1.1. Derivation from Y – Δ / Δ – Y

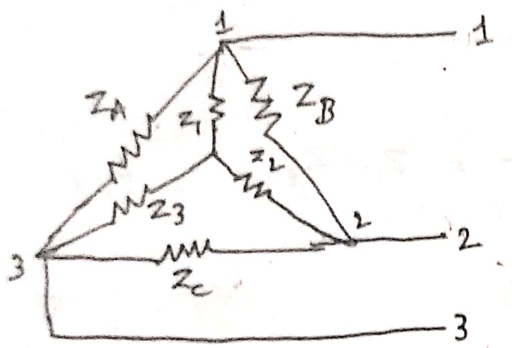
Obtain expressions for a set of equivalent

i) Δ Connected impedances to replace a set of Y Connected impedances

ii) Y Connected impedances to replace a set of Δ Connected impedances.

(This derivation is frequently asked in the exam)

i) Delta – star or Π to T transformation



Consider three impedances Z_A, Z_B, Z_c Connected in delta as shown in figure. The terminals between which these are connected in delta are named as 1, 2, 3.

Now it is possible to replace these delta (Π) impedances by three equivalent star or T connected impedances Z_1, Z_2, Z_3 between the same terminals 1, 2 & 3.

Between terminals 1 and 2 (3 open) impedance is given by parallel combination of $(Z_A + Z_c)$ & Z_B

$$Z_{12} = \frac{Z_B(Z_A+Z_c)}{Z_B+(Z_A+Z_c)} \qquad -(1)$$

For the same two terminals of equivalent star connection

$$Z_{12} = Z_1 + Z_2 \qquad -(2)$$

Now to have this star connection equivalent to Δ connection,

$$\frac{Z_B(Z_A+Z_C)}{Z_A+Z_B+Z_C} = Z_1+Z_2 \qquad -(3)$$

Similarly between terminals 2 & 3 (1 open)

$$\frac{Z_C(Z_A+Z_B)}{Z_A+Z_B+Z_C} = Z_2+Z_3 \qquad -(4)$$

Similarly between terminals 1 & 3 (2 open)

$$\frac{Z_A(Z_B+Z_C)}{Z_A+Z_B+Z_C} = Z_1+Z_3 \qquad -(5)$$

Eq (3) - Eq (4) gives

$$\frac{Z_AZ_B+\cancel{Z_BZ_C}-Z_AZ_C-\cancel{Z_BZ_C}}{Z_A+Z_B+Z_C} = Z_1-Z_3$$

$$\frac{Z_AZ_B-Z_AZ_C}{Z_A+Z_B+Z_C} = Z_1-Z_3 \qquad -(6)$$

Eq (5) + Eq (6) gives

$$\frac{Z_AZ_B+\cancel{Z_AZ_C}+Z_AZ_B-\cancel{Z_AZ_C}}{Z_A+Z_B+Z_C} = 2Z_1$$

$$\frac{2Z_AZ_B}{Z_A+Z_B+Z_C} = 2Z_1$$

$$\boxed{Z_1 = \frac{Z_AZ_B}{Z_A+Z_B+Z_C}}$$

Similarly we get $\boxed{Z_2 = \frac{Z_BZ_C}{Z_A+Z_B+Z_C}}$

$$\boxed{Z_3 = \frac{Z_AZ_C}{Z_A+Z_B+Z_C}}$$

ii) Star-Delta or T-π transformation (The same figure has to be written with explanation)

From the result of Δ-Y, we know that

$$Z_1 = \frac{Z_A Z_B}{Z_A+Z_B+Z_C} \quad -(1)$$

$$Z_2 = \frac{Z_B Z_C}{Z_A+Z_B+Z_C} \quad -(2)$$

$$Z_3 = \frac{Z_A Z_C}{Z_A+Z_B+Z_C} \quad -(3)$$

Eq (1) × Eq (2), Eq (2) × Eq (3), Eq (1) × Eq (3) we get

$$Z_1 Z_2 = \frac{Z_A Z_B^2 Z_C}{(Z_A+Z_B+Z_C)^2} \quad -(4)$$

$$Z_2 Z_3 = \frac{Z_A Z_B Z_C^2}{(Z_A+Z_B+Z_C)^2} \quad -(5)$$

$$Z_1 Z_3 = \frac{Z_A^2 Z_B Z_C}{(Z_A+Z_B+Z_C)^2} \quad -(6)$$

Adding Eq (4), Eq (5) & Eq (6)

$$Z_1 Z_2 + Z_2 Z_3 + Z_1 Z_3 = \frac{Z_A Z_B^2 Z_C + Z_A Z_B Z_C^2 + Z_A^2 Z_B Z_C}{(Z_A+Z_B+Z_C)^2}$$

$$= \frac{Z_A Z_B Z_C (Z_B + Z_C + Z_A)}{(Z_A+Z_B+Z_C)^2}$$

$$Z_1 Z_2 + Z_2 Z_3 + Z_1 Z_3 = \frac{Z_A Z_B Z_C}{(Z_A+Z_B+Z_C)} = \underbrace{\left(\frac{Z_A Z_B}{Z_A+Z_B+Z_C}\right)}_{Z_1 \text{ (from eq. 1)}} Z_C$$

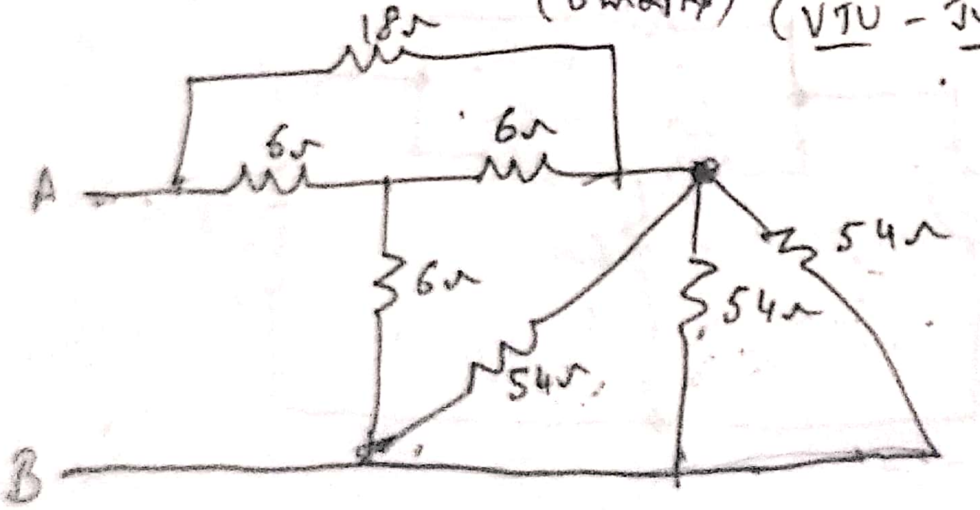
$$Z_1 Z_2 + Z_2 Z_3 + Z_1 Z_3 = Z_1 Z_C$$

$$\boxed{\begin{aligned} Z_C &= Z_2 + Z_3 + \frac{Z_2 Z_3}{Z_1} \\ Z_B &= Z_1 + Z_2 + \frac{Z_1 Z_2}{Z_3} \\ Z_A &= Z_1 + Z_3 + \frac{Z_1 Z_3}{Z_2} \end{aligned}}$$

|||ly

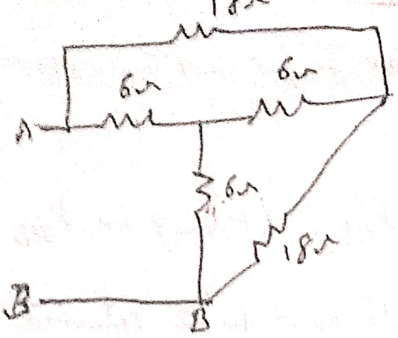
For resistances instead of Z use R

Prob 1: Determine the resistance between terminals A & B for the circuit shown below — (6 marks) (VTU - July/Aug. 2003) EC/TE/ML302
(6 marks) (VTU - July 07) EE34



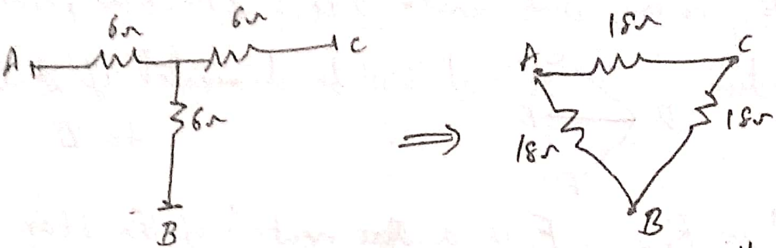
Sol: Looking for any series parallel elements, we find that that all the three 54Ω resistances are in parallel (apply loop concept or node concept)

Eq. resistance $= 54/3 = \underline{\underline{18\Omega}}$

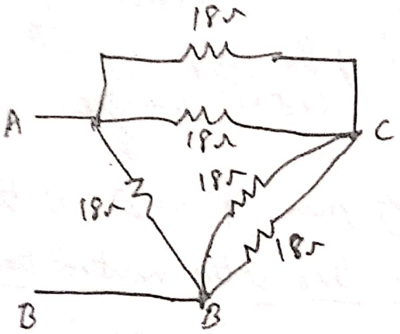


Instead of converting 6Ω, 6Ω, 18Ω (Δ) to star, the T(Y) connection can be converted to Δ since all the elements in T are equal.

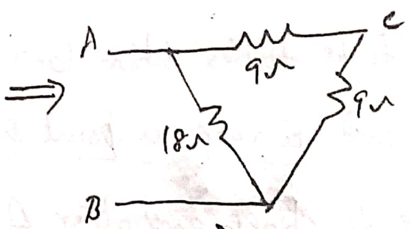
Name the star points.



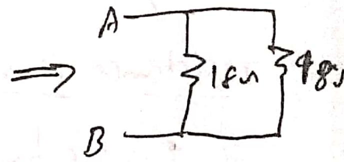
(First write the n/w without the T elements. Then insert the Δ elements.)



18Ω/18Ω in parallel across AC & BC



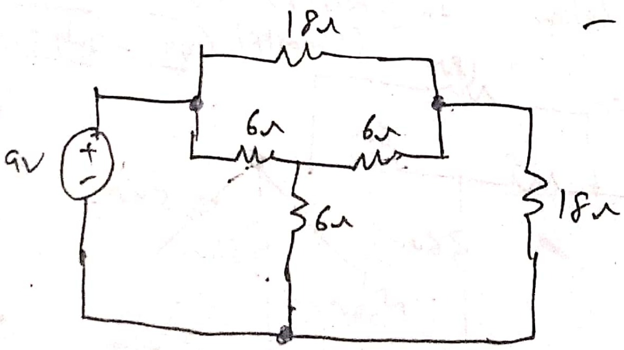
9Ω, 9Ω in series



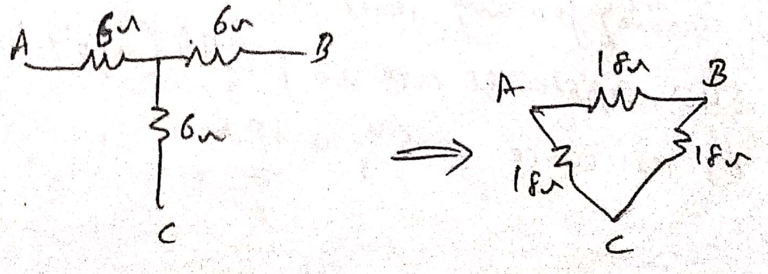
$\Rightarrow R_{AB} = 9\Omega$

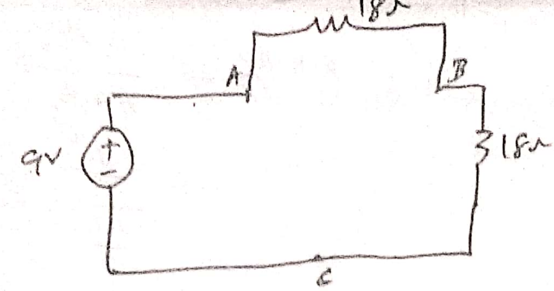
Prob 2: Using star/delta transformations, reduce the given n/w shown in figure and determine the total current supplied by the source.

— (6 marks) VTU - Jan/Feb 04 EC/TE/ML302



Sol: We can easily identify the T connection. Name the points.

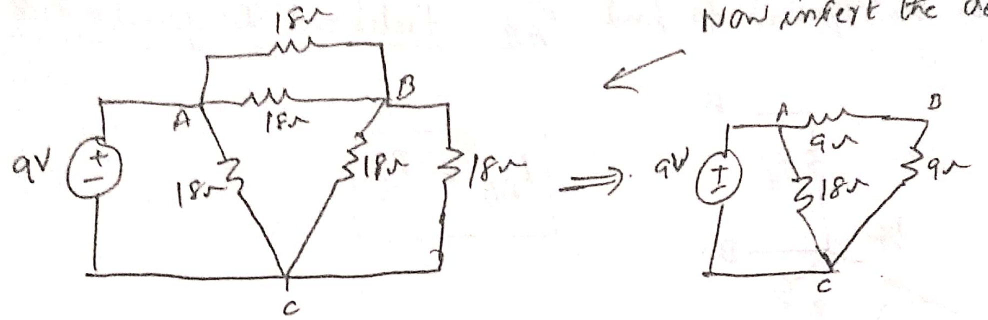


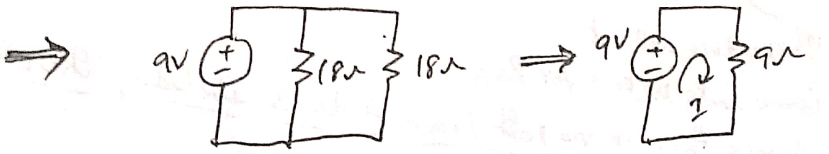


(Always write the n/w without the elements of Y or Δ, taken out. But the Y points or Δ points should be mentioned

(This step is to clarify students and not to be written in the solution)

Now insert the delta.

