ELEMENTS OF ELECTRICAL ENGINEERING
UE24EE141B

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Lectures 2 & 3 - Concept of Ideal Sources, Kirchhoff's Laws, Numerical Examples on Basic Laws

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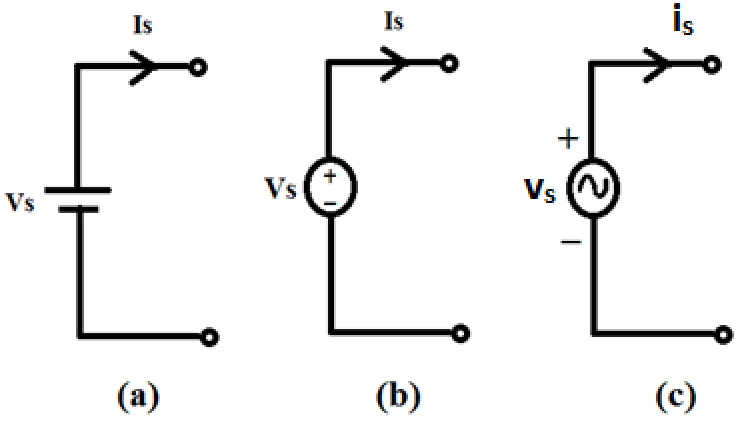
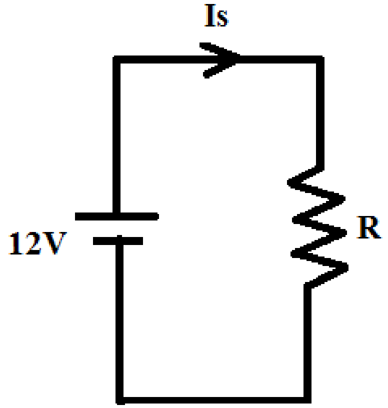
Ideal Voltage Source

Its terminal voltage is independent of current flowing through it.



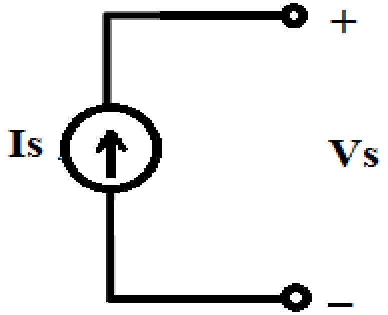
The current delivered by it depends on the circuit to which it is connected.



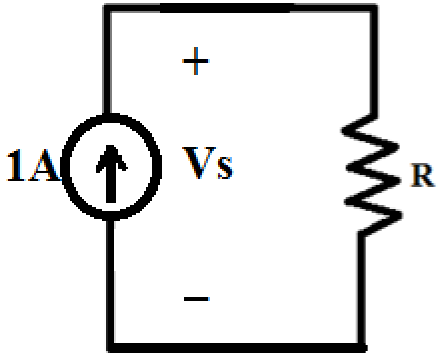
When R = 10Ω, I_S = 1.2A
When R = 1Ω, I_S = 12A

Ideal Current Source

Its current is independent of the voltage across it.



The voltage across it depends on the circuit to which it is connected.



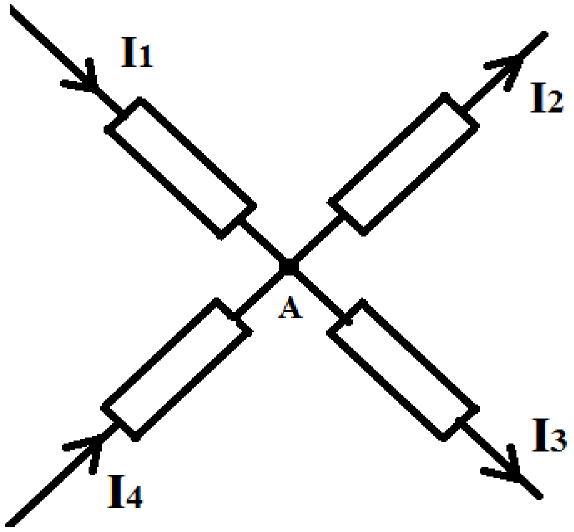
When R = 1Ω, V_S = 1V
When R = 10Ω, V_S = 10V

Kirchhoff's Current Law (KCL)

- KCL States "At every node in an electric network, the algebraic sum of currents is Zero (or) sum of incoming currents is equal to the sum of outgoing currents".

- A point at which two or more elements are interconnected is a node.

- KCL signifies the conservation of charge.



