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

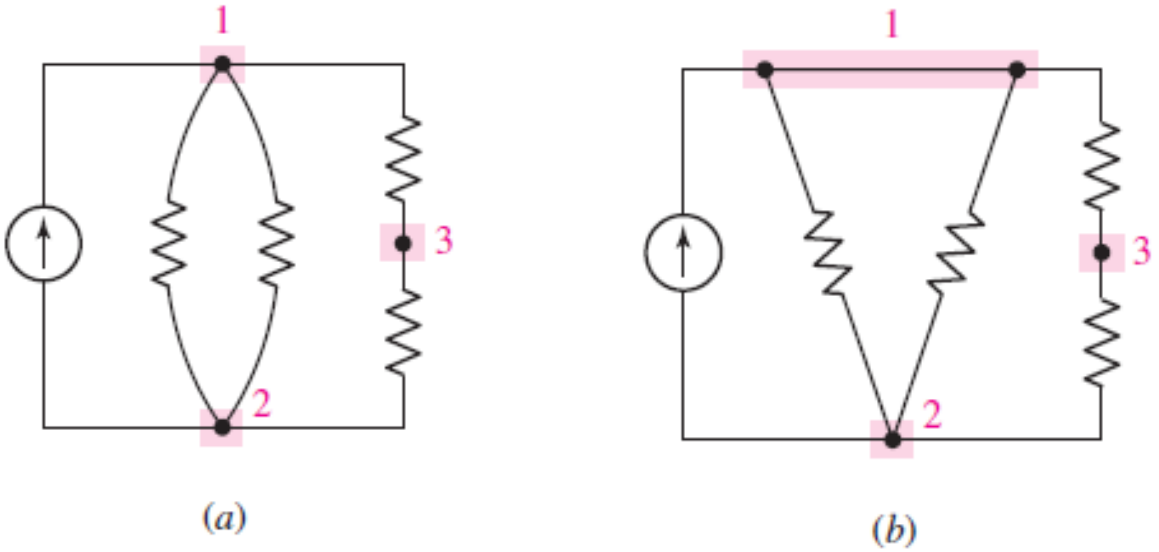
TOPIC - Kirchoff's Current Law

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.

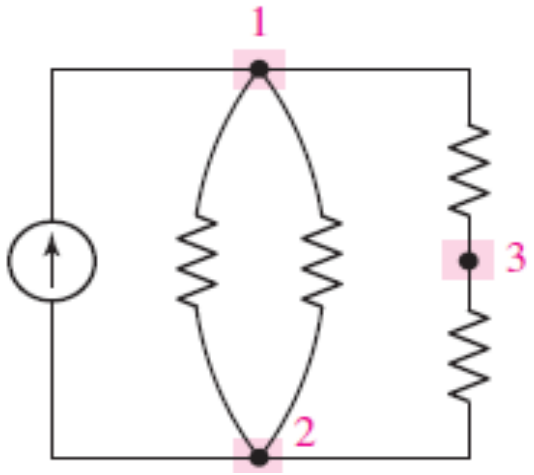
Nodes, Paths, Loops And Branches

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



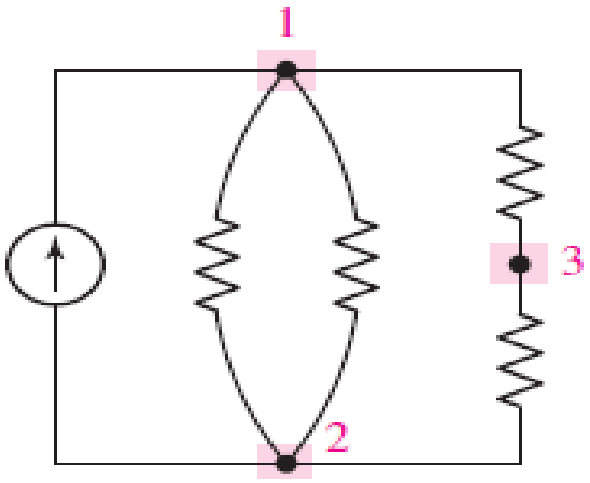
Nodes, Paths, Loops And Branches

- 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 Current Law (KCL)

- **Gustav Robert Kirchhoff**, *a German university professor who* was born about the time Ohm was doing his experimental work.
- Kirchhoff's current law (abbreviated KCL) states that

The algebraic sum of the currents entering any node is zero.

