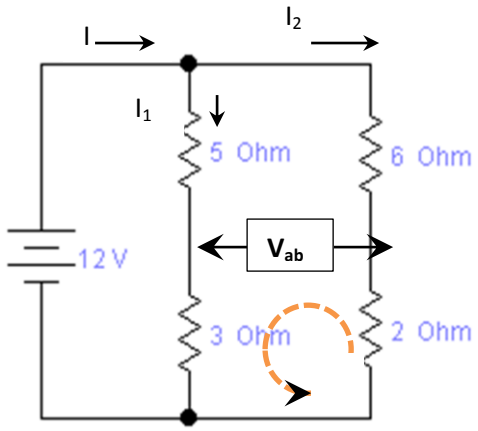
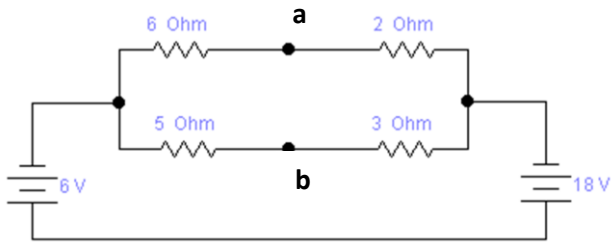
EX1: Find V_{ab}, I_1, I_2 ?

Solution:



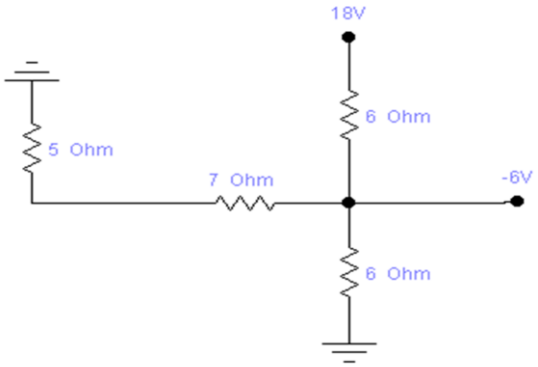


$$V_3 = 12 * \frac{3}{3+5} = 4.5V, V_2 = 12 * \frac{2}{2+6} = 3V$$

$$V_{ab} + V_2 + V_3 = 0\ ;\ V_{ab} = V_3 - V_2 = 1.5V$$

$$I = \frac{12}{8\ //\ 8} = 3A; I_1 = 3\frac{8}{8+8} = 1.5A = I_2$$

EX2: Find I?



Voltage divider:

$$V_1 = V * \frac{R_1}{R_1+R_2+R_3+\cdots} \quad all\ (R)\ are\ series$$

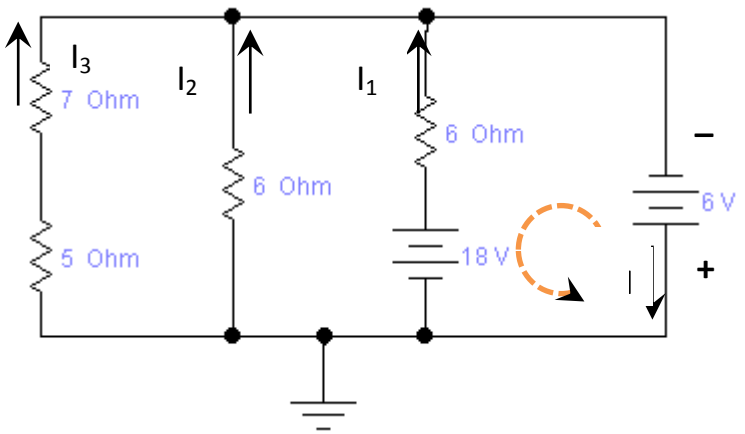
Current divider:

$$I_1 = I * \frac{G_1}{G_1+G_2+G_3+\cdots} \quad all\ (R)\ are\ parallel$$

Solution

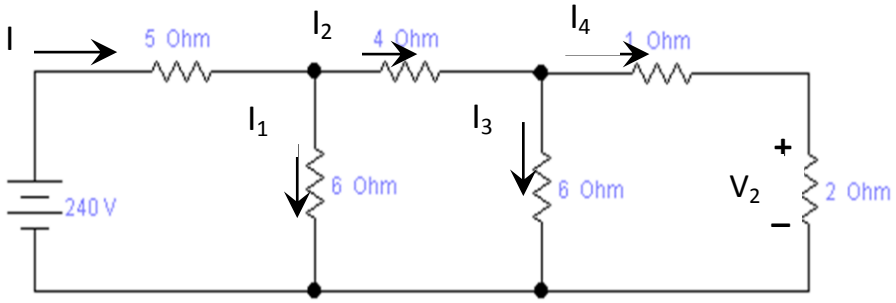
$$\mathbf{-18 + V_1 - 6 = 0; V_1 = 24V;\ I_1 = \frac{24}{6} = 4A;\ I_2 = \frac{6}{6} = 1A;\ I_3 = \frac{6}{12} = 0.5A;}$$

