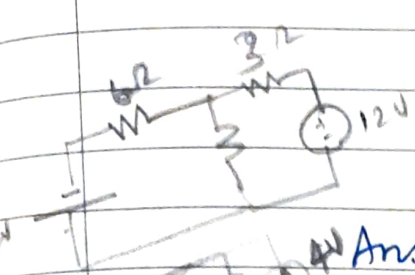
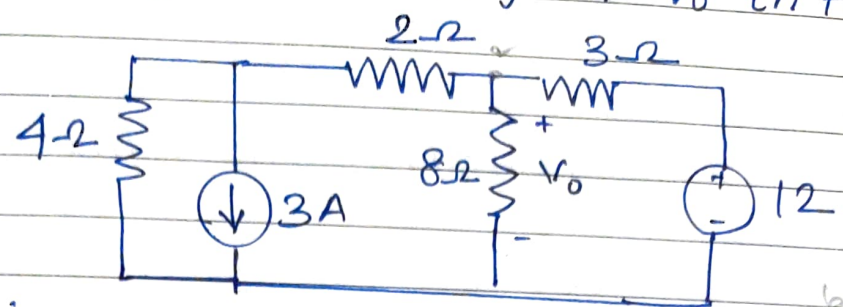
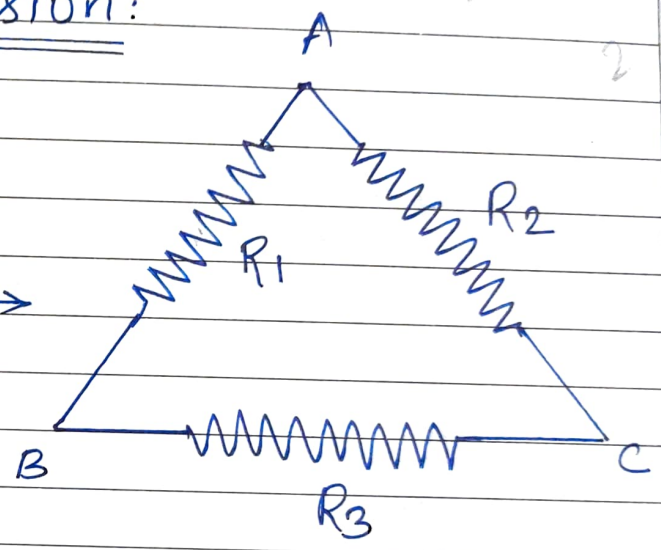
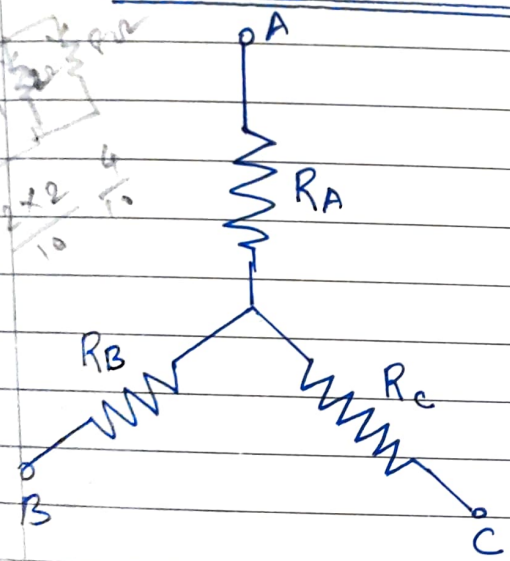


(4) Use source transformation to find V_0 in the circuit



Ans: $V_0 = 3.2V$

Star to delta conversion:



The resistance b/w A & B in star connection
 $R_{AB} = R_A + R_B \rightarrow \textcircled{1}$

The resistance b/w A & B in delta connection

$$R_{AB} = R_1 \parallel (R_2 + R_3)$$

$$R_{AB} = \frac{R_1 (R_2 + R_3)}{R_1 + R_2 + R_3} \rightarrow \textcircled{2}$$

Similarly B & C terminal in star'

$$R_{BC} = R_B + R_C \rightarrow \textcircled{3}$$

BSC terminal in delta.

$$R_{BC} = \frac{R_3 (R_1 + R_2)}{R_1 + R_2 + R_3} \longrightarrow \textcircled{4}$$

Illy C & A terminal in star

$$R_{CA} = R_C + R_A \longrightarrow \textcircled{5}$$

~~Illy~~ C & A terminal in delta

$$R_{CA} = \frac{R_2 (R_1 + R_3)}{R_1 + R_2 + R_3} \longrightarrow \textcircled{6}$$

Equating $\textcircled{1}$ & $\textcircled{2}$, $\textcircled{3}$ & $\textcircled{4}$ and $\textcircled{5}$ & $\textcircled{6}$

$$R_A + R_B = \frac{R_1 (R_2 + R_3)}{R_1 + R_2 + R_3} \longrightarrow \textcircled{7}$$

$$R_B + R_C = \frac{R_3 (R_1 + R_2)}{R_1 + R_2 + R_3} \longrightarrow \textcircled{8}$$

$$R_C + R_A = \frac{R_2 (R_1 + R_3)}{R_1 + R_2 + R_3} \longrightarrow \textcircled{9}$$

Subtract $\textcircled{8}$ from $\textcircled{7}$ and add $\textcircled{9}$

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

Subtract $\textcircled{9}$ from $\textcircled{8}$ and add $\textcircled{7}$

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

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

$R_C = R_C$

Subtract ⑦ from ⑨ and add ⑧

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

$$R_A R_B = \frac{R_1^2 R_2 R_3}{(R_1 + R_2 + R_3)^2}; \quad R_B R_C = \frac{R_3^2 R_1 R_2}{(R_1 + R_2 + R_3)^2}$$

$$R_C R_A = \frac{R_2^2 R_1 R_3}{(R_1 + R_2 + R_3)^2}$$

$$R_A R_B + R_B R_C + R_C R_A = \frac{R_1^2 R_2 R_3 + R_3^2 R_1 R_2 + R_2^2 R_1 R_3}{(R_1 + R_2 + R_3)^2}$$

$$R_A R_B + R_B R_C + R_C R_A = \frac{R_1 R_2 R_3 (R_1 + R_2 + R_3)}{(R_1 + R_2 + R_3)^2}$$

$$R_A R_B + R_B R_C + R_C R_A = \frac{R_1 R_2 R_3}{R_1 + R_2 + R_3} \quad \rightarrow \textcircled{10}$$

In eqn ⑩ dividing the LHS by R_A , gives R_2 ,
dividing it by R_B gives R_3 , and doing the
same with R_C , gives R_1 .

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

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

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