

# **Electrical Circuit (1)**

**Introduction (week3 class1)**

**Dr. Akram Al-Mahrouk**

**Philadelphia University**

## Chapter 3 Methods of Analysis 81

- 3.1 Introduction 82
- 3.2 Nodal Analysis 82
- 3.3 Nodal Analysis with Voltage Sources 88
- 3.4 Mesh Analysis 93
- 3.5 Mesh Analysis with Current Sources 98
- 3.6 †Nodal and Mesh Analyses by Inspection 100
- 3.7 Nodal Versus Mesh Analysis 104
- 3.8 Circuit Analysis with *PSpice* 105
- 3.9 †Applications: DC Transistor Circuits 107
- 3.10 Summary 112
  - Review Questions 113
  - Problems 114
  - Comprehensive Problem 126

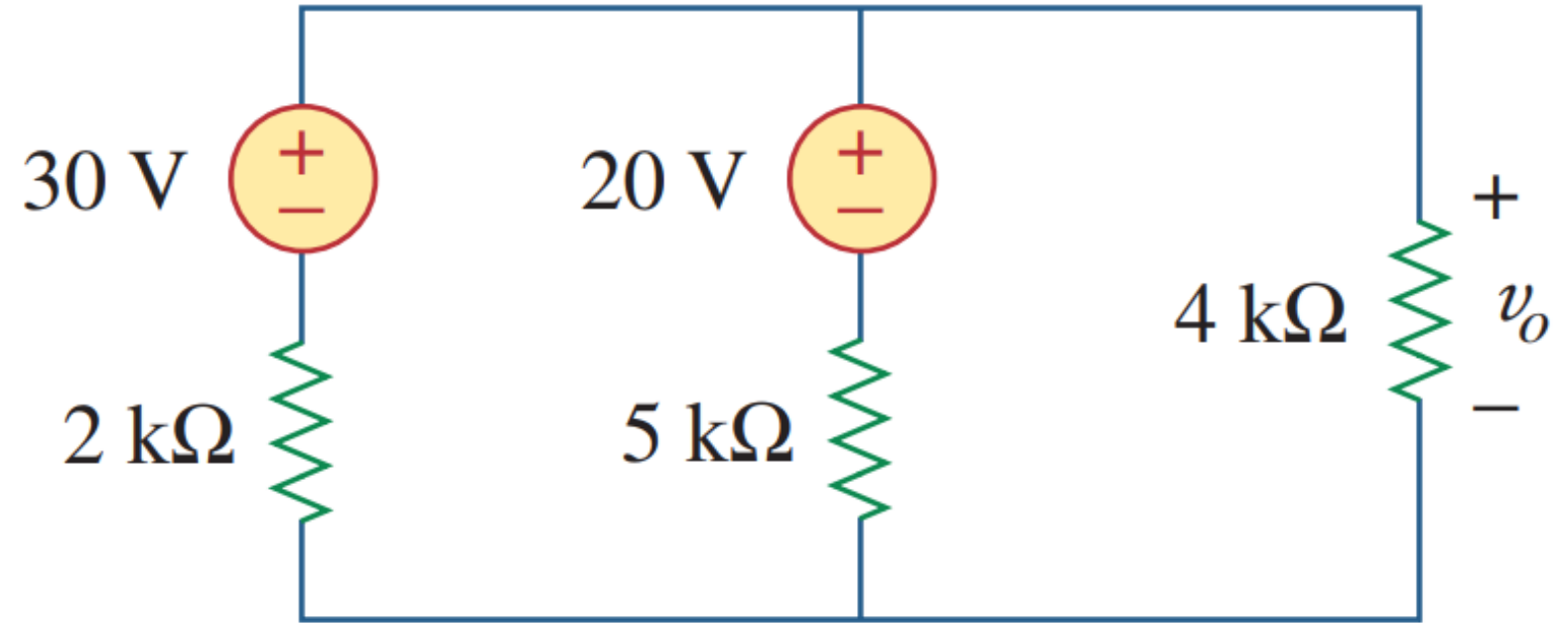
# Nodal Analysis



## Steps to Determine Node Voltages:

1. Select a node as the reference node. Assign voltages  $v_1, v_2, \dots, v_{n-1}$  to the remaining  $n - 1$  nodes. The voltages are referenced with respect to the reference node.
2. Apply KCL to each of the  $n - 1$  nonreference nodes. Use Ohm's law to express the branch currents in terms of node voltages.
3. Solve the resulting simultaneous equations to obtain the unknown node voltages.

