Basic Electrical Technology

Node Voltage Analysis

Objective

- Application of KCL for analysis of DC circuits

Introduction

Kirchhoff's Current Law (KCL)

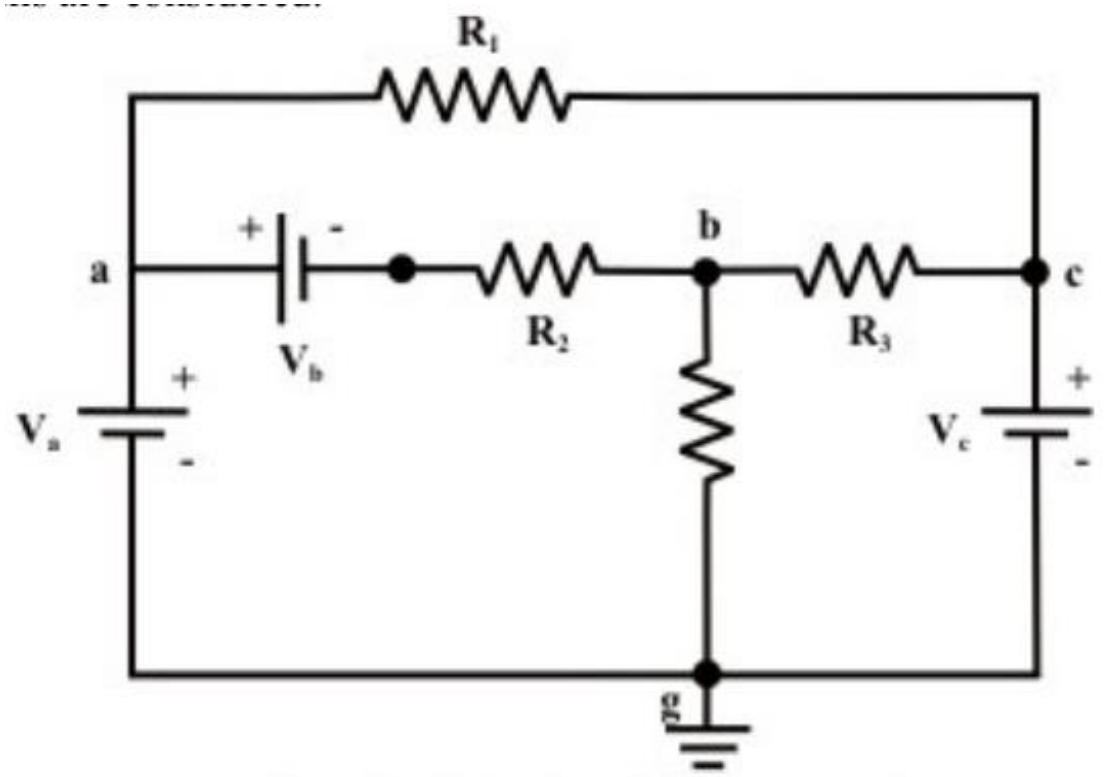
- States that at any node (junction) in a circuit, the algebraic sum of currents entering and leaving the node at any instant of time must be equal to zero.

Node

- A point in an electric circuit where 3 or more elements are connected.

Branch

- A conducting path between two nodes in a circuit containing circuit elements.
- The circuit has six branches

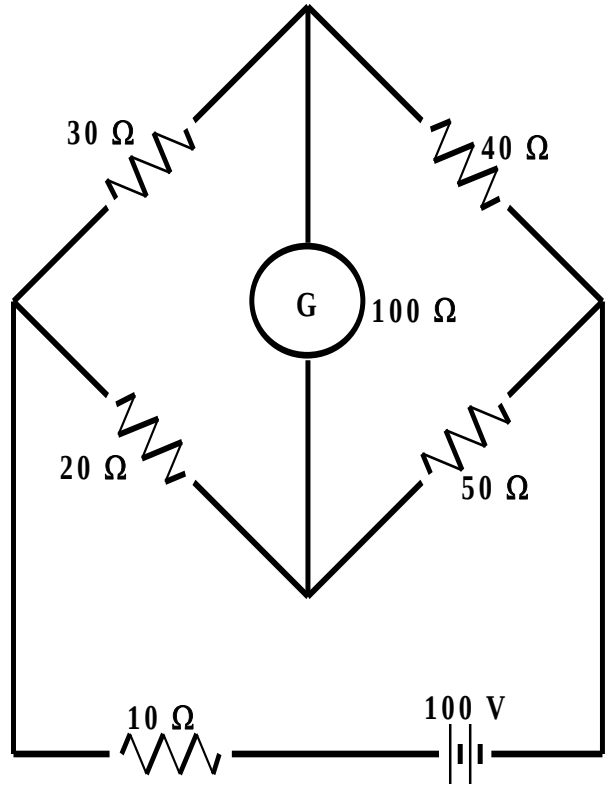


Node Voltage Analysis Method

- Convert all the practical voltage sources to current sources
- Identify nodes in the circuit
- One of the nodes is taken as reference node
- Assign a voltage to each of the remaining nodes
- Write KCL equations for all the nodes (excluding the reference node)
- Solve for voltages

Illustration 1

Determine the current through the galvanometer "**G**"



Ans: 84 mA

Illustration 1 contd…

How to write the network equations by inspection?

