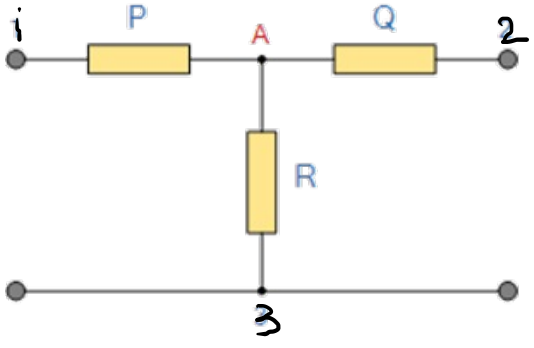
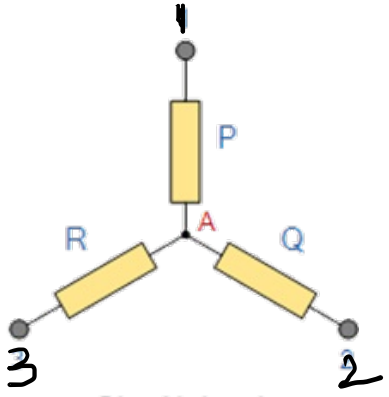
Star - Delta Network

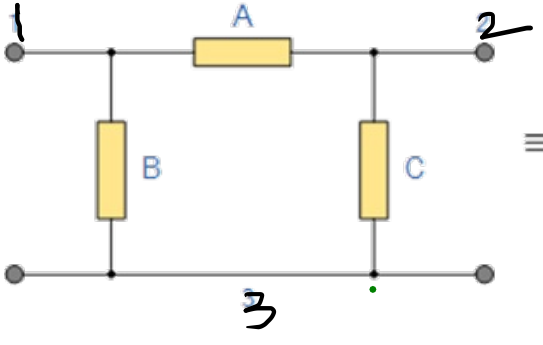


T-Network



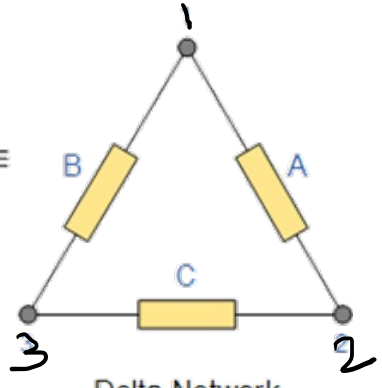
Star-Network

A resistive network consisting of three impedances can be connected together to form a T or "Tee" Star or Y type network.



Pi-Network

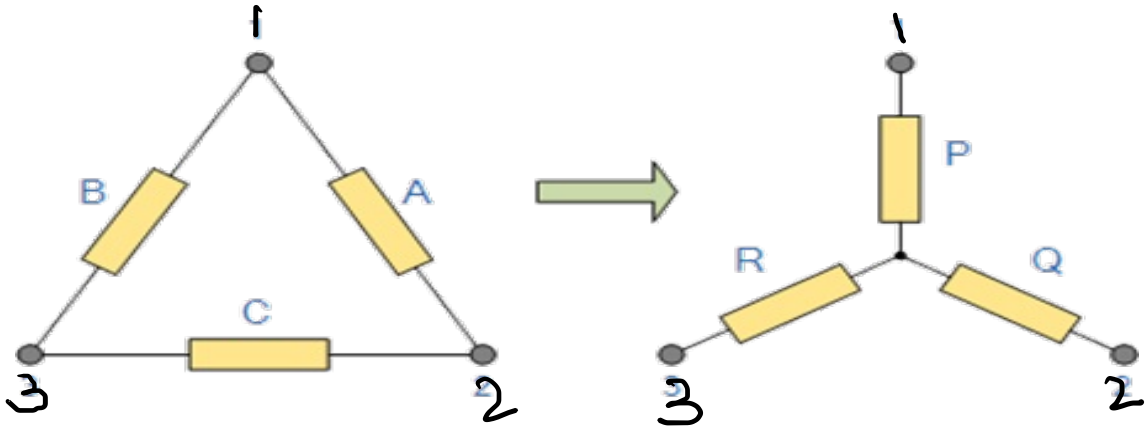
≡



Delta-Network

Pi or π type resistor network or Delta or Δ type network

Delta- Star Transformation



Resistances between terminals 1 and 2.

$$A||(B+C) = P+Q$$

$$\frac{A(B+C)}{A+B+C} = P+Q \quad \text{----(I)}$$

Resistances between terminals 2 and 3.

