SNS COLLEGE OF TECHNOLOGY
Coimbatore-35
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DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

23ECB101 – CIRCUIT ANALYSIS AND DEVICES

I YEAR/ II SEMESTER

UNIT 1 – MESH AND NODE ANALYSIS OF ELECTRIC CIRCUITS

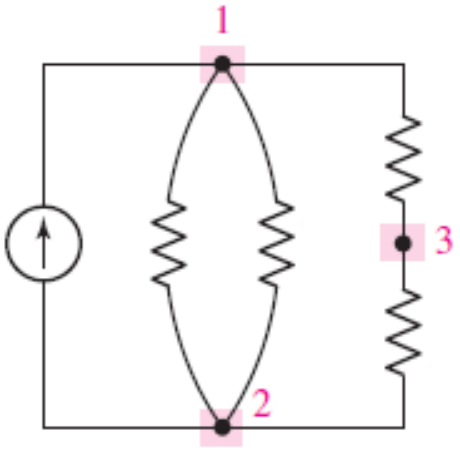
TOPIC - Kirchoff's voltage law

Introduction

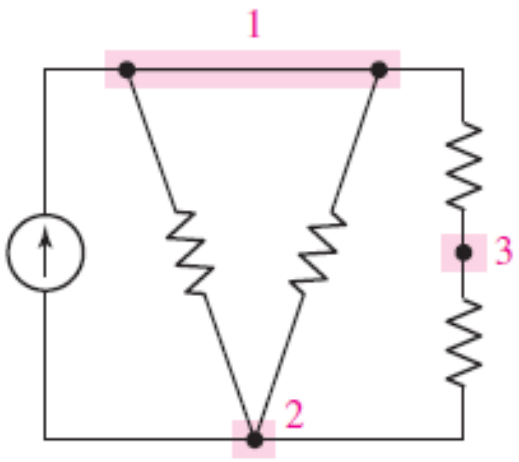
- In general, circuits must be analyzed to determine a complete set of voltages and currents.
- Only two simple laws are needed in addition to Ohm's law.
- The new laws are
  - **Kirchhoff's current law (KCL)**
  - **Kirchhoff's voltage law (KVL)**
- They are simply restatements of *charge and energy conservation*, respectively.

Nodes, Paths, Loops And Branches

- A point at which two or more elements have a common connection is called a ***node.***



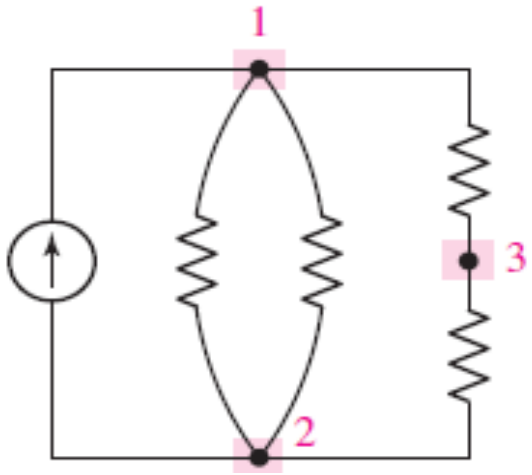
(a)



(b)

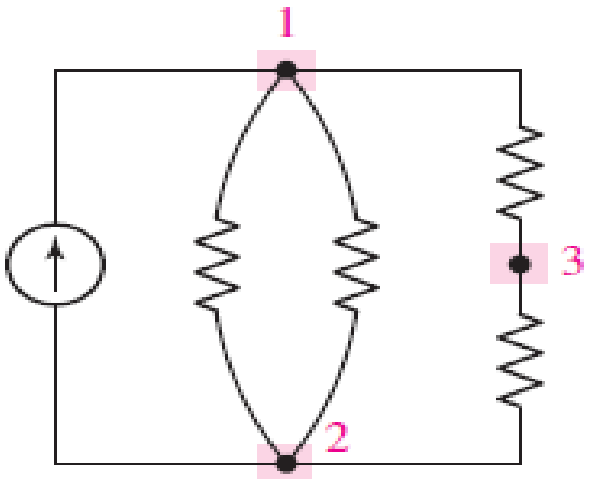
Nodes, Paths, Loops And Branches

- If no node was encountered more than once, then the set of nodes and elements that we have passed through is defined as a ***path.***
- ***If the node at which we started is*** the same as the node on which we ended, then the path is, by definition, a closed path or a ***loop.***



Nodes, Paths, Loops And Branches

- A **branch** as a single path in a network, composed of one simple element and the node at each end of that element.
- Thus, a path is a particular collection of branches.