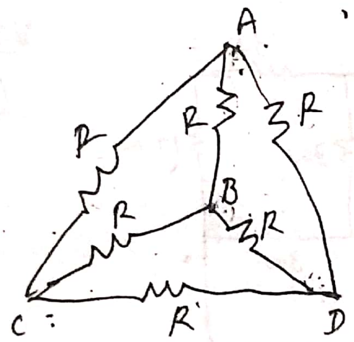




$I = \frac{9}{9} = \underline{\underline{1A}}$

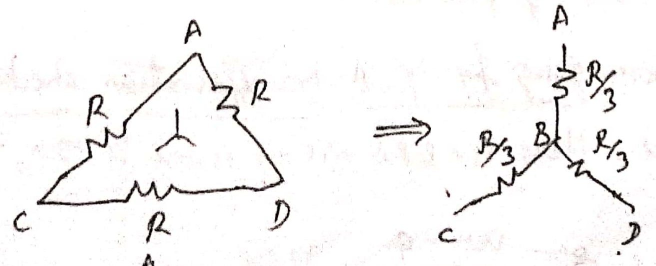
(current supplied by source)

Prob 3: Find the resistance between terminals A & B of the n/w shown in figure – (5 marks) (VTU – July/Aug 2005, EC/TE/ML 302)

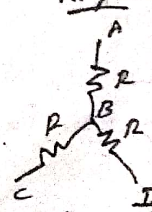


Sol: Caution: The inner star should not be converted to Δ since 'B' point will be lost. We need to find R_{AB}

We can convert outer Δ to Y

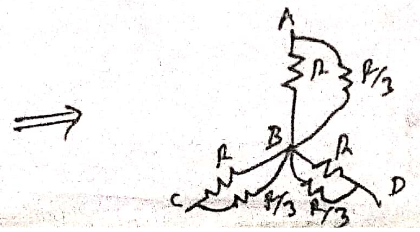


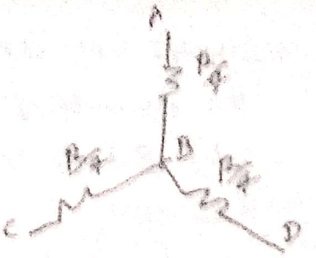
Rough



(The n/w with Δ taken o

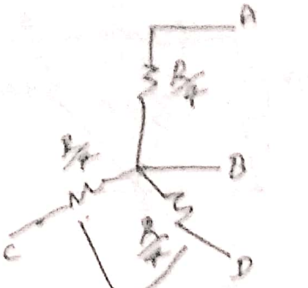
↓ Now inse the convert Δ i.e., Y





$$R \parallel R/3 \Rightarrow \frac{R \times R/3}{R + R/3} = \frac{R^2/3}{4R/3} = \frac{R}{4}$$

Now it is required to find R_{AB} stretch out the points A & B

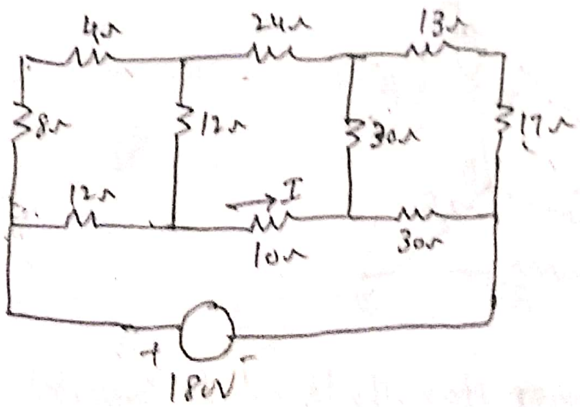


$$\boxed{R_{AB} = R/4}$$

These two will not come into picture for R_{AB} since there is no path from A to B including these elements

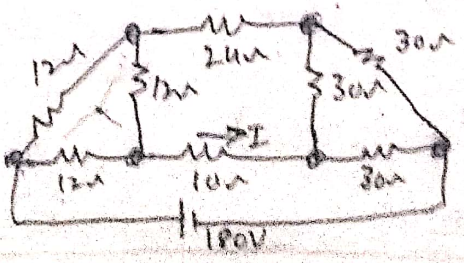
Prob 4: Determine the current through 10Ω resistance in the n/w shown in figure by star-delta conversion — (10 marks)

VTU - Jan/Feb 2006 (EE 302)

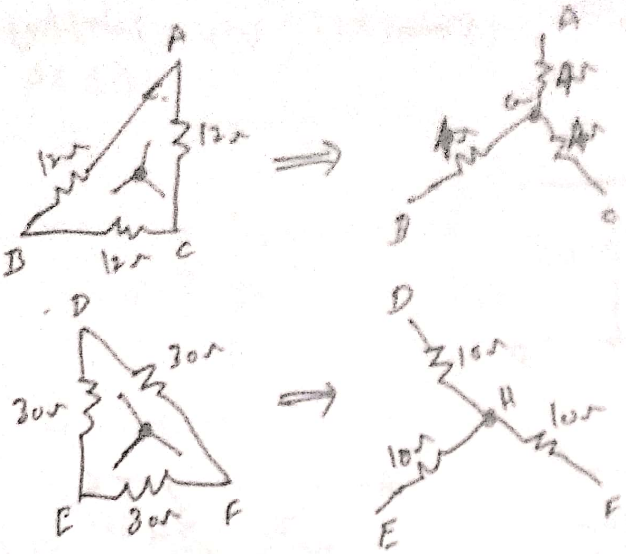


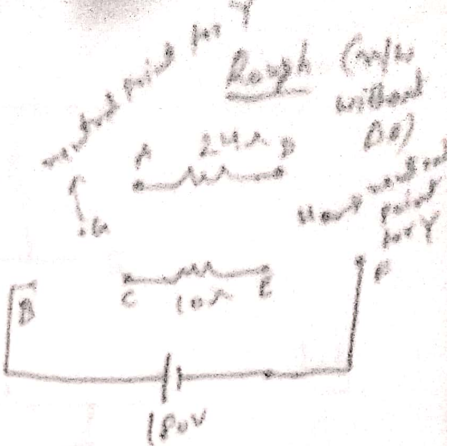
Sol: Since the current is needed in 10Ω, that branch has to be retained till the end of problem.

Before going for Y-Δ transformation check for any series parallel elements. Here 4Ω & 8Ω are in series & 13Ω, 17Ω

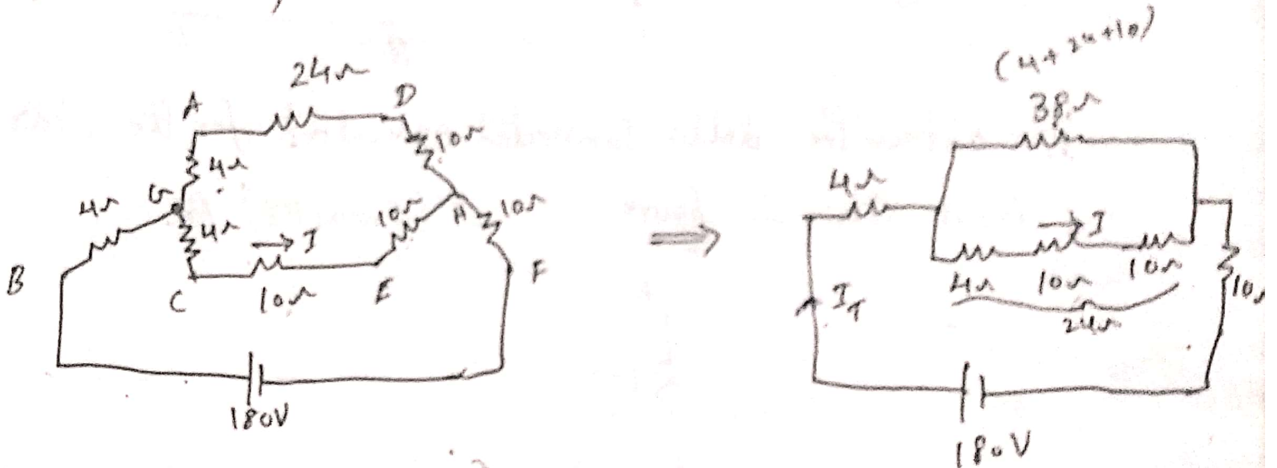


The two Δs can be ~~di~~ transformed to Y simultaneously. Name the delta points





Inserting the two Y,



We cant find 'I' till we find main current I_T, for which we need R_T

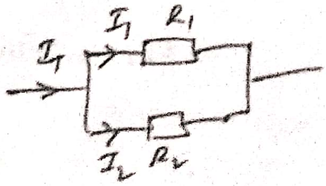
given $V_T = 180V$

$$R_T = 4 + \left(\frac{38 \times 24}{38+24}\right) + 10 = \underline{\underline{28.709\,\Omega}}$$

$$I_T = \frac{180}{28.709} = \underline{\underline{6.27\,A}}$$

$$\text{Branch current } I = \frac{\overset{I_T}{6.27} \times \overset{\text{'R' of opp. branch}}{38}}{(38+24)}$$

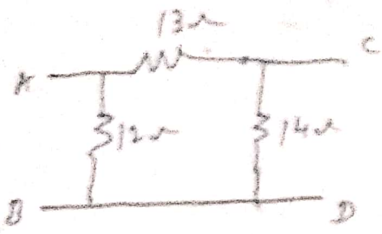
Total 'R' of 1st branch   Total 'R' of 2nd branch



$$I_1 = \frac{I_T R_2}{(R_1+R_2)}$$

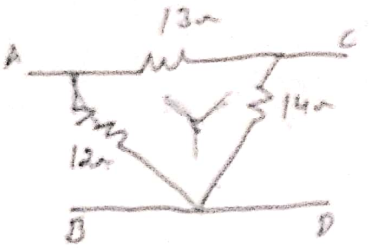
$$\boxed{I_{10\Omega} = 3.843\,A}$$

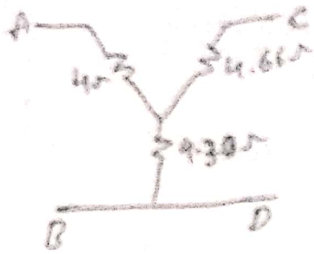
Prob 5: c) obtain the star connected equivalent for the delta connected circuit shown in figure — (5 marks) (VTU - July/Aug 2004)
EE34



Sol:

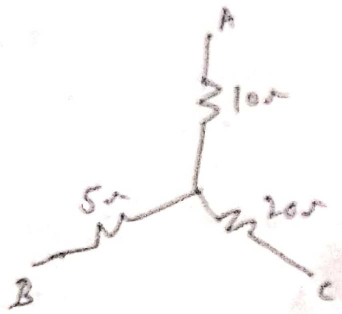
Π is written of A▽



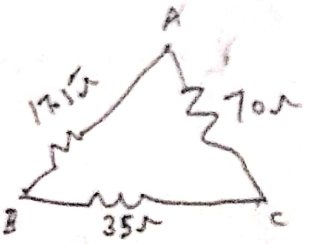


(Eq. star)

d) obtain the delta connected equivalent for the star connected circuit shown in figure — (5 marks)



Sol:



For writing the element between AC → In the star connection which are the resistance we come across in the path from A to C → 10Ω & 20Ω

So In Δ → $10 + 20 + \frac{10 \times 20}{5}$ ← the element which is not in the path

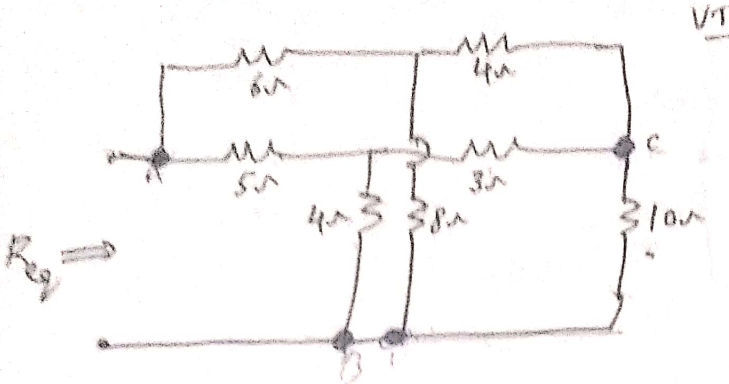
$|||^{ly}$ for AB, BC elements

$AB \rightarrow 10 + 5 + \frac{10 \times 5}{20}$

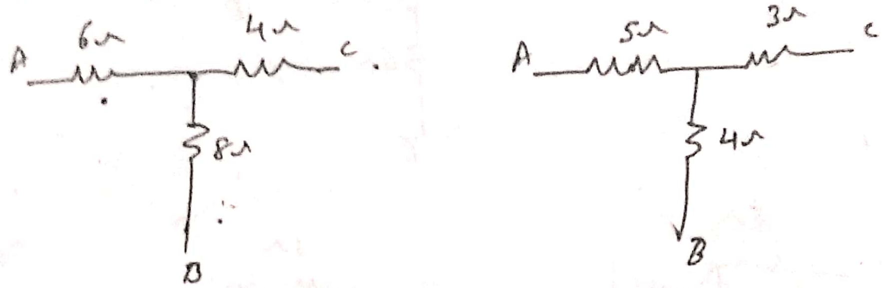
$BC \rightarrow 5 + 20 + \frac{5 \times 20}{10}$

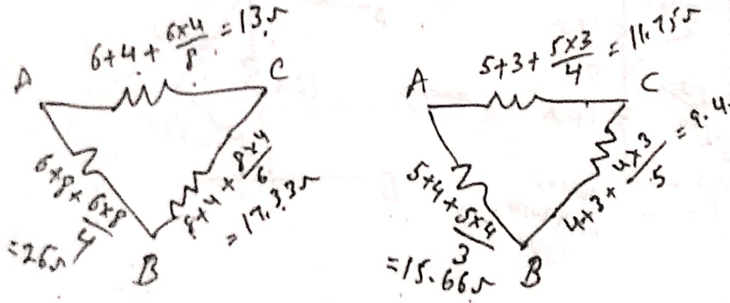
Prob 6: Determine the equivalent resistance R_{eq} by using Star-delta transformation — (10 marks) VTU – July 2006, EE34

VTU – June 2010, 06ES34 → In this paper 10Ω is not given. Remaining is same.

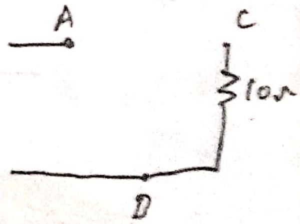


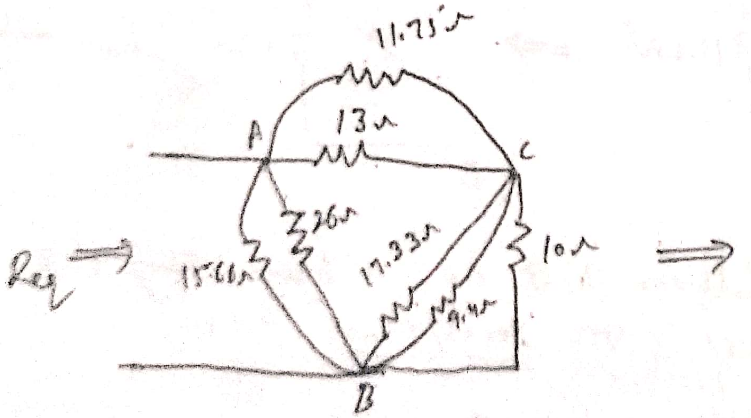
Sol: This is a Twin-T n/w where we can find two T. Here both T' will share the same points. We can go for simultaneous T-Δ conversion.



