CSE 251

Electronic Devices and Circuits

Lecture 2

Course instructor:

Mir Hamidul Hussain

Lecturer, Department of Computer Science and Engineering, School of Data and Sciences, BRAC University

Email: ext.hamidul.hussain@bracu.ac.bd

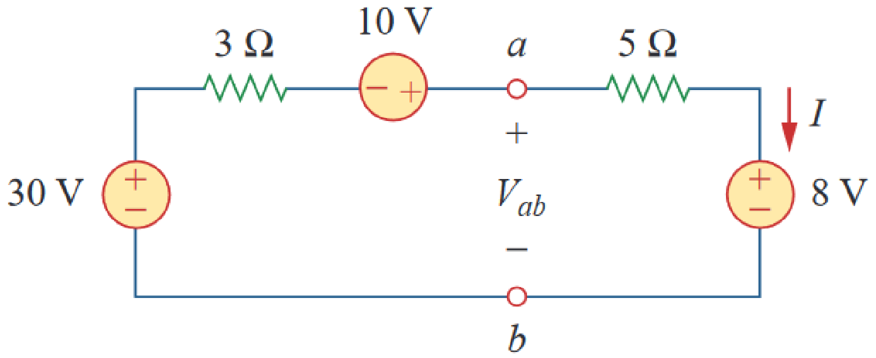
Alternative Circuit Representation: Line diagrams

Steps to decompose circuits to line diagram

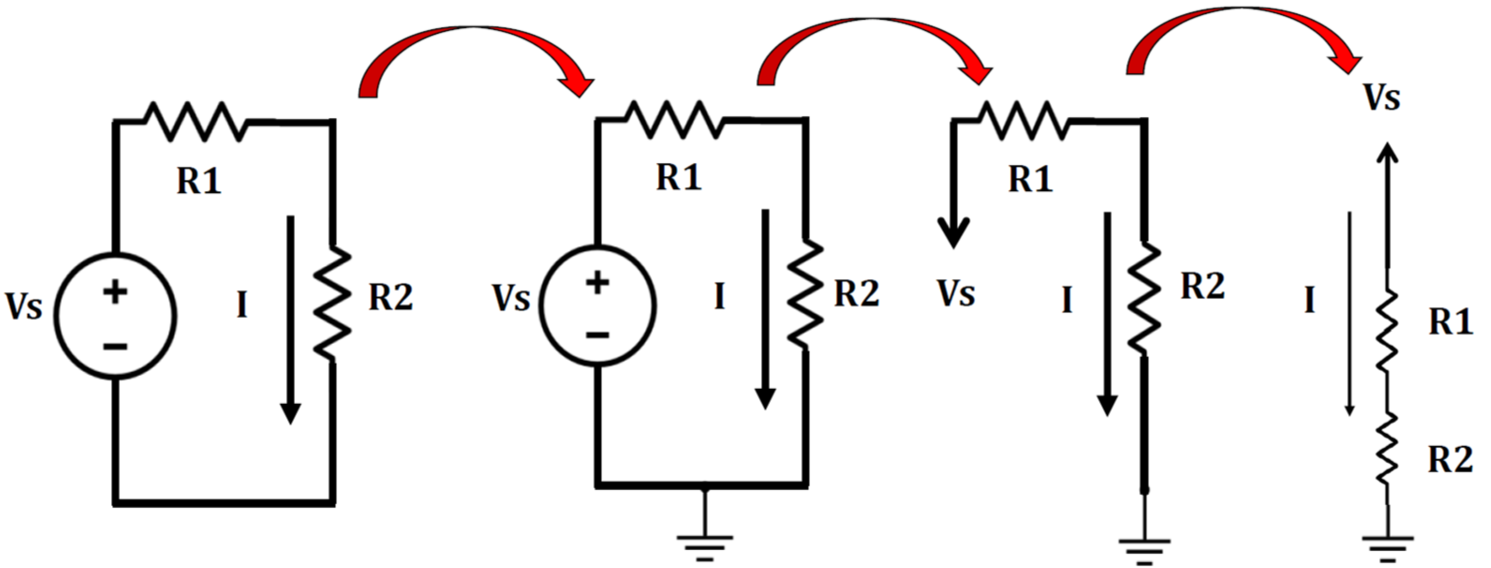
1. Set a ground so that number of **floating voltage** sources are minimized.
2. Detach the ground **from the voltage source**.
3. Convert the non-floating voltage sources (~~current sources~~) into:
   - Arrow : (→) **Fixed/Constant voltage source**
4. Keep passive elements as they are.