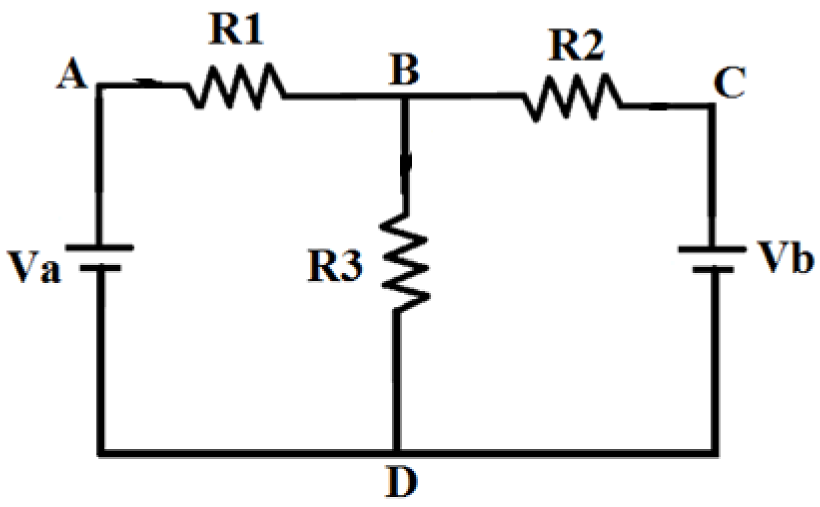
By KCL at node A,

$I_1 + I_4 = I_2 + I_3$

Kirchhoff’s Voltage Law (KVL)

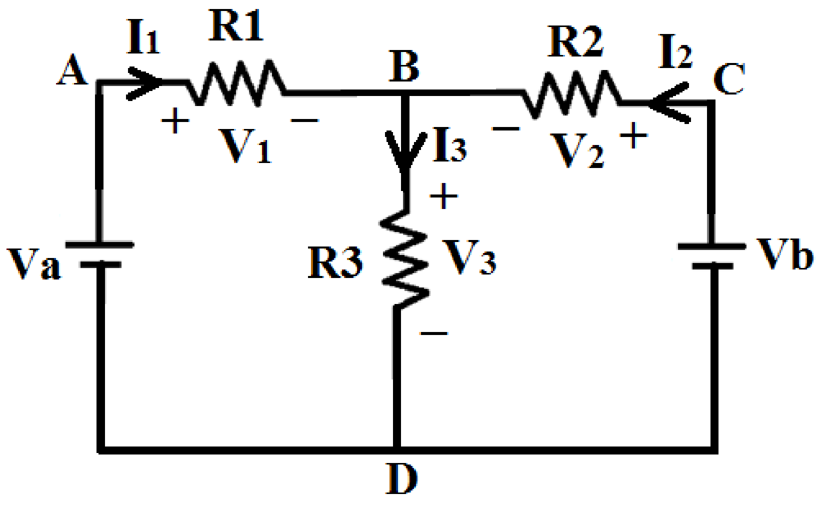
- KVL States “Around every closed path in an electric network, the algebraic sum of voltages is Zero”.

- A path in an electrical network which starts and ends at the same terminal is called a closed path.



Kirchhoff's Voltage Law (KVL)

Conventionally, Voltage drop is considered negative and voltage rise as positive.



- KVL in the path ABDA:

$-V_1-V_3+V_a = 0$

- KVL in the path BCDB:

$V_2-V_b+V_3 = 0$

- KVL in the path ABCDA:

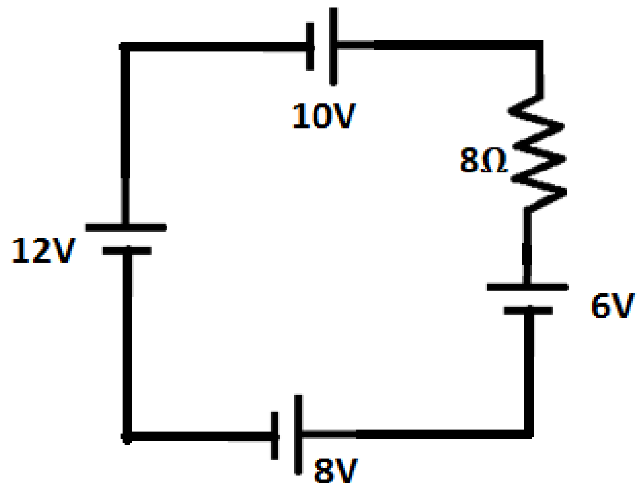
$-V_1+V_2-V_b +V_a = 0$

KVL signifies conservation of energy.