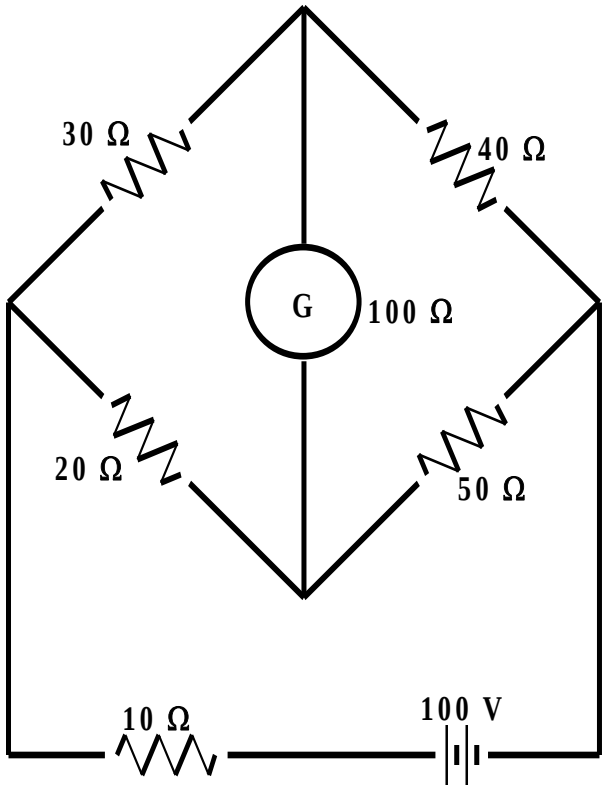
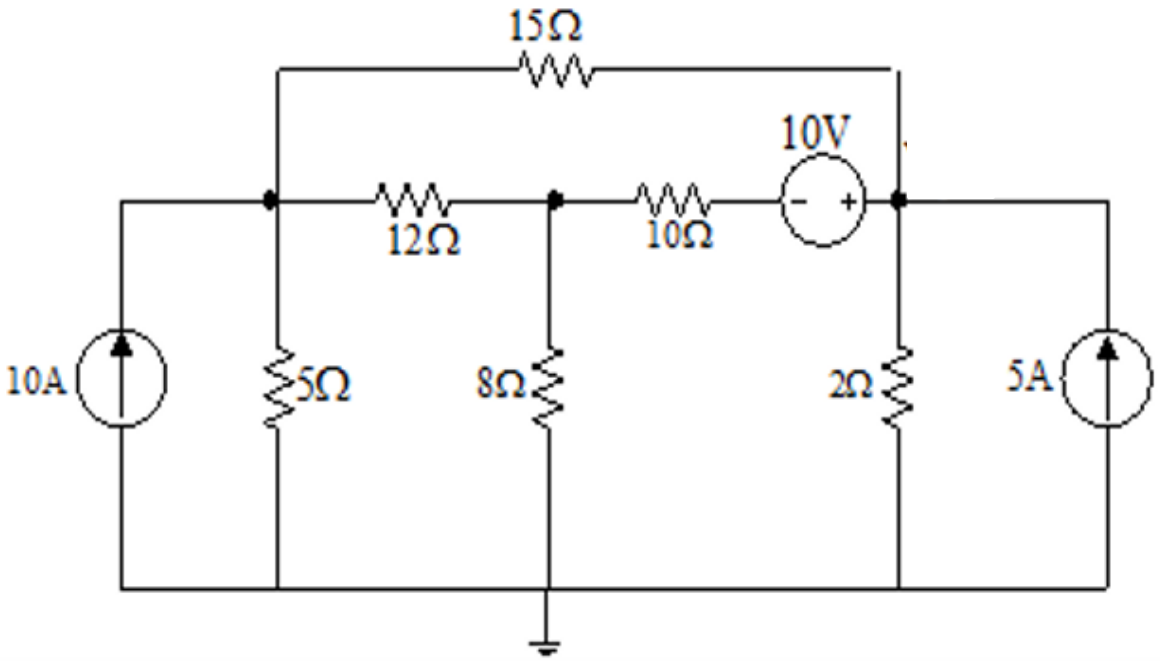


