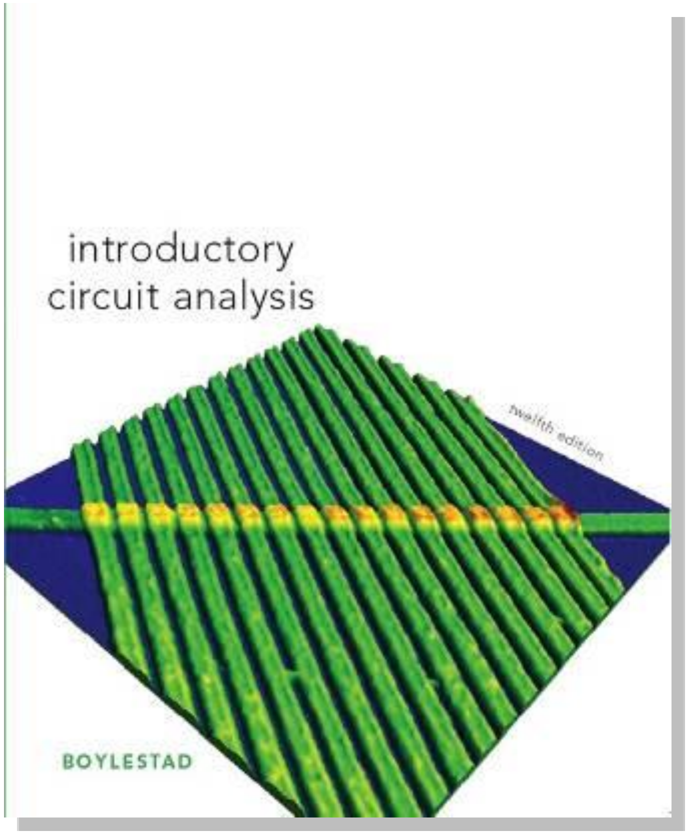
Chapter 7

Series-Parallel Circuits



OBJECTIVES

- Learn about the unique characteristics of series-parallel configurations and how to solve for the voltage, current, or power to any individual element or combination of elements.
- Become familiar with the voltage divider supply and the conditions needed to use it effectively.

INTRODUCTION

- ***A series-parallel configuration is one that is formed by a combination of series and parallel elements.***
- ***A complex configuration is one in which none of the elements are in series or parallel.***

