UNIT 2 : NETWORK REUDCTION AND NETWORK THEOREMS FOR DC AND

1. **State Thevenin's theorem.**
Thevenin's theorem states that any two terminal linear network having a number of voltage sources, current sources and resistances can be replaced by a simple equivalent circuit consisting of a single voltage source in series with a resistance.

2. **State Norton's theorem.**
Norton's theorem states that any two terminal linear network with current sources, voltage sources and resistances can be replaced by an equivalent circuit consisting of a current source in parallel with a resistance.

3. **State superposition theorem.**
Superposition theorem states that in any linear network containing two or more sources, the response in any element is equal to the algebraic sum of the responses caused by individual sources acting alone, while the other sources are non operative.

4. **State maximum power transfer theorem.**
The maximum power transfer theorem states that maximum power is delivered from a source to a load when the load resistance is equal to the source resistance.

$$R_S = R_L$$

5. **State compensation theorem.**
The compensation theorem states that any element in the linear, bilateral network, may be replaced by a voltage source of magnitude equal to the current passing through the element multiplied by the value of the element, provided currents and voltages in other parts of the circuit remain unaltered.

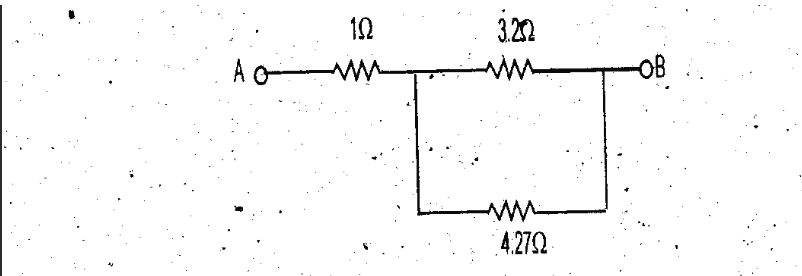
6. **State Reciprocity theorem.**
Reciprocity theorem states that if an input is applied to a circuit, the ratio of response (output) in any element to the input is constant, even when the position of input and output are interchanged.

7. **List the applications of Thevenin's theorem.**
The applications of Thevenin's theorem are :
    1. It is applied to all linear circuits, including electronic circuits represented by the controlled sources.
    2. This theorem is useful when it is desired to know the effect of the response in network or varying part of the network.

8. **Where and why maximum power transfer theorem is applied?**
   Maximum power transfer theorem is used in systems where maximum power is transfer is needed. For example, in communication circuits power involved is sufficiently small. In some situations to match source impedance with load impedance.

9.**Explain the purpose of Star-delta transformation?**
The transformation of a given set of resistance in star to delta or vice versa proves extremely useful in. circuit analysis and the apparent complexity of a given circuit can sometime be very much reduced.

10.In the figure determine the equivalent resistance by using star delta transformation

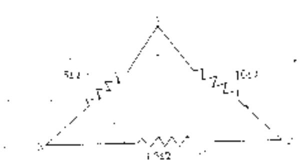


Ans: $\frac{3.2 \times 4.277}{3.2 + 4.277} = 1.83\Omega$

$R_{req} = 1 + 1.83$

$= 2.83\Omega.$

11.Convert given delta into equivalent star.

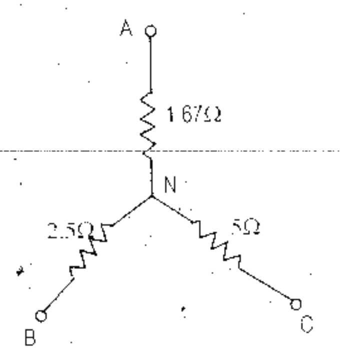


Ans: The equivalent star is given by

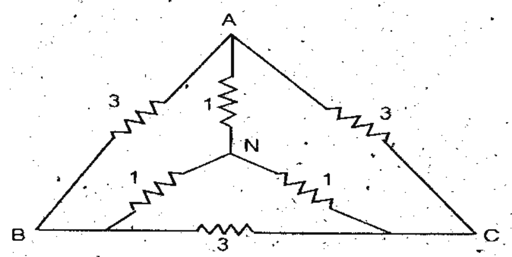
$R_1 = \frac{10 \times 5}{5 + 10 + 15} = 1.67\Omega$

