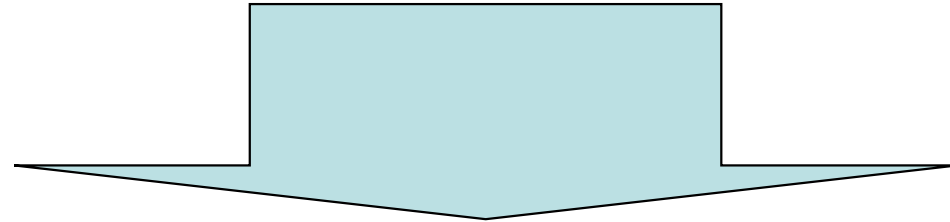


دوائر التيار المستمر



Resistances connection

توصيل (ربط) المقاومات

B –Rationale

مبررات الوحدة

□ It is very important to study

Resistances connection:

Series circuit, Parallel circuits and complex connection

□ Also to study **Voltage divider rule** ,
the current divider rule and Ohms' law

C – Central الفكرة المركزية **Idea**

- connect the resistance as series ,parallel and complex.
- **Voltage divider rule, the current divider rule.**
- **Ohms' law.**

D- Aim of lecture :

To let the student be able to identify the analyses different kind of resistance connection (series, parallel ,complex)

Pretest

الاختبار القبلي

1): If number of resistances connection in series wrights total voltage , current laws .

2) If number of resistances connection in Parallel wrights total voltage , current laws .

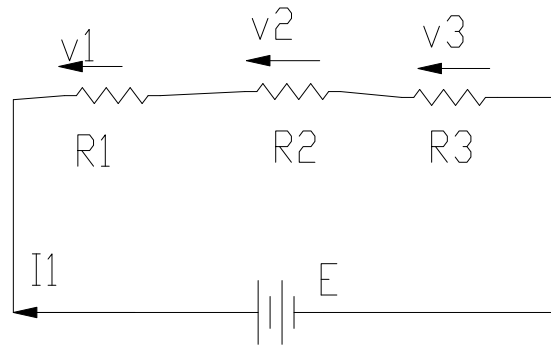
solution

$$1) V_T = V_1 + V_2 + \dots + V_n \quad , \quad I_T = I_1 = I_2 = I_n$$

$$2) I_T = I_1 + I_2 + \dots + I_n \quad , \quad V_T = V_1 = V_2 = V_n$$

1

Series circuit

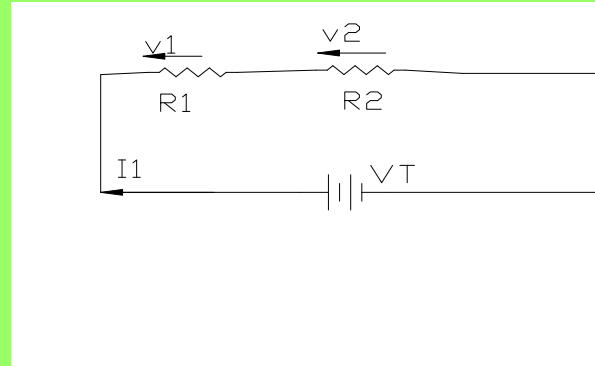


$$I = I_1 = I_2 = I_3 = \dots = I_n \quad V_T = V_1 + V_2 + V_3 + \dots + V_n$$

$$R_T = R_1 + R_2 + R_3 + \dots + R_n$$

When : n number of resistances

قانون تقسيم الفولتية Voltage divider rule



$$V_1 = I \cdot R_1 = V_T \cdot R_1 / (R_1 + R_2)$$

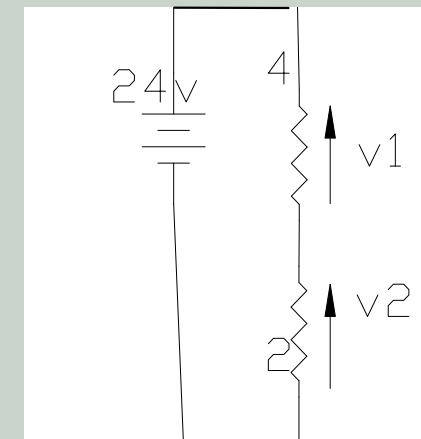
$$V_2 = I \cdot R_2 = V_T \cdot R_2 / (R_1 + R_2)$$