$$C||(A+B) = Q+R$$

$$\frac{C(A+B)}{A+B+C} = Q+R \quad \text{----(II)}$$

Resistances between terminals 3 and 1.

$$B||(A+C) = P+R$$

$$\frac{B(A+C)}{A+B+C} = P+R \quad \text{----(III)}$$

Delta- Star Transformation

$A \| (B+C) = P+Q$

$\frac{A(B+C)}{A+B+C} = P+Q \quad ----(I)$

$C \| (A+B) = Q+R$ --

$\frac{C(A+B)}{A+B+C} = Q+R \quad ----(II)$

$B \| (A+C) = P+R$

$\frac{B(A+C)}{A+B+C} = P+R \quad ----(III)$

Adding (I) & (II) & substract (III)

eqn (I) + eqn (II) − eqn (III)

$\frac{AB+AC+AC+BC-AB-BC}{A+B+C} = P+Q+Q+R-P-R$

$\frac{2AC}{A+B+C} = 2Q$

$Q = \frac{AC}{A+B+C}$

eqn (I) + eqn (III) − eqn (II)

$\frac{AB+AC+AB+BC-AC-BC}{A+B+C} = P+Q+P+R-Q-R$

$\frac{2AB}{A+B+C} = 2P \quad \therefore P = \frac{AB}{A+B+C}$

similarly $R = \frac{BC}{A+B+C}$

Star-delta Transformation

$$P = \frac{AB}{A+B+C}$$

$$Q = \frac{AC}{A+B+C}$$

$$R = \frac{BC}{A+B+C}$$

$$PQ + QR + PR$$

$$PQ = \frac{A^2BC}{(A+B+C)^2} \qquad QR = \frac{ABC^2}{(A+B+C)^2} \qquad PR = \frac{AB^2C}{(A+B+C)^2}$$

$$PQ+QR+PR = \frac{A^2BC + ABC^2 + AB^2C}{(A+B+C)^2} = \frac{ABC(A+B+C)}{(A+B+C)^2}$$

$$PQ+QR+PR = \frac{ABC}{(A+B+C)}$$

$$\frac{PQ+QR+PR}{P} = \frac{ABC}{(A+B+C)} \times \frac{(A+B+C)}{AB} = C$$

$$C = \frac{PQ+QR+PR}{P}$$

Star-delta Transformation

$$P = \frac{AB}{A+B+C}$$

$$Q = \frac{AC}{A+B+C}$$

$$R = \frac{BC}{A+B+C}$$

$$PQ + QR + PR$$

$$PQ = \frac{A^2BC}{(A+B+C)^2} \qquad QR = \frac{ABC^2}{(A+B+C)^2} \qquad PR = \frac{AB^2C}{(A+B+C)^2}$$

$$PQ+QR+PR = \frac{A^2BC + ABC^2 + AB^2C}{(A+B+C)^2} = \frac{ABC(A+B+C)}{(A+B+C)^2}$$

$$PQ+QR+PR = \frac{ABC}{(A+B+C)}$$

$$\frac{PQ+QR+PR}{Q} = \frac{ABC}{(A+B+C)} \times \frac{(A+B+C)}{AC}$$

$$B = \frac{PQ+QR+PR}{Q}$$

Star-delta Transformation

$$P = \frac{AB}{A+B+C}$$

$$Q = \frac{AC}{A+B+C}$$

$$R = \frac{BC}{A+B+C}$$

$$PQ + QR + PR$$

$$PQ = \frac{A^2BC}{(A+B+C)^2} \qquad QR = \frac{ABC^2}{(A+B+C)^2} \qquad PR = \frac{AB^2C}{(A+B+C)^2}$$