SERIES-PARALLEL NETWORKS

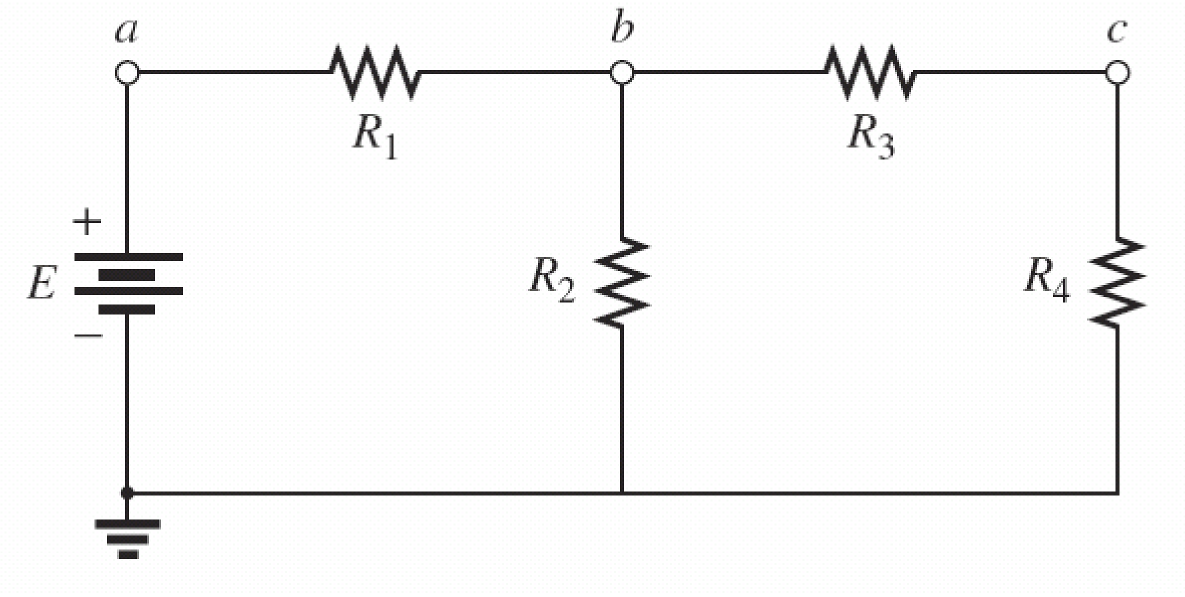


FIG. 7.1 *Series-parallel dc network.*

REDUCE AND RETURN APPROACH

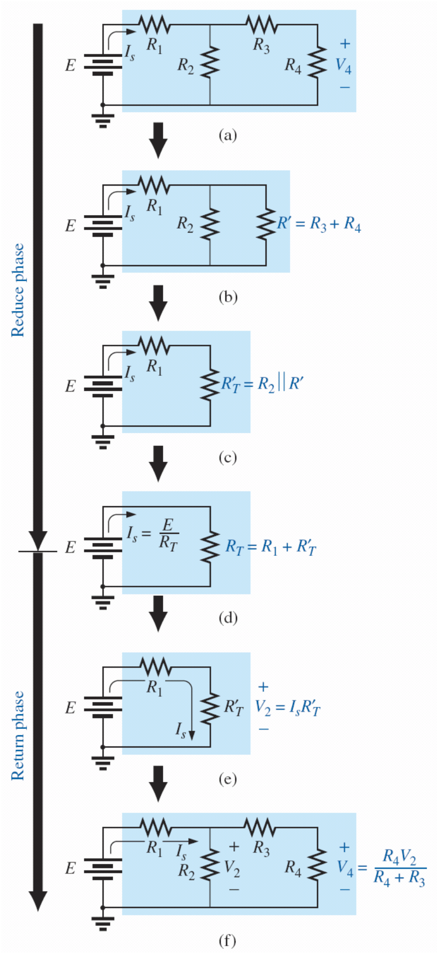


FIG. 7.2 *Introducing the reduce and return approach.*

REDUCE AND RETURN APPROACH

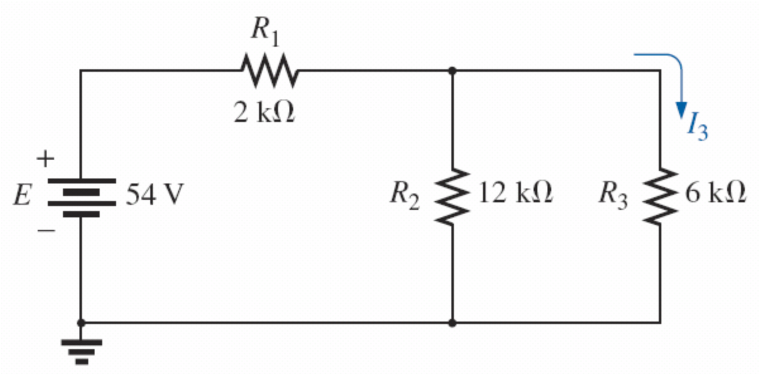


FIG. 7.3 *Series-parallel network for Example 7.1.*

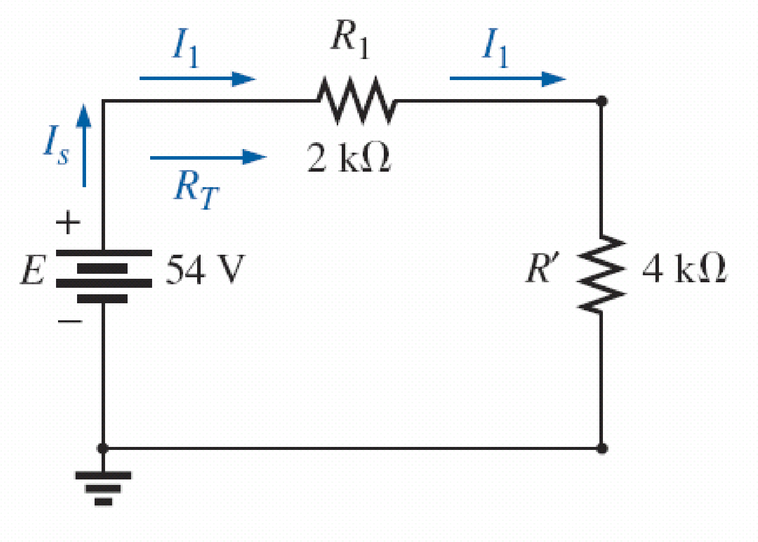