Ex: By using V.d. r. Find

V1, V2

$$V_1 = V_T \cdot R_1 / (R_1 + R_2) \\ = 4 \times 24 / (4 + 2) = 16\text{v}$$

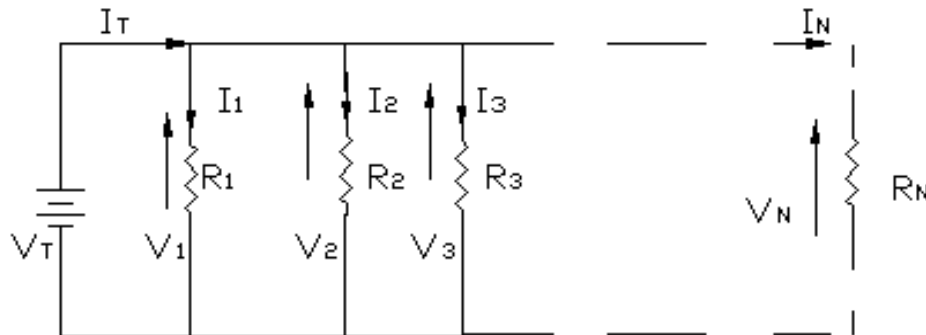
$$V_2 = V_T \cdot R_2 / (R_1 + R_2) \\ = 2 \times 24 / (4 + 2) = 8\text{v}$$



2

Parallel circuits

دوائر التوازي



$$V_T = V_1 = V_2 = V_3 = V_n$$

$$I_T = I_1 + I_2 + I_3 + \dots + I_n$$

$$1/R_T = 1/R_1 + 1/R_2 + 1/R_3 + \dots + 1/R_n$$

$$G_T = G_1 + G_2 + G_3 + \dots + G_n, \quad \{G = 1/R\}$$

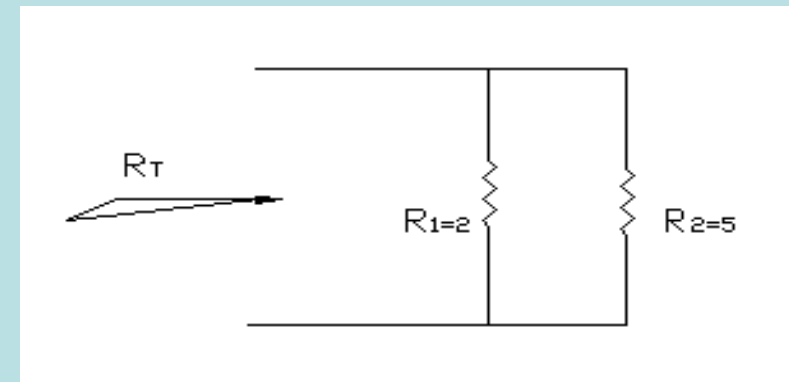
G : conductance الموصلية (مو)

For two resistance parallel connected as shown in fig.

$$1/R_T = 1/2 + 1/5 = 7/10 \therefore R_T = 10/7 = 1.4\Omega$$

OR: $R_T = R_1 \cdot R_2 / (R_1 + R_2)$

$$= 2 \times 5 / (2 + 5) = 10/7 = 1.4\Omega$$

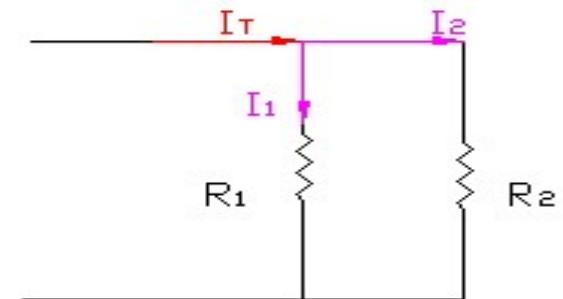


The current divider rule (قانون تقسيم التيارات)

$$I_1 = V/R_1 = I_T \times \frac{R_2}{R_1 + R_2}$$

$$\therefore I_1 = \frac{R_2}{R_1 + R_2} \cdot I_T$$

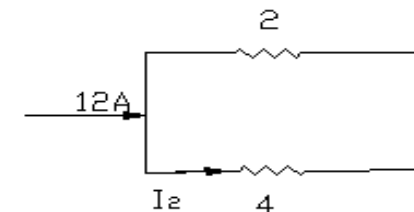
$$\text{Also: } I_2 = \frac{R_1}{R_1 + R_2} \cdot I_T$$



EX(1) : Find I1, I2 For the cct. Shown

؛ Solution; $I_1 = \frac{R_2}{R_1 + R_2} \times I_T = \frac{4}{2+4} \times 12 = 8A$