Kirchhoff's Voltage Law (KVL)

- Kirchhoff's voltage law (abbreviated **KVL):**

The algebraic sum of the voltages around any closed path is zero.

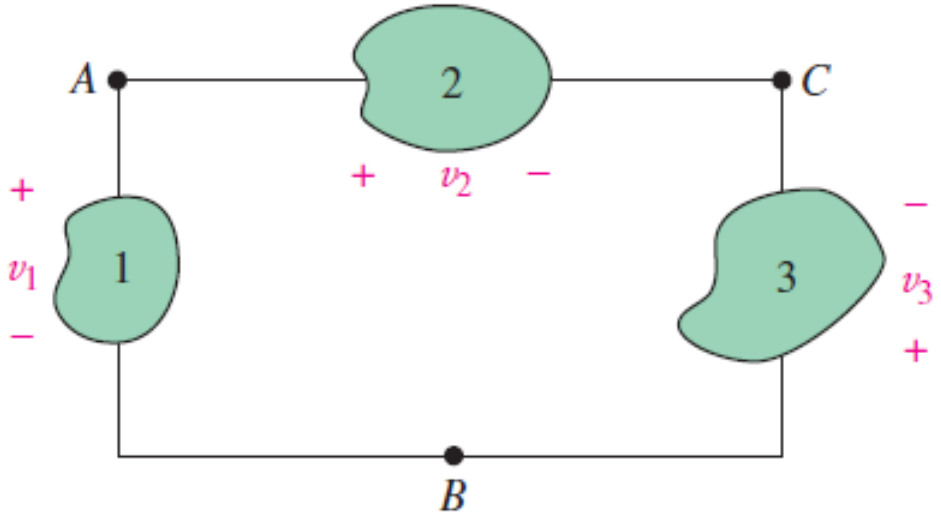
- The algebraic sum of the voltages across the individual elements around it must be zero. Thus,

$$v1 + v2 + v3 + \cdots + vN = 0$$

- or, more compactly,

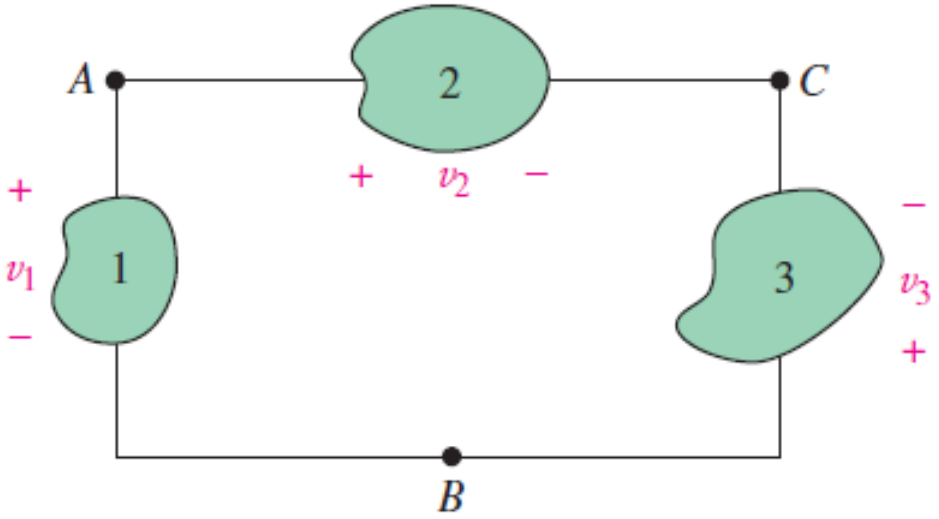
$$\sum_{n=1}^{N} v_n = 0$$

Kirchhoff's Voltage Law (KVL)



- If we carry a charge of 1 C from *A to B through element 1,* the reference polarity signs for *v1 show that we do v1 joules of work.*
- If we choose to proceed from *A to B via node C, then we expend (v2 − v3) joules of energy.*
- The work done, however, is independent of the path in a circuit, and so any route must lead to the same value for the voltage. In other words, ***v1 = v2 − v3***

Kirchhoff's Voltage Law (KVL)

