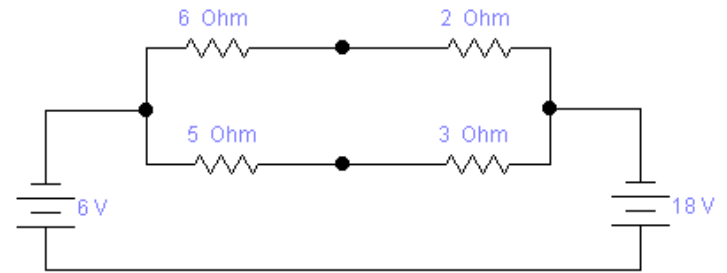


EX1: Find V_{ab} , I_1 , I_2 ?

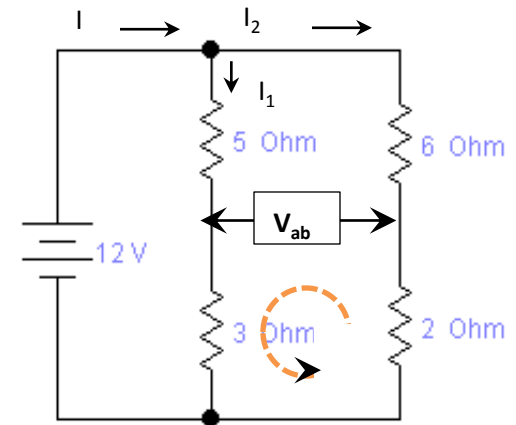


Solution:

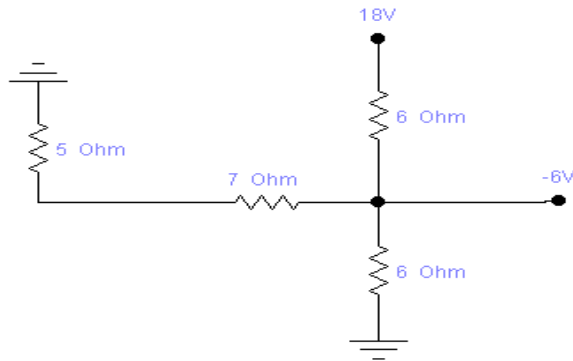
$$V_3 = 12 * \frac{3}{3 + 5} = 4.5V, V_2 = 12 * \frac{2}{2 + 6} = 3V$$

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

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



EX2: Find I?



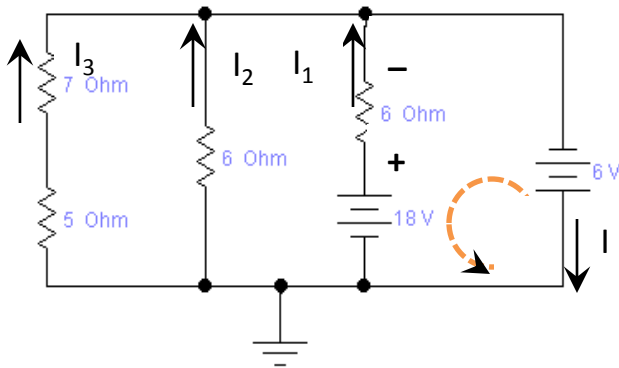
Voltage divider:

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

Current divider:

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

Solution:

