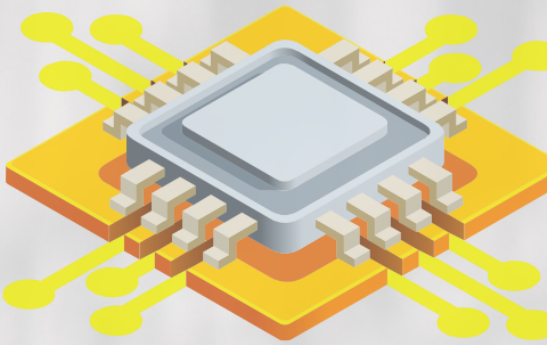
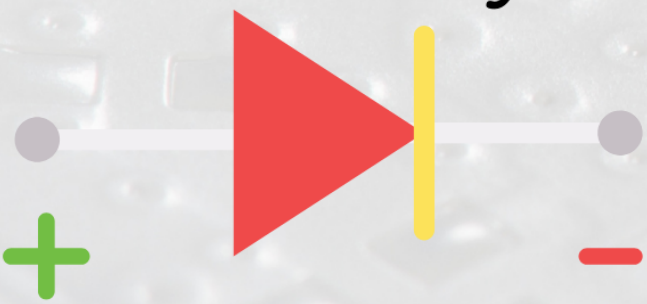
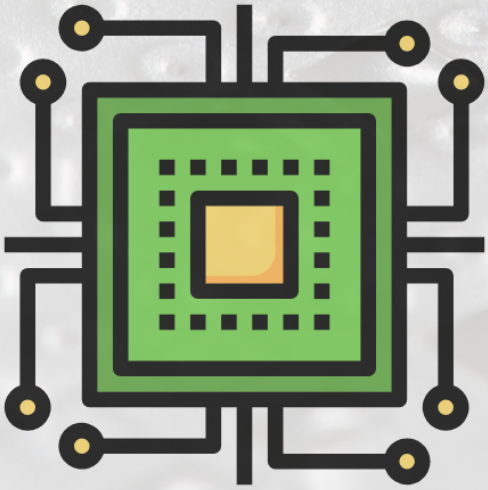


Circuits Analysis

By Rawan Alfares



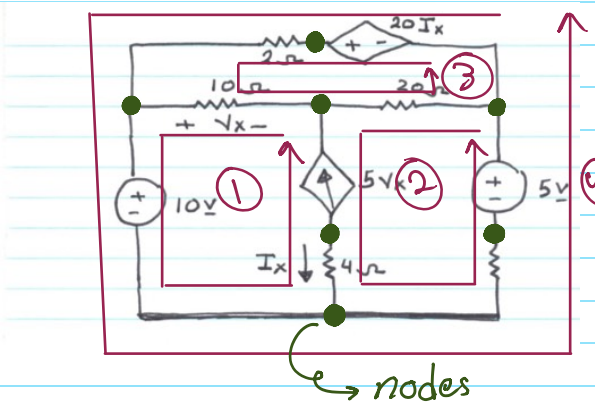


Voltage and Current laws

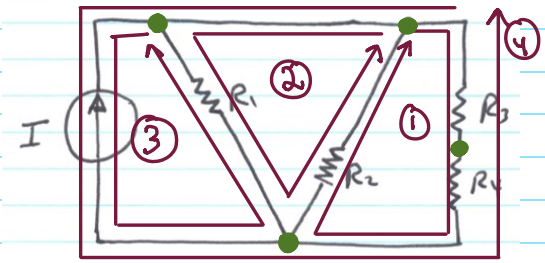
Node: A point of Connection of two or more Circuit elements

loop : Any closed path through the Circuit in which no node is crossed more than once.

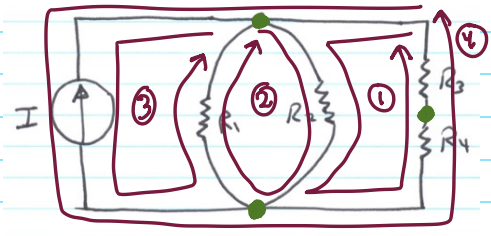
Mesh: Any loop that doesn't Contain within it another loop. "minimum number of loops". ← معنى يكون داخلها loop



* we have 4 loops
* we have 3 Mesh (1–3) 4 is not mesh since it has inside it 3 loops.
* 7 nodes.