# Nodal Analysis



# Nodal Analysis

## Basic equation

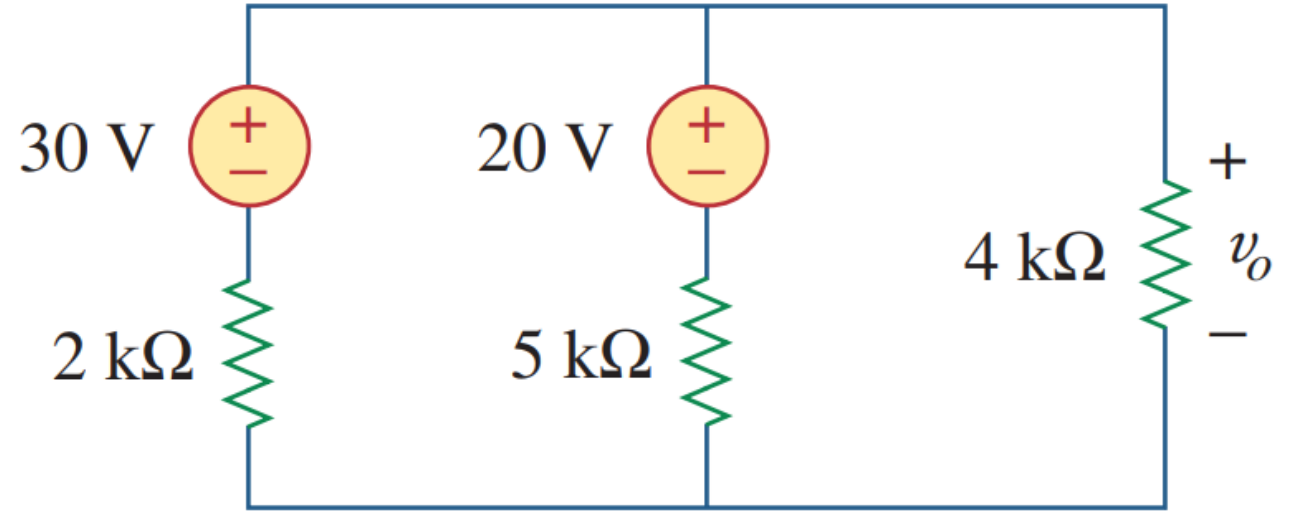
$$\frac{V_o - 30}{2000} + \frac{V_o - 20}{5000} + \frac{V_o}{4000} = 0$$

## Formulated equation

$$\frac{V_o}{2000} + \frac{V_o}{5000} + \frac{V_o}{4000} = \frac{30}{2000} + \frac{20}{5000}$$

