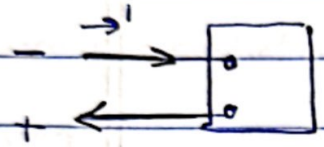
chapter 1:

$V = \frac{dw}{dq}$ w: energy in Joules
q: charge in coulombs

for DC $p = \frac{dw}{dt} = \left(\frac{dw}{dq}\right)\left(\frac{dq}{dt}\right)$

$p = vi$

supplying power ← في حالة البطارية



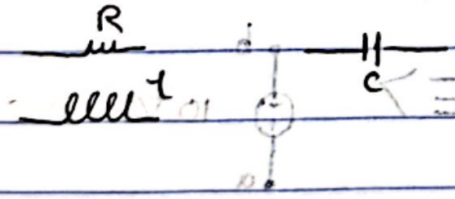
power absorbed ← موجبة

البطارية خارج فقط وحين $p = -vi$

supplied to : consumed
delivered to : consumed

supplied by : supplied by
delivered by :

circuit elements

passive 

Active sources → تنقسم
Active - pass or Active عكن يكونوا
البطارية في وضع discharge تكون تعطي
طاقة لعناصر الدارة بتصنف Active
لما تكون تأخذ طاقة تصنف passive

Active circuit elements
↳ Batteries and Generators
↓
non-electric energy → electric energy

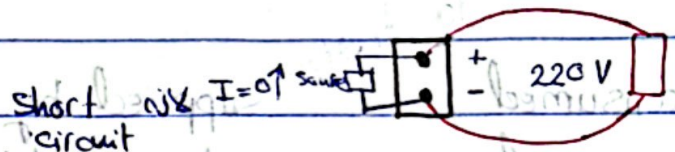
Short circuit $V = 0$

Active elements

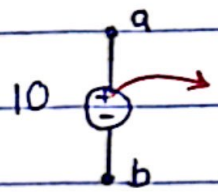
- Independent Sources
- Dependent Sources

1.1 Independent Sources

1.1.1 Voltage source : It maintains a specific voltage across its terminal independent of the current that flows through it.

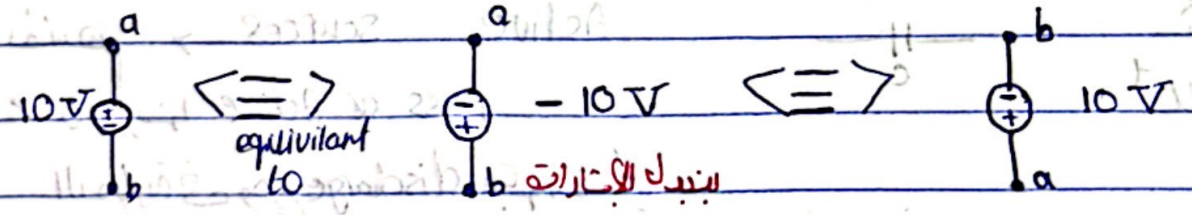


voltage source يحافظ على فرق الجهد بين طرفيه بغض النظر عن قيمة التيار



It represents the positive reference polarity

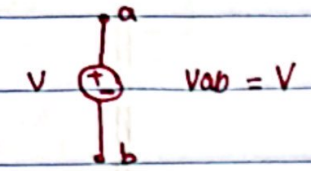
$V_{ab} = 10\ V \qquad V_{ba} = -10\ V$



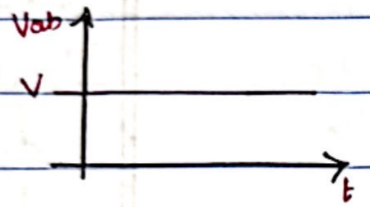
يتبدل الإشارة ويحافظ على Terminal بضربه بالرقم سالب

Voltage sources

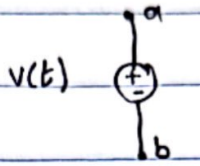
DC voltage source



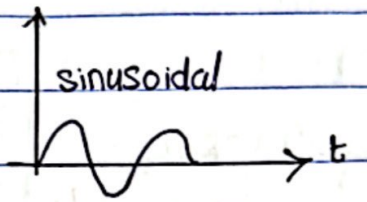
where V is constant

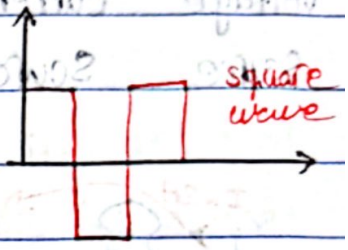


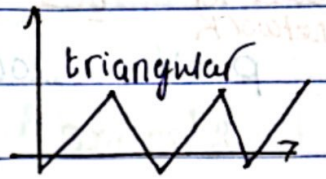
AC voltage source



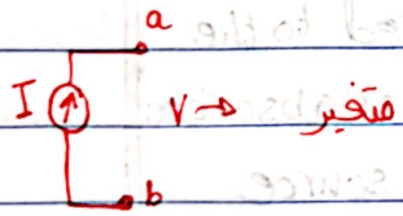
where v(t) is a function of time



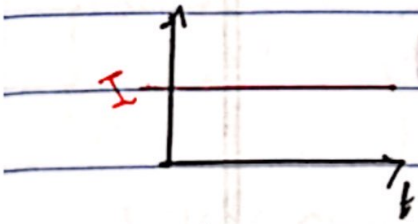


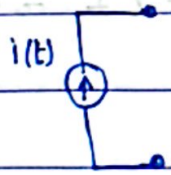


1.1.2 current source : It maintains a specific current through it independent of the voltage developed across its terminals.