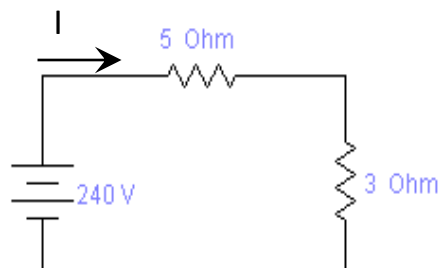
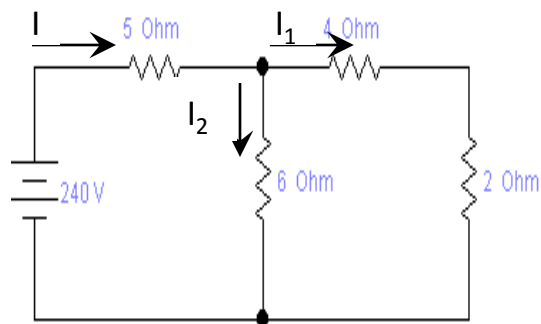
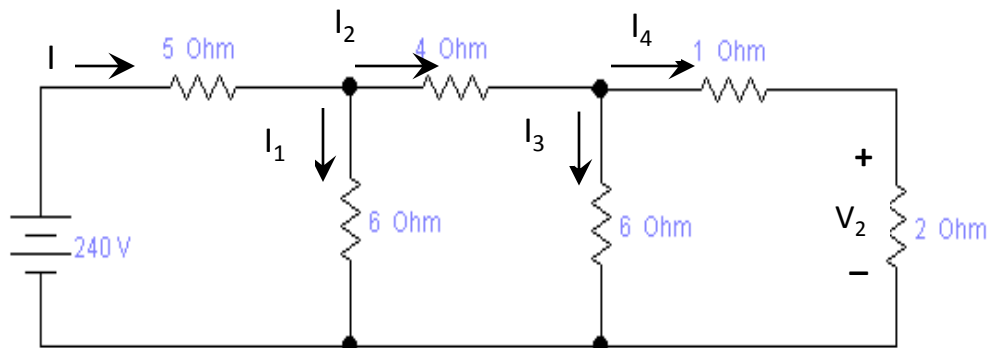


$$-18 + V_1 - 6 = 0; V_1 = 24V; I_1 = \frac{24}{6} = 4A; I_2 = \frac{6}{6} = 1A; I_3 = \frac{6}{12} = 0.5A;$$

$$I = I_1 + I_2 + I_3 = 5.5A$$

Ladder cct

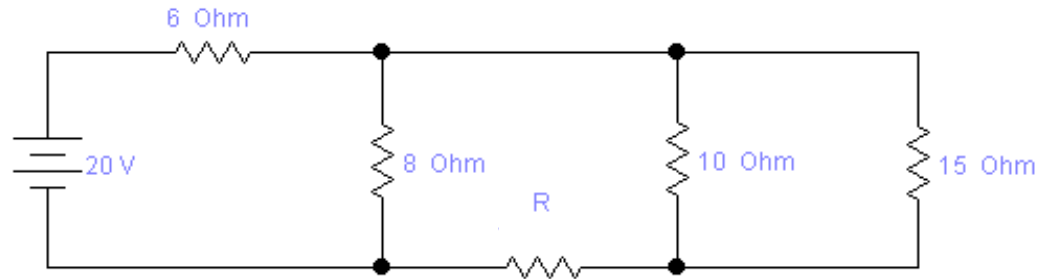
EX3: Find V_2 ?



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

$$\therefore V_2 = 2 * 10 = 20V$$

EX4: Find R?



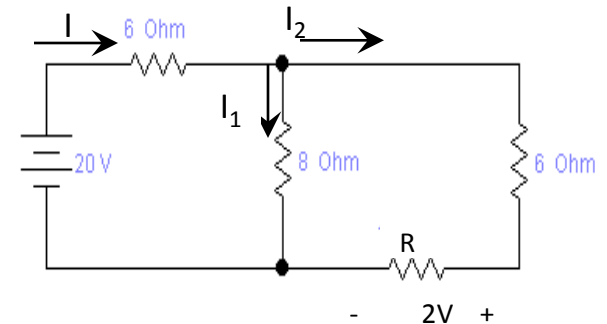
$$[8 \parallel (6 + R)] = \frac{8(6+R)}{8+6+R} = \frac{48+8R}{14+R}$$