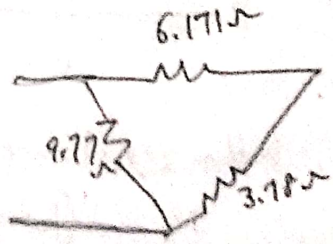


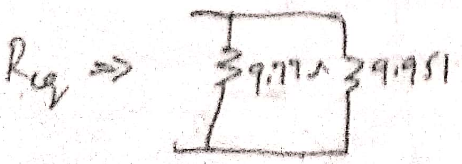
Rough (after removing twin T')





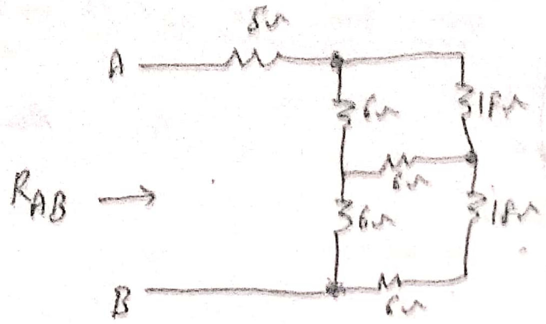
⟹



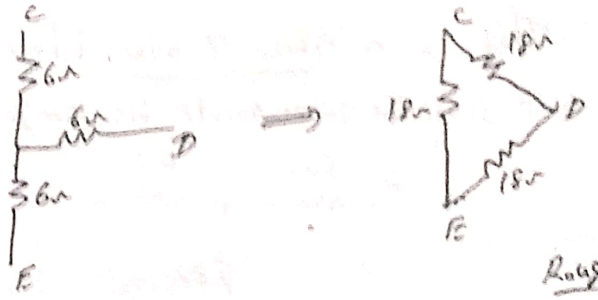


⟹ 4.93Ω

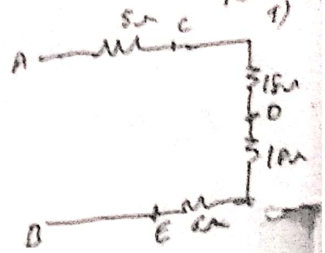
Prob 7: Determine R_{AB} in the n/w shown in figure. — (6 marks) (June-July/09 EE34)

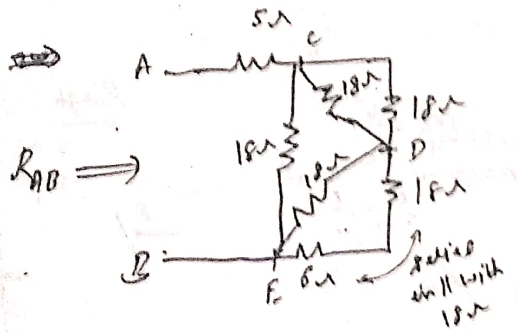


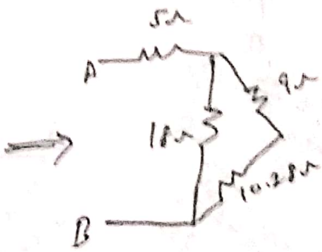
Sol: Converting T – Δ

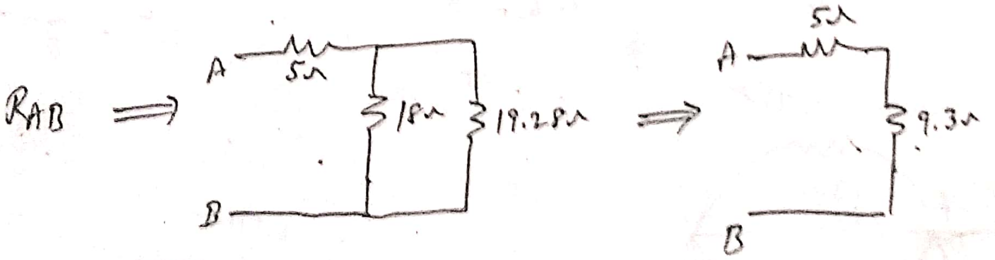


Rough (after removing 1)



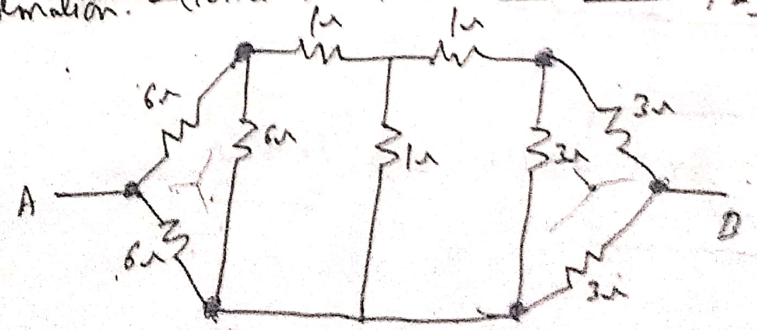




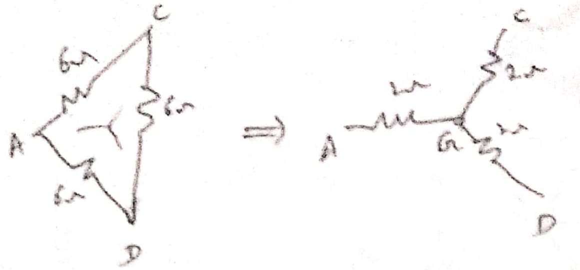


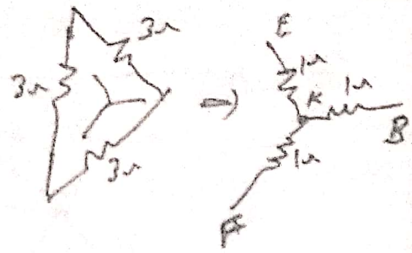
$R_{AB} = 14.3\Omega$

Prob 8: Find the resistance between point A & B in figure using Y – Δ transformation. —(10 marks) (VTU - Dec 08/Jan 09, EE34)

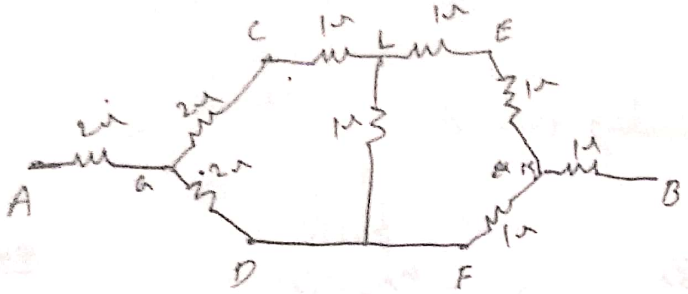


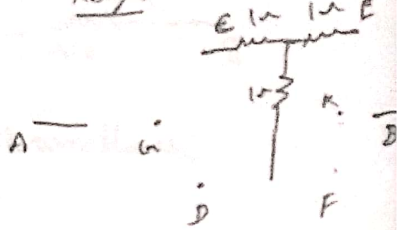
Sol: Converting two Δ simultaneously to Y, we get

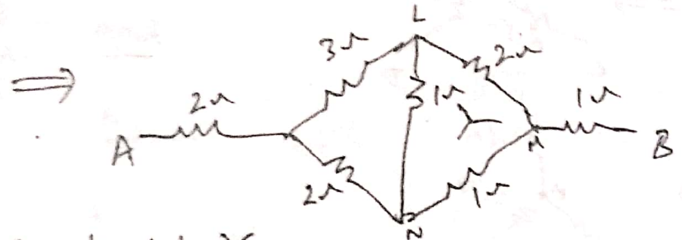




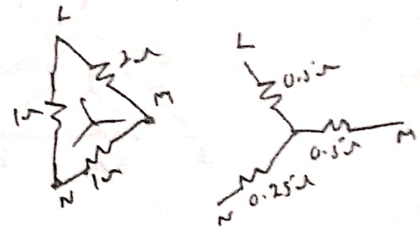
Rough

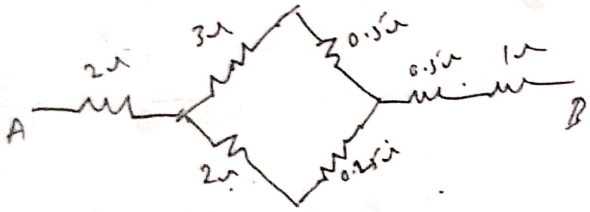


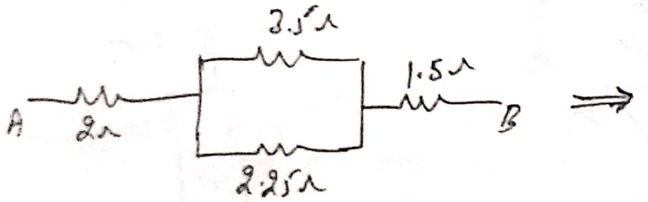


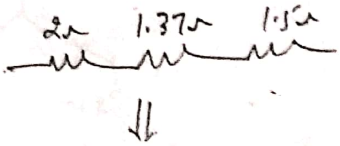


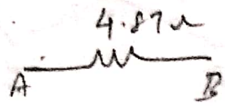
Converting Δ to Y





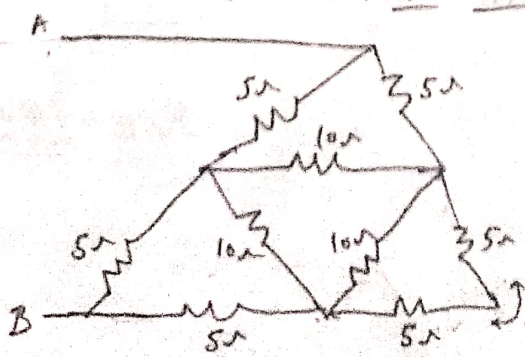






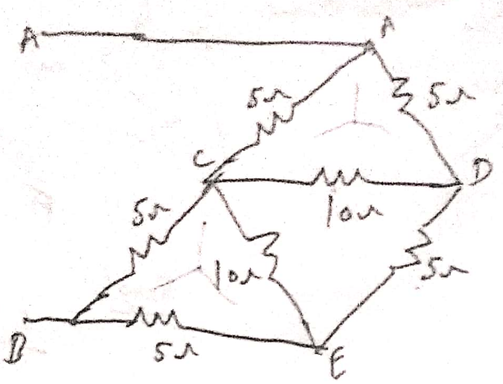
$R_{AB} = 4.87\Omega$

Prob 9: Determine the equivalent resistance at AB in the n/w shown in figure. — (5 marks) (VTU – June/July 08) (EE34)

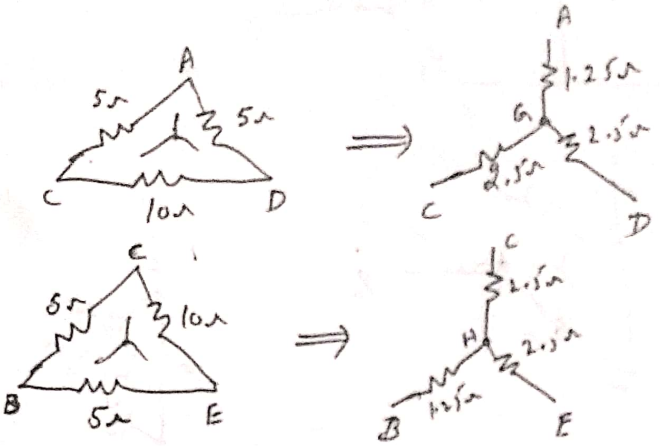


→ these two are in series. that is in parallel with 10Ω

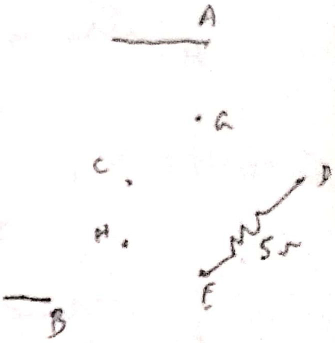
Sol:

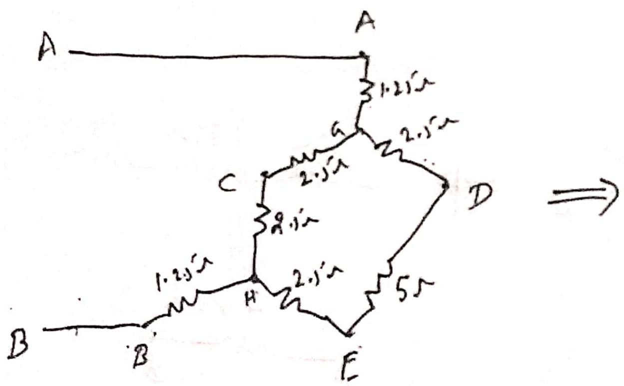


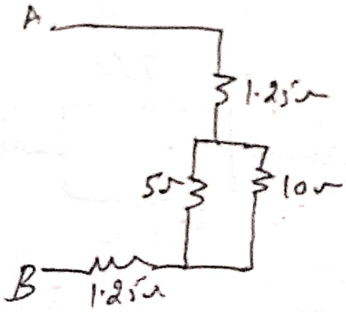
Simultaneously eliminating two Δ

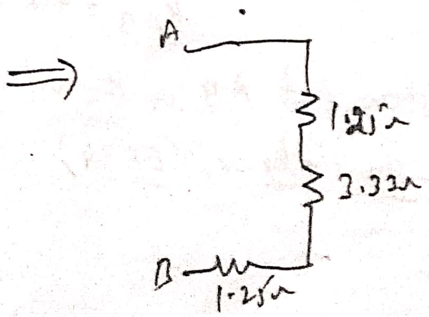


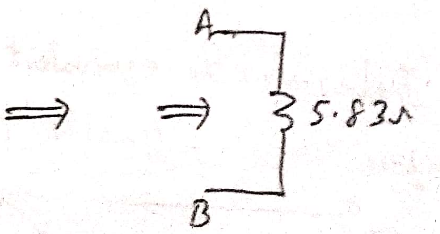
Rough (without two Δ)





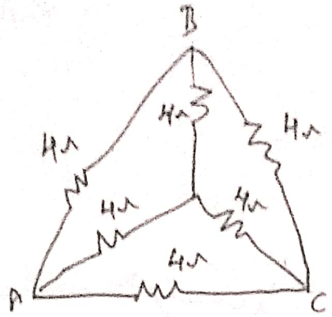




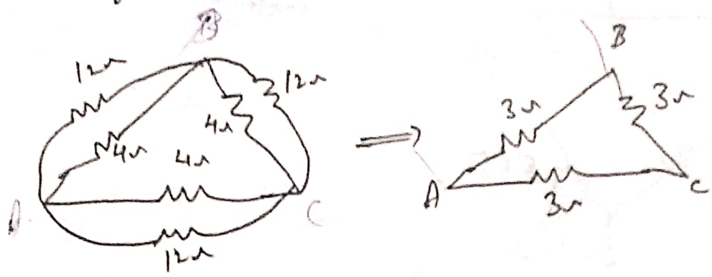


$R_{AB} = \underline{\underline{5.83\Omega}}$

Prob 12: Six equal resistors each of 4Ω are connected as shown in figure. Find the equivalent resistance between any two corners (Mangalore university).



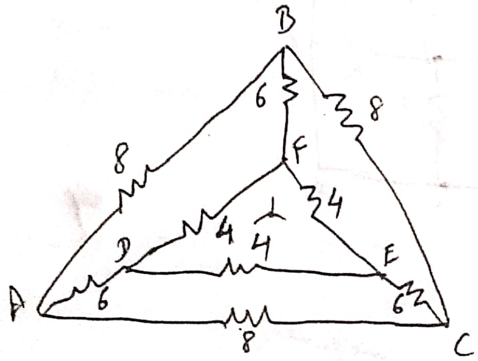
Sol: Converting inner Y → Δ



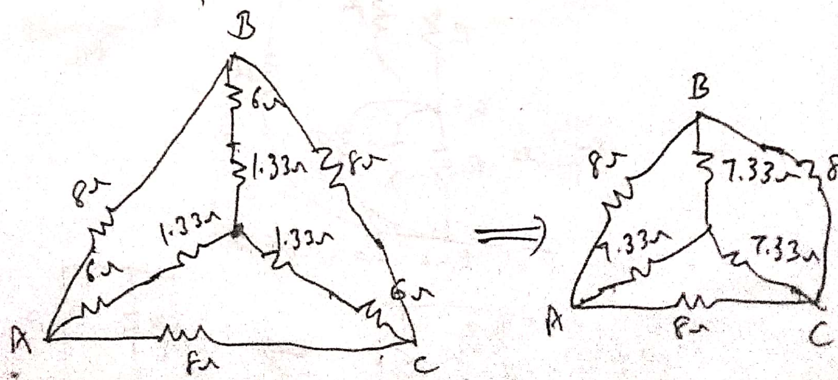
Resistance between any two corners, R_{AB} (R_{BC}) (R_{CA})

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

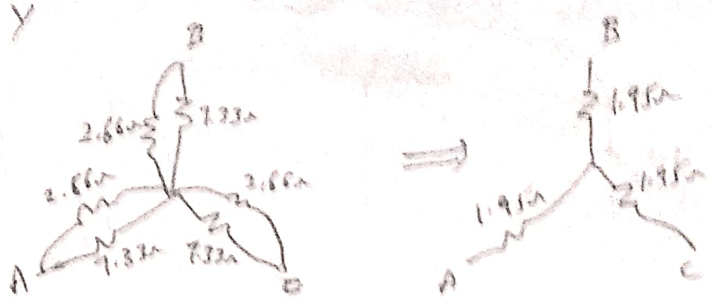
Prob 13: In the n/w shown in figure, the numbers represent the value of resistance in Ω. Find the resistance between the points A & B (Karnataka university)