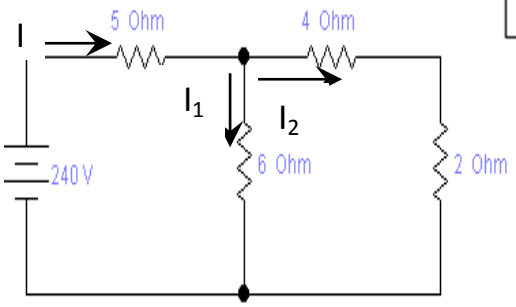
$$I = \boldsymbol{I_1 + I_2 + I_3} = 5.5A$$

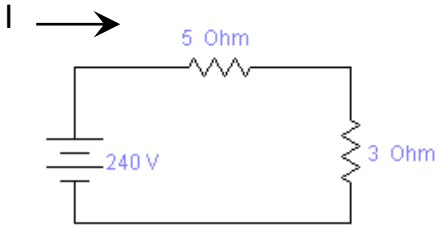


Ladder cct.

EX3: Find V_2?

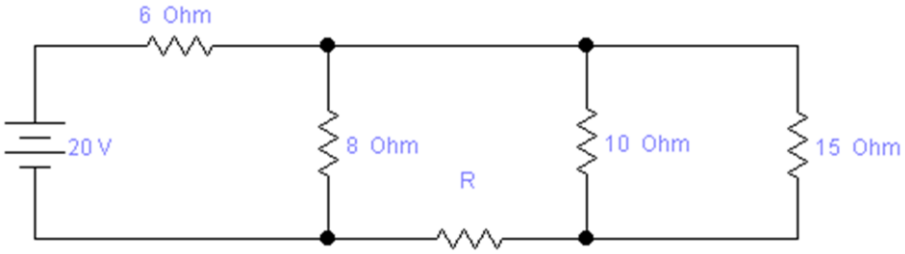


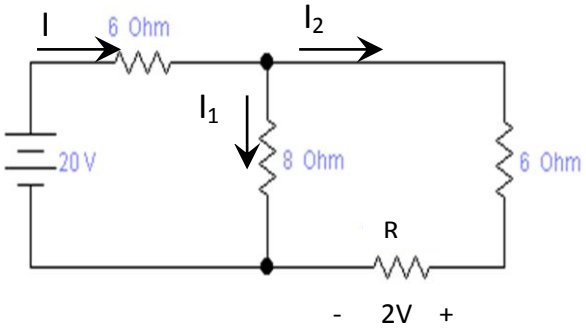




$$I = \frac{240}{8} = 30A \;;\; I_1 = \frac{30 * 6}{12} = 15A = I_2 \;;\; I_4 = 15\frac{6}{3+6} = 10A \;;\; \therefore V_2 = 2 * 10 = 20V$$

EX4: Find R?





$$[8 \parallel (6+R)] = \frac{8(6+R)}{8+6+R} = \frac{48+8R}{14+R}$$

$$R_t = \frac{48+8R}{14+R} + 6 = \frac{48+8R+84+6R}{14+R} = \frac{132+14R}{14+R}$$

$$I = \frac{20}{R_t} = \frac{20(14+R)}{132+14R} \;; I_2 = \frac{20(14+R)}{132+14R} * \frac{8}{14+R}$$

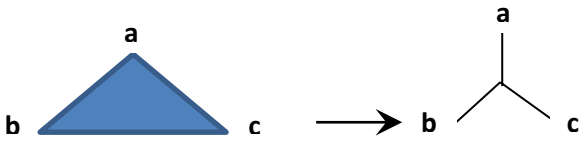
$$I_2 = \frac{160}{132+14R} \;; R = \frac{2}{I_2} = \frac{2(132+14R)}{160}$$

$$= \frac{132+14R}{80} = \frac{66+7R}{40}$$

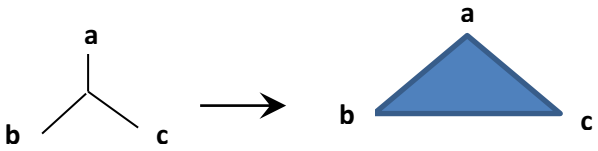
$$40R = 66 + 7R \Longrightarrow 40R - 7R = 66 \Rightarrow 33R = 66$$

