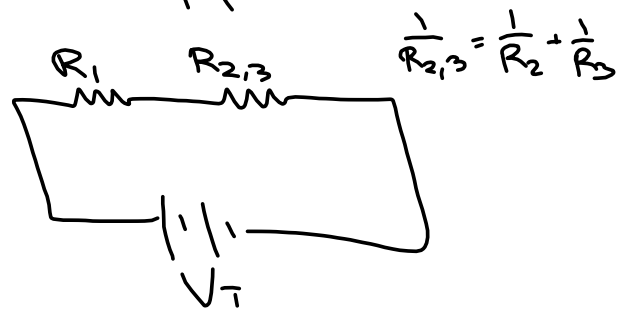
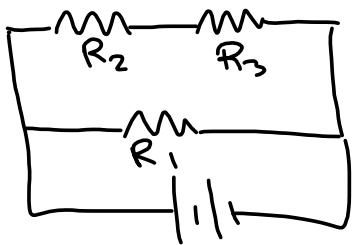
$$I_2 = 6A$$

$$I_3 = 4A$$

$$R_T = \frac{V_T}{I_T} = 5.45\Omega$$



Combination Circuits and Circuit Reduction



$$\frac{1}{R_{2,3}} = \frac{1}{R_2} + \frac{1}{R_3}$$