Sol: Converting Δ (4Ω) to Y

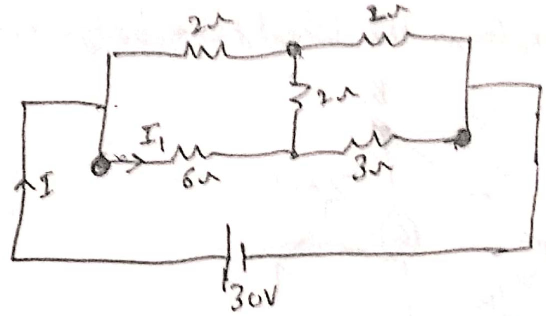


Converting outer Δ – Y

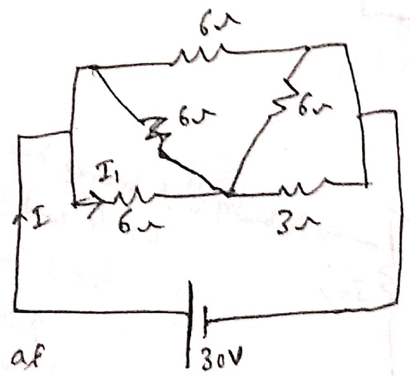


$$R_{AB} = 1.95 + 1.95$$
$$= 3.9\,\Omega$$

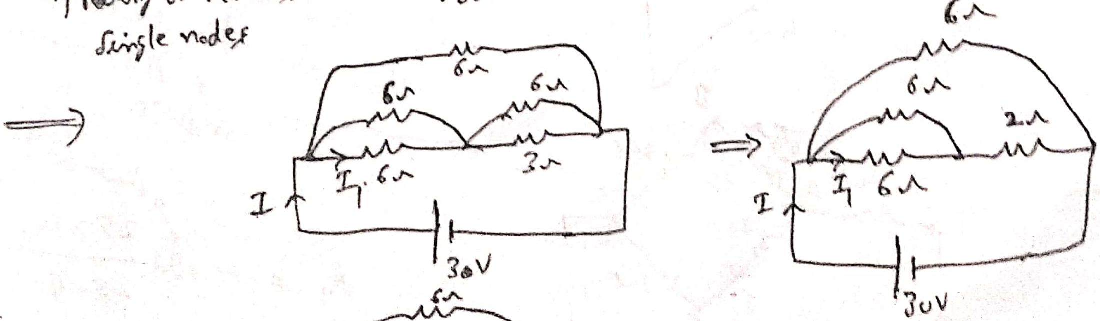
Prob 14: In the n/w shown in fig, find I & I_1 using Y–Δ transformation (Karnataka university)



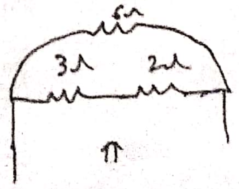
Sol: Converting T (2Ω) to Δ



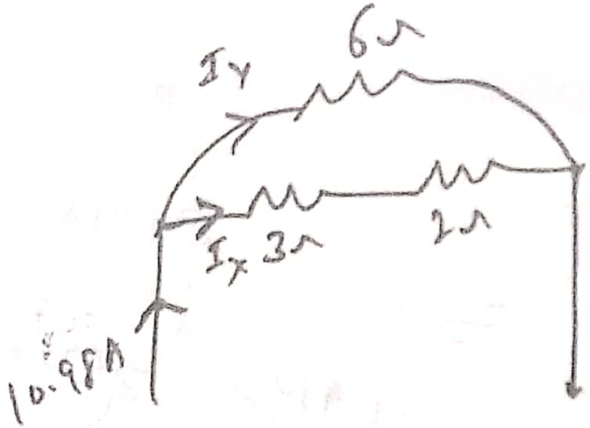
Treating shorts as single nodes



R_T =

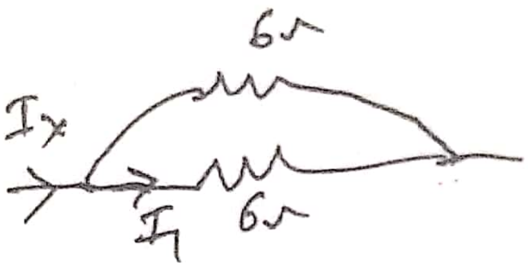


$$R_T = 2.73\,\Omega \;\therefore\; I = \frac{30\,(V_T)}{2.73\,(R_T)} = 10.98\,A$$



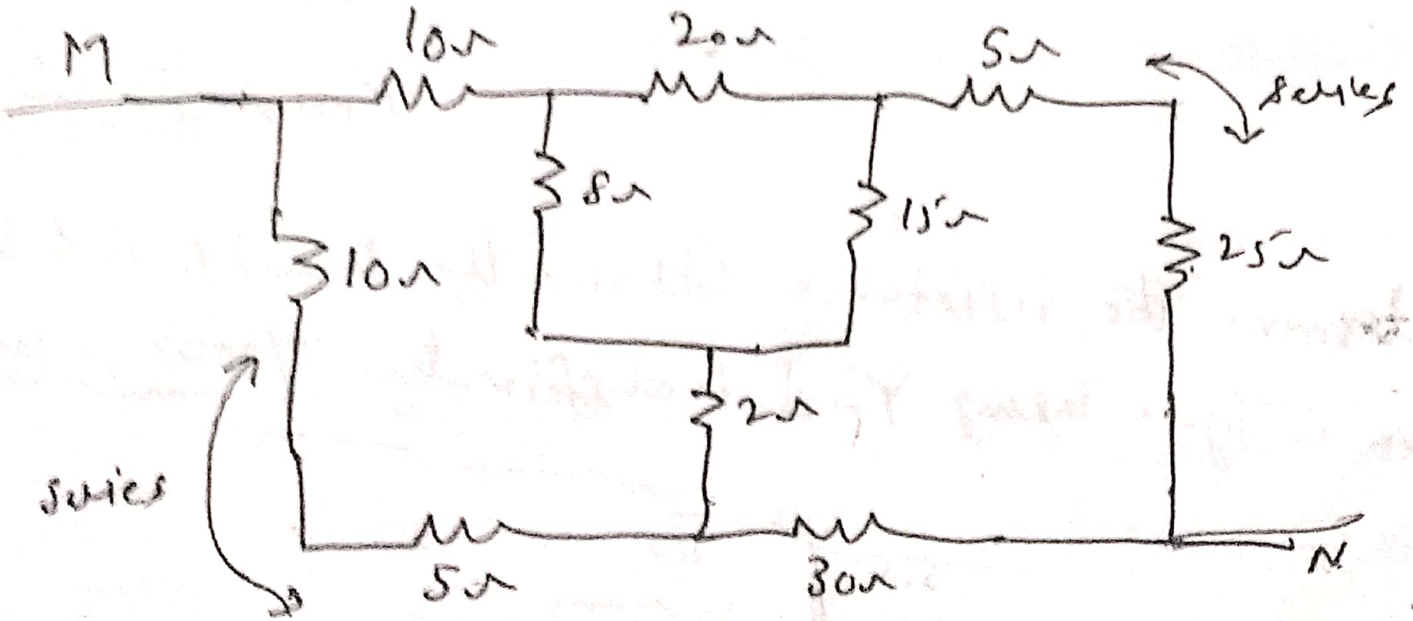
$$\Longrightarrow \quad I_x = \frac{10.98 \times 6}{(6+3+2)} \simeq \underline{\underline{6A}}$$

Now



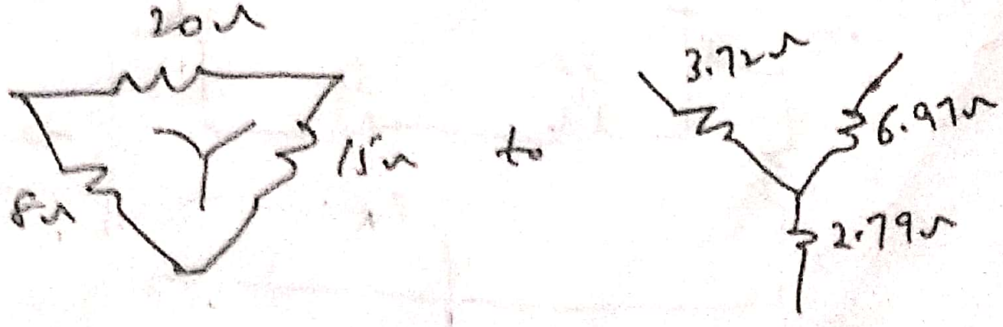
$$I_1 = \frac{6 \times 6}{12} = \underline{\underline{3A}}$$

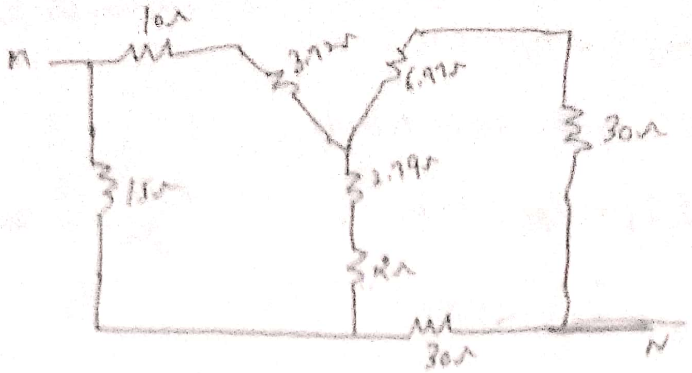
Determine the resistance between the terminals M & N of the n/w shown in figure using Y-Δ transformation (Bangalore university)

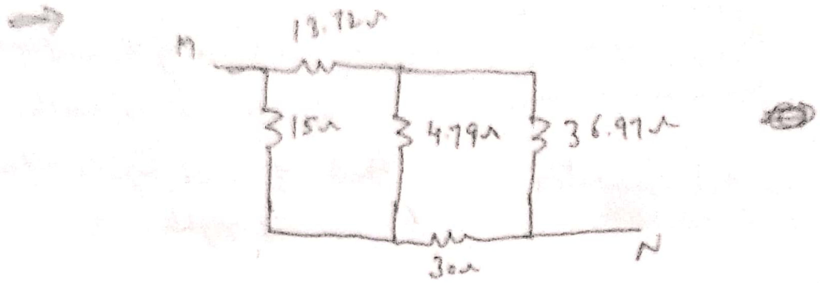


Sol :

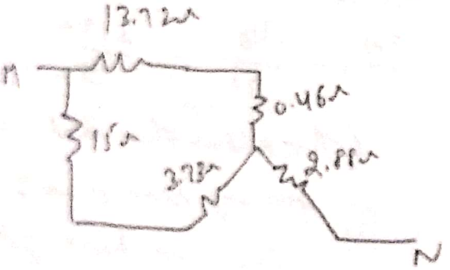
Converting

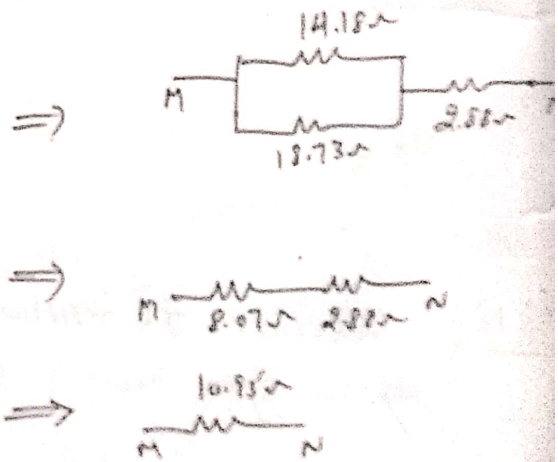






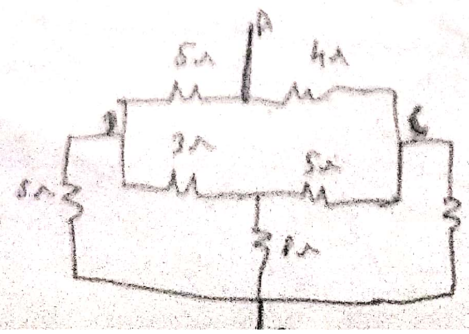
Converting



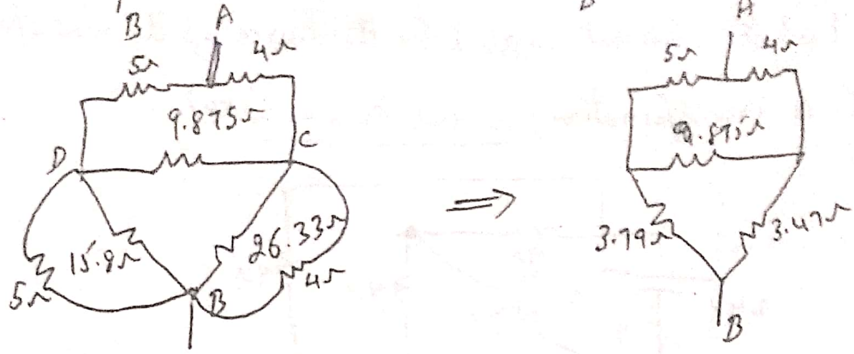


$R_{MN} = \underline{10.95\Omega}$

Prob 17 Determine the resistance between the points A & B in the n/w shown in figure using Y-Δ transformation (Mysore university)

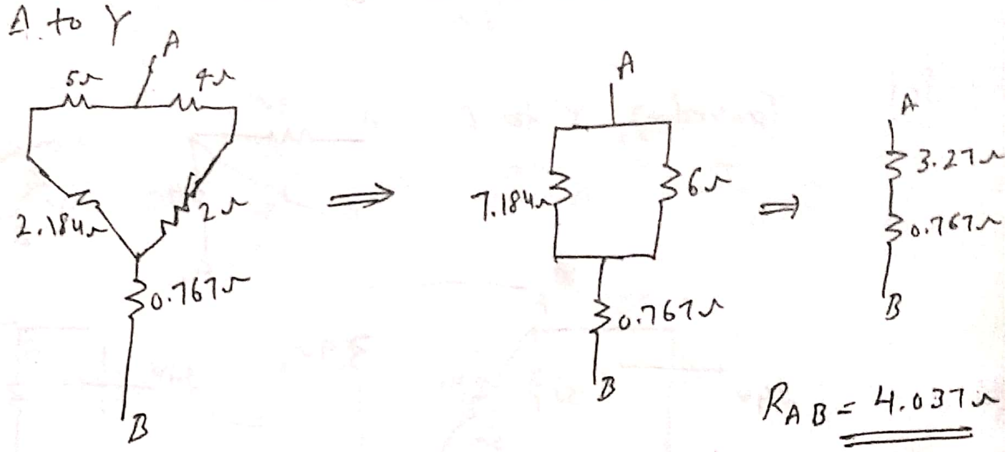


Converting T - Δ



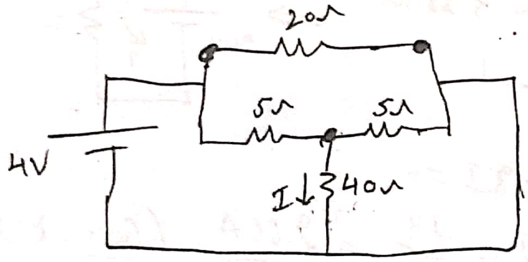
5Ω & 4Ω are not in series.

Converting Δ to Y



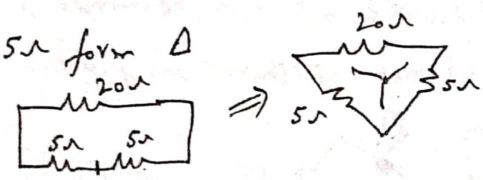
$R_{AB} = 4.037\Omega$

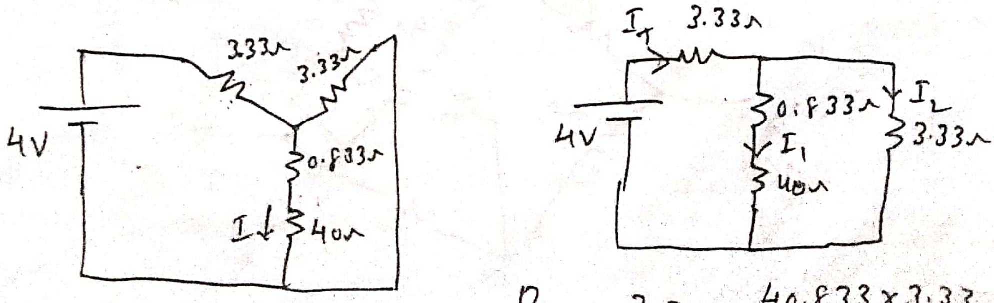
Prob 18: Calculate the current in the 40Ω resistance of the n/w shown in figure, using Y-Δ transformation (Kuvempu university)



Sol: We can't convert T to Δ since we need current in 40Ω.