- A compact expression for Kirchhoff's current law is

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

Kirchhoff's Current Law (KCL)

- This law represents a **mathematical statement** of the fact that charge cannot accumulate at a node.
- *A node is not a circuit element, and it certainly* cannot store, destroy, or generate charge.
- Hence, the currents must sum to **zero**.
- A hydraulic analogy : *three water pipes joined in the shape of a Y.*

Kirchhoff's Current Law (KCL)

- The sum of currents **entering** the node must be zero:

  $iA + iB + (-iC) + (-iD) = 0$

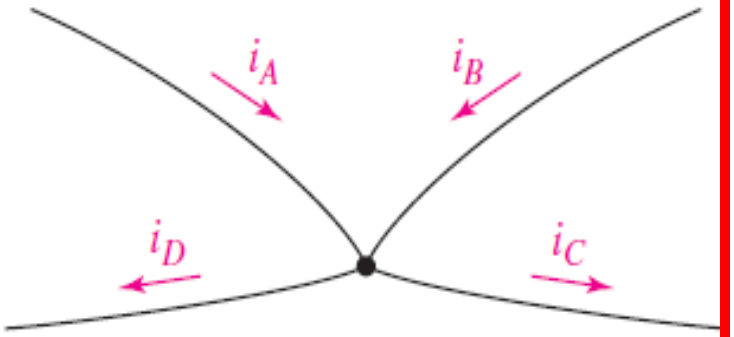
- However, sum of currents ***leaving*** *the node also zero:*

  $(-iA) + (-iB) + iC + iD = 0$

- We might also wish to equate

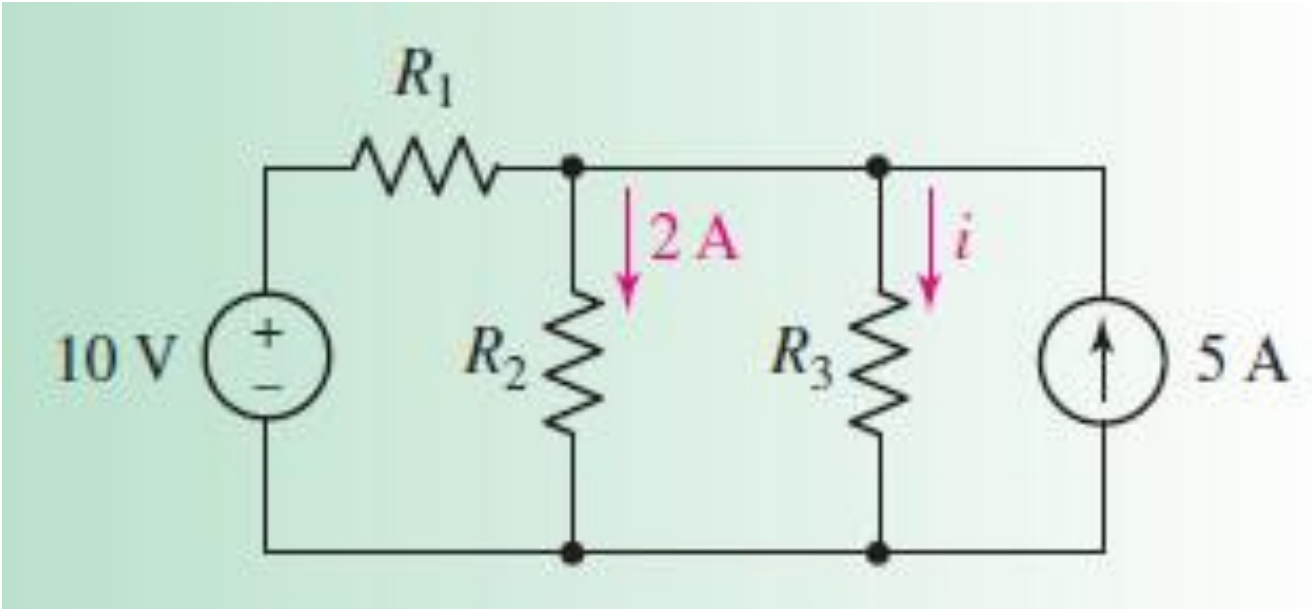
  $iA + iB = iC + iD$

- The sum of the currents going in **must equal** the sum of the currents going out.