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

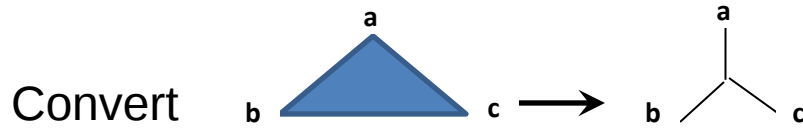
$$I = \frac{20}{R_t} = \frac{20(14 + R)}{132 + 14R} ; I_2 = \frac{20(14 + R)}{132 + 14R} * \frac{8}{14 + R}$$

$$I_2 = \frac{160}{132 + 14R} ; R = \frac{2}{I_2} = \frac{2(132 + 14R)}{160} = \frac{132 + 14R}{80}$$

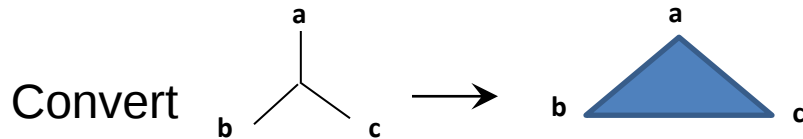
$$R = \frac{66+7R}{40} \Rightarrow 40R = 66 + 7R \Rightarrow 40R - 7R = 66 \Rightarrow 33R = 66 \Rightarrow R = \frac{66}{33} = 2\Omega$$



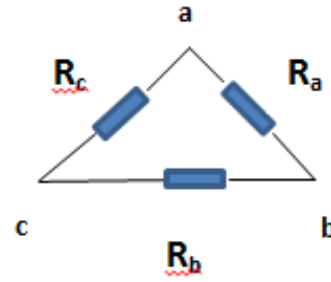
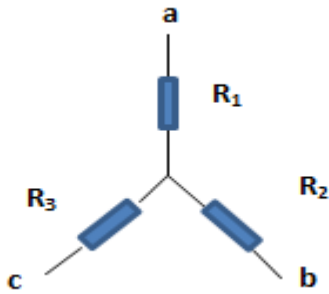
Delta & Star



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



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



R_{ab} for Star = R_{ab} for Δ

$$R_{ab} = R_1 + R_2 = R_a \parallel (R_b + R_c) = \frac{R_a(R_b + R_c)}{R_a + R_b + R_c}$$

$$R_{ab} = R_1 + R_2 = \frac{R_a R_b + R_a R_c}{R_a + R_b + R_c} \quad ; \quad R_{bc} = R_2 + R_3 = \frac{R_a R_b + R_b R_c}{R_a + R_b + R_c}$$

$$R_{ac} = R_1 + R_3 = \frac{R_a R_c + R_b R_c}{R_a + R_b + R_c}$$

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

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

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

Following the same procedure:

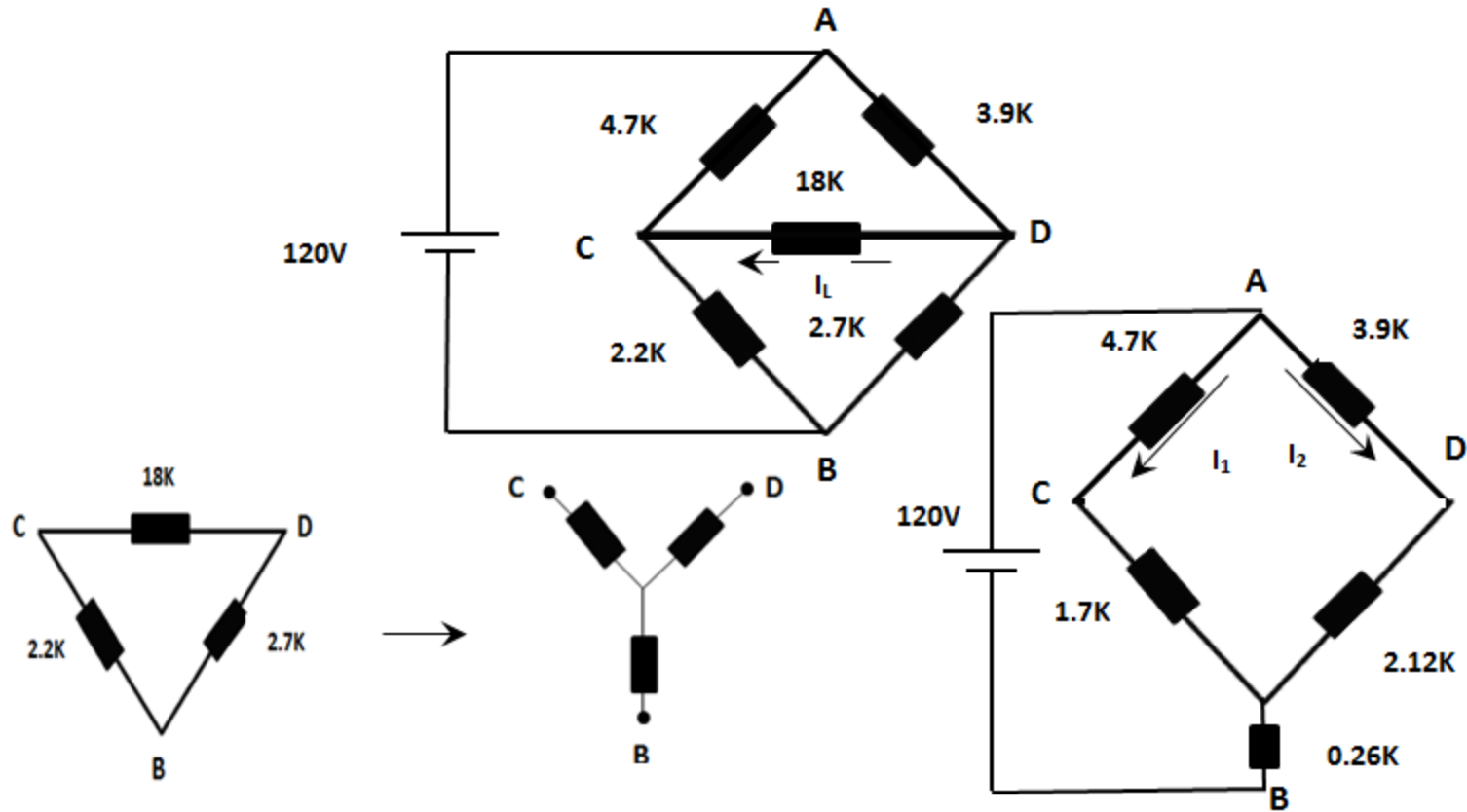
$$R_1 = \frac{R_a R_c}{R_a + R_b + R_c} \quad \text{and} \quad R_2 = \frac{R_a R_b}{R_a + R_b + R_c}$$

Converting $\triangle \longrightarrow \text{Y}$ we will have:

$$R_a = \frac{R_1 R_2 + R_2 R_3 + R_1 R_3}{R_3} \quad ; \quad R_b = \frac{R_1 R_2 + R_2 R_3 + R_1 R_3}{R_1} \quad ; \quad R_c = \frac{R_1 R_2 + R_2 R_3 + R_1 R_3}{R_2}$$

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

EX1: Find I_L ?



$$R_1 = \frac{18 * 2.2}{18 + 2.2 + 2.7} = 1.73K\Omega \quad ; \quad R_2 = \frac{18 * 2.7}{18 + 2.2 + 2.7} = 2.12K\Omega \quad ; \quad R_3 = \frac{2.2 * 2.7}{18 + 2.2 + 2.7} = 0.26K\Omega$$

$$R_t = \frac{(4.7 + 1.73)(3.9 + 2.12)}{(4.7 + 1.73) + (3.9 + 2.12)} + 0.26 \quad ; \quad R_t = 3.37K\Omega$$

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

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

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

$$V_D = 120 - I_2 * 3.9$$

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

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

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

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