20Ω, 5Ω, 5Ω form Δ



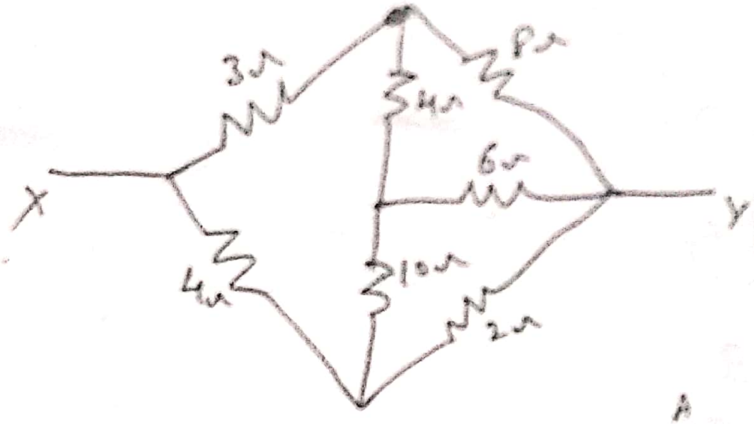


$$R_T = 3.33 + \frac{40.833 \times 3.33}{44.163}$$

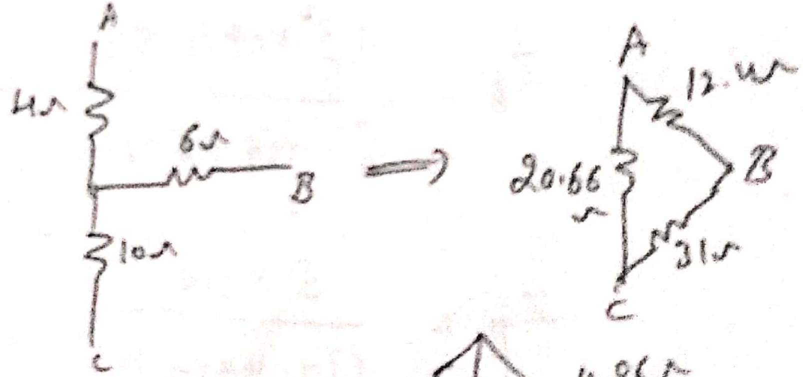
$$R_T = 6.4\Omega$$

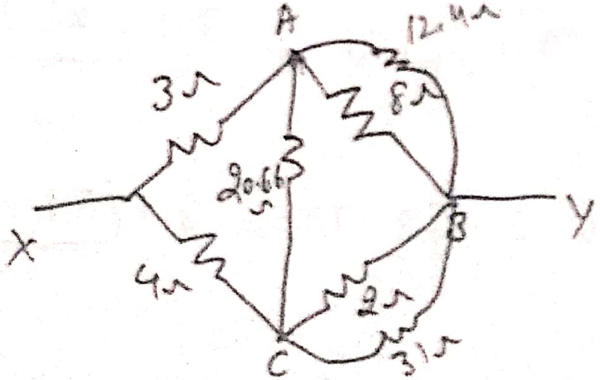
$$I_T = \frac{4}{6.4} = 0.625A$$

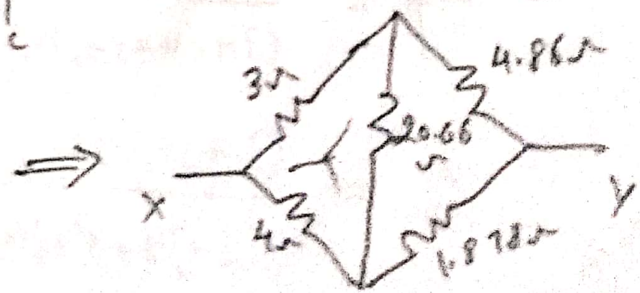
Prob 2.4 : Determine the resistance between XY in the circuit shown in the figure.



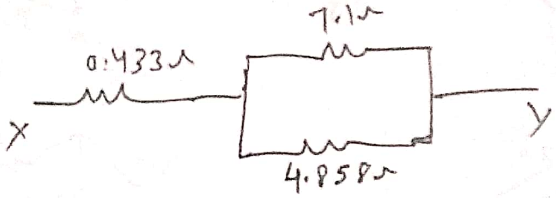
Sol : Converting T to Δ



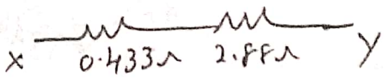




$\Rightarrow$

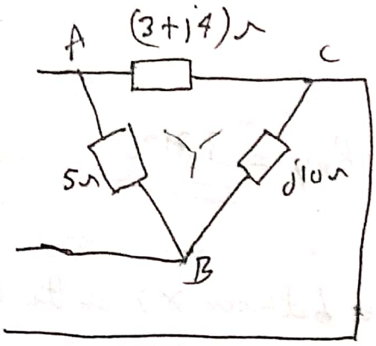


$\Rightarrow$

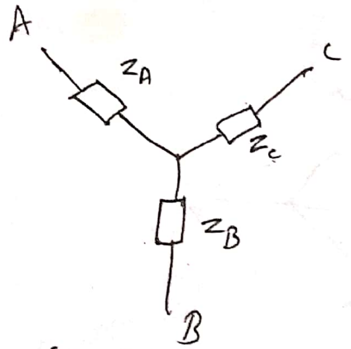


$\Rightarrow R_{xy} = \underline{\underline{3.313\Omega}}$

Prob 27: obtain the star connected equivalent n/w for the given delta connected n/w shown in figure (Bangalore university)



Sol:



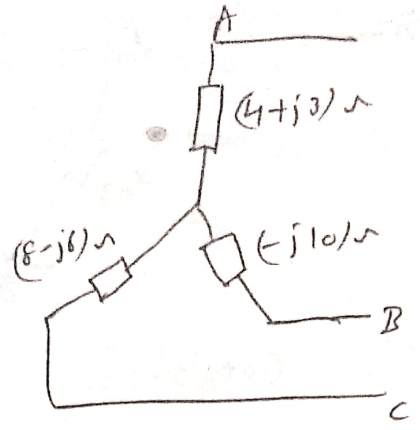
$$Z_A = \frac{(3+j4)(5)}{(3+j4+5+j10)} = 1.538 - j0.1923 = 1.55\angle -7.12\ \Omega$$

$$Z_B = \frac{5 \times j10}{(3+j4+5+j10)} = 2.69 + j1.538 = 3.1\angle 29.74\ \Omega$$

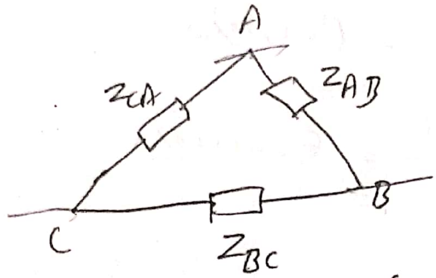
$$Z_C = \frac{(3+j4) \times j10}{(3+j4+5+j10)} = 0.38 + j3.076 = 3.1\angle 82.87\ \Omega$$

Note: use calculator in complex mode. use brackets for rectangular form wh...
Ex: $(3+j4)$ (degree mode) (if real & imaginary...

Prob 27: obtain the delta connected equivalent n/w for the given star connected n/w shown in figure (Kuvempu university)



Sol:



$$Z_{AB} = (4+j3)+(-j10) + \frac{(4+j3)\times -j10}{(8-j6)} = 8.8-j8.4 = 12.17\angle{-43.6}\,\Omega$$

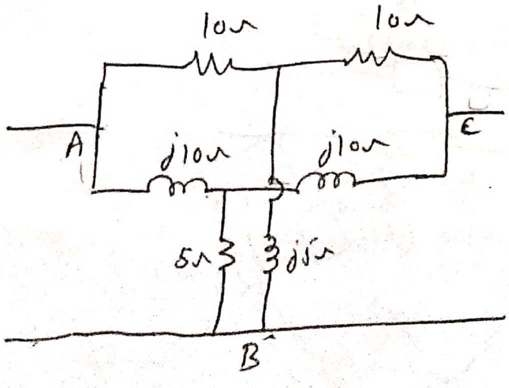
$$Z_{BC} = (8-j6)+(-j10) + \frac{(8-j6)\times -j10}{(4+j3)} = -11.2-j21.6$$

$$= 24.33\angle{-117.4}\,\Omega$$

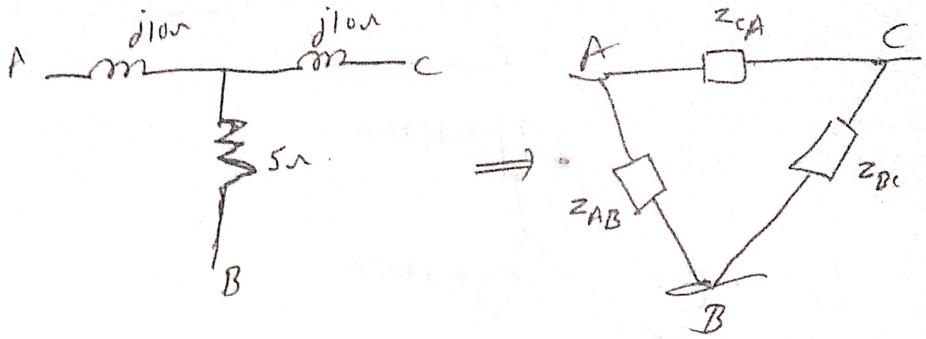
$$Z_{CA} = (8-j6)+(4+j3) + \frac{(8-j6)\times(4+j3)}{-j10} = 12+j2$$

$$= 12.17\angle{9.46}\,\Omega$$

Prob 26. obtain the delta connected eq. n/w for the n/w shown in figure.



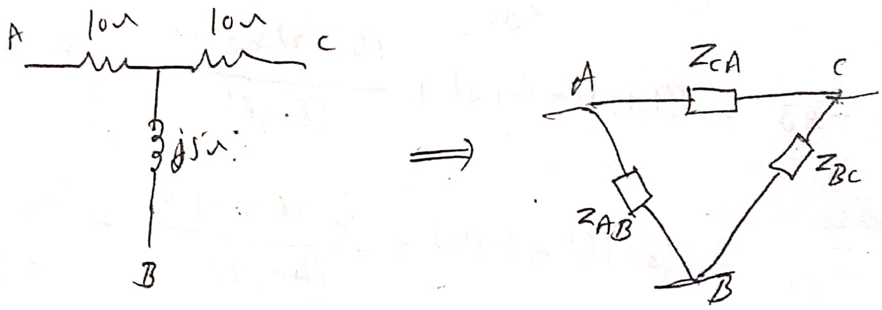
Sol: This is Twin T- n/w. Converting the Twin T - to Twin Δ



$$Z_{AB} = j10 + 5 + \frac{j10 \times 5}{j10} = (10+j10)\Omega$$

$$Z_{BC} = 5 + j10 + \frac{5 \times j10}{j10} = (10+j10)\Omega$$

$$Z_{CA} = j10 + j10 + \frac{j10 \times j10}{5} = (-20+j20)\Omega$$

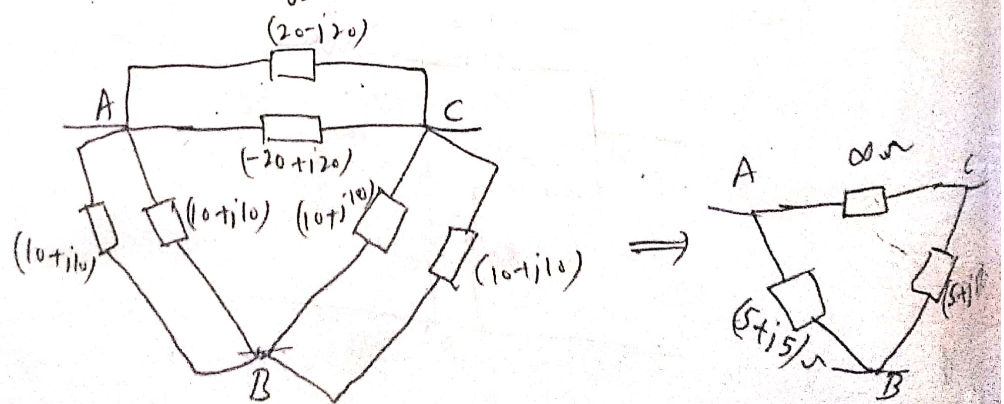


$$Z_{AB} = 10 + j5 + \frac{10 \times j5}{10} = (10+j10)\Omega$$

$$Z_{BC} = j5 + 10 + \frac{10 \times j5}{10} = (10+j10)\Omega$$

$$Z_{CA} = 10 + 10 + \frac{10 \times 10}{j5} = (20-j20)\Omega$$

Eq. Ckt:

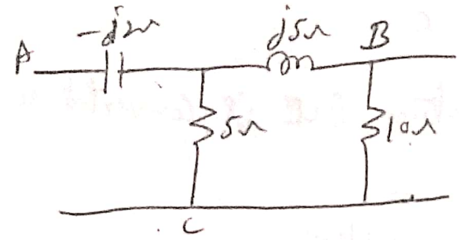


$$\Rightarrow \quad Z_{AB} = \frac{(10+j10)\times(10+j10)}{(10+j10+10+j10)} = (5+j5)\Omega$$

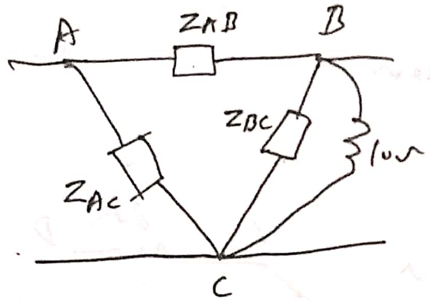
$$\therefore Z_{BC} = \frac{(10+j10)\times(10+j10)}{(10+j10+10+j10)} = (5+j5)\,\Omega$$

$$Z_{CA} = \frac{(20-j20)\times(-20+j20)}{(20-j20-20+j20)} = \frac{NT}{0} = \infty \quad \text{(open ckt)}$$

Prob 25: Obtain the delta connected equivalent of the n/w shown in figure — (6 marks) VTU – July/Aug 2005 (EE 34)



Sol: Converting the star n/w to Δ
$(-j2, j5, 5)$



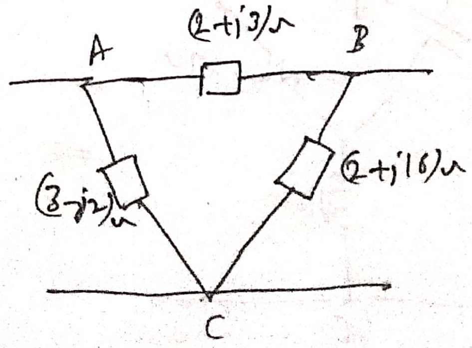
$$Z_{AB} = -j2 + j5 + \frac{-j2\times j5}{5} = (2+j3)\,\Omega$$

$$Z_{BC} = j5 + 5 + \frac{j5\times 5}{-j2} = (-7.5+j5)\,\Omega$$

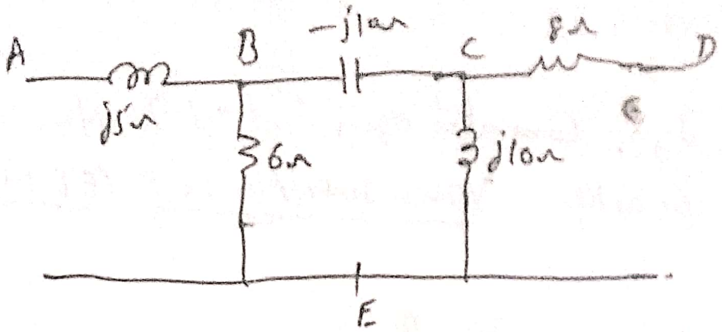
$$Z_{CA} = 5 - j2 + \frac{5\times -j2}{j5} = (3-j2)\,\Omega$$

$$10\,\Omega \parallel Z_{BC} = \frac{10\times(-7.5+j5)}{(10-7.5+j5)} = (2+j16)\,\Omega$$

The equivalent Δ



Prob 2: obtain the delta connected equivalent n/w for the n/w shown in figure (Bangalore university)

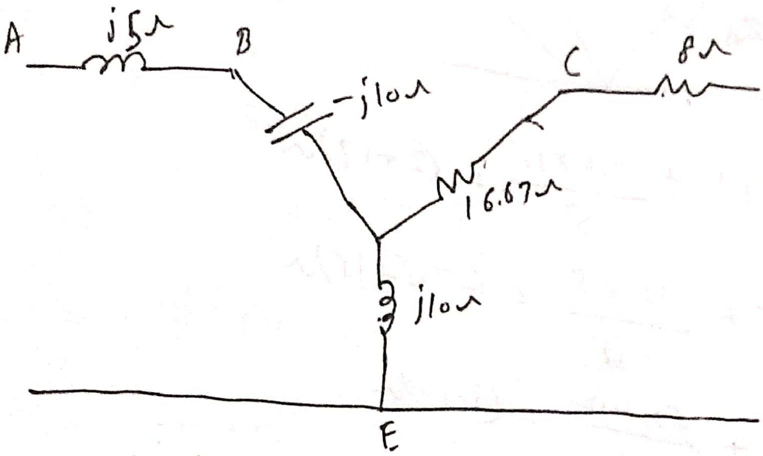


Sol: The delta connection BCE is converted to star.