## Final answer

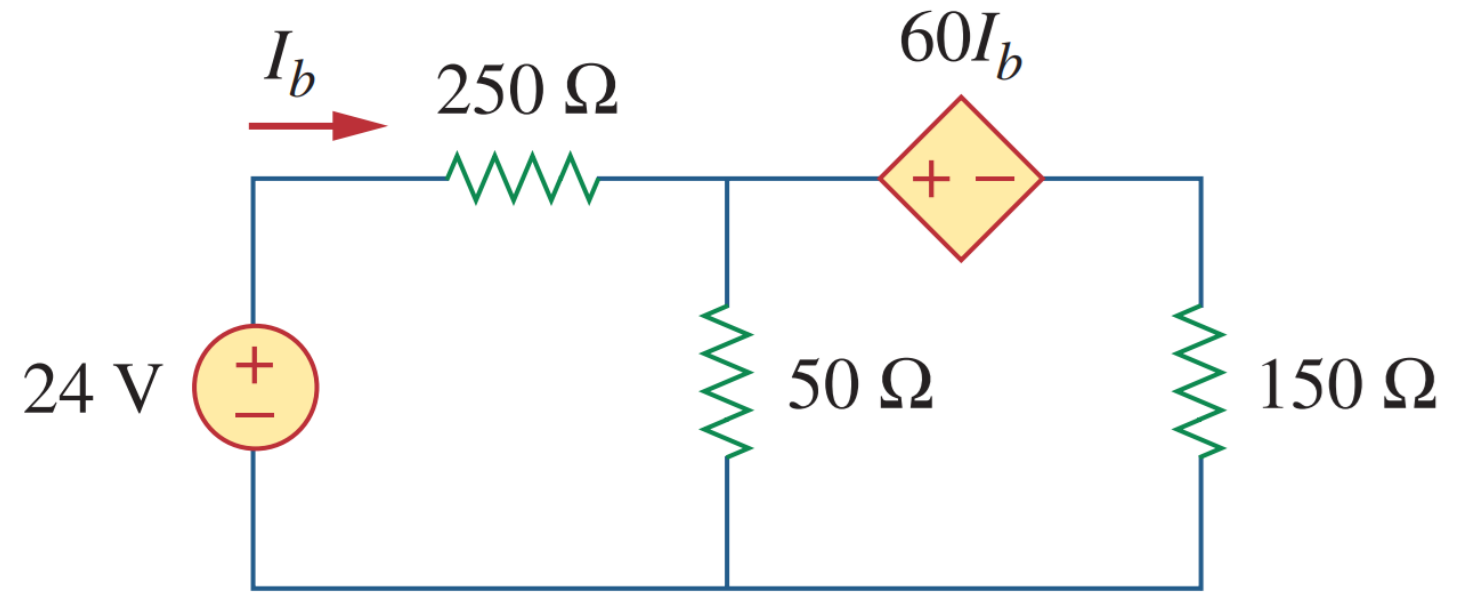
$$V_o = 20 \text{ V}$$



## Additional answer

XXXXXX

# Nodal Analysis



# Nodal Analysis

## Basic equation

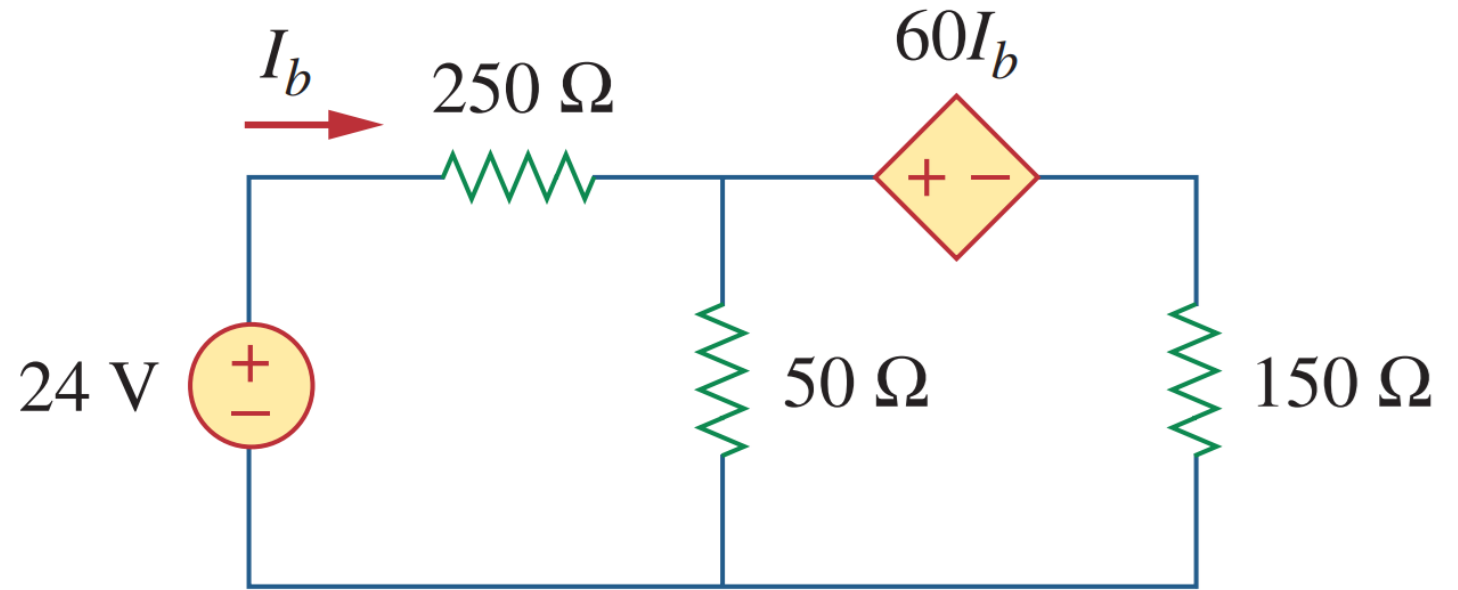
$$\frac{V_o - 24}{250} + \frac{V_o}{50} + \frac{V_o - 60\left(\frac{24 - V_o}{250}\right)}{150} = 0$$