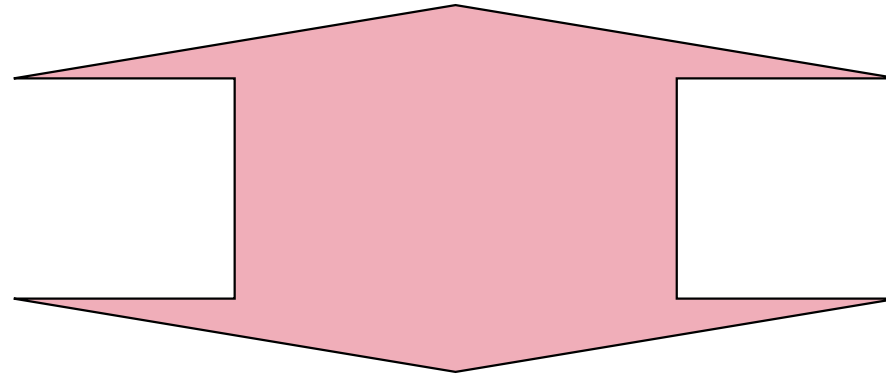
$$I_2 = \frac{2}{2+4} \times 12 = 4A$$



Ohms' law

I = current in Ampere (A)

$$V = I \times R$$

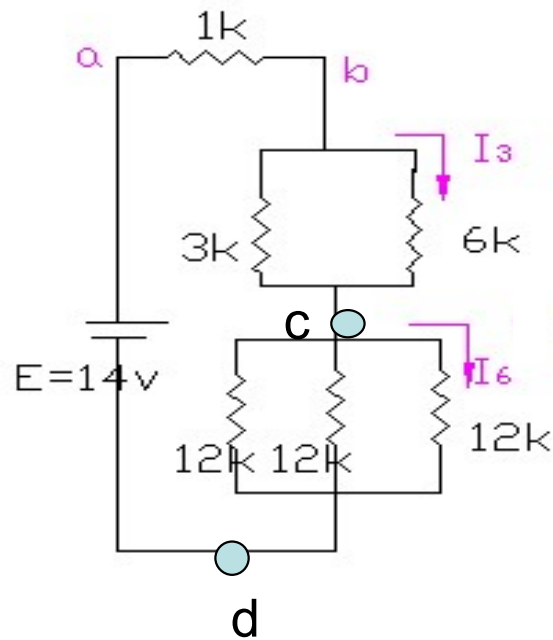


THE POWER

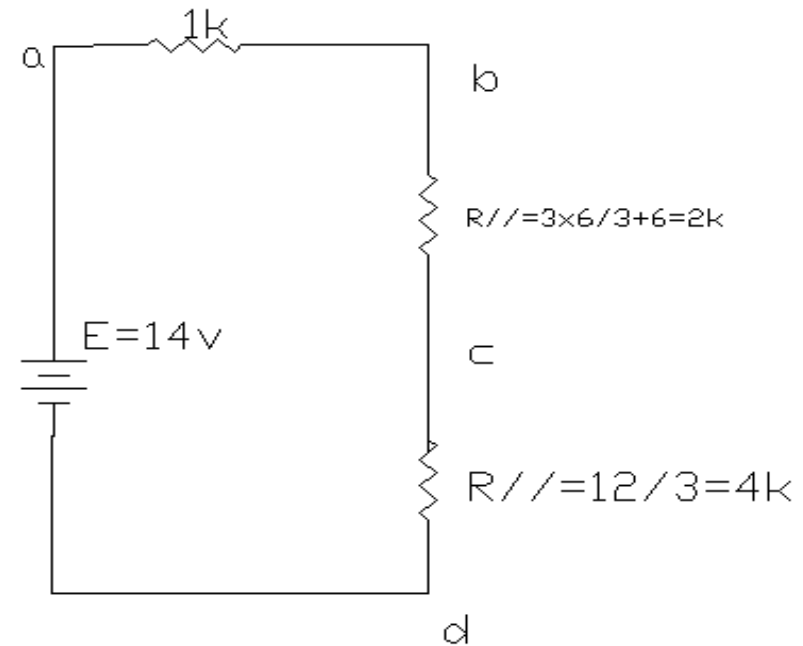
$$P = V \times I \text{ (watt)} \quad \text{Also} \quad P = I \cdot R \cdot I = I^2 \cdot R$$