Floating voltage sources:

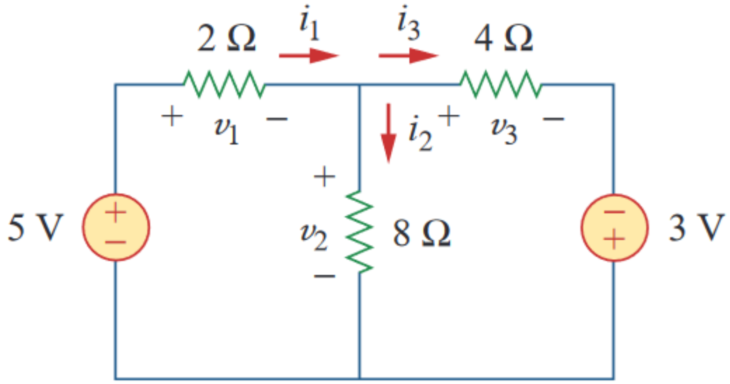
Voltage sources which are **not connected the ground** terminal. In the diagram, the **10 V** voltage source is floating

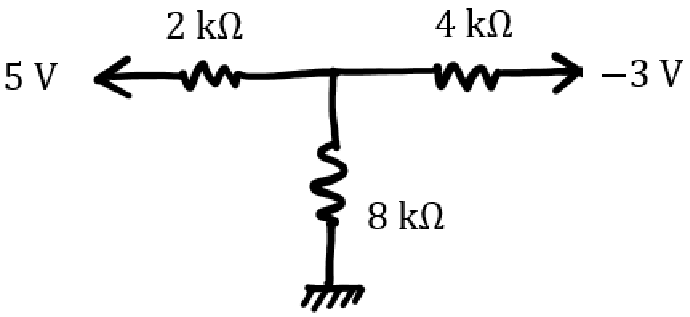


Line Diagram: Example 1

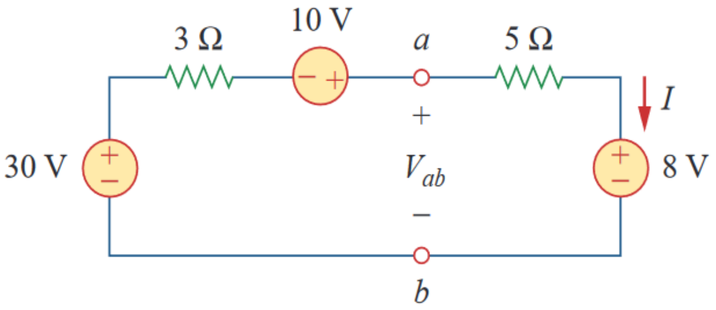


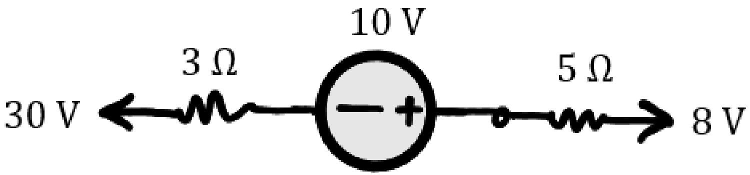