$R_2 = \frac{15 \times 10}{5 + 10 + 15} = 5\Omega$

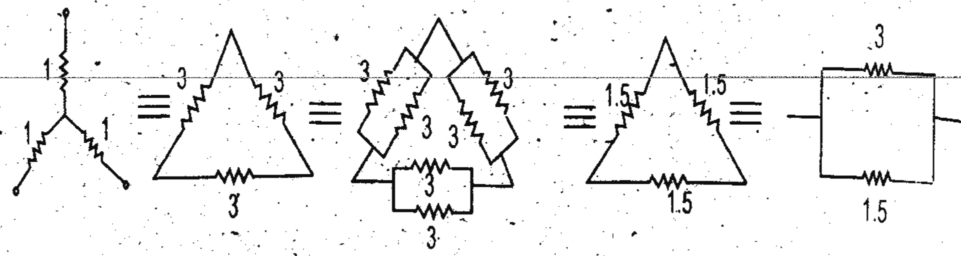
$R_3 = \frac{5 \times 15}{5 + 10 + 15} = 2.5\Omega$



11.For the network shown find the equivalent resistance between terminals B and C



Ans:



The resistance between B and C is

$$R_{BC} = \frac{3\times1.5}{3+1.5} = 1\Omega.$$

12. **What is Star and. Delta connection?**

One end of each resistance is connected at a point called star point and the other. three terminals are connected to A, B, C. Thi s is called **star connection**
When three resistances are connected end to en d to form delta shape it is called **delta connection.**

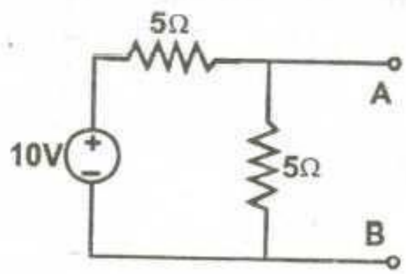
13. What is the condition for maximum power transfe r in DC and AC circuits?

Condition for maximum power transfer for DC circuit $P_{max} = V^2_{th} /4 R_L$
Condition for maximum power transfer for AC circuit $P_{max} = V^2_{th} /4 Z_L$
Where $Z_L = Z_{th}^*$

14. Superposition theorem is applicable only to ……… .. networks
Answer: Linear

15.……….**theorem is useful when the current in a one branch of a network is to be determined for different values of the branch resistance.**
Answer:Thevenin's

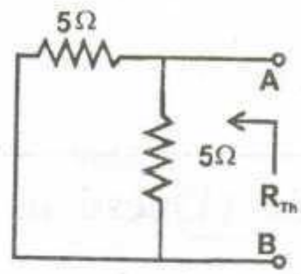
16. **Find the thevenins equivalent for the circuit shown in fig.**