$$P = V \cdot V / R = V^2 / R$$

Ex(2); Find V_{ad} , V_{ab} , V_{bc} , V_{cd} , I_3 , I_6



solution



$$\therefore R_T = 7k \Omega \quad \therefore I_T = 14/7 = 2A$$

$$\therefore V_{ab} = 2A \times 1k = 2v \quad V_{bc} = 2A \times 2k = 4v$$

$$V_{cd} = 2A \times 4k = 8v$$

$$I_3 = 2A \times 3k / (3k + 6k) = 0.666A$$

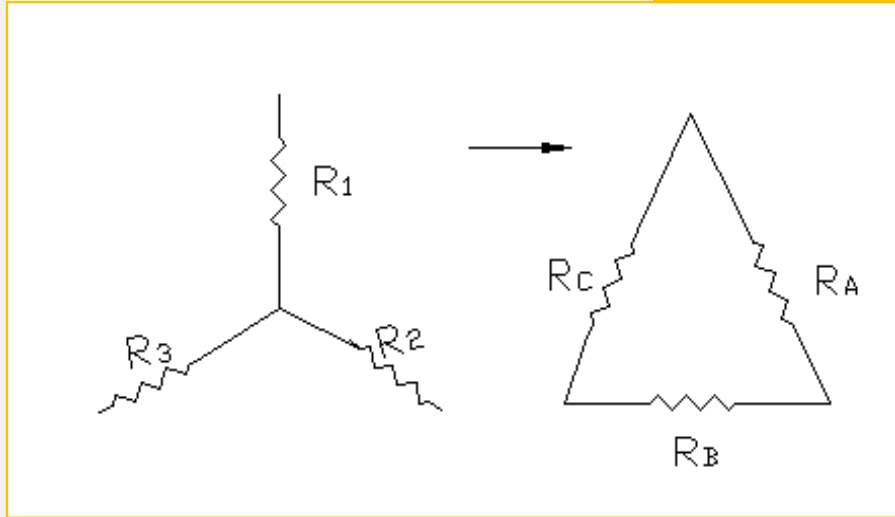
$$I_6 = 8v / 12k = 0.666A$$

3

Delta(Δ) - star (Y)
Transformation

تحويل الربط النجمي والمثلثي

Change star (Y) to delta (Δ)

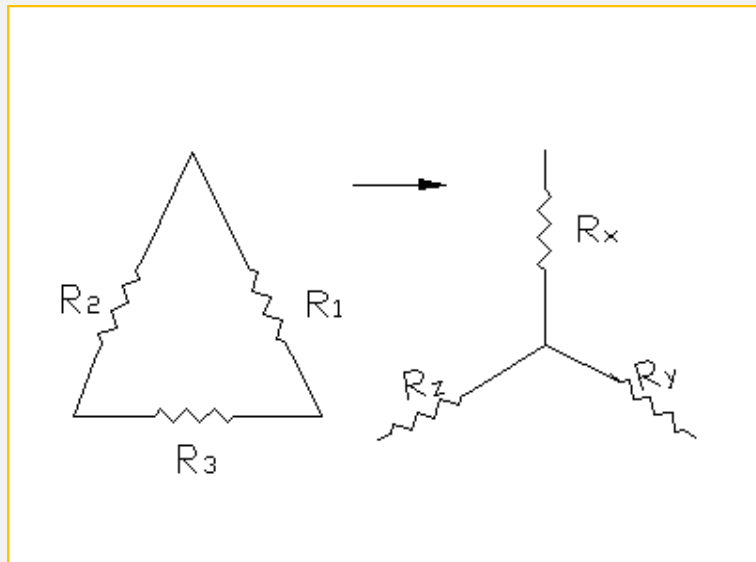


$$R_A = \frac{R_1 R_2 + R_2 R_3 + R_3 R_1}{R_3}$$

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

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

Change delta to star (Δ) to (Y)