Line Diagram: Example 2



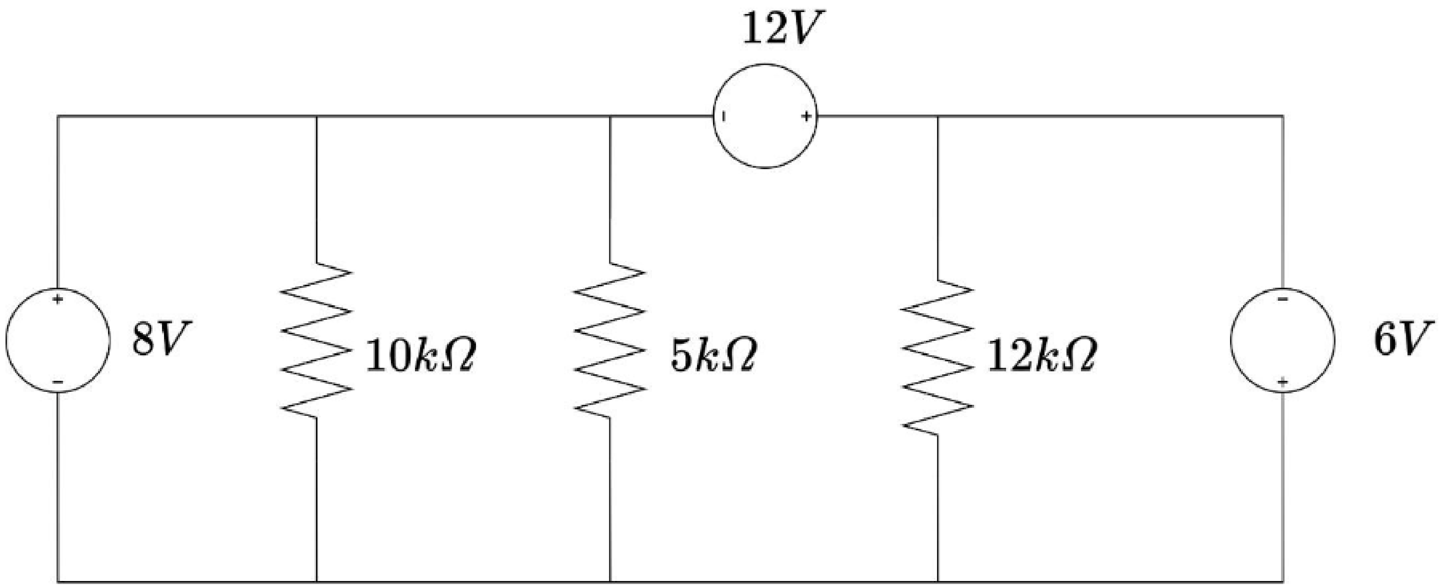


Line Diagram: Example 2

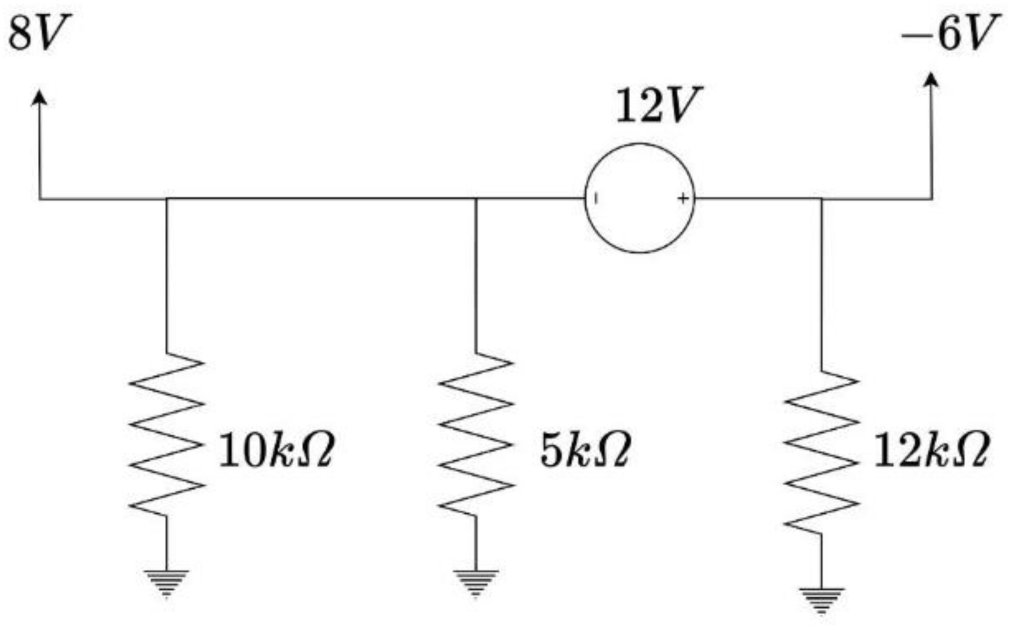




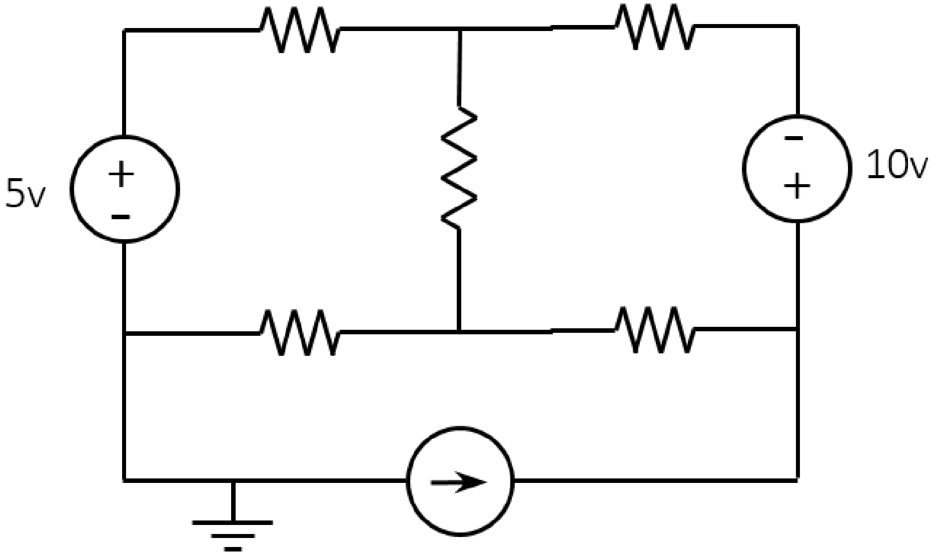
Line Diagram: Example 3

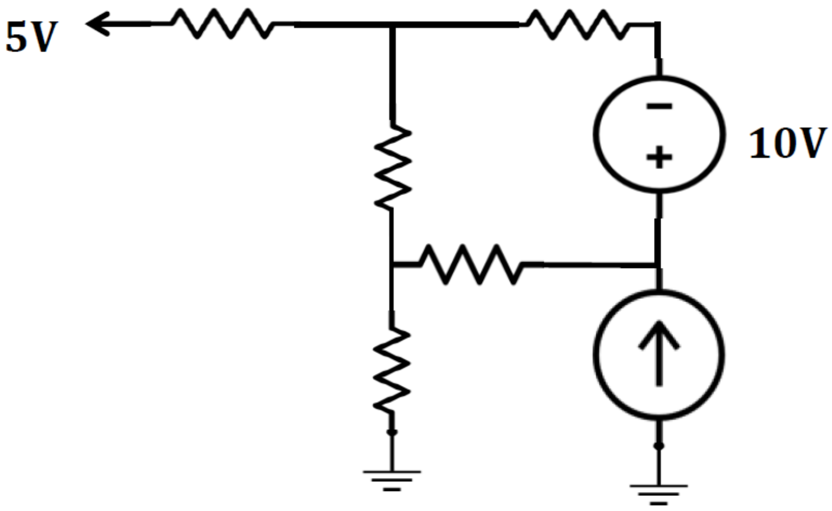


Line Diagram: Example 3

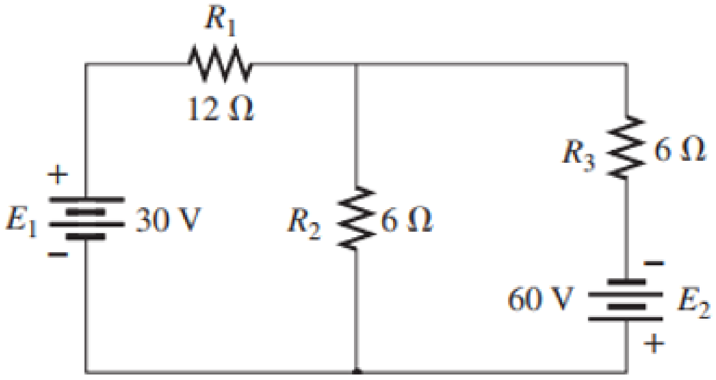