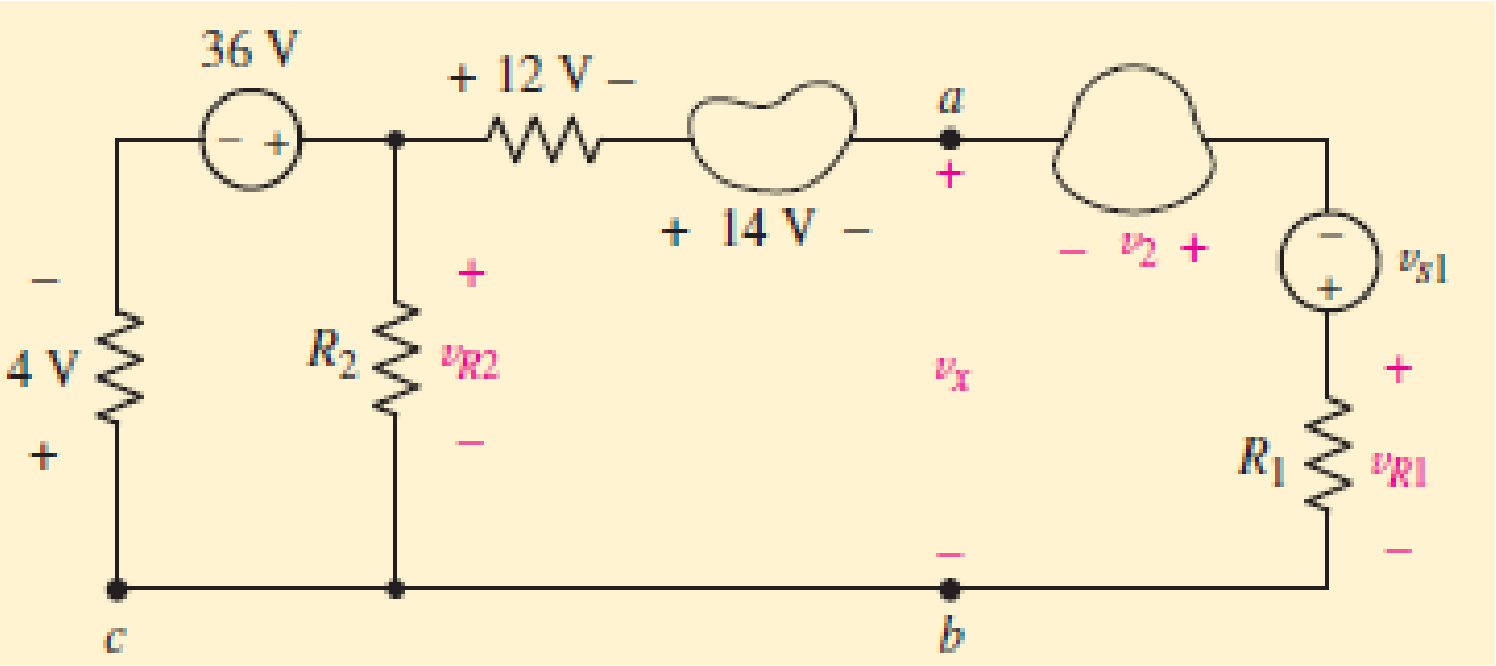


- Another method of applying KVL is moving mentally around the closed path in a clockwise direction
- Writing down directly the voltage of each element whose (+) terminal is entered, and writing down the negative of every voltage first met at the (−) sign.
- Applying this to the single loop, we have

$$-v1 + v2 - v3 = 0$$

Example

- In the circuit, there are eight circuit elements. Find v_{R2} (the voltage across *R2) and the voltage labelled* v_x.



Example

- we find v_{R2} *by writing a KVL equation around the loop on the left,* starting at point *c:*

$$4 - 36 + v_{R2} = 0$$

- which leads to $\boldsymbol{v_{R2} = 32\ V.}$
- we apply KVL beginning at point *c, moving* up and across the top to *a, through vx to b, and through the conducting* lead to the starting point:

$$+4 - 36 + 12 + 14 + vx = 0$$

- so that ***vx = 6 V***
- ***An alternative approach: Knowing*** $\boldsymbol{v_{R2}}$**,** we might have taken the shortcut through *R2:*

$$-32 + 12 + 14 + vx = 0$$

- yielding *vx = 6 V once again.*

Assessment

1. KVL deals with the conservation of?
a) Mass
b) Momentum
c) Charge
d) Energy

2. The sum of the voltages over any closed loop is equal to _____
a) 0V
b) Infinity
c) 1V
d) 2V

3. What is the basic law that has to be followed in order to analyze the circuit?
a) Newton's laws
b) Faraday's laws
c) Ampere's laws
d) Kirchhoff's law


THANK YOU