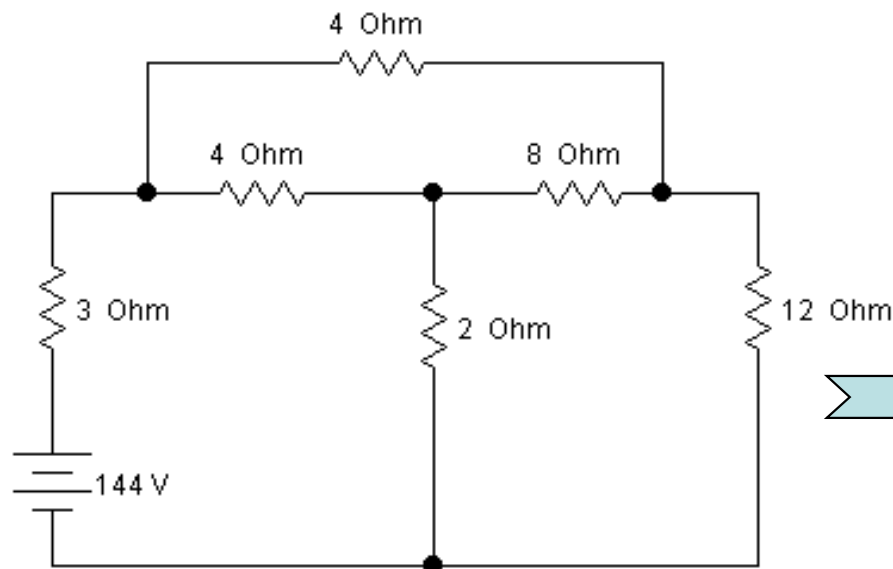


$$R_x = \frac{R_1 \times R_2}{R_1 + R_2 + R_3}$$

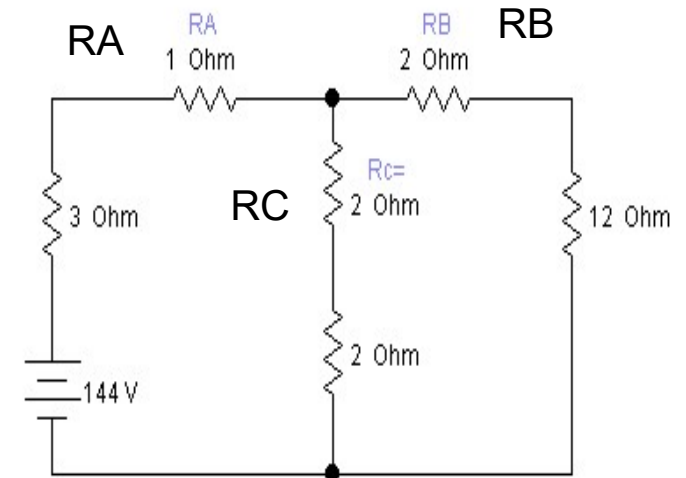
$$R_y = \frac{R_1 \times R_3}{R_1 + R_2 + R_3}$$

$$R_z = \frac{R_2 \times R_3}{R_1 + R_2 + R_3}$$

Example (3): For the cct. shown below calculate (I_T) .



Solution ;



$$R_A = \frac{4 \times 4}{4 + 4} = 1 \text{ ohm}$$

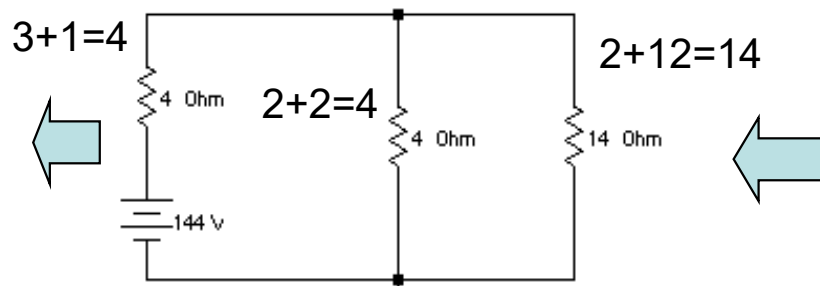
$$16$$

$$R_B = \frac{4 \times 8}{2 + 12} = 2 \text{ ohm}$$

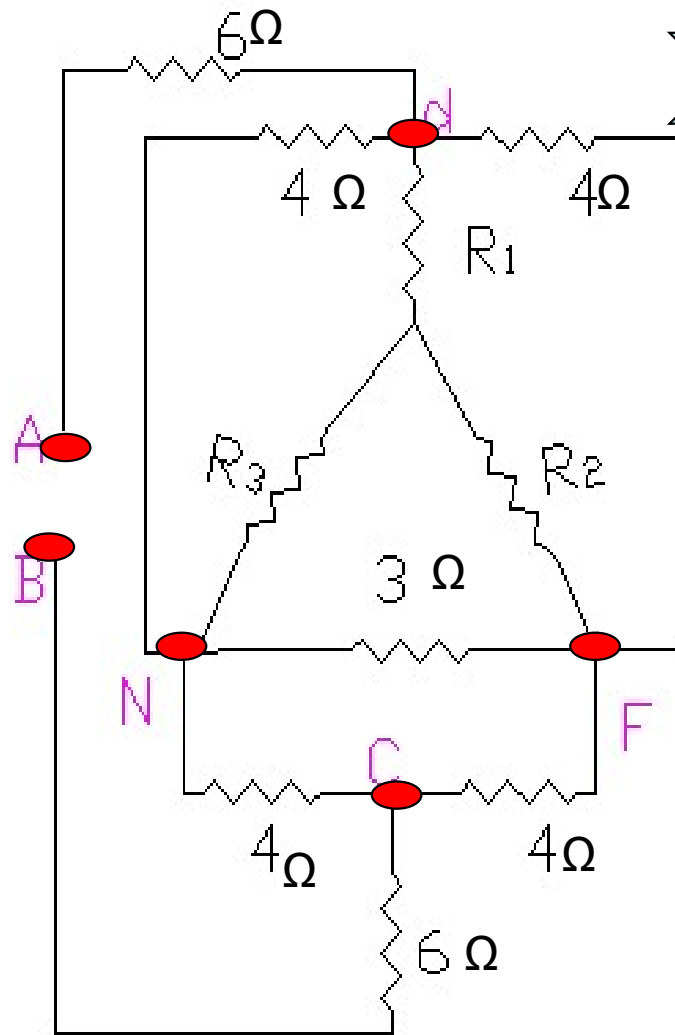
$$R_C = \frac{4 \times 8}{2 + 12} = 2 \text{ ohm}$$