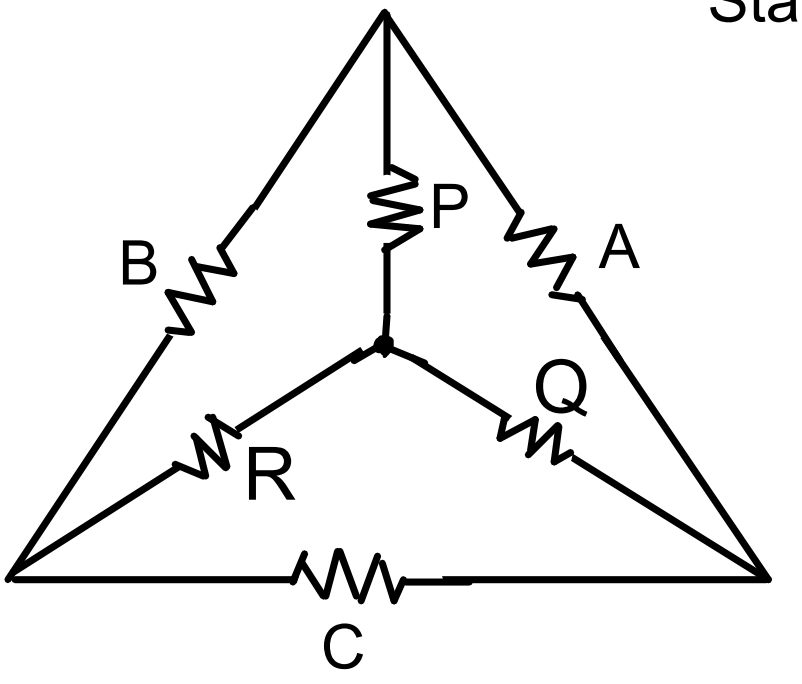
$$PQ+QR+PR = \frac{A^2BC + ABC^2 + AB^2C}{(A+B+C)^2} = \frac{ABC(A+B+C)}{(A+B+C)^2}$$