Line Diagram: Example 4

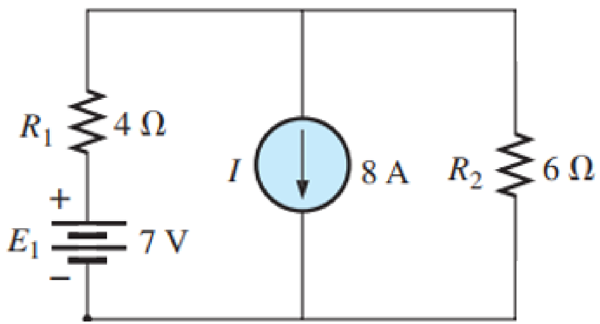




More Examples

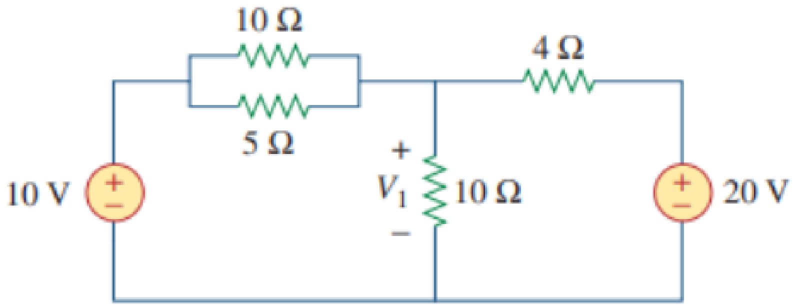


Circuit 1

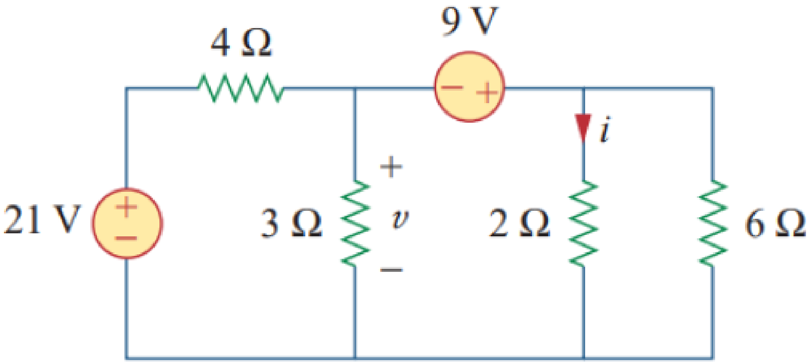


Circuit 2

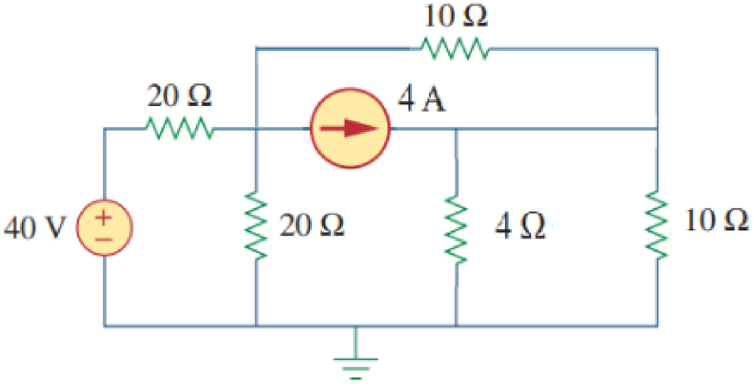
Practice Problems



Circuit 1



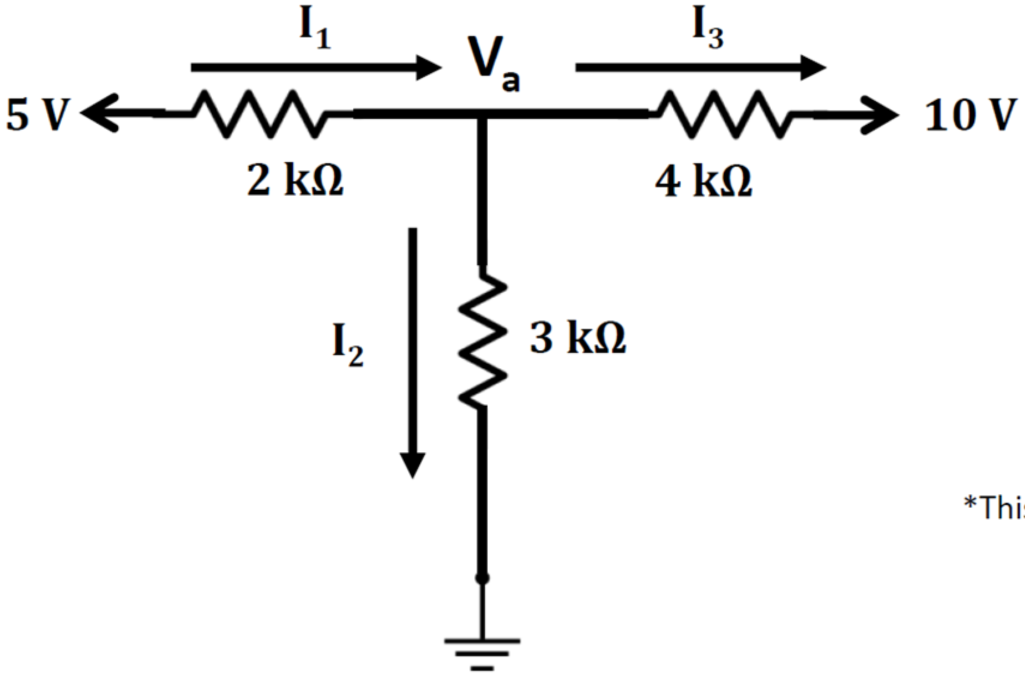
Circuit 2



Circuit 3