$$R_T = \frac{4 \times 14}{4 + 14} + 4 = 7.111$$

$$I_T = \frac{144}{7.111} = 20.25 \text{ A}$$



EX (4): For the cct. Shown Find (RT) between A and B



solution

$$R1 = 4 \times 4 / (4 + 4 + 3) = 1.45 \Omega$$

$$R2 = 4 \times 3 / (11) = 1.09 \Omega$$

$$R3 = 4 \times 3 / (11) = 1.09 \Omega$$

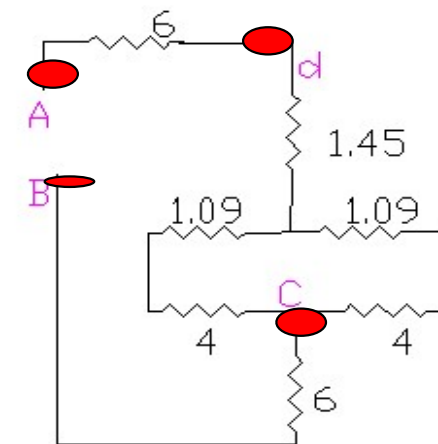
$$R_x = 6 + 1.45 = 7.45 \Omega$$

$$R_y = 1.09 + 4 = 5.09 \Omega$$

$$R_z = 1.09 + 4 = 5.09 \Omega$$

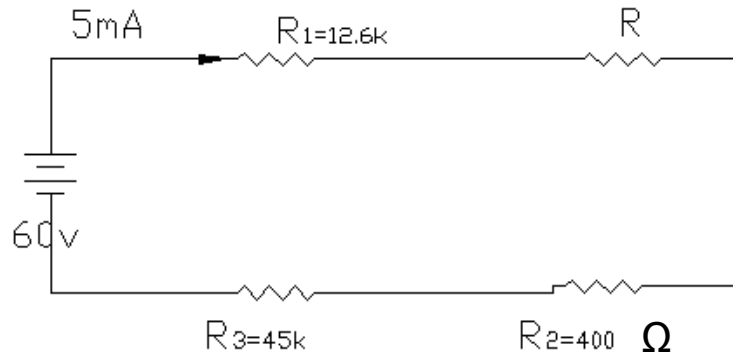
$$R // = (5.09 \times 5.09) / (5.09 + 5.09)$$