## Formulated equation

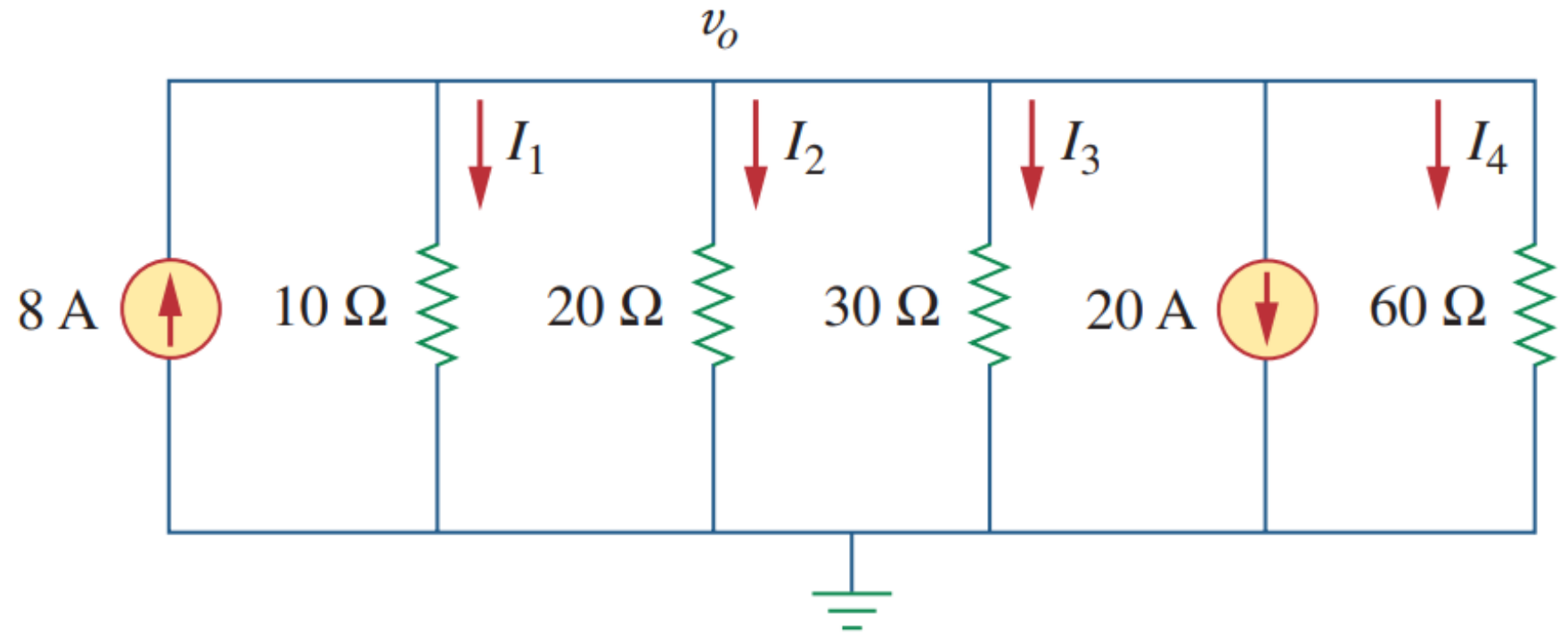
$$\frac{V_o}{250} + \frac{V_o}{50} + \frac{V_o}{150} + \frac{(60 * V_o)/250}{150} = \frac{24}{250} + \frac{(60 * 24)/250}{150}$$