Kirchhoff's Current Law (KCL):

- "The algebraic sum of all currents entering and exiting a node must equal zero."
- "Currents flowing into a node (or a junction) must be equal to the currents flowing out of it."



$$\boxed{I_1 = I_2 + I_3}$$

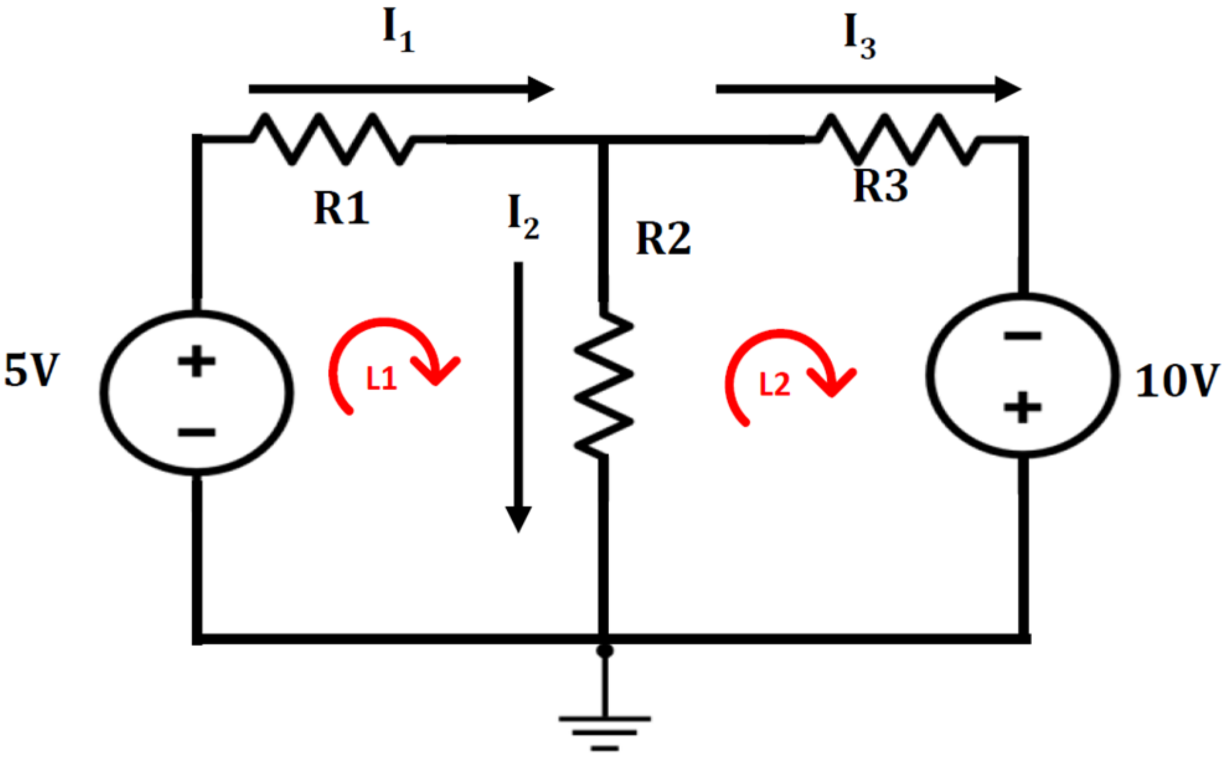
*This is also applicable for supernodes!