FIG. 7.4 *Substituting the parallel equivalent resistance for resistors R_2 and R_3 in Fig. 7.3.*

REDUCE AND RETURN APPROACH

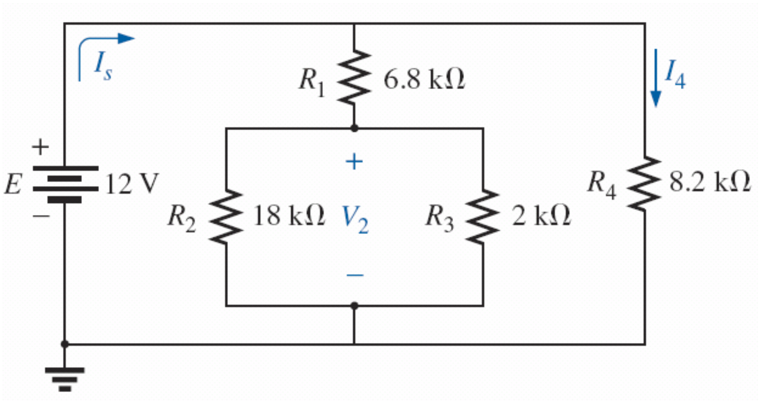


FIG. 7.5 *Series-parallel network for Example 7.2.*

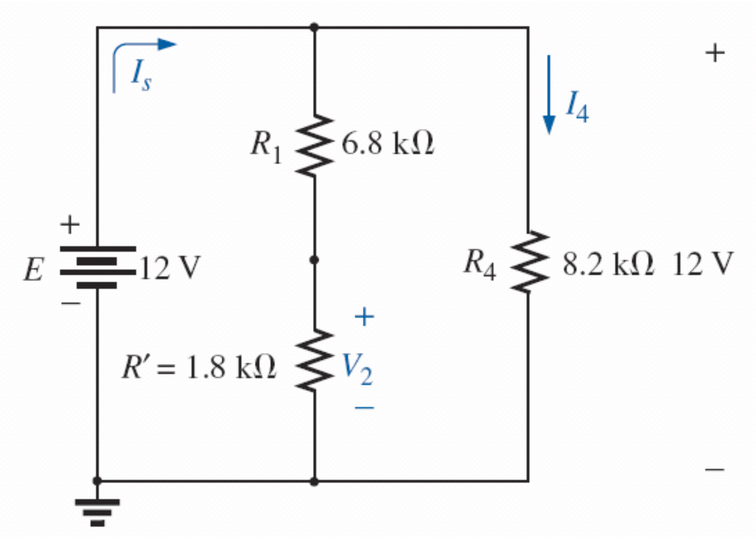


FIG. 7.6 *Schematic representation of the network in Fig. 7.5 after substituting the equivalent resistance R for the parallel combination of R_2 and R_3.*