$$2.54 \Omega \quad \therefore R_T = 16 \Omega$$

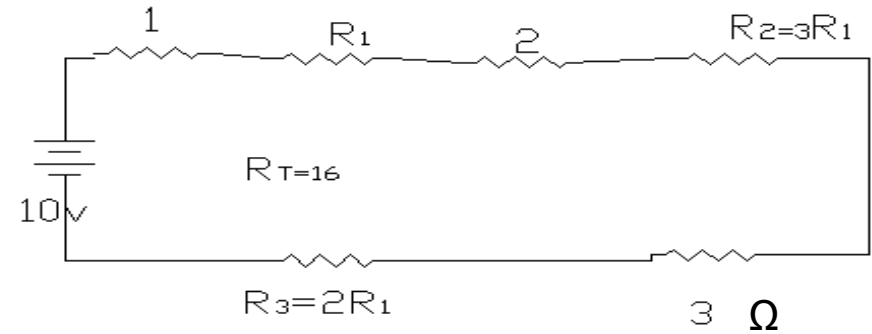


Posttest

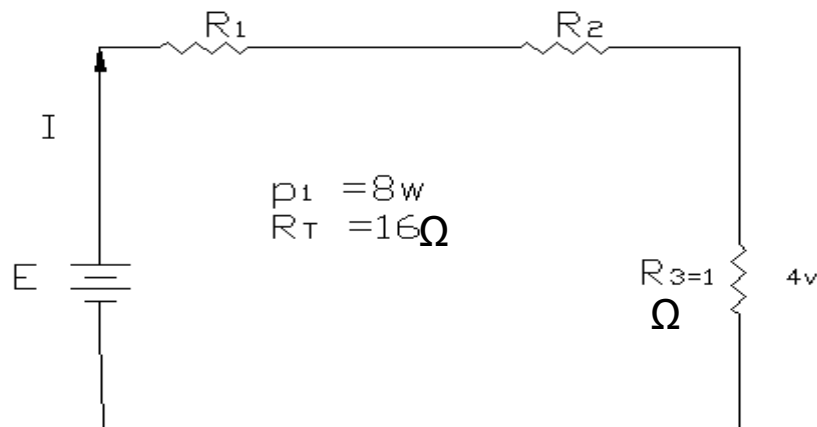
EX1; For the cct. Shown ; Find R_T, R



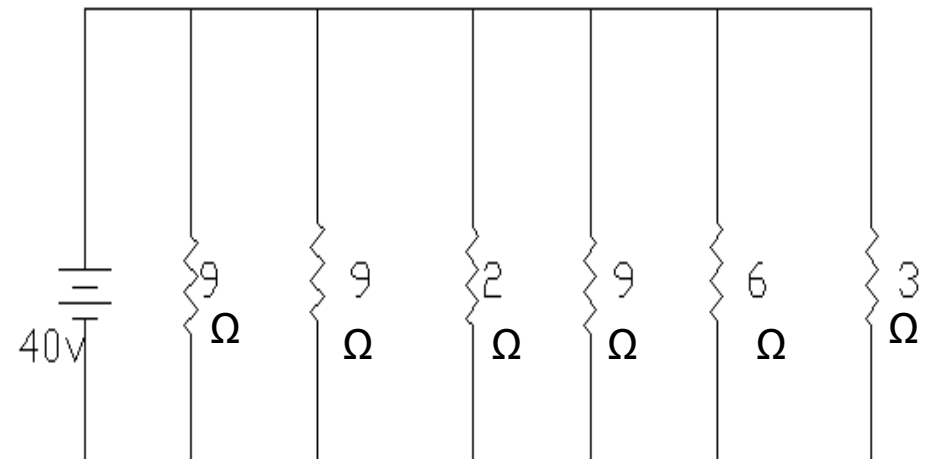
Ex2; Find (R_1, I_T)



Ex3; Find I, E, R_1, R_2



Ex4; Find G_T, R_T



H.W.

Solution H. W

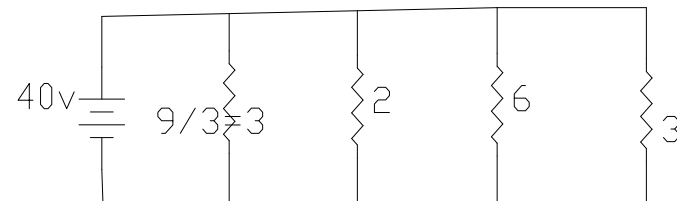
$$1) R_T = 60 / .001 = 60k$$
$$\therefore 12.6 + R + 0.4 + 45 = 60 \quad \therefore R = 60 - 58 \quad \therefore R = 2k$$

$$2) I_T = V / R_T = 10 / 16 = 0.625 \text{ A} \quad R_T = 16 = 1 + R_1 + 2 + 3 R_1 + 3 + 2 R_1$$
$$\therefore 16 = 6 + 6 R_1 \quad \therefore R_1 = 10 / 6 = 1.6 \Omega$$

