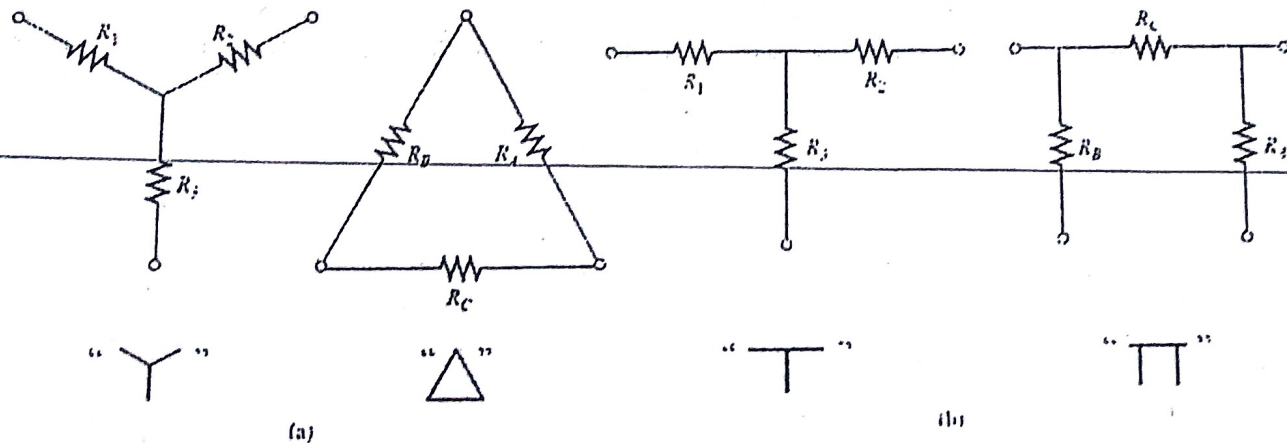
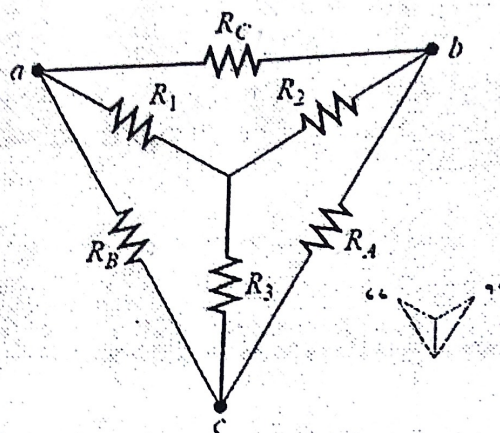


Y-D (T-p) and D-Y (p-T) Conversions

Circuit configurations are often encountered in which the resistors do not appear to be in series or parallel. Under these conditions, it may be necessary to convert the circuit from one form to another.





$\Delta \rightarrow Y$

$$R_1 = \frac{R_B R_C}{R_A + R_B + R_C}$$

$$R_2 = \frac{R_A R_C}{R_A + R_B + R_C}$$

$$R_3 = \frac{R_A R_B}{R_A + R_B + R_C}$$

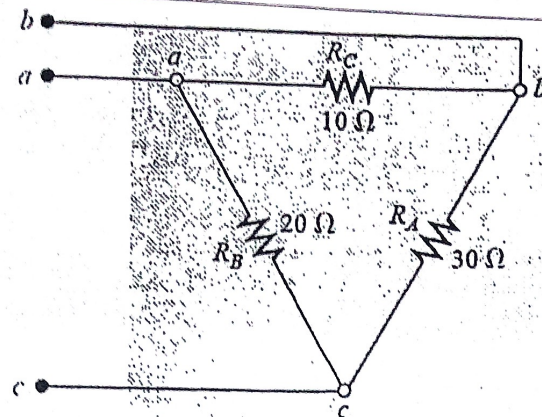
$Y \rightarrow \Delta$

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

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

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

EXAMPLE: Convert the Δ to a Y.

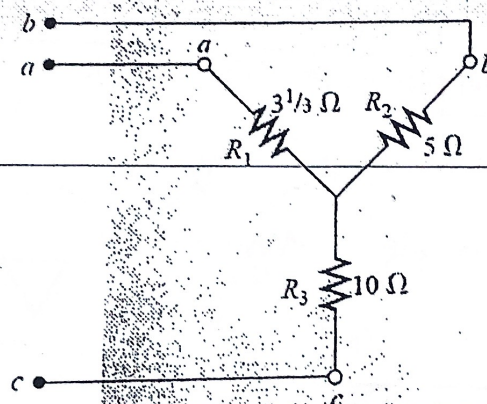


Solution:

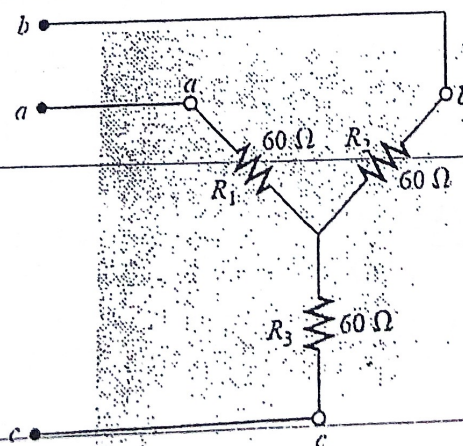
$$R_1 = \frac{R_B R_C}{R_A + R_B + R_C} = \frac{(20 \Omega)(10 \Omega)}{30 \Omega + 20 \Omega + 10 \Omega} = \frac{200 \Omega}{60} = 3\frac{1}{3} \Omega$$

$$R_2 = \frac{R_A R_C}{R_A + R_B + R_C} = \frac{(30 \Omega)(10 \Omega)}{60 \Omega} = \frac{300 \Omega}{60} = 5 \Omega$$

$$R_3 = \frac{R_A R_B}{R_A + R_B + R_C} = \frac{(20 \Omega)(30 \Omega)}{60 \Omega} = \frac{600 \Omega}{60} = 10 \Omega$$



EXAMPLE: Convert the Y to a Δ .