REDUCE AND RETURN APPROACH

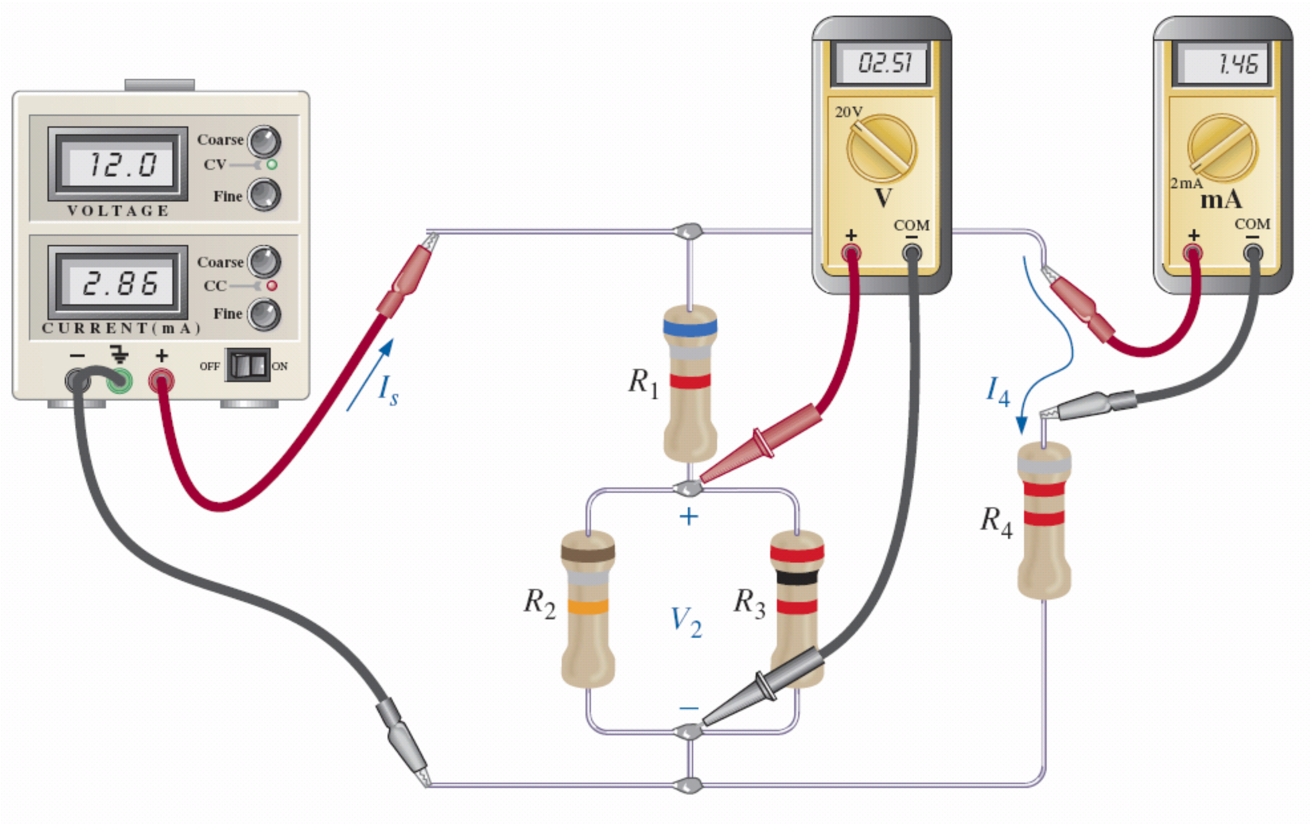


FIG. 7.7 *Inserting an ammeter and a voltmeter to measure I_4 and V_2, respectively.*

BLOCK DIAGRAM APPROACH

- Once the grouping of elements reveals the most direct approach, you can examine the impact of the individual components in each group.
- This grouping of elements is called the *block diagram approach*