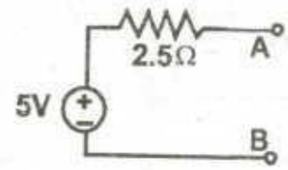


Solution

Fig. 2.367

$$R_{Th} = 5||5$$
$$= 2.5\Omega$$
$$V_{Th} = \frac{10}{(5+5)}(5V) = 5\text{ V}$$





17. Find the value of R_L for maximum power transfer.

To find R_L maximum power transfer we have to find R_{Th}

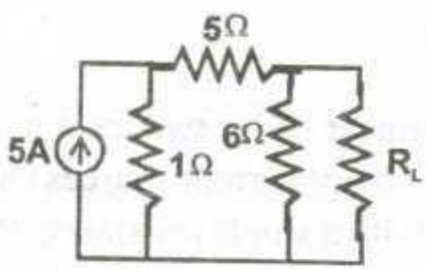


Fig.2.370

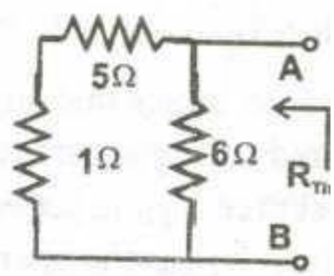
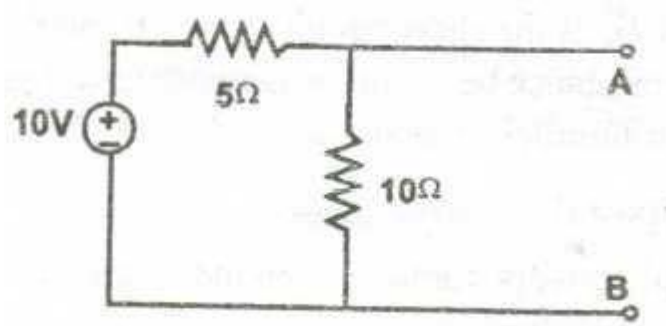


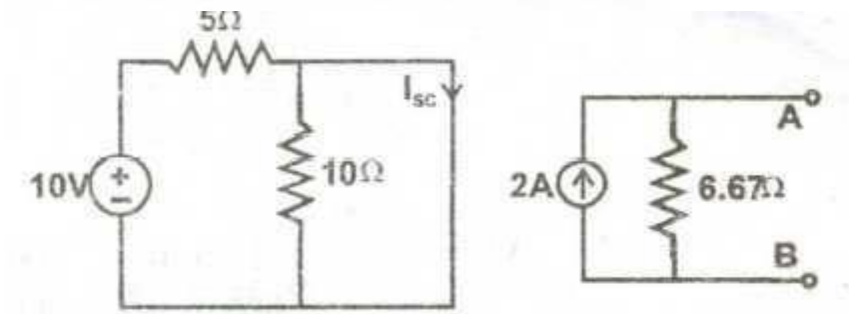
Fig.2.371

$$R_{Th} = 6||6 = 3\Omega$$

Therefore $R_L = 3\Omega$

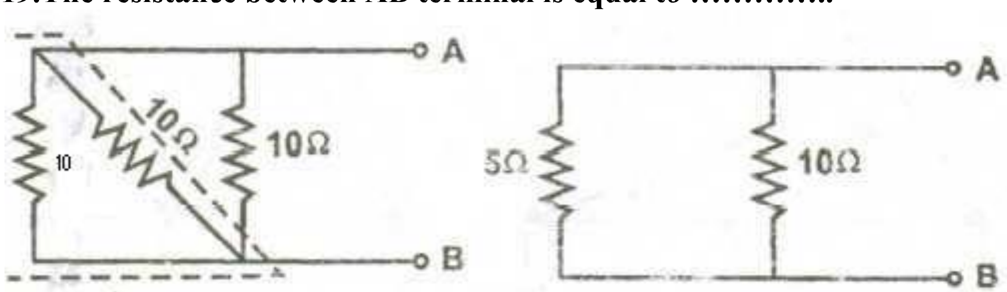
18.Find the Nortons equivalent of the circuit shown in fig.





To find I_{sc} short AB , I_{sc} = 10 /5 =2A , R_{th} = (5x10)/(5+10)= 6.67ohms

19.The resistance between AB terminal is equal to …………..