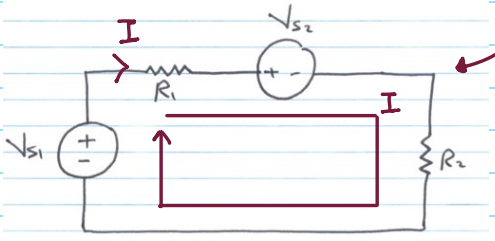
* 4 loops
* 4 nodes



* 4 loops , 4 mesh.
* 3 nodes

Series Connections

All of the elements in a Circuit that Carry the Same Current are said to be Connected in Series

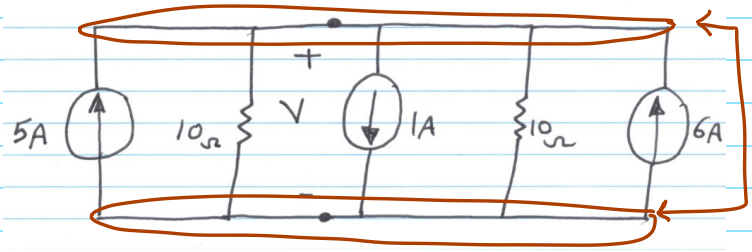


← كل الـ elements يمر فيهم نفس التيار

* $\Sigma V = 0$ closed path (كيرشوف).

Parallel Connections

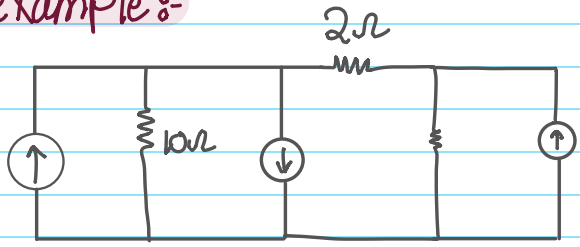
elements in a circuit having a common voltage across them are said to be connected in parallel.



يشتركوا مع بعض بـ [2 nodes] *

* having the same voltage
* $\Sigma I = 0$

example:-

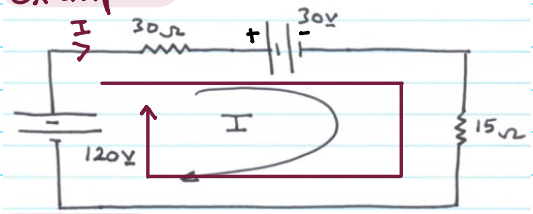


Kirchhoff Voltage Low KVL

KVL: the algebric sum of the voltage around any loop is zero.

$\Sigma V = 0$, for each loop

example:



* إذا كان اتجاه التيار بنفس اتجاه السهم بكون الـ Voltage +.

1. find I

$\Sigma V = 0$

$0 = 30I + 30 + 15I - 120$

$90 = 45I$

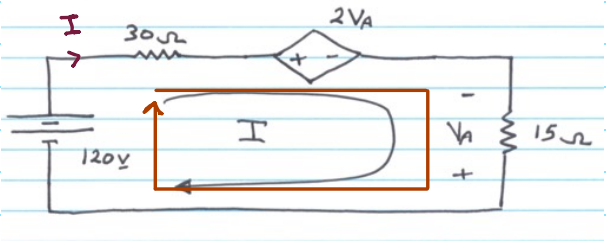
$I = 2A$

2. find V for each R.

$V_{3\Omega} = IR = (2)(30) = 60\ V$

$V_{15\Omega} = IR = (2)(15) = 30\ V$

example:



1. find I

method 1:

$\Sigma V = 0$

$0 = 30I + 2V_A + 15I - 120 \rightarrow ①$

$0 = 30I - 30I + 15I - 120$

$\frac{120}{15} = I$

$I = 8A \longrightarrow V_A = -15 \times 8 = -120\ V$

from the figure:

$V_A = -15I \rightarrow ②$

substitute in ①

---

method 2.

$\Sigma V = 0$

$0 = 30I + 2VA - VA - 120$

$0 = 30I + VA - 120$

$0 = 30I - 15I - 120$

$0 = 15I - 120$

$\frac{120}{15} = I$

$I = 8A$

$VA = -15I$

2. Calculate the power absorbed by each Circuit elements 8-

$P_{30\Omega} = (8)^2(30) = 1920\ W$

$P_{15\Omega} = (8^2)(15) = 960\ W$

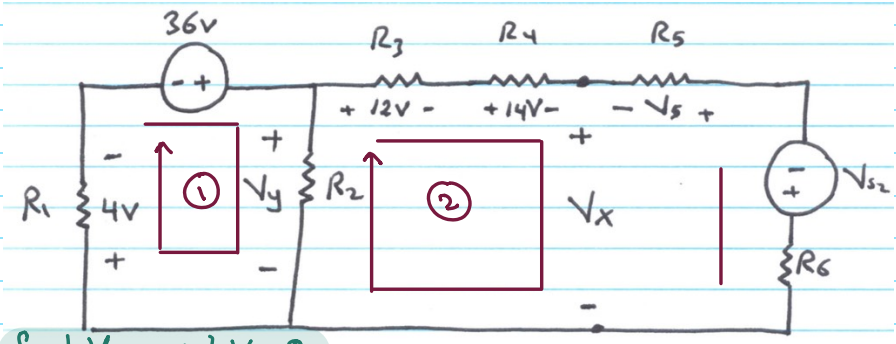
$P = I^2R$

$P_{120} = -(8)(120) = -960\ W$

$P_2 = (8)(2)(-120) = -1920$

$P = IV$

example:



find V_x and V_y 8-

$\Sigma V = -36 + V_y + 4 = 0$

$V_y = 32\ V$

$\Sigma V = 0$

$0 = 12 + 14 + V_x - 32$

$V_x = 6\ V$

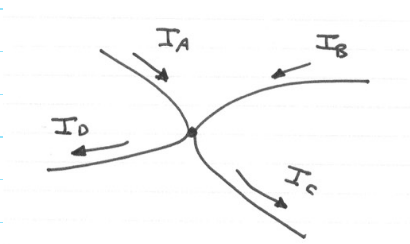
Kirchhoff Current Low KCL

KCL: the algebric Sum of the Current entering any node is zero.

- $\Sigma I = 0$, for each node
- $\Sigma I_{in} = \Sigma I_{out}$

* التيار الخارج من النود (+)
التيار الداخل على النود (-)

Example:



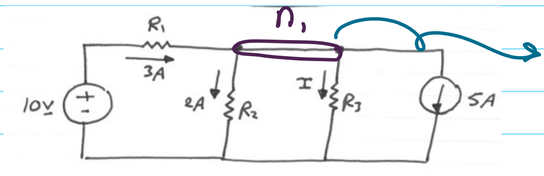
① $\Sigma I = 0$

$-I_A - I_B + I_D + I_C = 0$

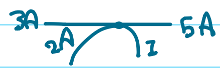
② $\Sigma I_{in} = \Sigma I_{out}$

$I_A + I_B = I_D + I_C$

Example 8-



كأنها



Find I:

for n_1, $\Sigma I = 0$

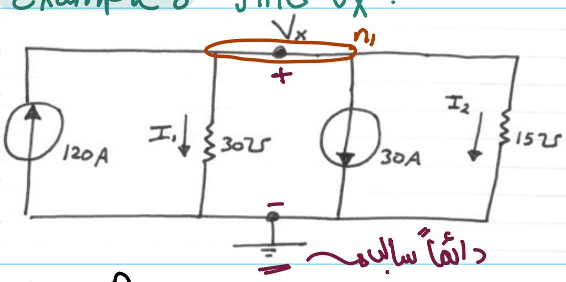
$-3 + 2 + I_1 + 5 = 0$

$I_1 = -4\,A$

بخليها مثل مهي ←

وبأي قانون بعوضها بنفس الإشارة.

Example 8 Find V_x :-



$V = IR$

$V = \frac{I}{G} \rightarrow I = VG$

for n_1, $\Sigma I = 0$

$-120 + I_1 + 30 + I_2 = 0$

$-90 + I_1 + I_2 = 0$

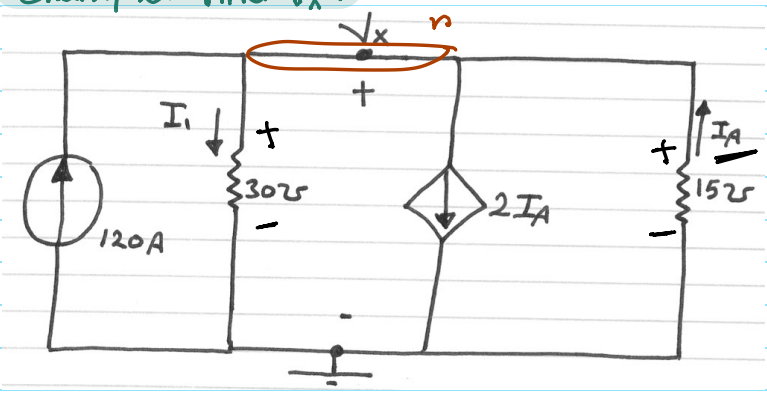
$I_1 + I_2 = 90$

$30V_x + 15V_x = 90 \rightarrow 45V_x = 90 \rightarrow V_x = 2\,V$

$I_1 = (30)(2) = 60\,A$

$I_2 = (15)(2) = 30\,A$

Example: find V_x:



$V = IR$

$I = GV$

$I_1 = 30\,V_x$

$I_A = -15\,V_x$

for n , $\Sigma I = 0$

$-120 + I_1 + 2I_A - I_A = 0$

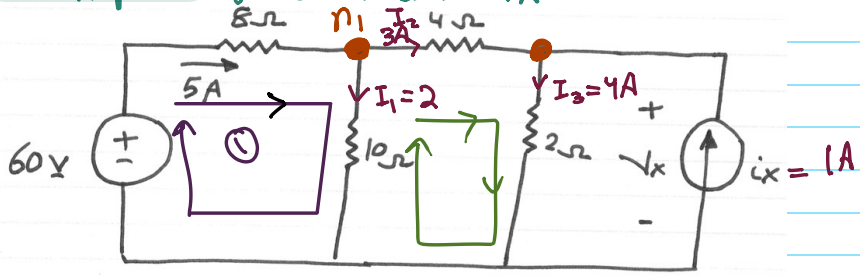
$-120 + I_1 + I_A = 0$

$-120 + 30\,V_x - 15\,V_x = 0$

$-120 = -15\,V_x$

$V_x = 8\,V$

example: find V_x and i_x



* for n_1, $\Sigma I = 0$

$-5 + I_1 + I_2 = 0 \rightarrow ①$

* for n_2, $\Sigma I = 0$

$-I_2 + I_3 - i_x = 0 \rightarrow ②$

* for loop 1, $\Sigma V = 0$

$40 + 10I_1 - 60 = 0$

$I_1 = 2A$ → Substitute in ①

$-5 + 2 + I_2 = 0$

$I_2 = 3A$

* for loop 2, $\Sigma V = 0$

$12 + 2I_3 - 20 = 0$

$I_3 = 4A$ → Substitute in ②

by eq. 2 .

$-3+4-i_x=0$

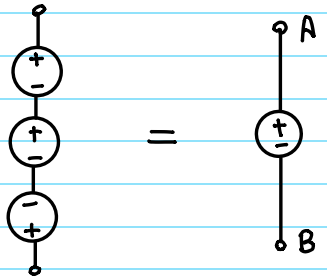
$i_x = 1\ A$

$V_x = I_3 R$

$= 4 \times 2 = 8\ V$

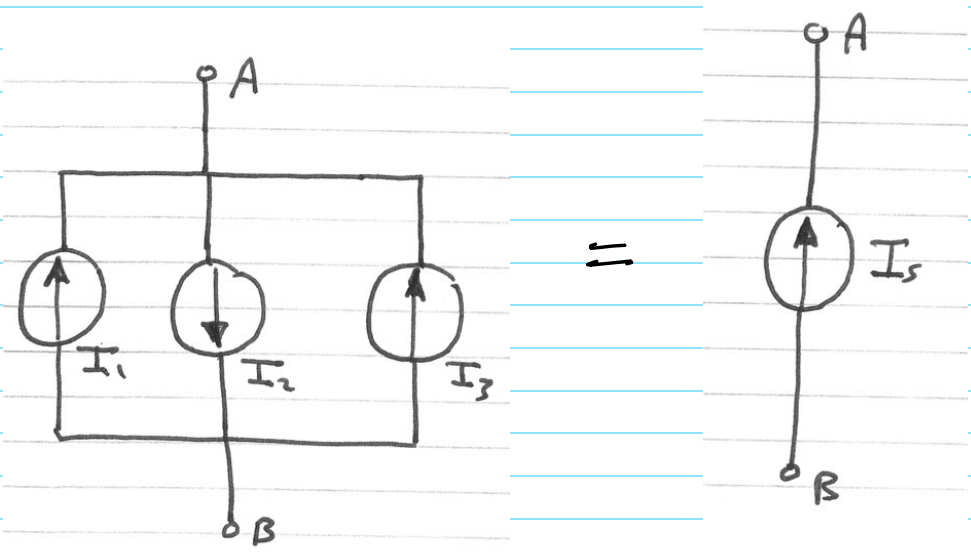
Series And Parallel Sources

→ Voltage Sources Connected in Series can be Combined into equivilant Source:



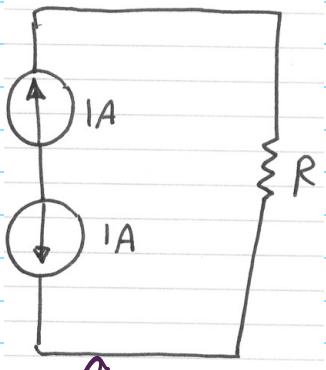
$V_s = V_1 + V_2 - V_3$

→ Current Sources Connected in Parallel Can be Combined into an equivilant Current Source.

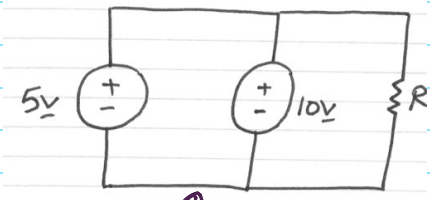


$I_s = I_1 + I_3 - I_2$

Impossible Circuits



* مستحيل يكون ماسرين تيارات على التوالي



* مستحيل يكون ماسرين جهد على التوازي.

ربنا تقبَّل منَّا إنَّك أنتَ السميعُ العليم