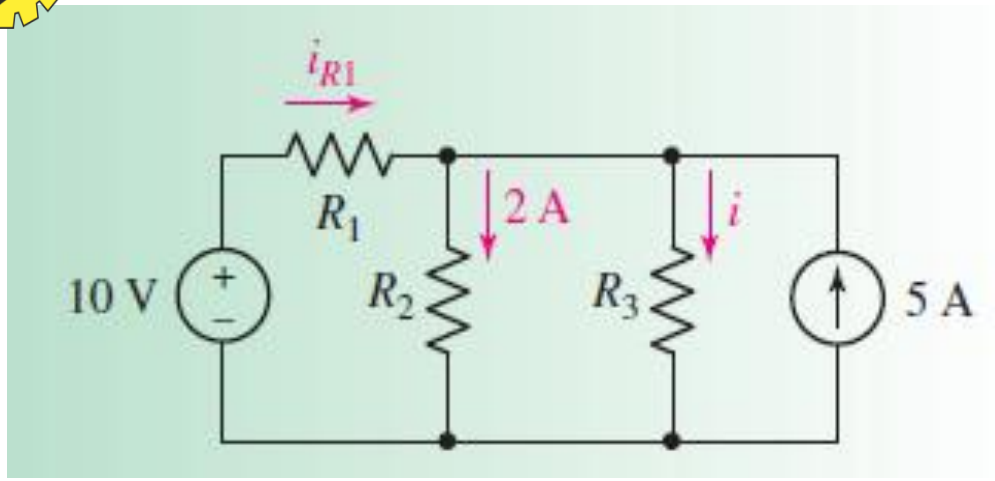


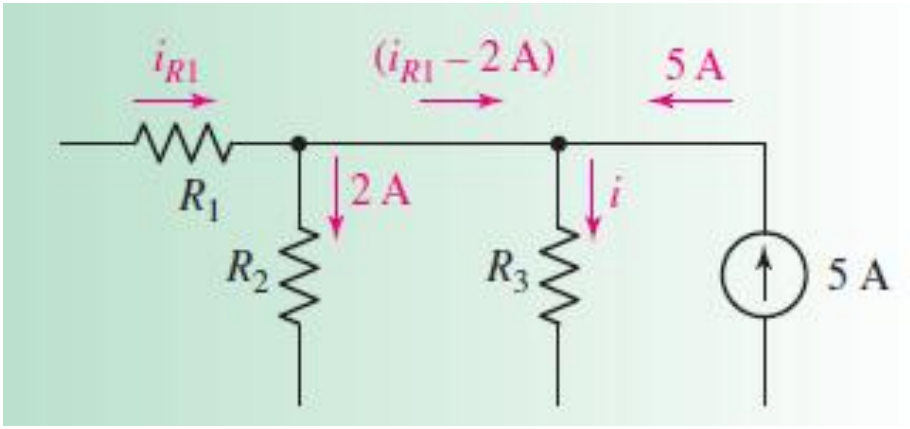
Example

- For the circuit, compute the current through resistor R3 if it is known that the voltage source supplies a current of 3 A.



Example





Example

- Summing the currents flowing into the node:

$$i_{R1} - 2 - i + 5 = 0$$

- We know the 10 V source is supplying 3 A.
- Substituting, we find that

$$i = 3 - 2 + 5 = 6\ A.$$

Procedures

- *Identify the goal of the problem*
- *Collect the known information*
- *Devise a plan*
- *Construct an appropriate set of equations*
- *Determine if additional information is required*
- *Attempt a solution*
- *Verify the solution. Is it reasonable or expected?*

Assessment

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

2. KCL is applied at _____
a) Loop
b) Node
c) Both loop and node
d) Neither loop nor node

3. KCL can be applied for _____
a) Planar networks
b) Non-planar networks
c) Both planar and non-planar
d) Neither planar nor non-planar


THANK YOU