Illustration 2

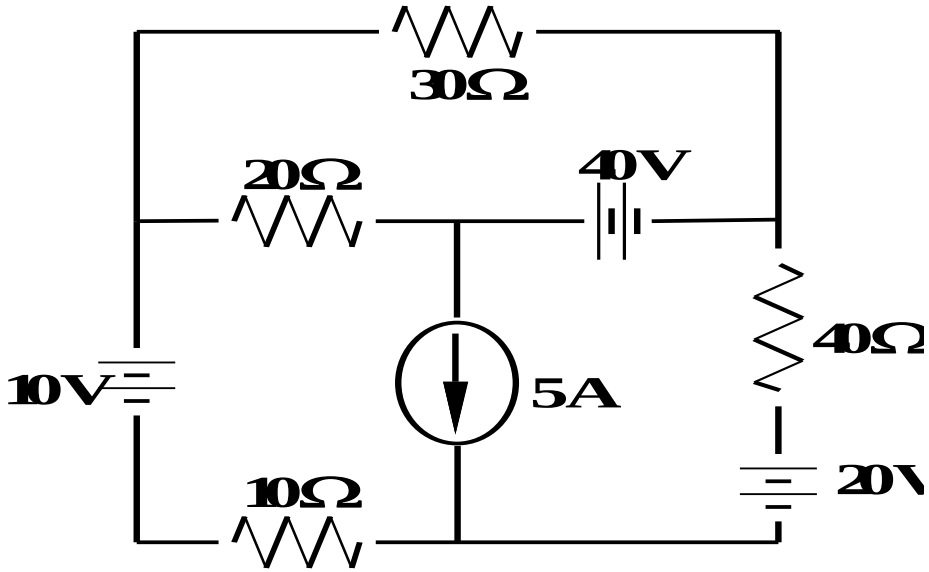
Find the power dissipated in 8 Ω resistor. Use Node Voltage Method



Ans: 13.47 W

Illustration 3

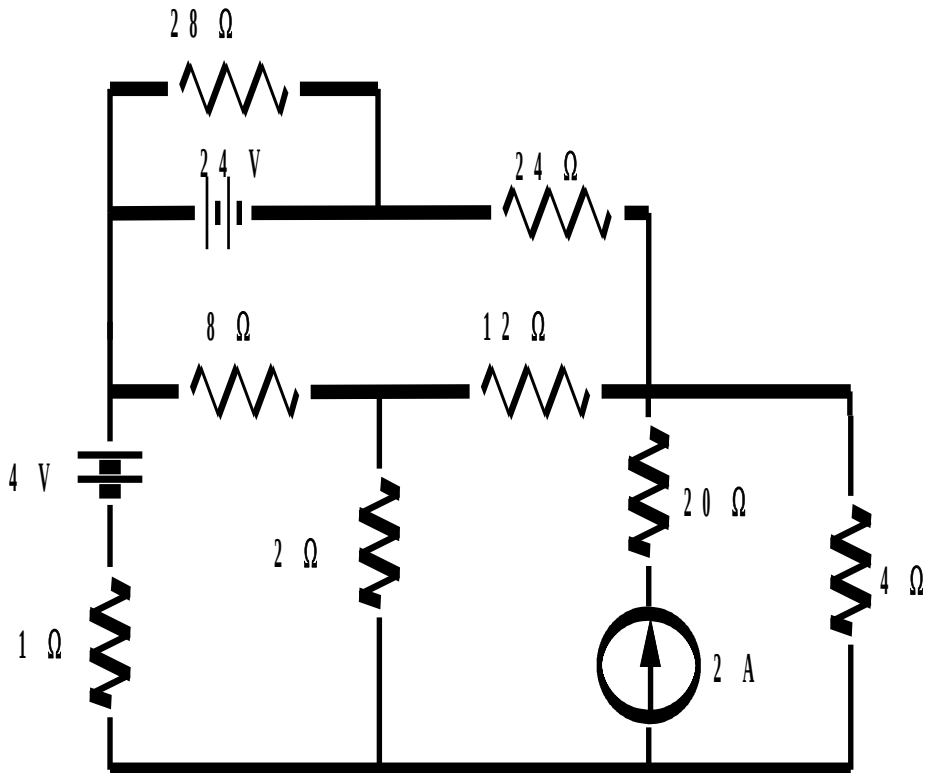
Find the current through 40 V battery. Is the battery charging or discharging?



Ans: 4.19 A, Discharging

Homework

Determine the power dissipated in 8 Ω resistor. Is the 4 V source charging or discharging?



Ans: $P_{8\Omega}$ = 1.386 W
Charging

Summary

- Node voltages are determined
- Other operating conditions can be determined using the node voltages
- Concept of super-node:- If there is a voltage source between two nodes