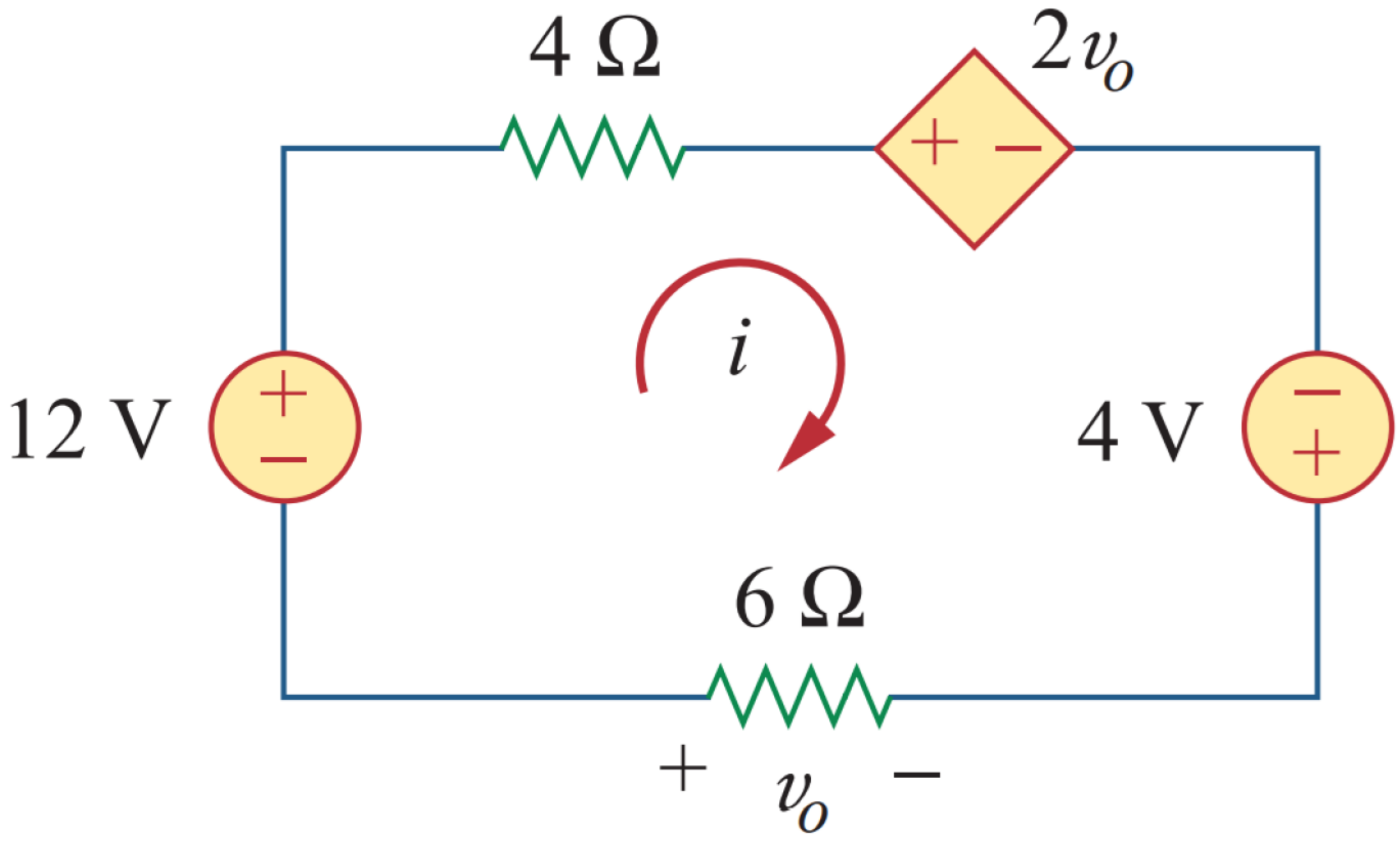
Kirchhoff's Voltage Law (KVL): The algebraic sum of all voltages in a loop must equal zero