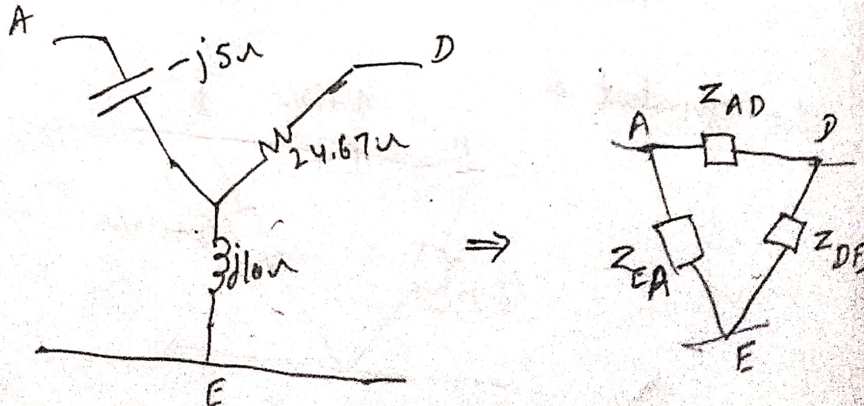
$$Z_B = \frac{6 \times -j10}{6-j10+j10} = -j10\Omega$$

$$Z_C = \frac{-j10 \times j10}{6} = 16.67\Omega$$

$$Z_E = \frac{6 \times j10}{6} = j10\Omega$$



The n/w is further simplified



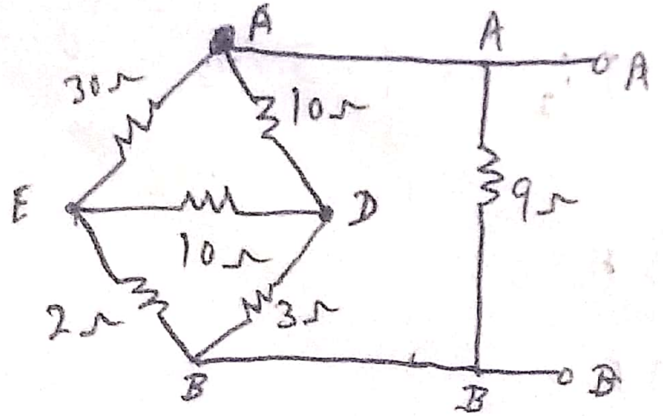
$$Z_{AD} = -j5 + 24.67 + \frac{-j5 \times 24.67}{j10} = 12.335 - j5 = 13.3\angle{-22.06}$$

$$Z_{DE} = 24.67 + j10 + \frac{24.67 \times j10}{-j5} = -24.67 + j10 = 26.6\angle{157.9}$$

$$Z_{EA} = j10 + -j5 + \frac{j10 \times -j5}{24.67} = 2.02 + j5 = 5.4\angle{67.93}$$

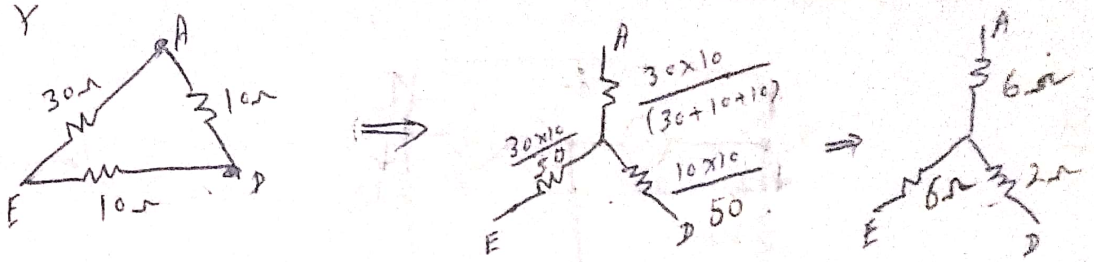
2. a. Determine the equivalent resistance between the terminals AB for the network shown in figure. (5 Marks)

Sol:

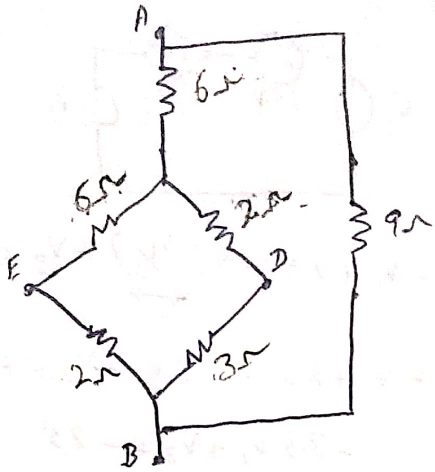


(Note: Name the nodes, it is not given in problem)

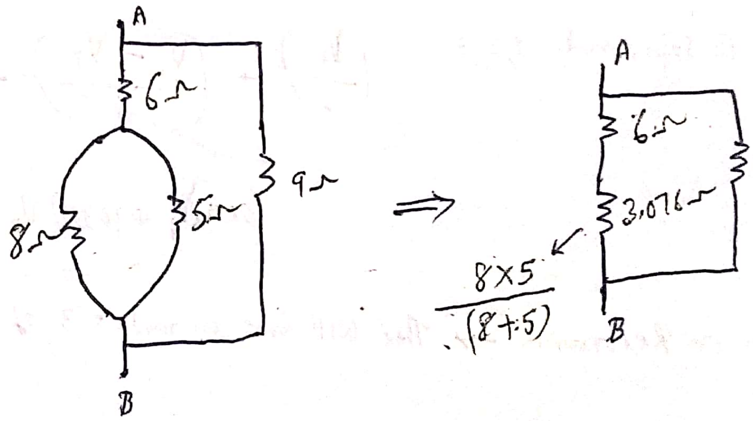
Converting Δ to Y

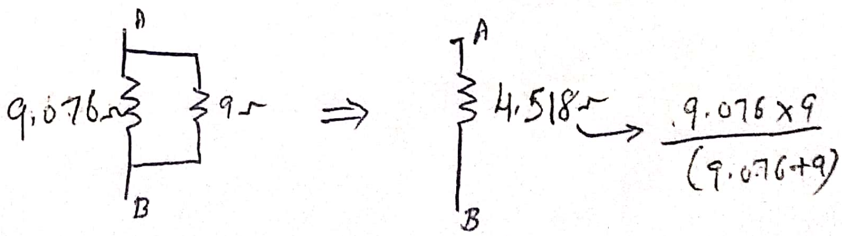


Inserting the Y between nodes ADE



Looking for series/parallel elements



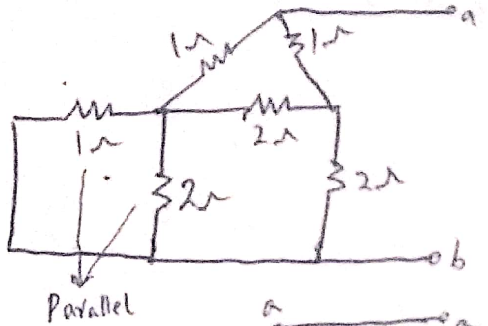


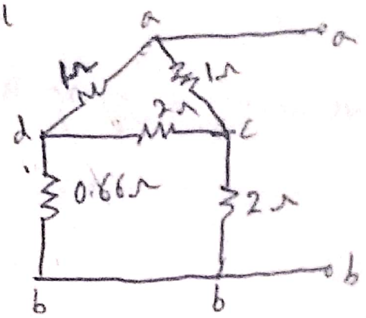
$R_{AB} = 4.518\Omega$

OR

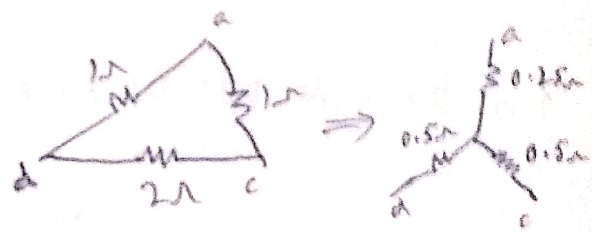
2. a. Find the equivalent resistance across a-b of the circuit shown in figure using delta-star conversion. (4 marks)

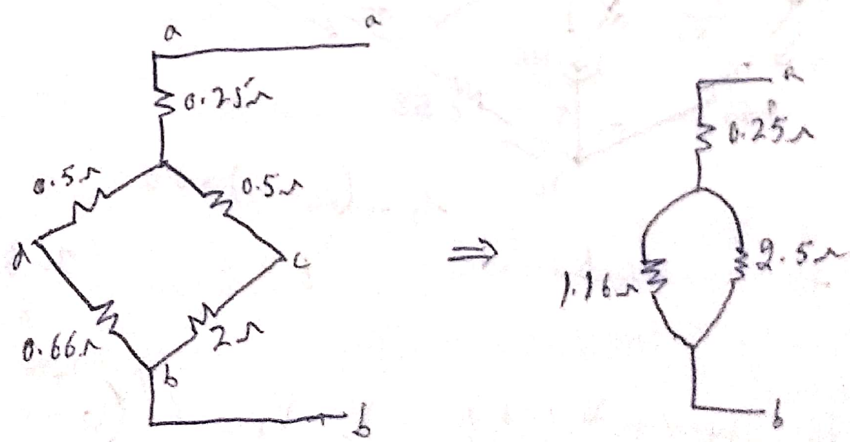
Sol:

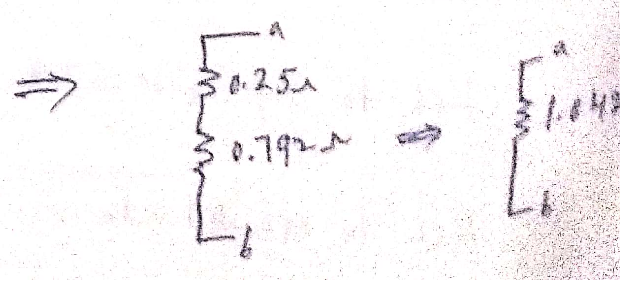




(Name the nodes)

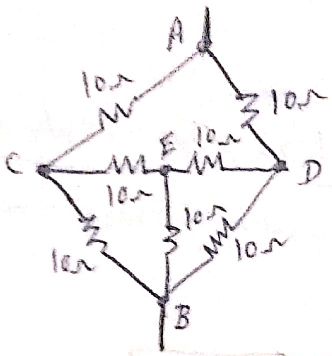






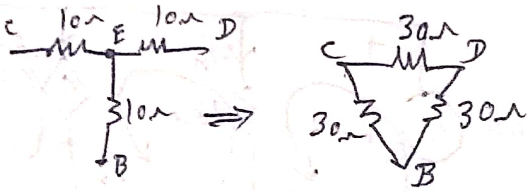
6. Find the equivalent resistance across AB of the network shown in figure using star-delta transformation. Consider all resistance as $10\,\Omega$. (5 Marks)

Sol:



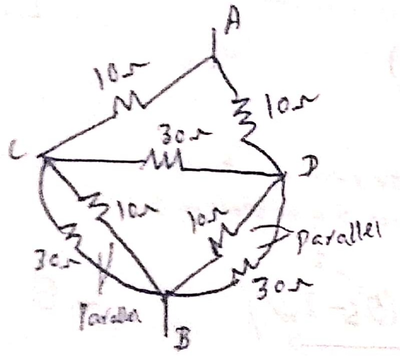
Stretch the points A & B

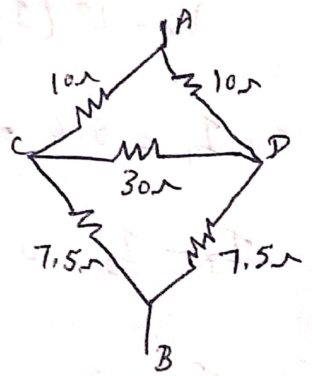
Convert the inner star to delta



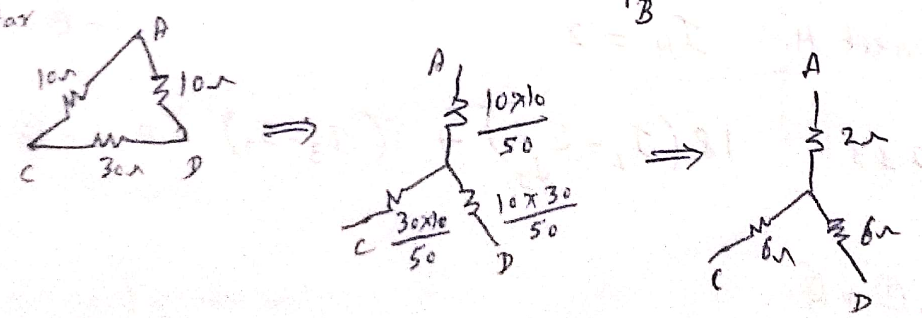
$Y \xrightarrow{\times 3} \Delta$

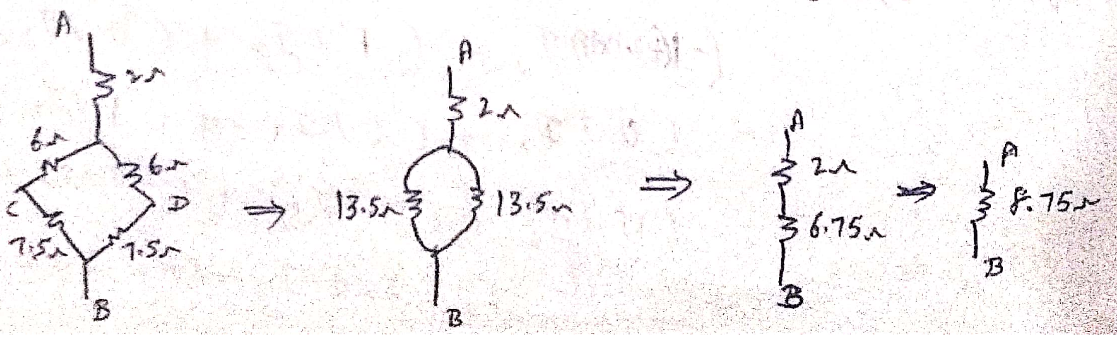
(When all the three resistances are equal)





