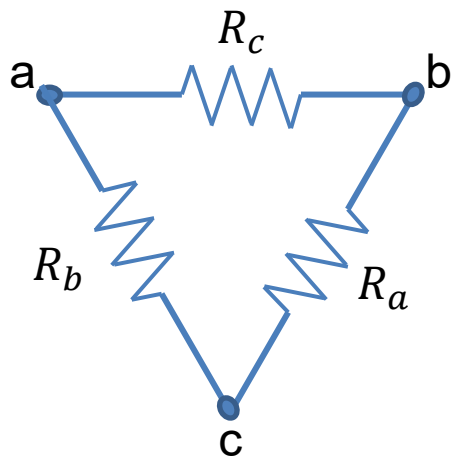
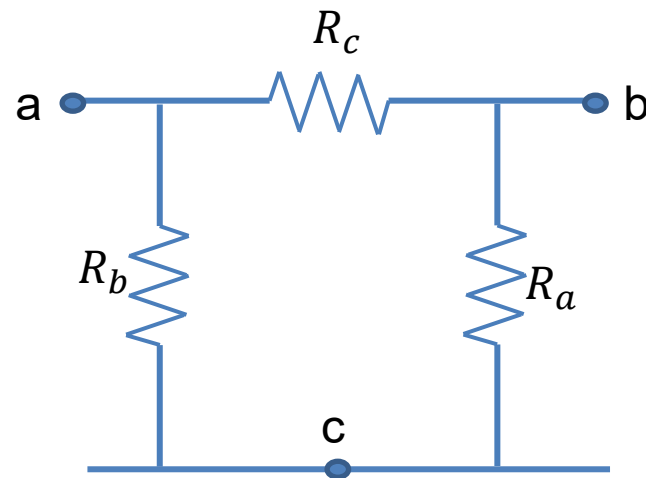


# $\Delta$ -Y ( $\Pi$ -T) Equivalent Circuits

Sometimes we encounter a triangular configuration of resistors. These cannot be simplified by series or parallel equivalents.