## Final answer

$$V_o = 4.16 V$$



# Nodal Analysis



# Nodal Analysis

## Basic equation

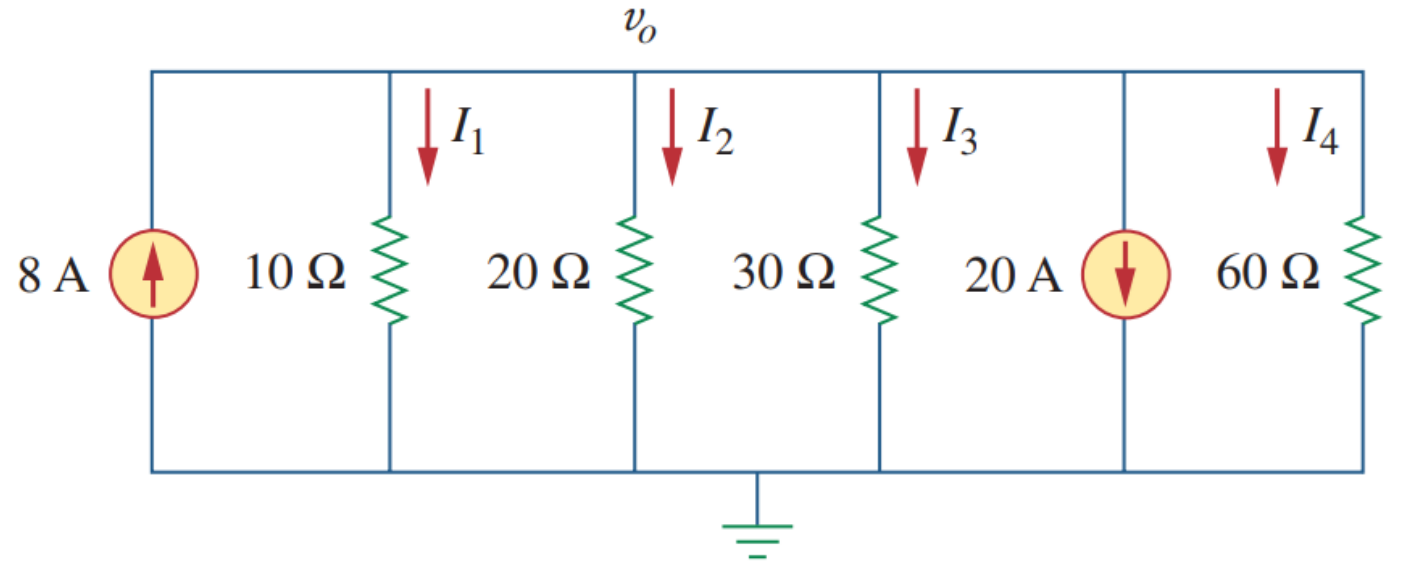
$$-8 + \frac{V_o}{10} + \frac{V_o}{20} + \frac{V_o}{30} + 20 - \frac{V_o}{60} = 0$$