$$R = \frac{66}{33} = 2\Omega$$

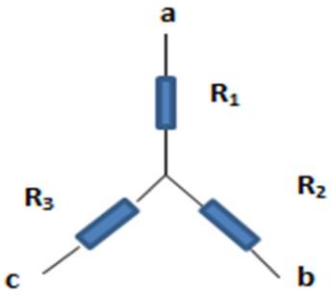
Delta & Star

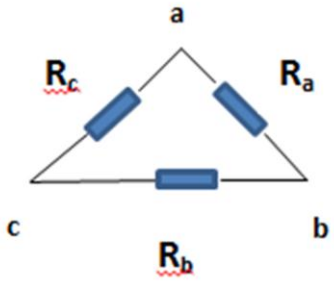
Convert 

$$R_a = \frac{R_{ab} * R_{ac}}{R_{ab}+R_{ac}+R_{bc}} \quad ; \quad R_b = \frac{R_{ab} * R_{bc}}{R_{ab}+R_{ac}+R_{bc}} \quad ; \quad R_c = \frac{R_{ac} * R_{bc}}{R_{ab}+R_{ac}+R_{bc}}$$

Convert 

$$R_{ab} = R_a + R_b + \frac{R_a * R_b}{R_c} \quad ; \quad R_{ac} = R_a + R_c + \frac{R_a * R_c}{R_b} \quad ; R_{bc} = R_b + R_c + \frac{R_b * R_c}{R_a}$$





R_{ab} for Star = R_{ab} for △

$$\text{Rab} = R_1 + R_2 = R_a \parallel (R_b + R_c) = \frac{R_a(R_b + R_c)}{R_a + R_b + R_c}$$

$$\text{R}_{ab} = R_1 + R_2 = \frac{R_aR_b + R_aR_c}{R_a + R_b + R_c} \quad ; \quad \text{R}_{bc} = R_2 + R_3 = \frac{R_aR_b + R_bR_c}{R_a + R_b + R_c}$$

$$\text{R}_{ac} = R_1 + R_3 = \frac{R_aR_c+R_bR_c}{R_a+R_b+R_c}$$

$$R_1 + R_2 - (R_2 + R_3) = \frac{\cancel{R_aR_b} + R_aR_c - \cancel{R_aR_b} - R_bR_c}{R_a + R_b + R_c}$$

$$R_1 - R_3 = \frac{R_aR_c - R_bR_c}{R_a + R_b + R_c}$$

$$R_1 + R_3 - (R_1 - R_3) = \frac{\boldsymbol{R_a R_c + R_b R_c - R_a R_c - R_b R_c}}{\boldsymbol{R_a + R_b + R_c}} \quad ; \quad 2R_3 = \frac{\boldsymbol{2R_b R_c}}{\boldsymbol{R_a + R_b + R_c}}$$

Following the same procedure:

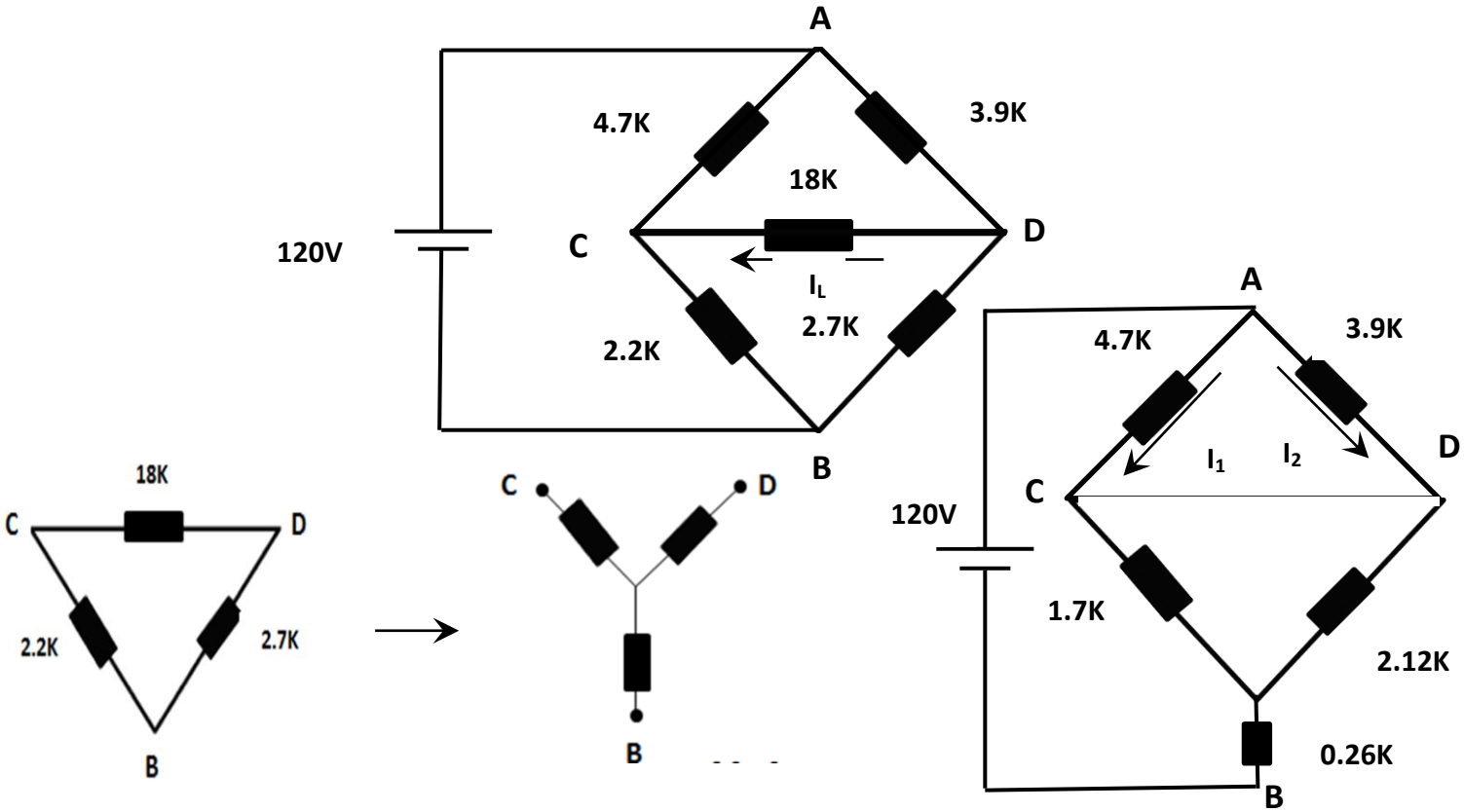
$$R_1 = \frac{\boldsymbol{R_a R_c}}{\boldsymbol{R_a + R_b + R_c}} \quad \boldsymbol{and} \quad R_2 = \frac{\boldsymbol{R_a R_b}}{\boldsymbol{R_a + R_b + R_c}}$$

Converting △ ⟶ Y we will have:

$$\boldsymbol{R_a} = \frac{\boldsymbol{R_1R_2 + R_2R_3 + R_1R_3}}{\boldsymbol{R_3}} \; ; \; \boldsymbol{R_b} = \frac{\boldsymbol{R_1R_2 + R_2R_3 + R_1R_3}}{\boldsymbol{R_1}} \; ; \; \boldsymbol{R_c} = \frac{\boldsymbol{R_1R_2 + R_2R_3 + R_1R_3}}{\boldsymbol{R_2}}$$

1. Each resistor of the Y is equal to the product of a resistors in the two closes branches of the △ divided by the sum of the resistors in the △.
2. Each resistor of the △ is equal to the sum of the possible product combination of the resistance of the Y divided by the resistance o Y for these from the resistor to be determined.

EX1: Find I_L?



$$R_1 = \frac{18 * 2.2}{18 + 2.2 + 2.7} = 173K\Omega \quad ; \quad R_2 = \frac{18 * 2.7}{18 + 2.2 + 2.7} = 2.12K\Omega \quad ; \quad R_3 = \frac{2.2 * 2.7}{18 + 2.2 + 2.7} = 0.26K\Omega$$

$$R_t = \frac{(4.7 + 1.73)(3.4 + 2.12)}{(4.7 + 1.73) + (3.4 + 2.12)} + 0.26 \quad ; \quad R_t = 3.37K\Omega$$

$$I_t = \frac{120}{3.37} = 35.6mA$$

$$I_1 = 35.6\frac{(3{,}9 + 2.12)}{(3.9 + 2.12) + (4.7 + 1.73)} = 17.2mA$$

$$I_1 = 17.2mA \quad ; \quad I_2 = I_t - I_1 \quad ; \quad I_2 = 18.38mA$$

$$V_D = 120 - I_2 * 3.9$$

$$V_D = 120 - (18.38 * 3.9\ ) = 48.32V$$

$$V_C = 120 - I_1 * 4.7 \quad ; \quad V_C = 120 - (17.2 * 4.7) = 39.18V$$

$$V_{DC} = V_D - V_C \quad ; \quad V_{DC} = 48.32 - 39.18 = 9.14\text{V}$$

$$I_L = \frac{V_{DC}}{18} = \frac{9.14}{18} = 0.507mA$$