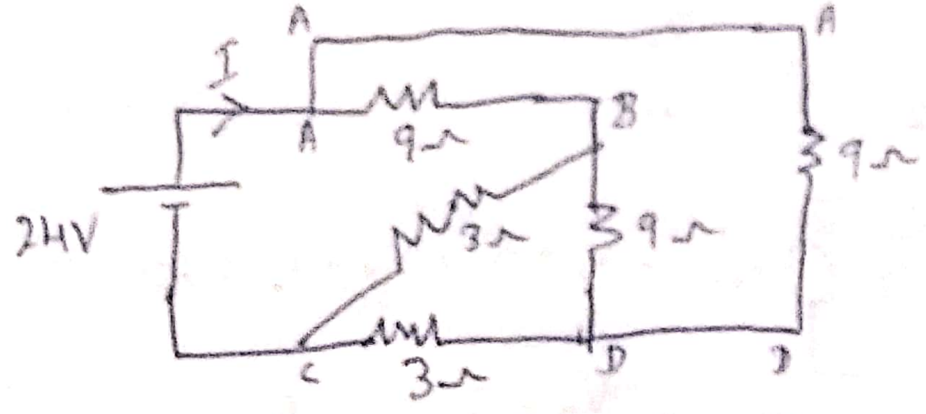
Convert delta to star





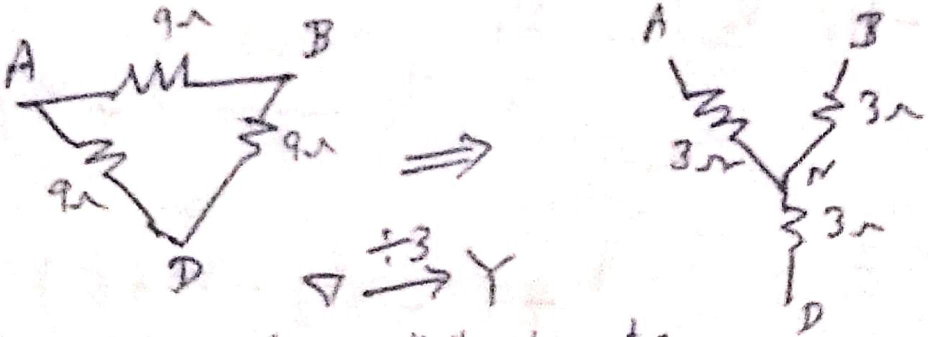
c. Find the current I in the circuit shown in figure using star delta transformation (5 Marks)

Sol:



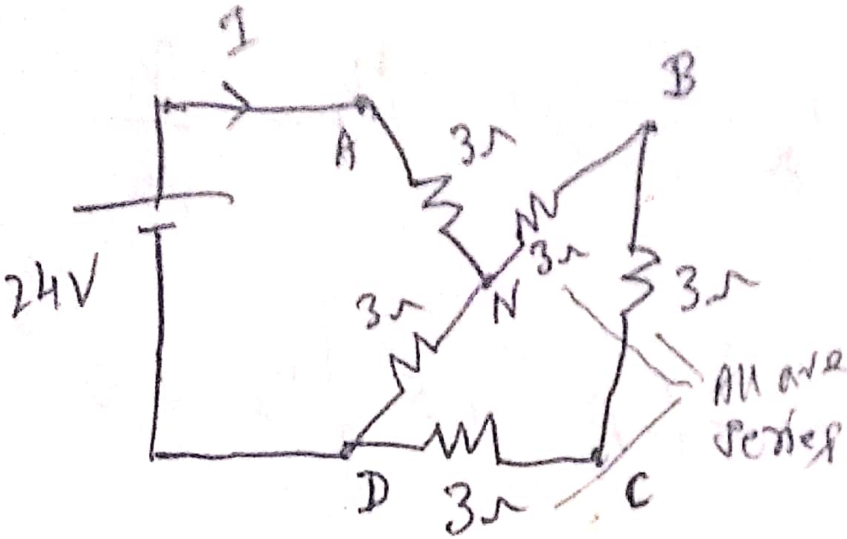
(Name the nodes)

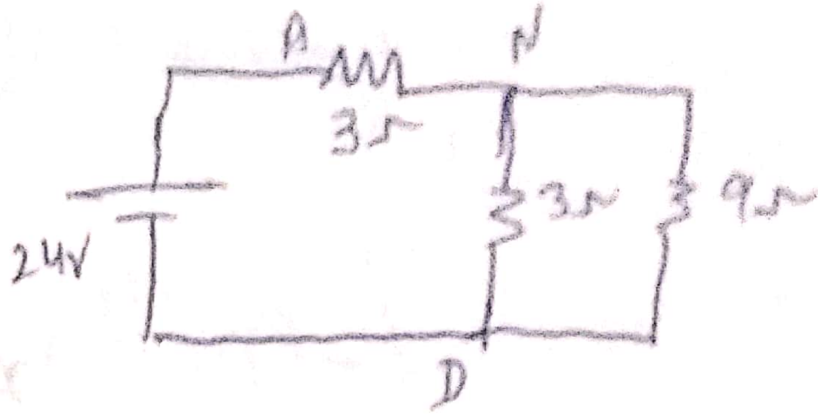
Converting Δ to Y ↓ between nodes A B D

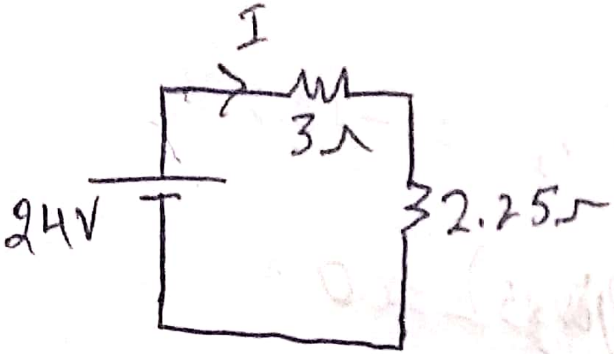


$\Delta \xrightarrow{\div 3} Y$

(when all the elements in Δ are equal)

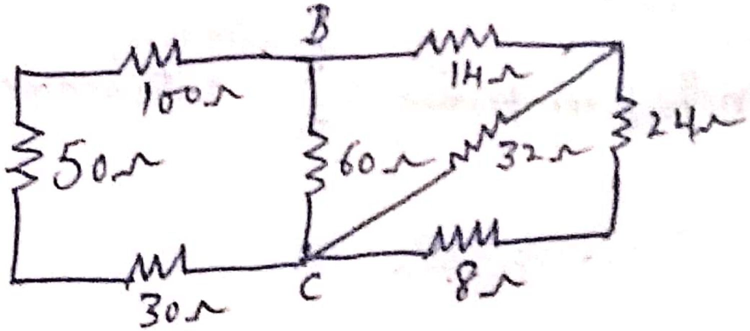






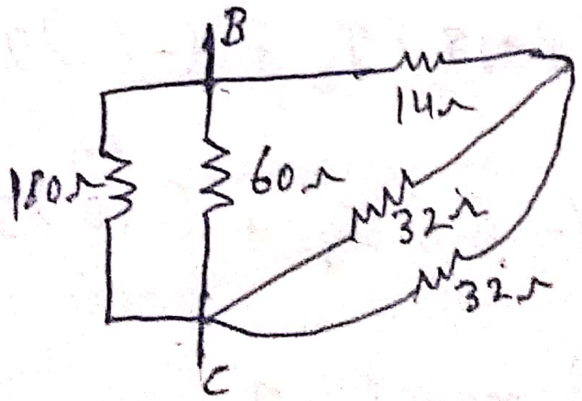
$$I = \frac{24}{(3+2.25)} = 4.57A$$

Sol :



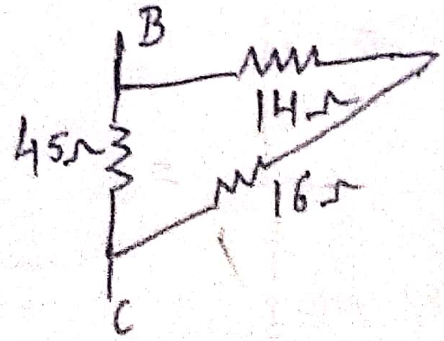
Stretch the points B & C. Then 100Ω, 50Ω, 30Ω will be in series

8Ω, 24Ω in series

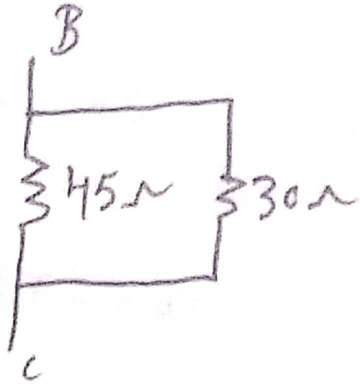


180Ω, 60Ω parallel

32Ω, 32Ω parallel



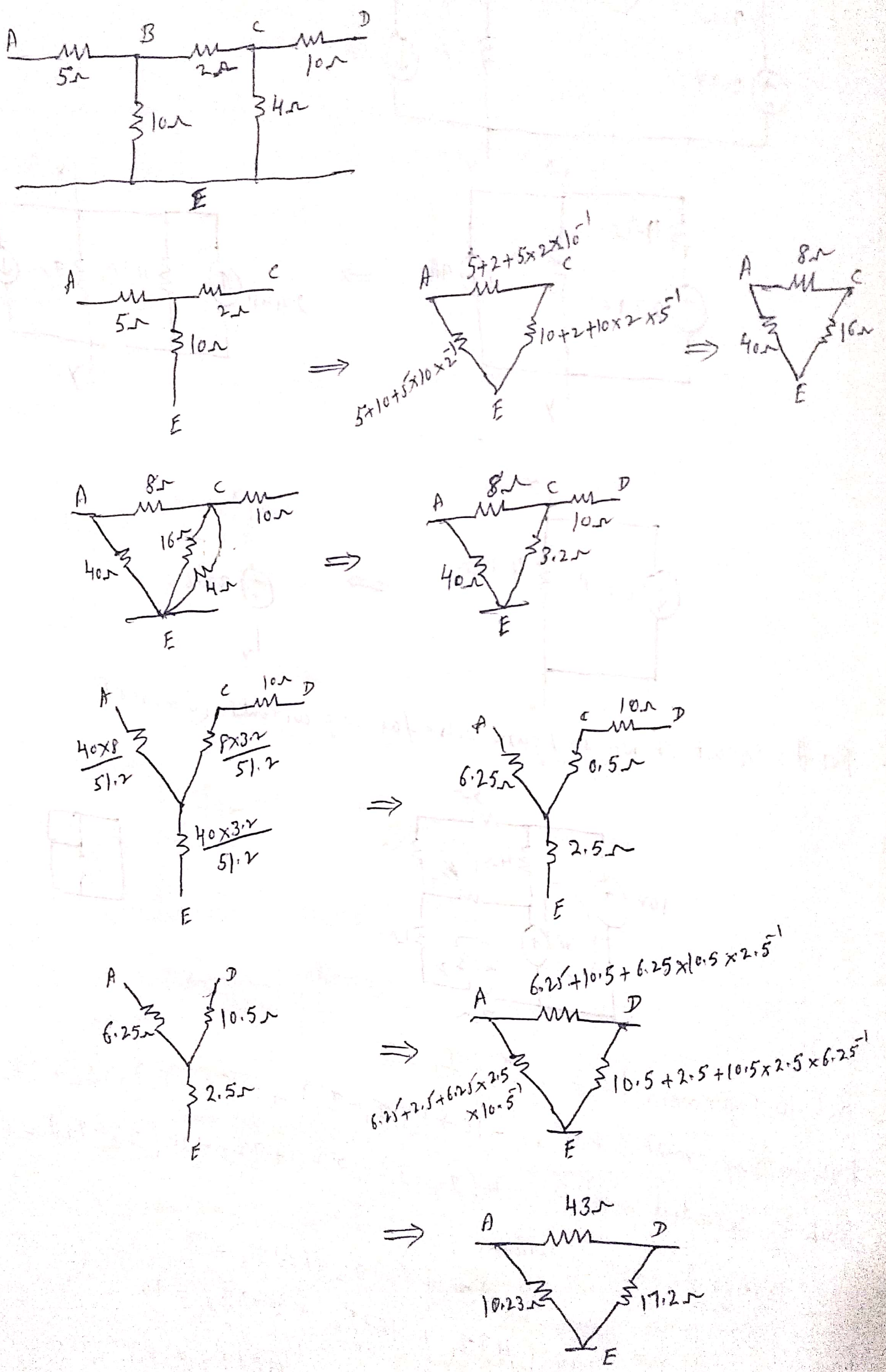
14Ω, 16Ω in series



45Ω, 30Ω in parallel

c. Find the equivalent delta connection for the circuit shown in figure. (8 Marks)

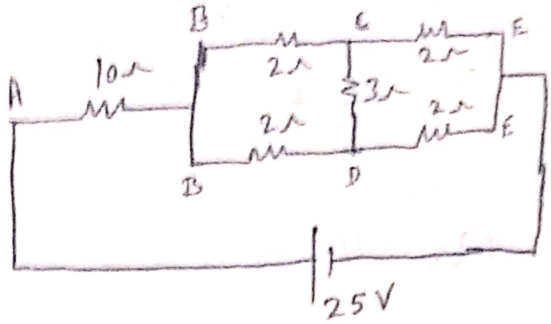
Sol:



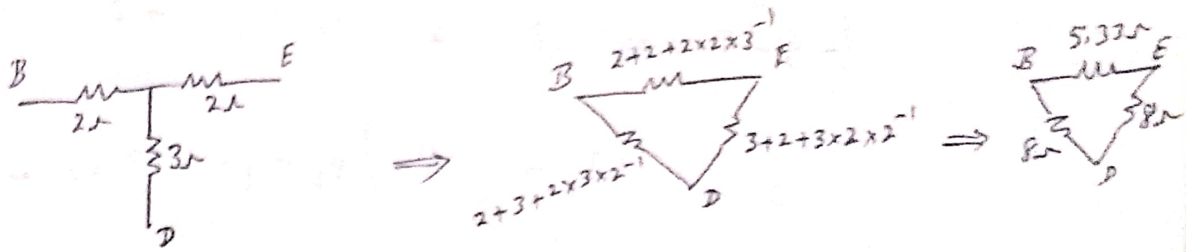
OR

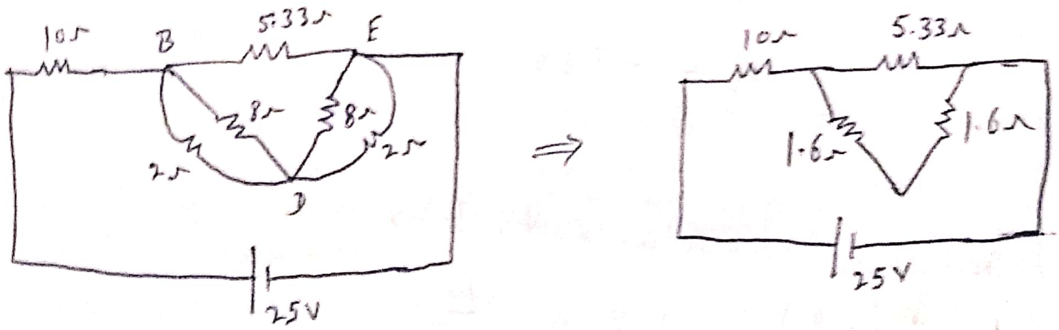
2.a. Find the current in the 10 ohm for the circuit shown in figure. Use Star delta transformation (6 Marks)