$$PQ+QR+PR = \frac{ABC}{(A+B+C)}$$

$$\frac{PQ+QR+PR}{R} = \frac{ABC}{(A+B+C)} \times \frac{(A+B+C)}{BC}$$

$$A = \frac{PQ+QR+PR}{R}$$

Star-Delta Transformation



Delta - Star

$$P = \frac{AB}{A+B+C}, \quad Q = \frac{AC}{A+B+C}$$

$$R = \frac{BC}{A+B+C}$$

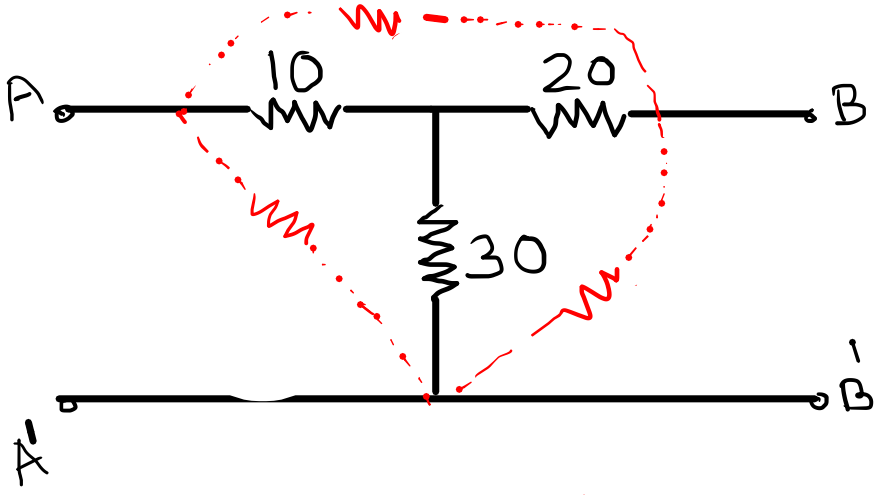
Star - Delta

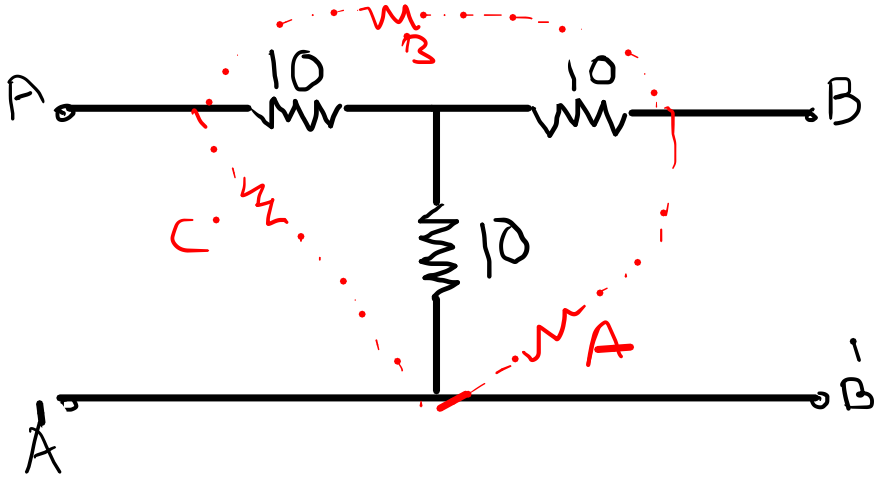
$$A = \frac{PQ+QR+PR}{R}$$

$$B = \frac{PQ+QR+PR}{Q}$$

$$C = \frac{PQ+QR+PR}{P}$$

Example:1 Convert following star networks into equivalent delta network





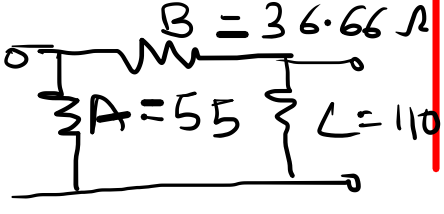
$PQ+QR+PR = 10\times20+20\times30+30\times10$

$PQ+QR+PR = 200+600+300 = 1100$

$A = \frac{1100}{2\phi} = 55\,\Omega$

$B = \frac{1100}{3\phi} = \frac{110}{3} = 36.66\,\Omega$

$C = \frac{1100}{10} = 110\,\Omega$

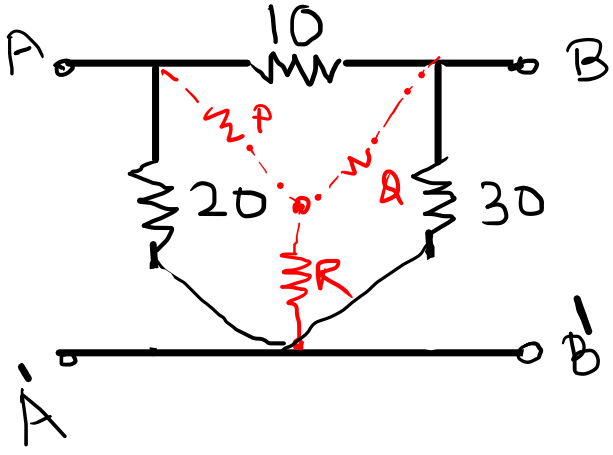


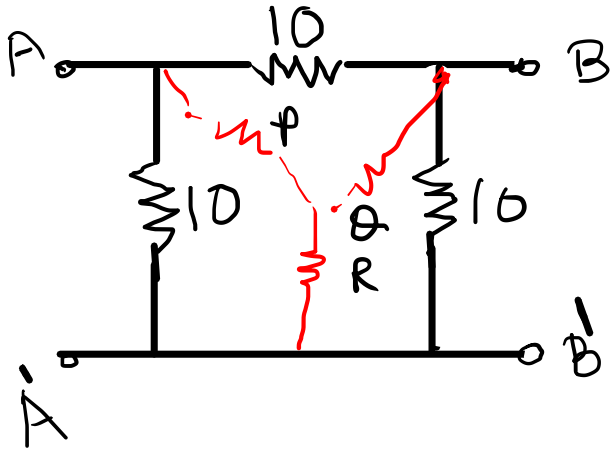
$A = \frac{10\times10+10\times10+10\times10}{10}$

$A = \frac{300}{10} = 30\,\Omega$

$A = B = C = 30\,\Omega$

Example:2 Convert following delta networks into equivalent star network





$$P = \frac{10 \times 20}{10+20+30} = \frac{20\Omega}{6} = \frac{20}{6}\Omega$$

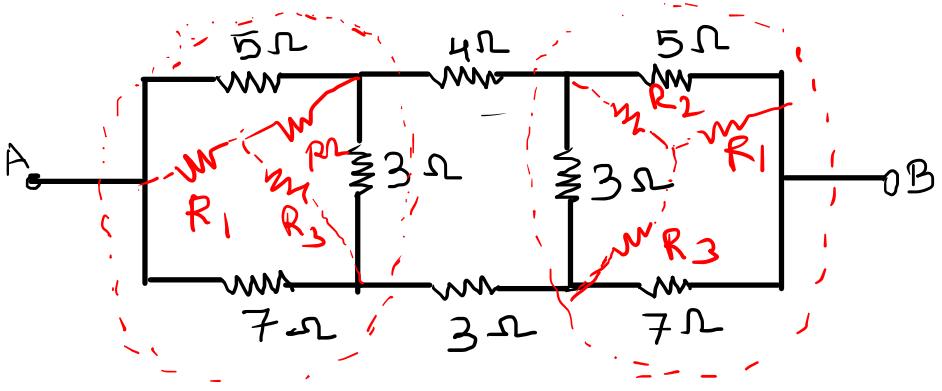
$$Q = \frac{10 \times 30}{10+20+30} = \frac{300}{60} = 5\Omega$$

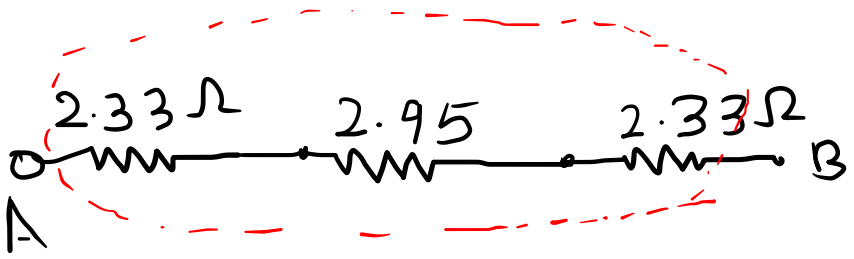
$$R = \frac{20 \times 30}{10+20+30} = \frac{600}{60} = 10\Omega$$

$$P = Q = R = \frac{10 \times 10}{10+10+0} = \frac{100}{30}$$

$$= 3.33\Omega$$

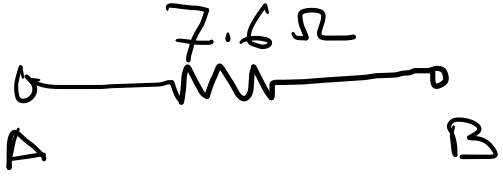
Example 3: Find the equivalent resistance between terminal A and B

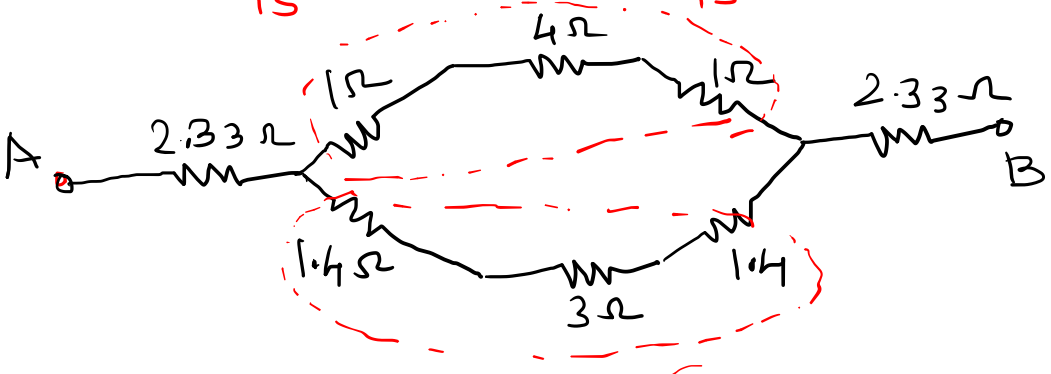


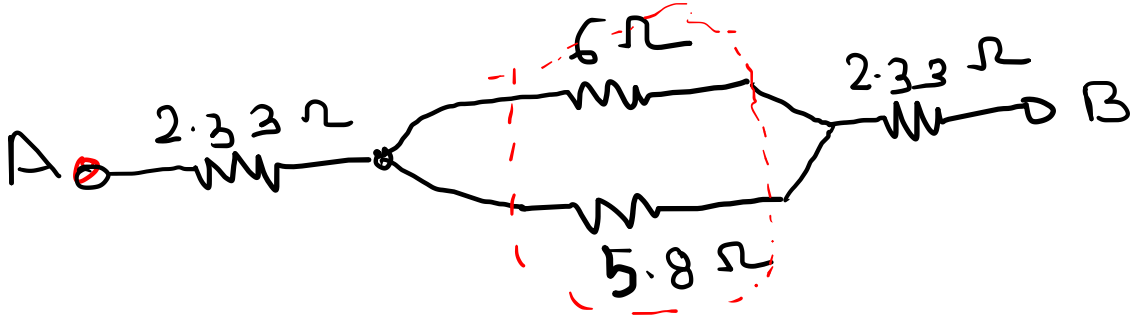


$$R_1 = \frac{5 \times 7}{5+3+7} = \frac{35}{15} = 2.33$$

$$R_2 = \frac{5 \times 3}{15} = 1 \quad \& \quad R_3 = \frac{3 \times 7}{15} = 1.4\Omega$$







Example 4: Find the equivalent resistance between terminal A and B