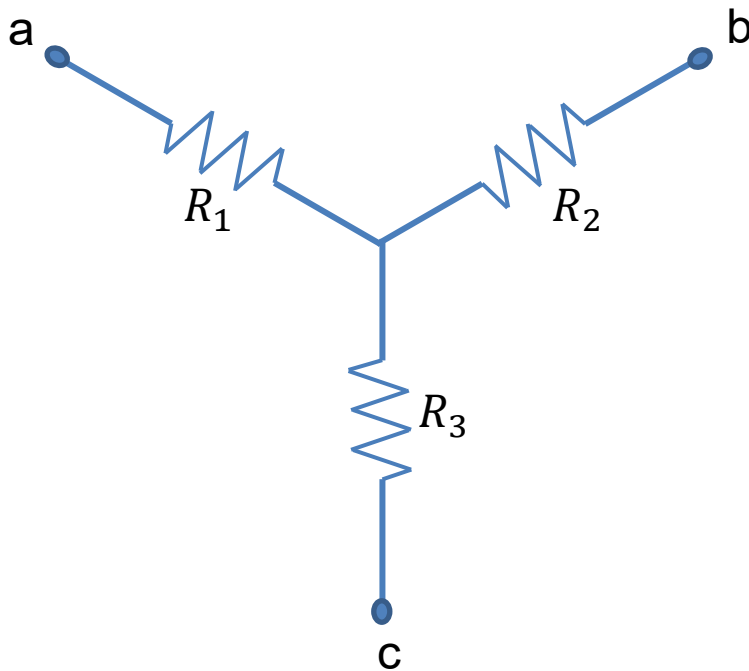
“Delta ( $\Delta$ )” configuration



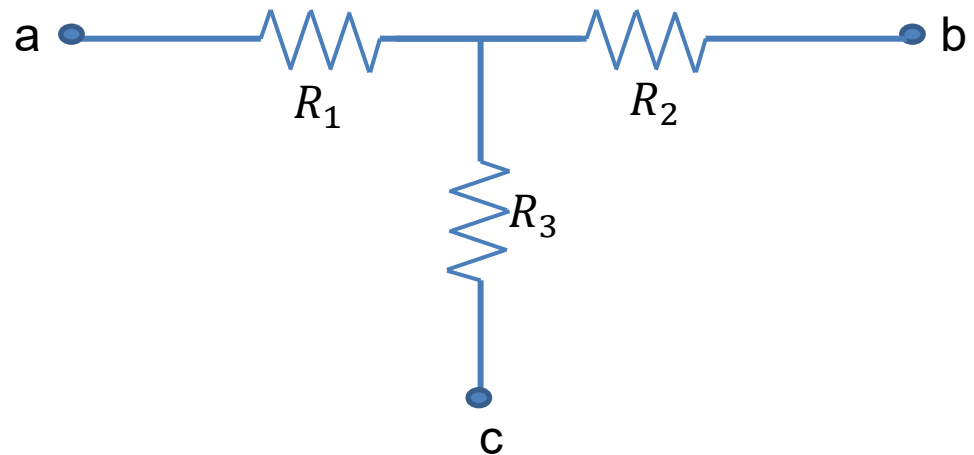
“Pi ( $\Pi$ )” configuration

# $\Delta$ -Y ( $\Pi$ -T) Equivalent Circuits

$\Delta/\Pi$  configurations can be transformed to a Y (or T) configuration. Sometimes by doing so, the resulting circuit can be further simplified.

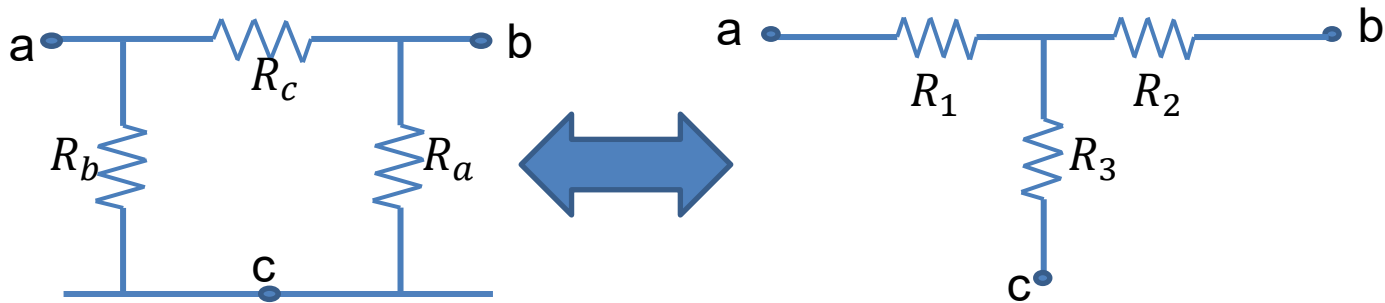


“Y” configuration



“T” configuration

# $\Delta$ -Y ( $\Pi$ -T) Equivalent Circuits



For the  $\Delta$  and Y configurations to be equivalent, the resistances between each pair of nodes must be equivalent.

	$\Delta$ -configuration	Y-configuration
$R_{ab}$	$\frac{R_c \cdot (R_a + R_b)}{R_a + R_b + R_c}$	$R_1 + R_2$
$R_{ac}$	$\frac{R_b \cdot (R_a + R_c)}{R_a + R_b + R_c}$	$R_1 + R_3$
$R_{bc}$	$\frac{R_a \cdot (R_b + R_c)}{R_a + R_b + R_c}$	$R_2 + R_3$

# $\Delta$ -Y ( $\Pi$ -T) Equivalent Circuits

With some straightforward algebra, we can solve for  $R_a$ ,  $R_b$ , and  $R_c$  in terms of  $R_1$ ,  $R_2$ , and  $R_3$  or vice-versa. The following relationships result.

$$R_1 = \frac{R_b \cdot R_c}{R_a + R_b + R_c}$$

$$R_2 = \frac{R_a \cdot R_c}{R_a + R_b + R_c}$$

$$R_3 = \frac{R_a \cdot R_b}{R_a + R_b + R_c}$$



These 3 equations allow us to replace a  $\Delta$  structure with an equivalent Y structure.

$$R_a = \frac{R_1 R_2 + R_2 R_3 + R_1 R_3}{R_1}$$

$$R_b = \frac{R_1 R_2 + R_2 R_3 + R_1 R_3}{R_2}$$

$$R_c = \frac{R_1 R_2 + R_2 R_3 + R_1 R_3}{R_3}$$



These 3 equations allow us to replace a Y structure with an equivalent  $\Delta$  structure.

See if you can derive these equations on your own...then put them on your “cheat sheet.”

# Example

Find the voltage  $V$  in the circuit shown.