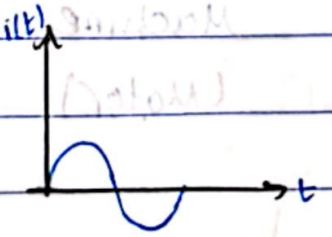


DC "constant"



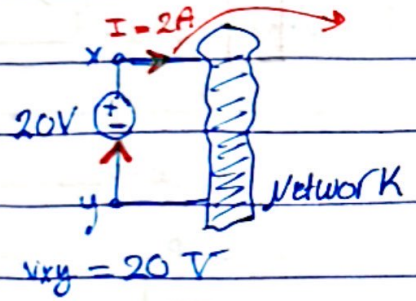


AC " Function of time "



circuit Elements

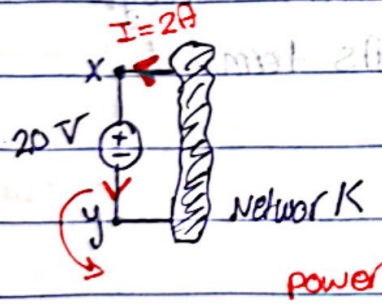
- ① Active
  - 1.1 Indep
    - 1.1.1 Voltage Source
    - 1.1.2 Current Source
  - 1.2 Dep
- ② passive



power for network السهم داخل من البطارية يعطي

$p = VI = 20(2) = 40\ W$ delivered to the network

Machine or Battery (generator) (Discharge mode)

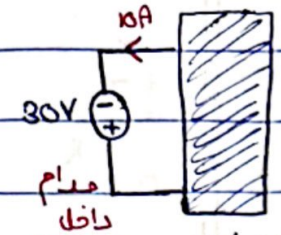


power from network يزود

$p = VI = 40W$ delivered to the Source or absorbed by the source

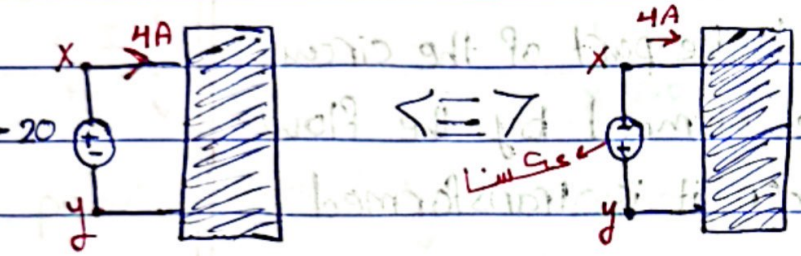
Machine or Battery (Motor) (charging mode)

Ex:



$p = 300\ w$ delivered to the network

Ex:



$p = 20(4) = 80\ w$ delivered to the source

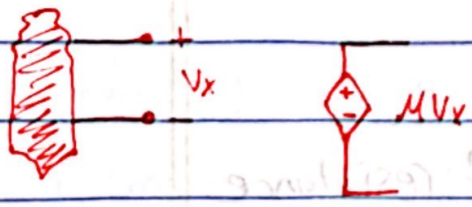
1.2 Dependent sources (controlled sources):

They generate a voltage or a current that is determined by a voltage or current at a specified location in the circuit

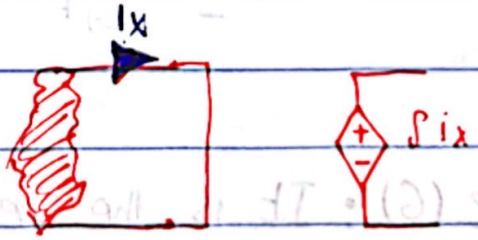
Symbol 

Examples (Transistors)

1.2.1 voltage source



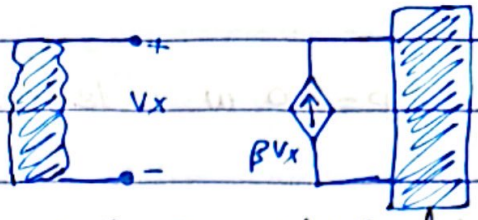
Voltage controlled voltage source



current controlled voltage source

1.2.2 current source

current controlled current source

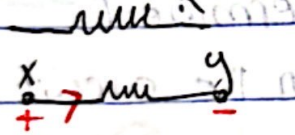


voltage controlled current source

2. passive Elements

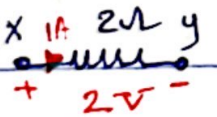
2.1 Resistor (R): It represent the part of the circuit in which energy entering the element by the flow of current through it, and then it is transformed to heat.