R_{eq} = (10 x10)/(10+10) =5 ohms

R_{AB} = (5X10)/(5+10) = 3.33 ohms

20. The resistance between the terminal AB is 30ohm s, the value of R is…….

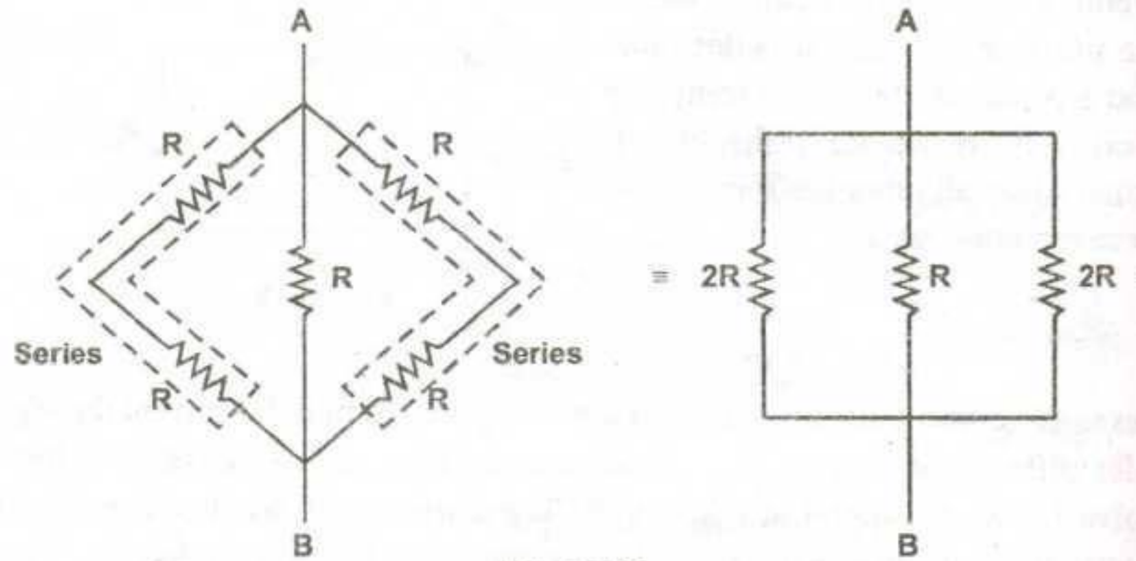


Fig. 2.378

$$\frac{1}{R_{eq}} = \frac{1}{2R} + \frac{1}{R} + \frac{1}{2R} = \frac{4}{2R} = \frac{2}{R}$$

$$\frac{1}{30} = \frac{2}{R} \qquad (\because \; R_{eq} = 30\Omega)$$

$$\boxed{R = 60\Omega}$$

21.Find the resistance between the points A and B for the circuit shown in fig.

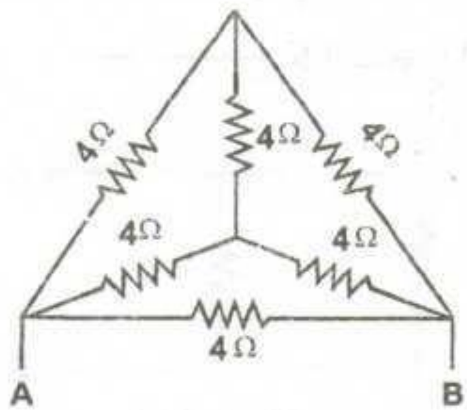


Fig.2.379

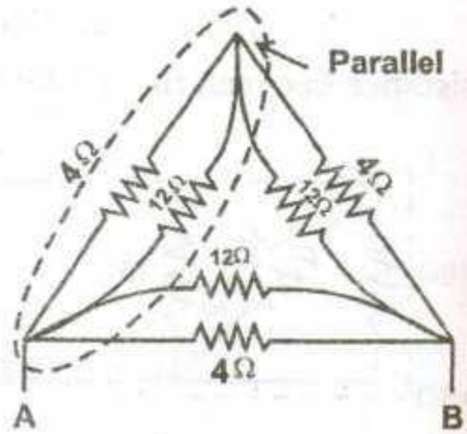


Fig.2.380

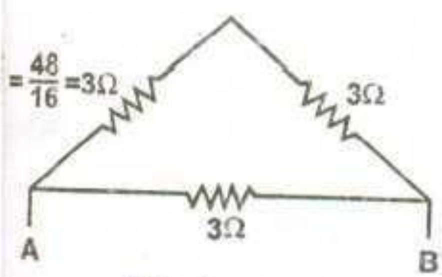
$$\frac{4 \times 12}{4 + 12} = \frac{48}{16} = 3$$

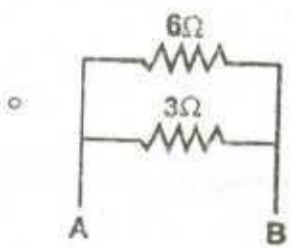
$$R_{AB} = R_A + R_B + \frac{R_A R_B}{R_C}$$

$$R_A = R_B = R_C = R$$

$$R_{AB} = 3R$$

$$= 3 \times 4 = 12$$





$$\equiv \frac{6 \times 3}{6 + 3} = \frac{18}{9} = 2\Omega$$