## Formulated equation

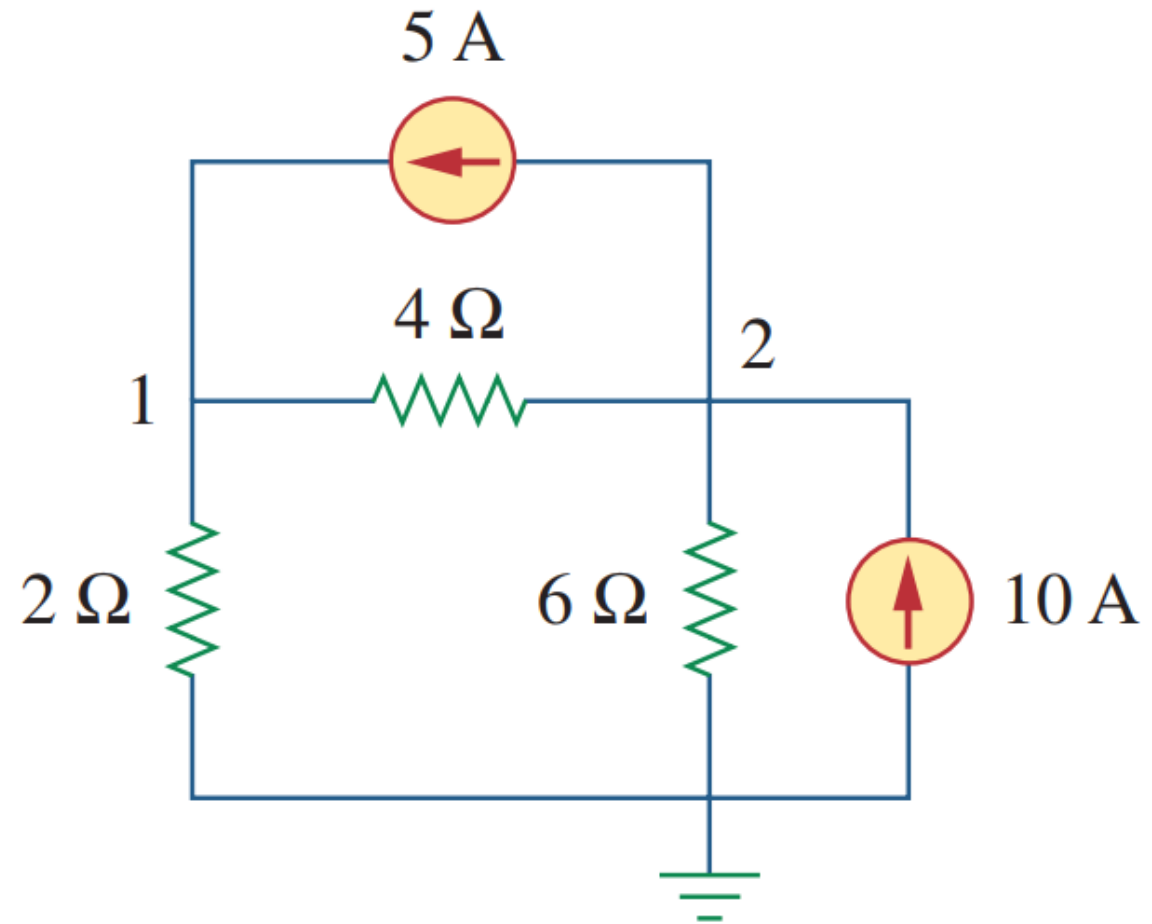
$$\frac{V_o}{10} + \frac{V_o}{20} + \frac{V_o}{30} + \frac{V}{60} = -20 + 8$$

## Final answer

$$V_o = -60 \text{ V}$$



# Nodal Analysis



# Nodal Analysis

## Basic equation

$$\frac{V_1}{2} + \frac{V_1 - V_2}{4} - 5 = 0$$

$$\frac{V_2}{6} - 10 + \frac{V_2 - V_1}{4} + 5 = 0$$

## Formulated equation

$$\left(\frac{1}{2} + \frac{1}{4}\right)V_1 - \frac{1}{4}V_2 = 5$$

$$\left(\frac{-1}{4}\right)V_1 + \left(\frac{1}{6} + \frac{1}{4}\right)V_2 = 5$$

## Final answer

$$V_1 = 13.333 \text{ V} \quad V_2 = 20 \text{ V}$$