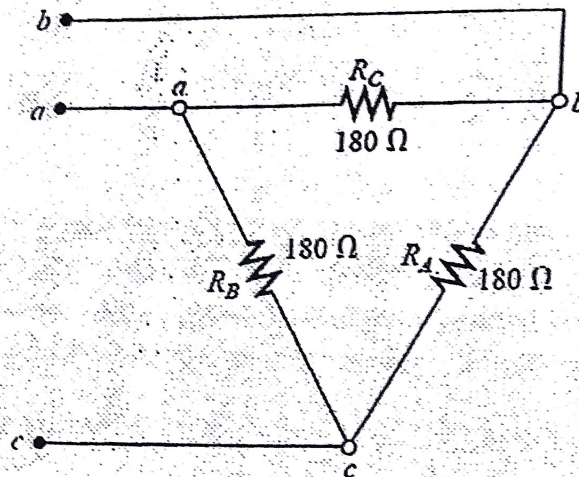
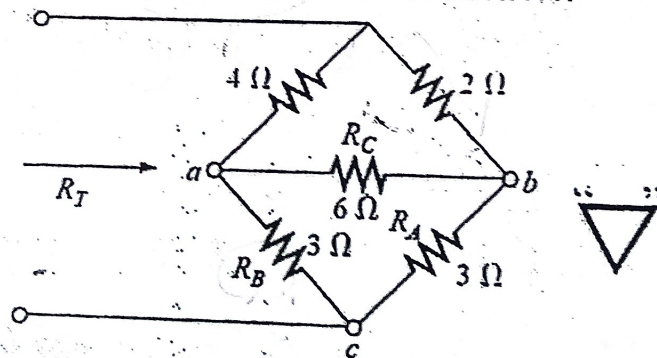
Solution:

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

$$= \frac{(60 \Omega)(60 \Omega) + (60 \Omega)(60 \Omega) + (60 \Omega)(60 \Omega)}{60 \Omega}$$

$$= \frac{3600 \Omega + 3600 \Omega + 3600 \Omega}{60} = \frac{10,800 \Omega}{60}$$

$$R_A = 180 \Omega$$

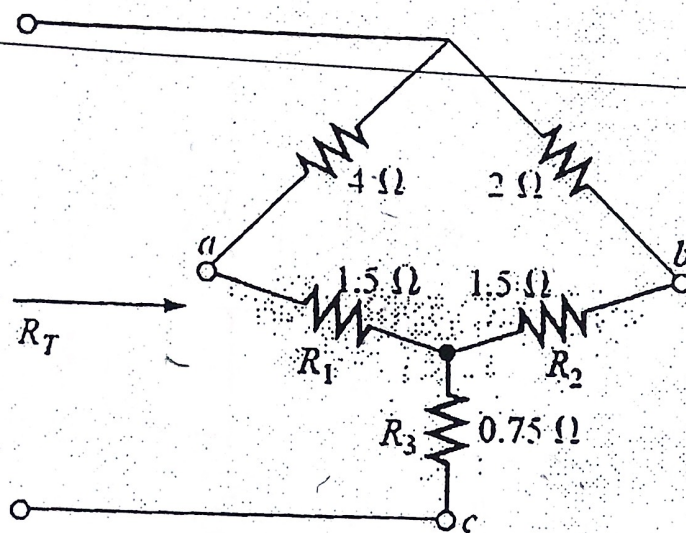
**EXAMPLE:** Find the total resistance of the network**Solution:**

Two resistors of the Δ were equal:
therefore, two resistors of the Y will
be equal.

$$R_1 = \frac{R_B R_C}{R_A + R_B + R_C} = \frac{(3 \Omega)(6 \Omega)}{3 \Omega + 3 \Omega + 6 \Omega} = \frac{18 \Omega}{12} = 1.5 \Omega \leftarrow$$

$$R_2 = \frac{R_A R_C}{R_A + R_B + R_C} = \frac{(3 \Omega)(6 \Omega)}{12 \Omega} = \frac{18 \Omega}{12} = 1.5 \Omega \leftarrow$$

$$R_3 = \frac{R_A R_B}{R_A + R_B + R_C} = \frac{(3 \Omega)(3 \Omega)}{12 \Omega} = \frac{9 \Omega}{12} = 0.75 \Omega$$



$$R_T = 0.75\ \Omega + \frac{(4\ \Omega + 1.5\ \Omega)(2\ \Omega + 1.5\ \Omega)}{(4\ \Omega + 1.5\ \Omega) + (2\ \Omega + 1.5\ \Omega)}$$

$$= 0.75\ \Omega + \frac{(5.5\ \Omega)(3.5\ \Omega)}{5.5\ \Omega + 3.5\ \Omega}$$

$$= 0.75\ \Omega + 2.139\ \Omega$$

$$\underline{R_T = 2.889\ \Omega}$$