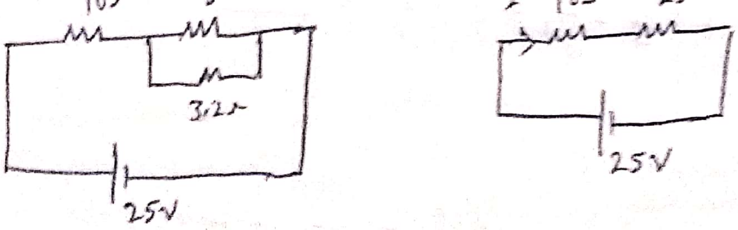
Sol:



Name the nodes



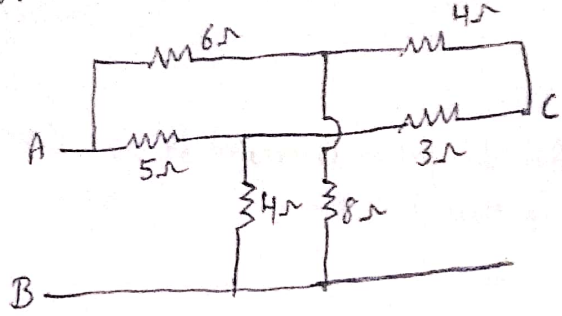




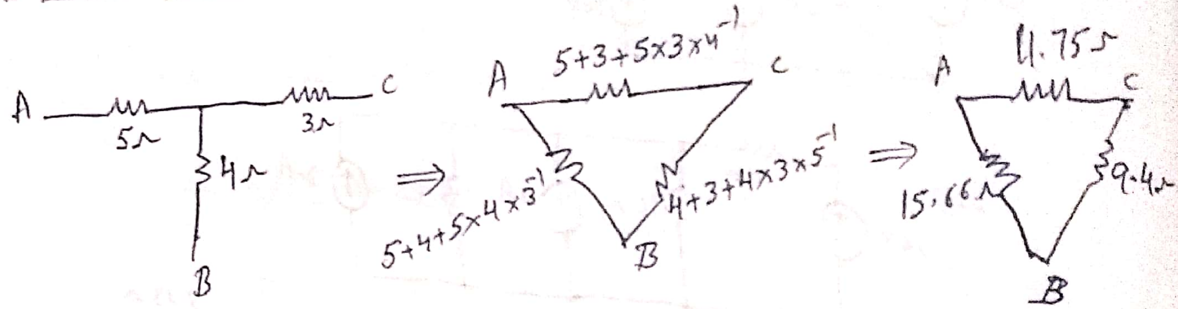
$$I_{10\Omega} = \frac{25}{12} = 2.083A$$

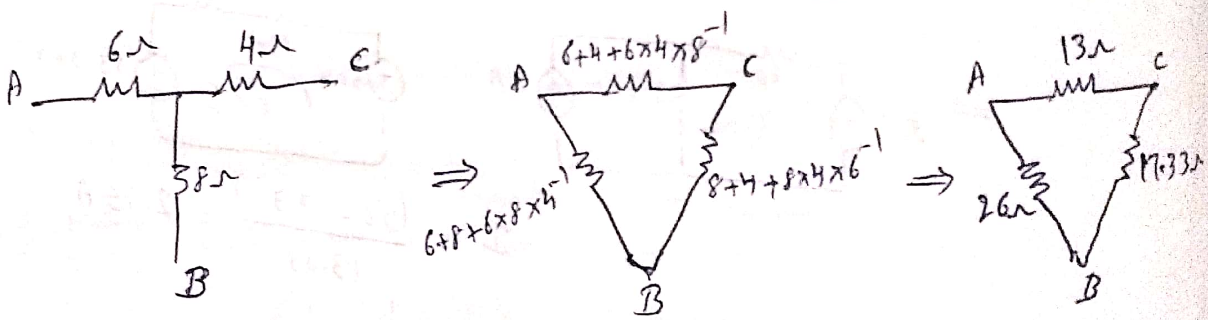
1.a. Find an equivalent resistance between A & B for the network shown in figure using star-delta transformation. (6 Marks)

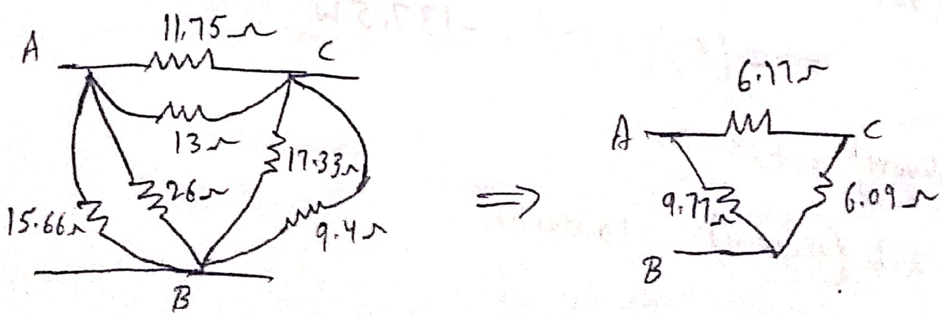
Sol:

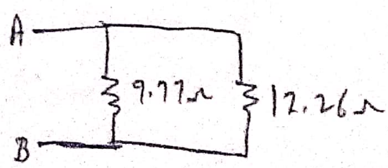


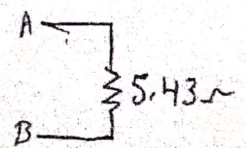
This is Twin-T network





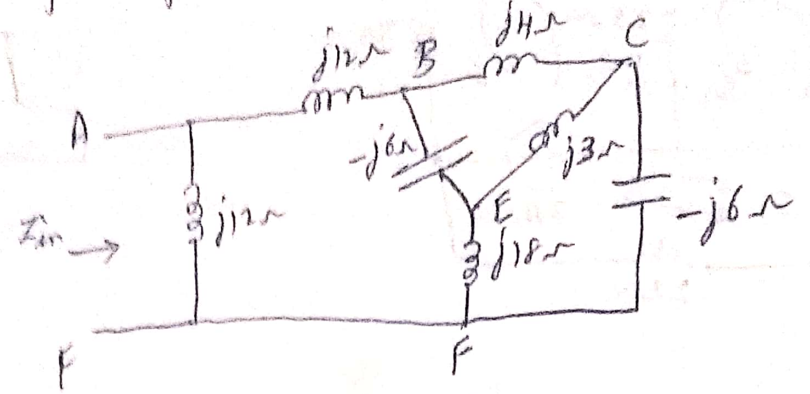




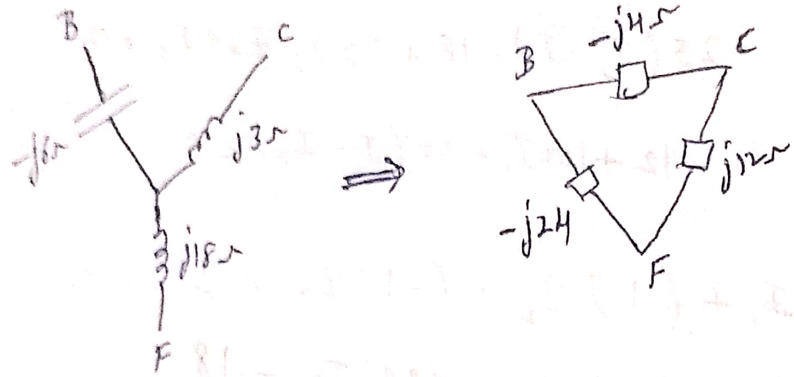


1.a. Find the input impedance Z_{in} for the network shown in figure (6 Marks)

Sol:



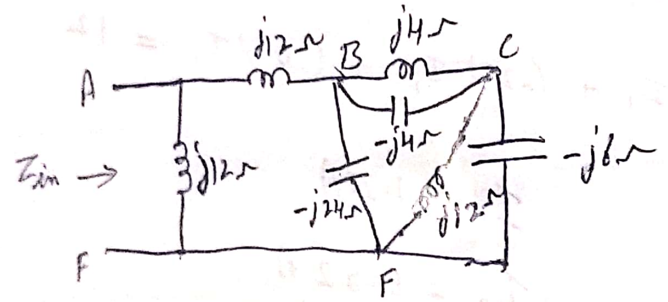
Y → Δ



$Z_{BC} = -j6 + j3 - j6 \times j3 \times (j18)^{-1}$

$Z_{CF} = j3 + j18 + j3 \times j18 \times (-j6)^{-1}$

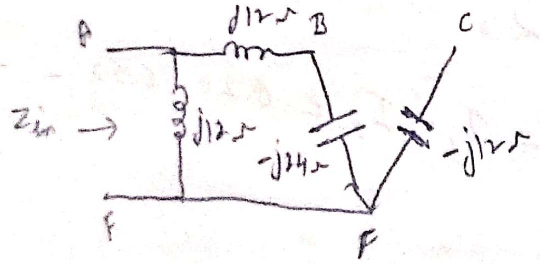
$Z_{BF} = -j6 + j18 - j6 \times j18 \times (j3)^{-1}$

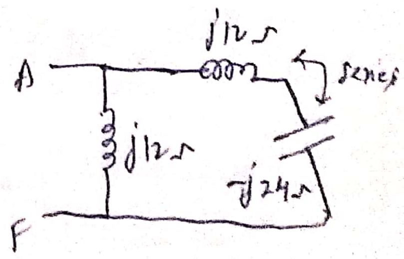


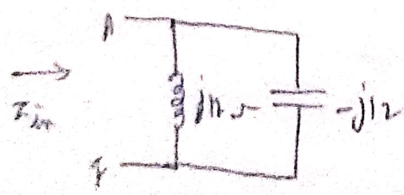
Don't use calculator. It will show Math error.

$\frac{Z_1 Z_2}{Z_1+Z_2} = \frac{j4 \times j4}{j4 - j4} = \frac{Nr}{0} = \infty \Rightarrow$ open circuit

$\frac{j12 \times -j6}{j12 - j6} = -j12\Omega$







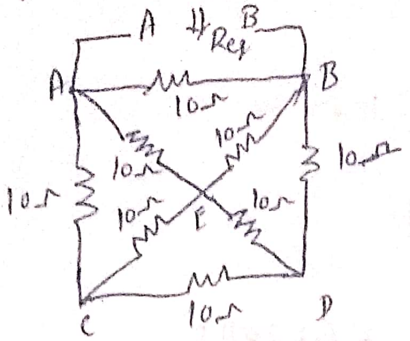
$\frac{j12 \times -j12}{j12 - j12} = \frac{Nr}{0} = \infty$

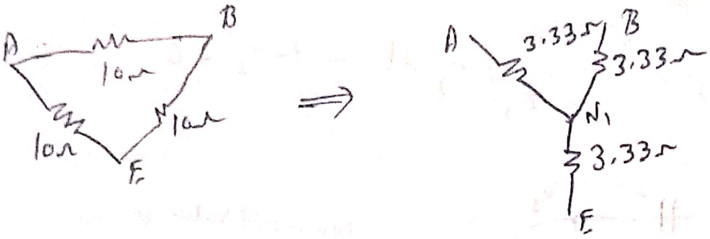
$Z_{in} = \infty\,\Omega$

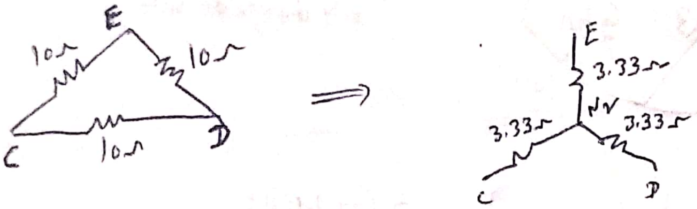
$\boxed{\text{OR}}$

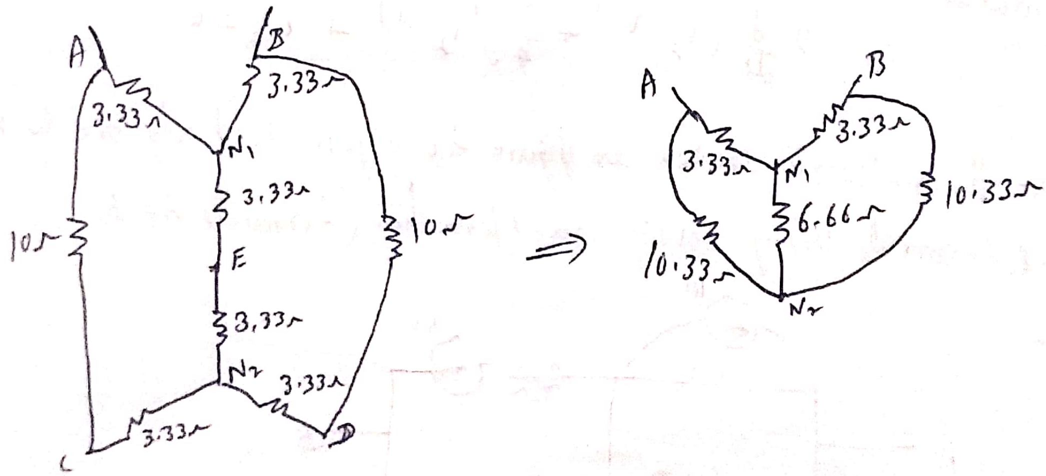
Q.9. Find R_{eq} for the network shown in figure across A & B. Each resistance is 10Ω (6 marks)

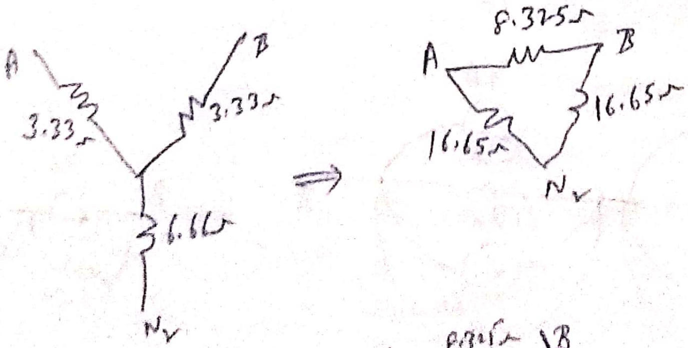
Sol:







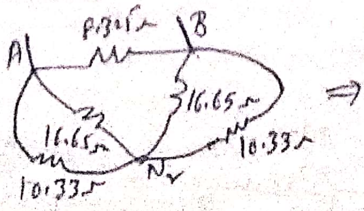


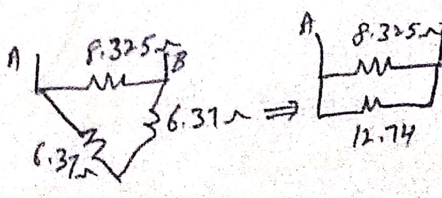


$R_{AB} = 3.33 + 3.33 + 3.33 \times 3.33 \times 6.66^{-1}$

$R_{BN_2} = 3.33 + 6.66 + 3.33 \times 6.66 \times 3.33^{-1}$

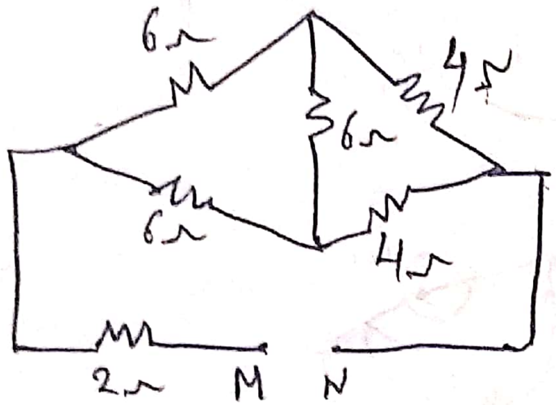
$R_{AN_2} = R_{BN_2}$





$R_{eq} = R_{AB} = 5.034\Omega$

1.b. For the Circuit shown in figure determine resistance between M & N using Star/delta transformation (6 marks)



Sol: