Basic Electrical Technology

LECTURE 3 – 27 OCTOBER 2021

- NETWORK REDUCTION

Illustration 1

Two incandescent bulbs have the following ratings:

Bulb-1: 120 V, 60 W; **Bulb-2:** 240 V, 480 W

a) Both of them are connected in series across a voltage source.
   i. Which bulb will glow brighter and why?
   ii. What is the maximum voltage that can be applied so that none of the bulbs fuse?

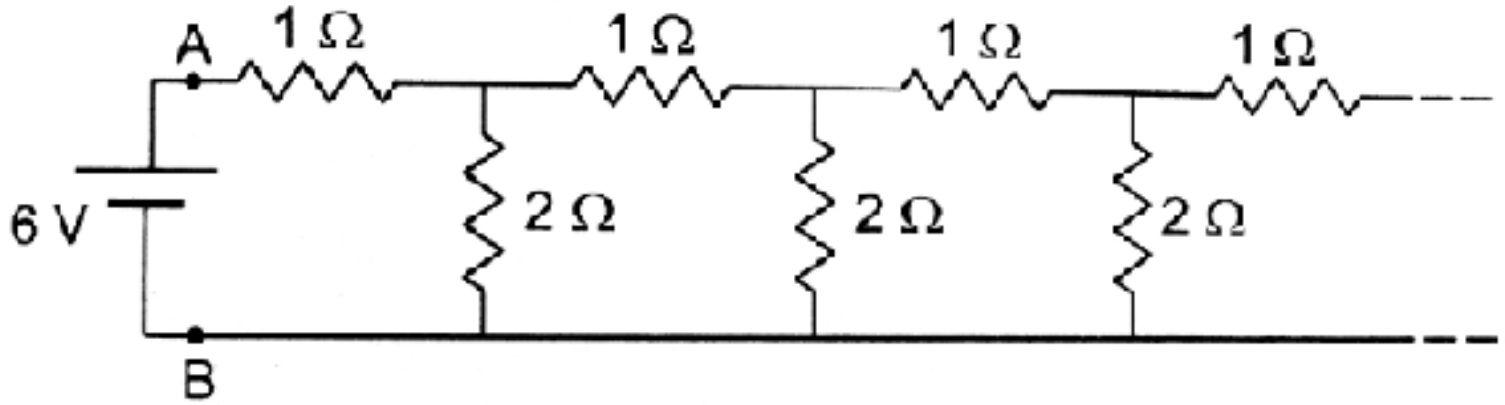
b) Now both of them are connected in parallel across a voltage source.
   i. Which bulb will glow brighter and why?
   ii. What is the maximum voltage that can be applied so that none of the bulbs fuse?

Assume that the incandescent bulbs are purely resistive.

Ans: (a) – (i) Bulb 1 will glow brighter as P1 > P2, (ii) Max. voltage = 180 V
(b) – (i) Bulb 2 will glow brighter as P2 > P1, (ii) Max. voltage = 120 V

Illustration 2

What is the equivalent resistance across the terminals A & B in the network shown?



Ans: 2 Ohms

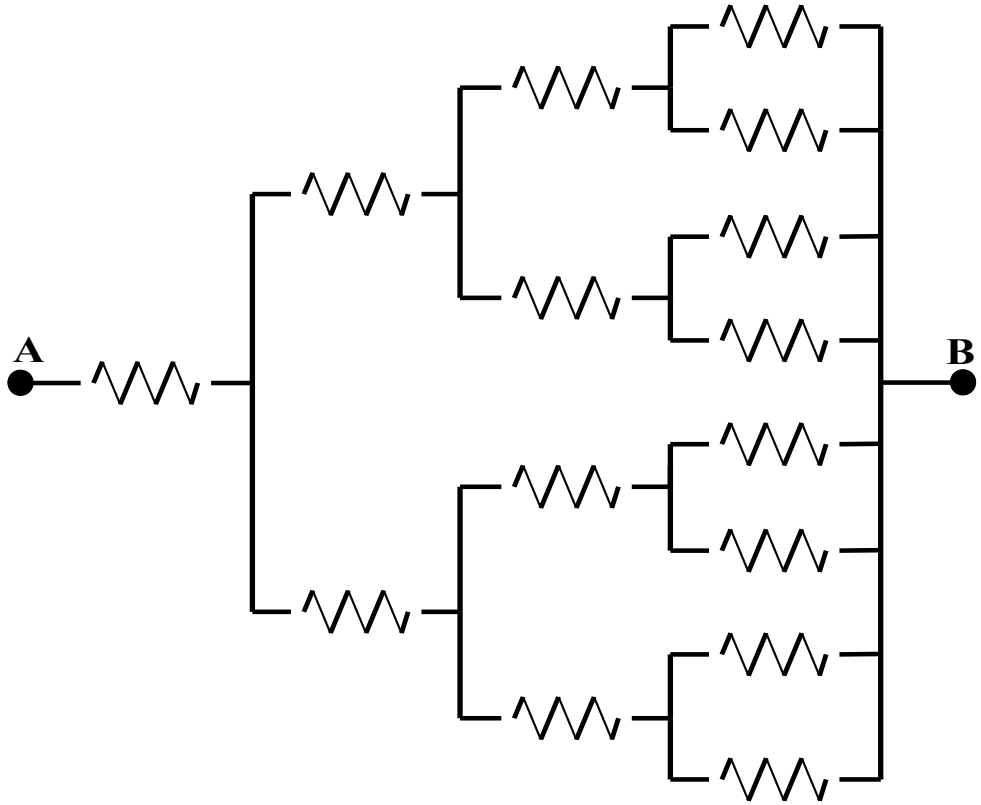
Illustration 3

15 resistors are connected as shown in the diagram. Each of the resistors has resistance 1 Ω.

a) Find the equivalent resistance of the network between A & B.

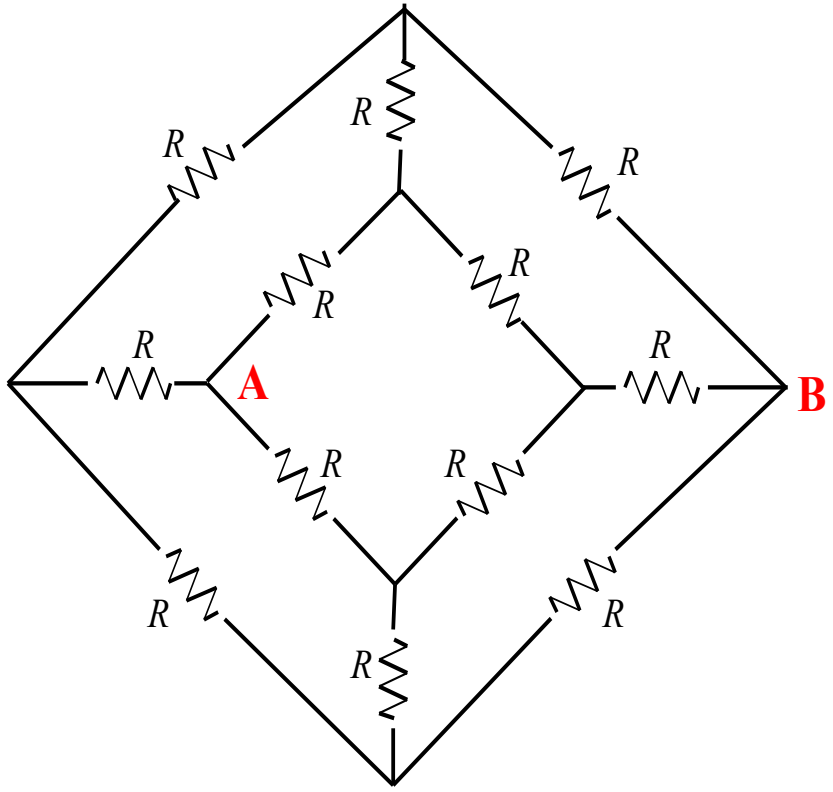
b) What will be the equivalent resistance of this network if the resistors arranged in the sequence extends to infinity?

Ans: (a) 1.875 Ohms, and (b) 2 Ohms



Home Work 1

Reduce the network to its equivalent resistance between terminals A and B

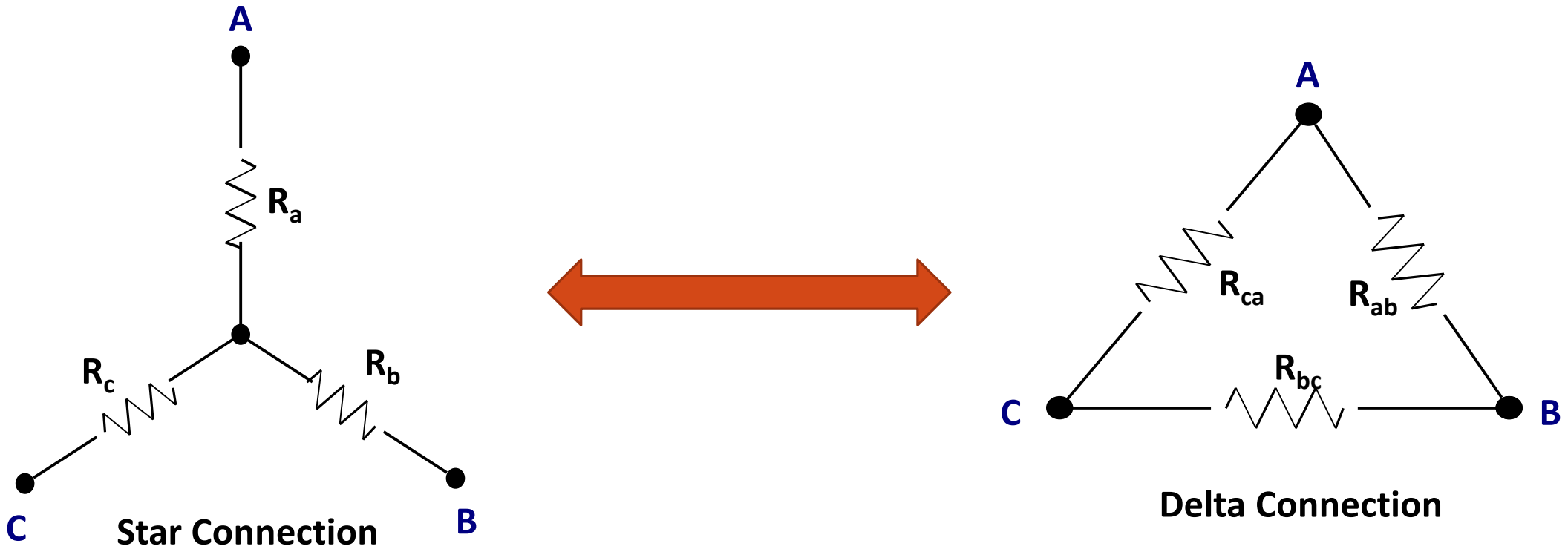


Ans: 5R/6

Star - Delta Transformation

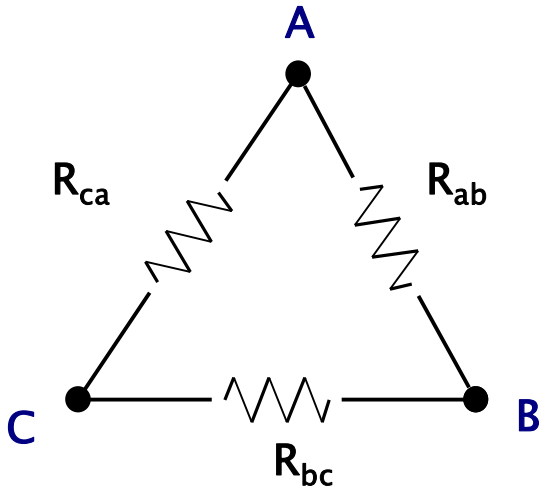
NETWORK REDUCTION TECHNIQUE

Star & Delta Connections



Link for the formula derivation:
https://nptel.ac.in/content/storage2/courses/108105053/pdf/L-06(GDR)(ET)%20((EE)NPTEL).pdf

Delta - Star Transformation

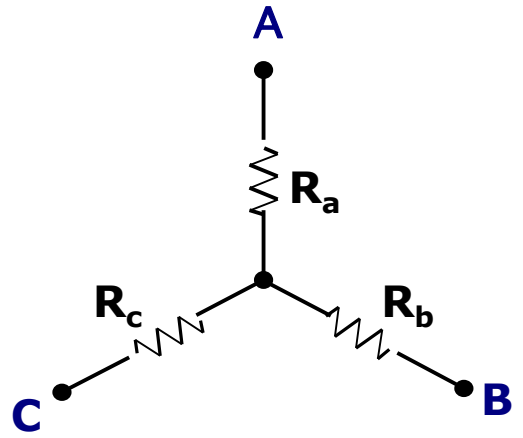


Delta to Star Transformation

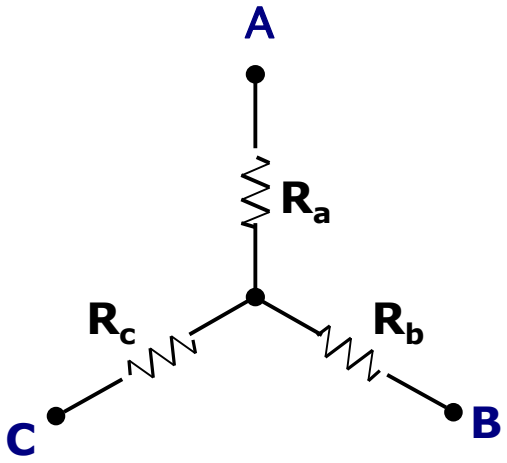
$$R_a = \frac{R_{ab}\,R_{ca}}{R_{ab}+R_{bc}+R_{ca}} = \frac{R_{ab}\,R_{ca}}{\sum R_\Delta}$$

$$R_b = \frac{R_{bc}\,R_{ab}}{R_{ab}+R_{bc}+R_{ca}} = \frac{R_{bc}\,R_{ab}}{\sum R_\Delta}$$

$$R_c = \frac{R_{ca}\,R_{bc}}{R_{ab}+R_{bc}+R_{ca}} = \frac{R_{ca}\,R_{bc}}{\sum R_\Delta}$$



Star - Delta Transformation



Star to Delta Transformation

$$R_{ab} = \frac{R_aR_b + R_bR_c + R_cR_a}{R_c} = R_a + R_b + \frac{R_aR_b}{R_c}$$

$$R_{bc} = \frac{R_aR_b + R_bR_c + R_cR_a}{R_a} = R_b + R_c + \frac{R_bR_c}{R_a}$$

$$R_{ca} = \frac{R_aR_b + R_bR_c + R_cR_a}{R_b} = R_c + R_a + \frac{R_aR_c}{R_b}$$

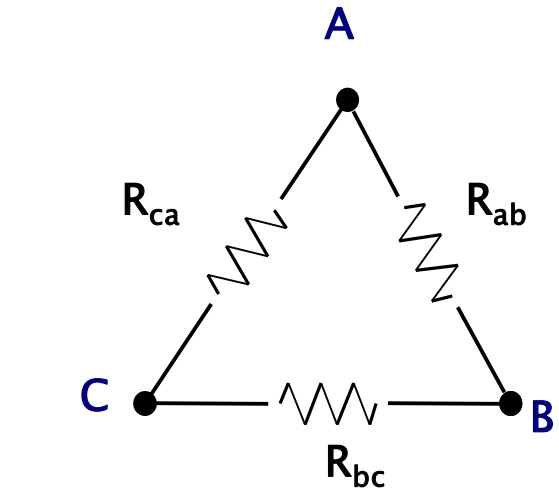
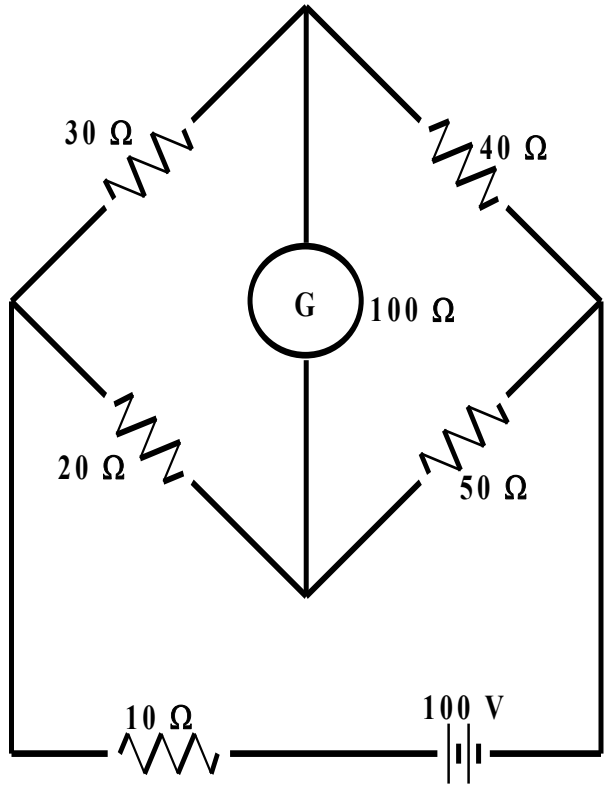


Illustration 4

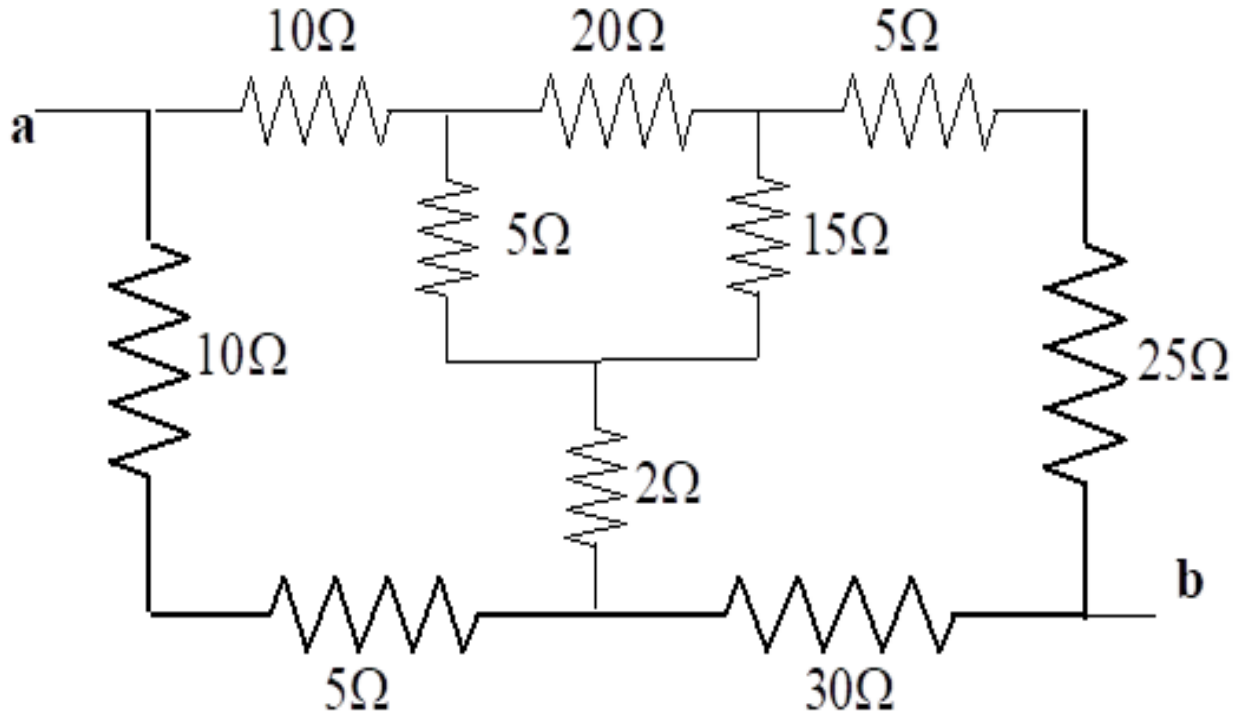
For the circuit shown, determine the total power supplied by the source using star-delta transformation



Ans: $P_{supplied}$ = 223.1608 W

Illustration 5

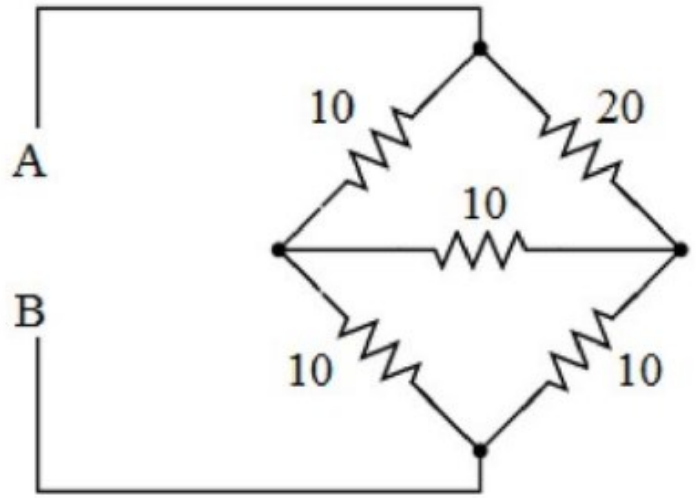
Determine the resistance between terminals a & b of the network shown in figure, using Star-Delta transformation.



Ans: 23.518 Ω

Homework 2

Find R_{AB}



Ans: 11.818 Ohms