Loop 1: $5 - I_1R_1 - I_2R_2 = 0$

Loop 2: $10 + I_2R_2 - I_3R_3 = 0$

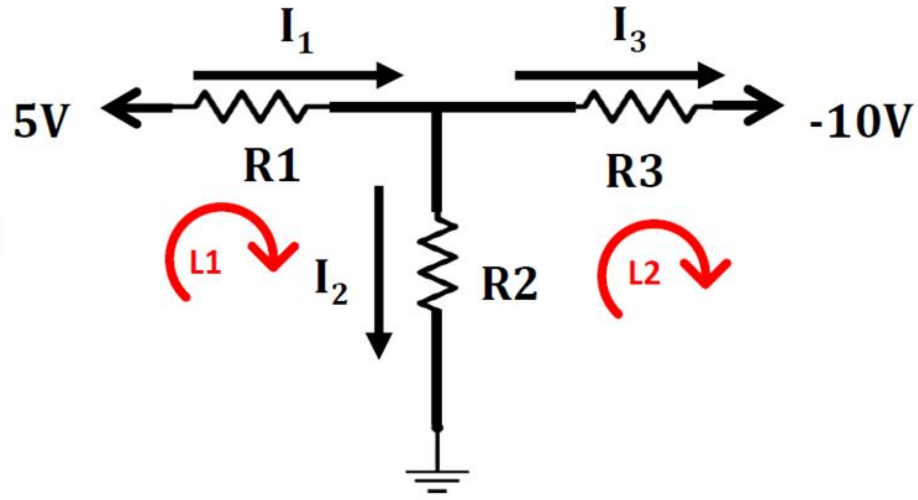
$$\sum V = 0$$





4 Ω
2v_o
12 V
i
4 V
6 Ω
+ v_o −

$$\sum V\ [along\ line] = Voltage\ at\ the\ starting\ of\ the\ node - Voltage\ at\ the\ ending\ of\ the\ node$$