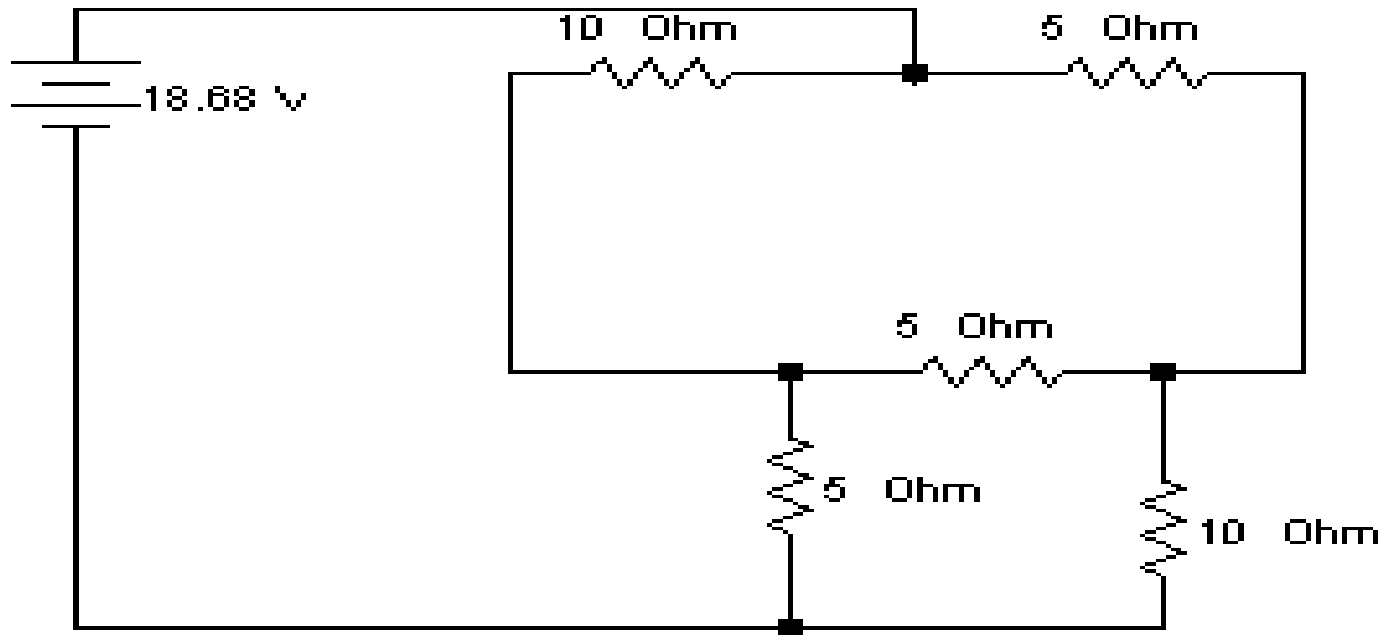
$$3) I_T = v / R = 4 / 1 = 4 \text{ A} \quad \therefore E = I_T \times R_T = 4 \times 16 = 64 \text{ v} \quad P = VI = I^2 \times R \quad \therefore 8 = 16 \times R_1$$
$$\therefore R_1 = 8 / 16 = 0.5 \Omega \quad R_T = 16 = 0.5 + R_2 + 1 \quad \therefore R_2 = 16 - 1.5 = 14.5 \Omega$$

$$4) G_T = 1 / R_T \text{ mho}$$

$$G_T = 2/3 + 0.5 + 1/6 = 1.3333 \text{ mho}$$
$$\therefore R_T = 1 / 1.3333 = 0.75 \Omega$$

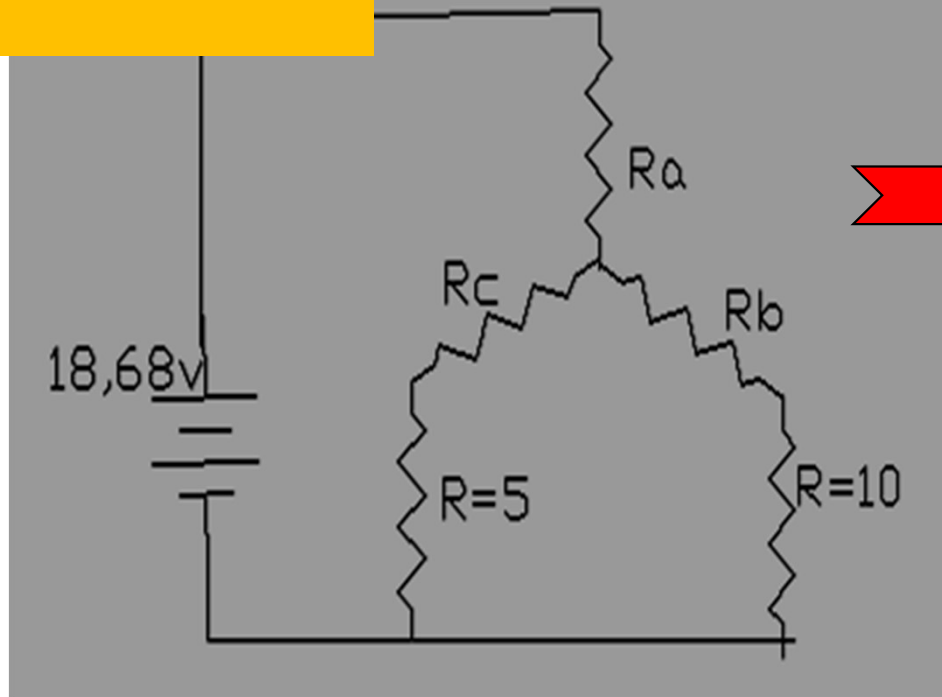


Ex5. Find (I_T) H.W



Notes: $I_T = 2.66A$

Solution Ex.5



$$R_a = (5 \times 10) / 20 = 2.5 \Omega$$

$$R_b = (5 \times 5) / 20 = 1.25 \Omega$$

$$R_c = (5 \times 10) / 20 = 2.5 \Omega$$

$$\therefore R_T = (11.25 \times 7.5) / (11.25 + 7.5) + 2.5$$
$$\therefore R_T = 7 \Omega$$

$$I_T = V / R_T = 18.68 / 7 = 2.66 \text{ A}$$