Numerical Example on KVL

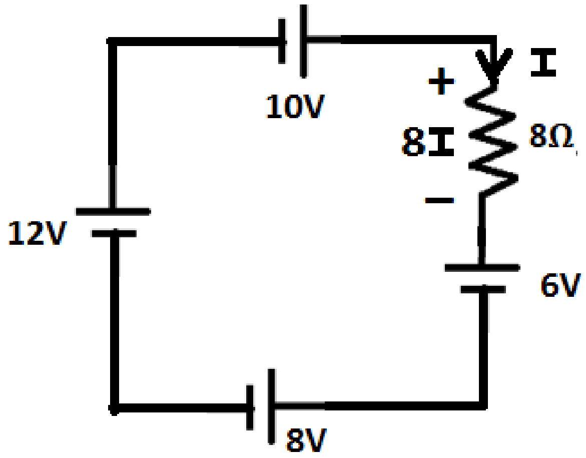
Example 1:

Find the current through 8Ω resistor in the network given.



Numerical Example on KVL

Solution:

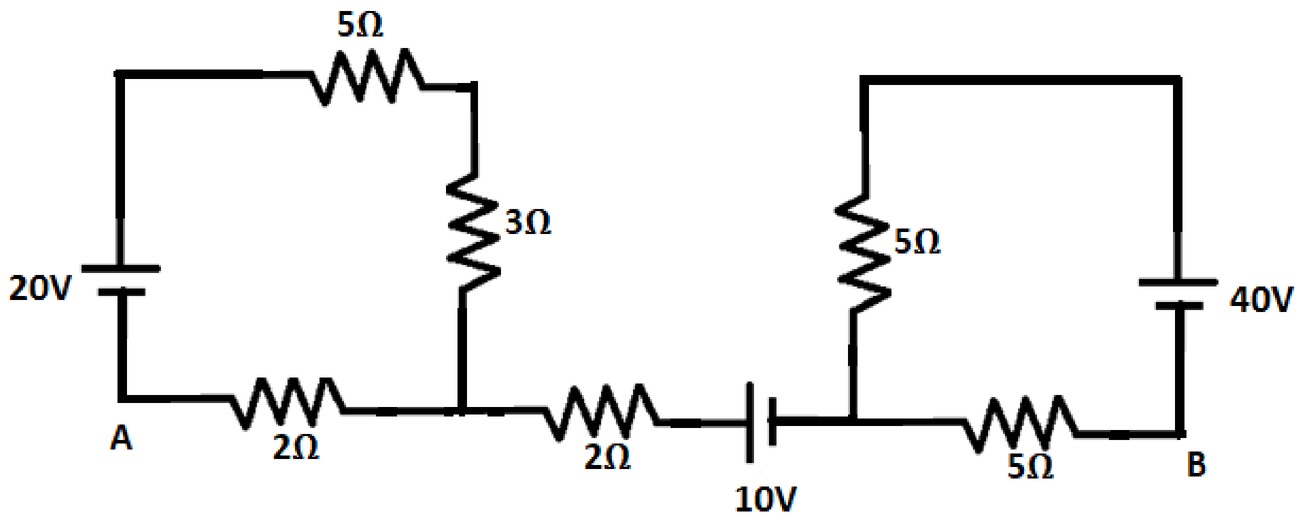


KVL: +10-8I-6-8+12 = 0

Hence, I = 1A

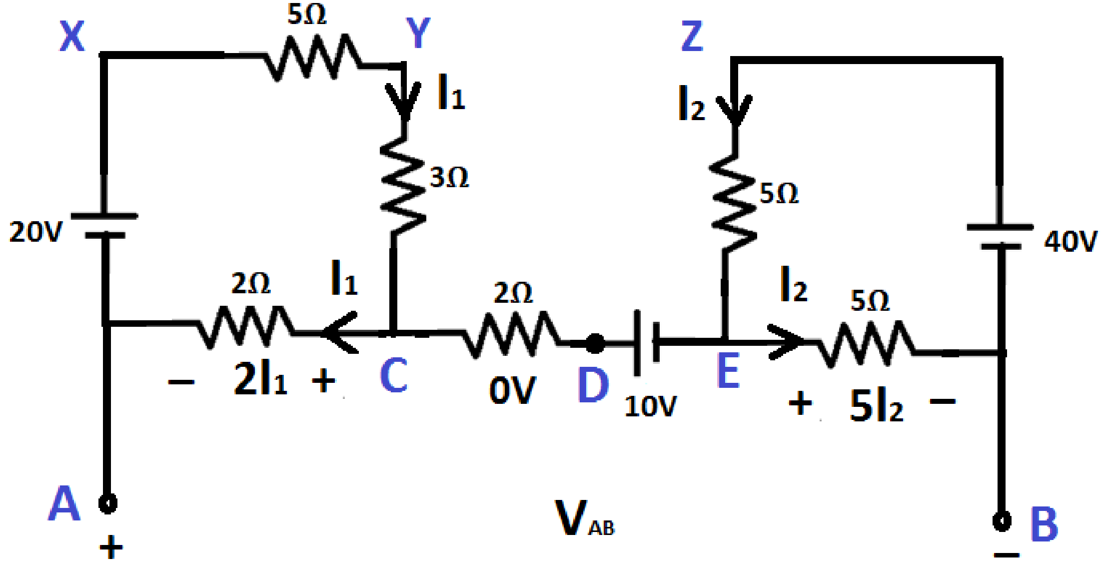
Example 2:

Find the voltage V_{AB} in the network shown:



Numerical Example on KVL

Solution:



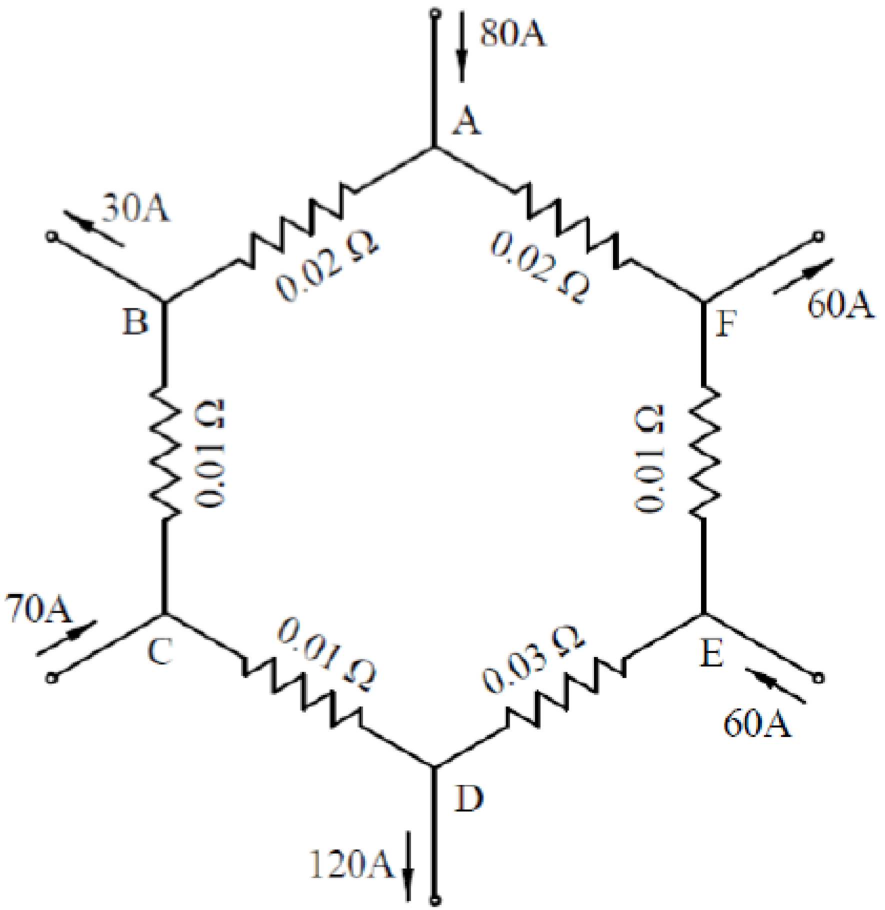
KVL (AXYCA): $+20-5I_1-3I_1-2I_1 = 0$; Hence, $I_1 = 2A$

KVL (BZEB): $+40-5I_2-5I_2 = 0$; Hence, $I_2 = 4A$

KVL (ACDEBA): $+2I_1-10-5I_2+V_{AB} = 0$; Hence, $V_{AB} = 26V$; In path CDE, there is no closed path for the current to flow. Hence, Current through CD is 0 and voltage across is 0 V

Numerical Example on KVL

Q3. Find the current in all the branches in the network shown.



Text Book & References

Text Book:

"Electrical and Electronic Technology" E. Hughes (Revised by J. Hiley, K. Brown & I.M Smith), 11th Edition, Pearson Education, 2012.

Reference Books:

1. "Basic Electrical Engineering", K Uma Rao, Pearson Education, 2011.
2. "Basic Electrical Engineering - Revised Edition", D. C. Kulshreshta, Tata- McGraw-Hill, 2012.
3. "Engineering Circuit Analysis", William Hayt Jr., Jack E. Kemmerly & Steven M. Durbin, 8th Edition, McGraw-Hill, 2012.

THANK YOU

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