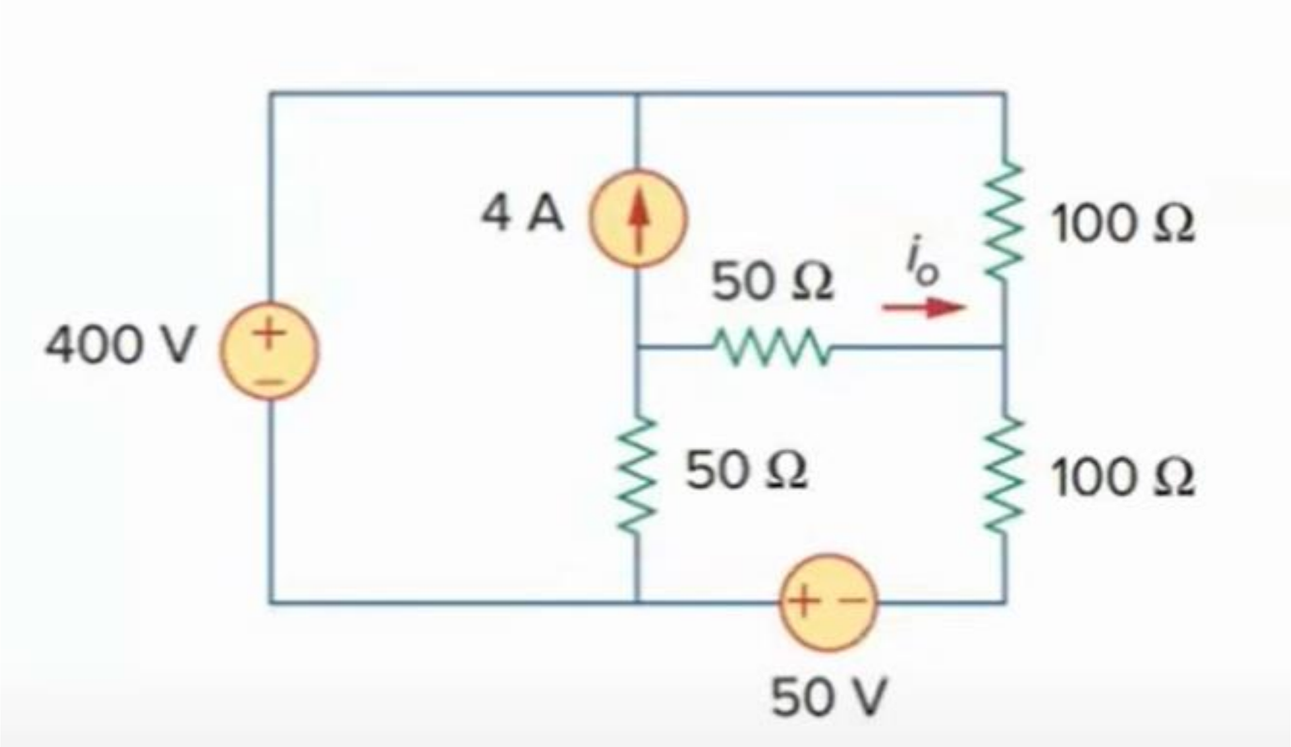


Line 1: $5\text{-}0 = I_1R_1 + I_2R_2 = 0$

Line 2: $0+10 = -I_2R_2 + I_3R_3$

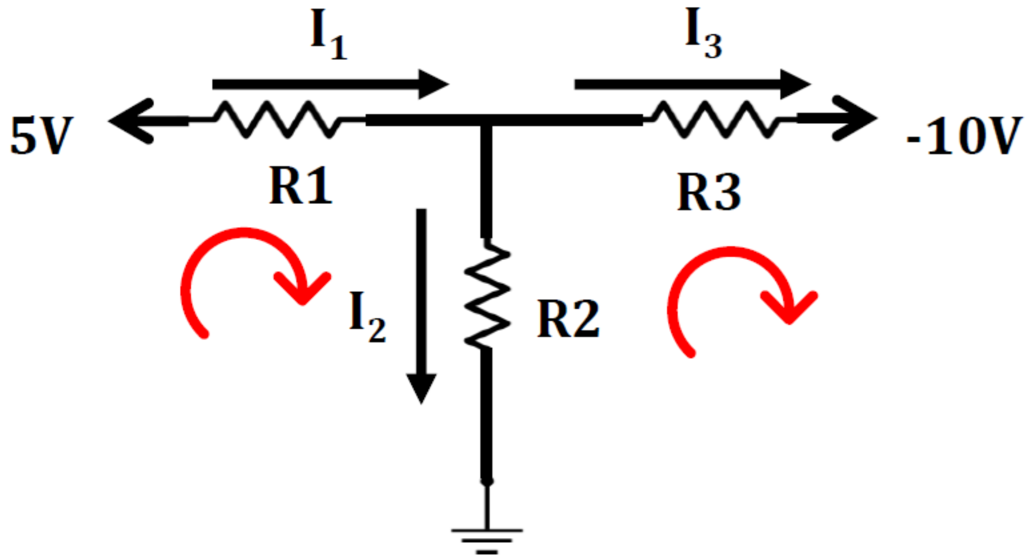
Practice Problem

Draw the alternative representation of the following circuit minimizing the number of floating voltage sources
Find $\boldsymbol{i_o}$ using KVL



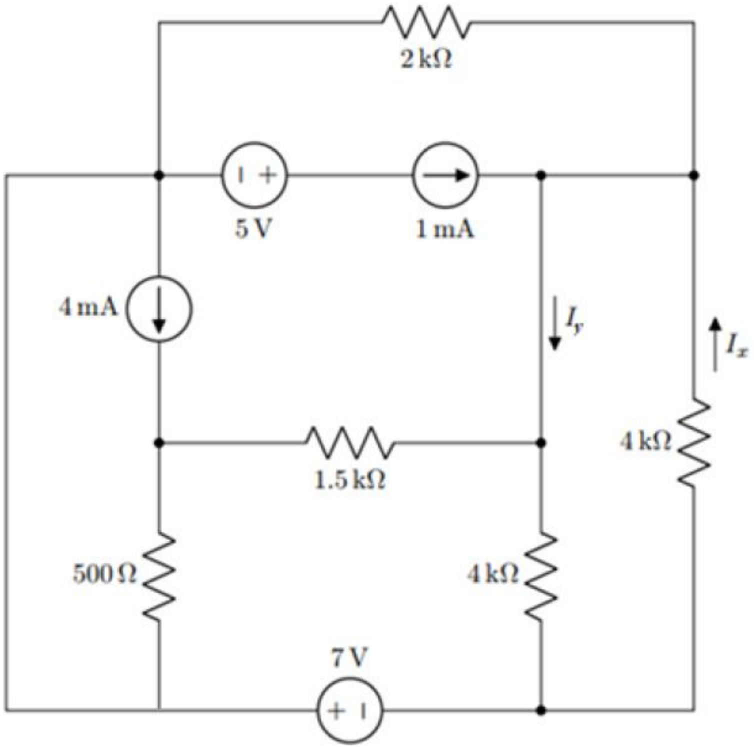
Nodal analysis:

$$V_a\left(\frac{1}{R1}+\frac{1}{R2}+\frac{1}{R3}\right)-\frac{5}{R1}-\frac{0}{R2}-\frac{-10}{R3}=0$$



Practice Problem

Draw the alternative representation of the following circuit minimizing the number of floating voltage sources. Find $\boldsymbol{i_x}$ and $\boldsymbol{i_y}$ using Nodal analysis



Practice Problem

Draw the alternative representation of the following circuit minimizing the number of floating voltage sources.
Find $\boldsymbol{i_x}$ using KVL