The resistor is measured in ohms [Ω]

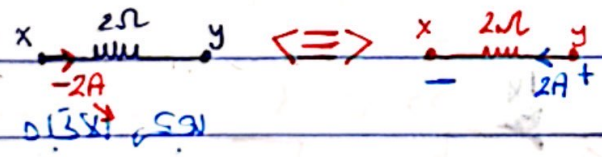


التيار يتجه من الجهد الأعلى للأقل

Exp:



$V = 2.1 = 2\ V$



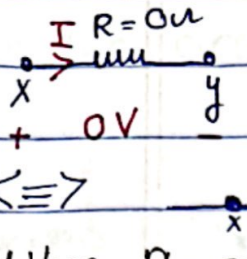
$V = 4\ V$

Conductance (G): It is the reciprocal of resistance and measured in [siemens or ℧]

$$G = \frac{1}{R}$$

when $R = 0 \Rightarrow V = RI$

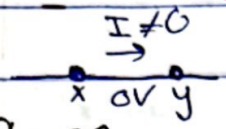
$= 0$



The element is called short circuit

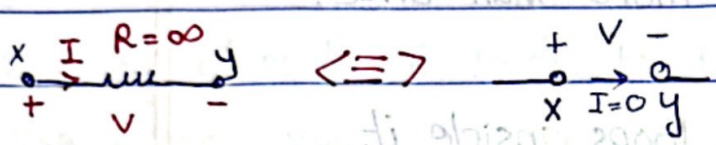
مورد تيار عالي على فرق جهد صغير مع مقاومة تساوي صفر

$\Leftrightarrow$



When $R = \infty$ open circuit

$I = \frac{V}{R} = \frac{V}{\infty} = 0$



power absorbed by the resistor

$p = VI \quad p = \frac{V^2}{R} \quad p = I^2R$

Kirchhoff Laws

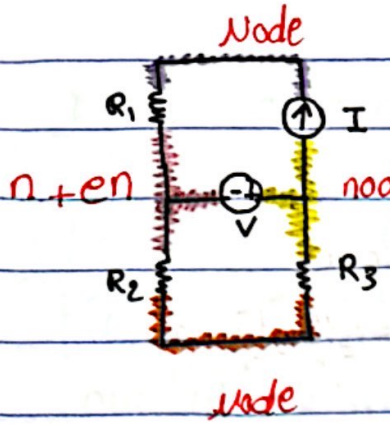
↳ Kirchhoff's voltage law (KVL)

↳ Kirchhoff's current law (KCL)

Node: It is a point of connection of two or more circuit element.

نقطة التقاء

Essential node: It is a point of connection of three or more circuit elements.



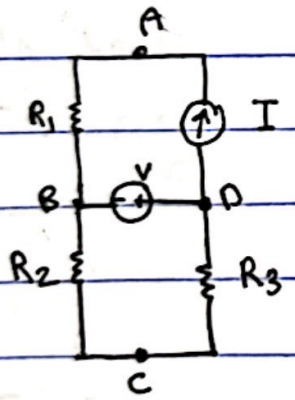
n+en node + essential node

2 ess

4 node

Loop: It is any closed path through the circuit such that no node is crossed more than once.

Mesh: It is a loop with no loops inside it.

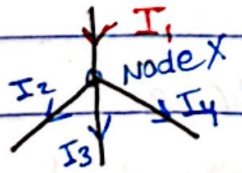


Loops: ABDA, BCDB, ABCDA ↘ not Mesh loops 2 lol,

Meshs: ABDA, BCDB

Kirchhoff current law (KCL)

The algebric sum of all currents at any node in the circuit equals to zero.



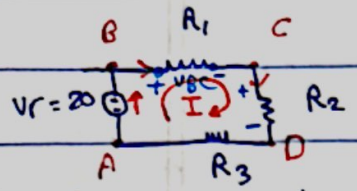
$I_1 = I_2 + I_3 + I_4$

$-I_1 + I_2 + I_3 + I_4 = 0$

$$\sum_{i=1}^{N} I_i = 0$$

Kirchhoff's voltage Law (KVL)

The algebric sum of all voltages around any closed path in the circuit is zero.



V_{BA} = يكتب عكس الجهد لانه بقرأ من القطب السالب

لحا يكون بالدارة بس مقاومات مستحيل الحهد يكون 0 لانه لازم يصير فرق الجهد هو يلي يعطي طاقة motor

$V_{BA} = 20$ (4 node عكس)

$V_{AB} = -20$

Starting at node A leads to the expression

$$V_{AB} + V_{BC} + V_{CD} + V_{DA} = 0$$

$$-V_s + R_1 I + R_2 I + R_3 I = 0$$] clockwise

$$V_{AD} + V_{DC} + V_{CB} + V_{BA} = 0$$

$$-R_3 I - R_2 I - R_1 I + V_s = 0$$] counter