BLOCK DIAGRAM APPROACH

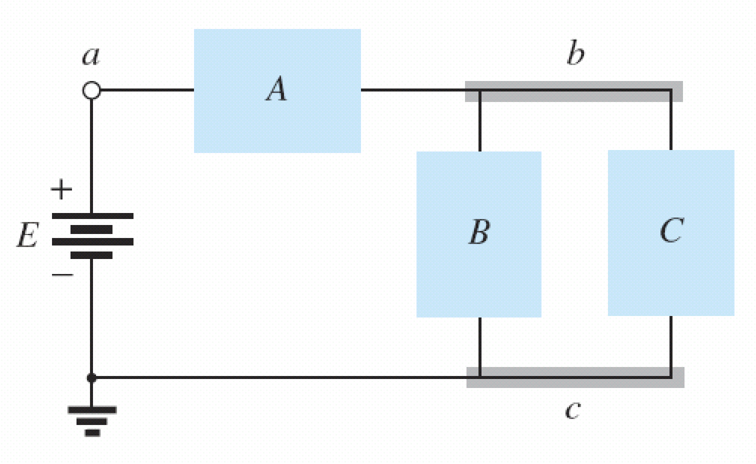


FIG. 7.8 *Introducing the block diagram approach.*

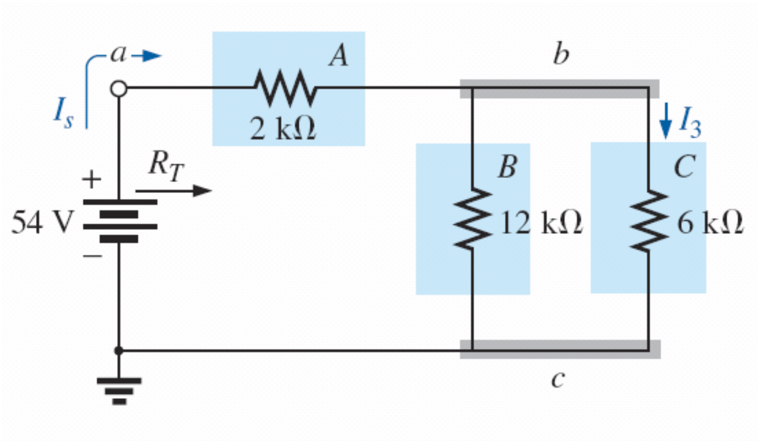


FIG. 7.9 *Block diagram format of Fig. 7.3.*

BLOCK DIAGRAM APPROACH

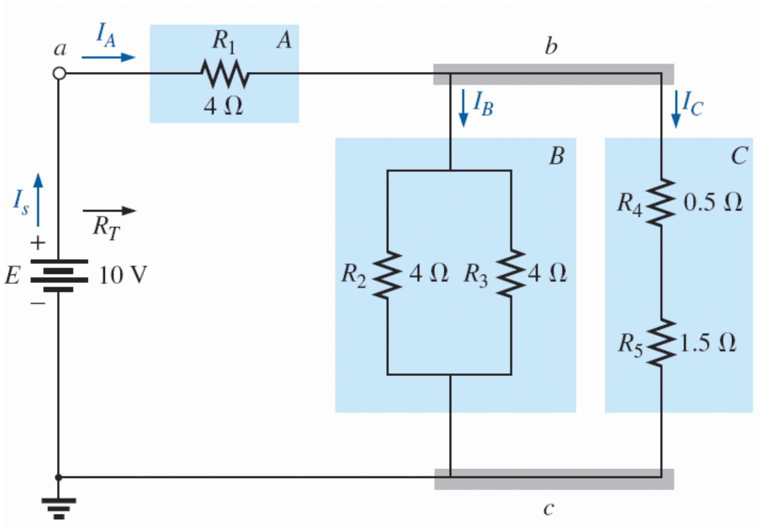


FIG. 7.10 *Example 7.3.*

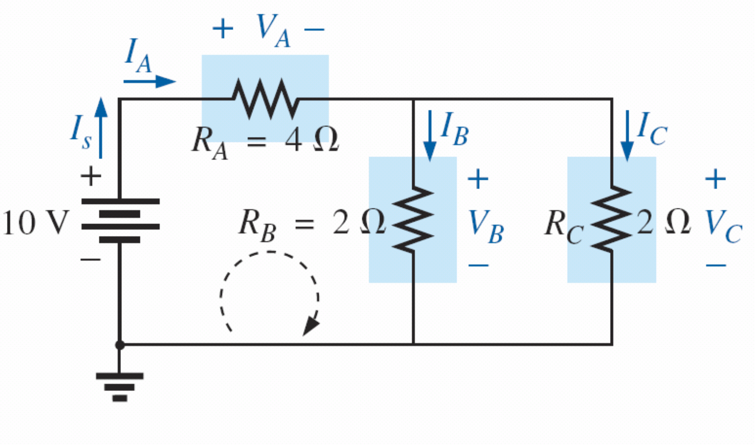


FIG. 7.11 *Reduced equivalent of Fig. 7.10.*

BLOCK DIAGRAM APPROACH

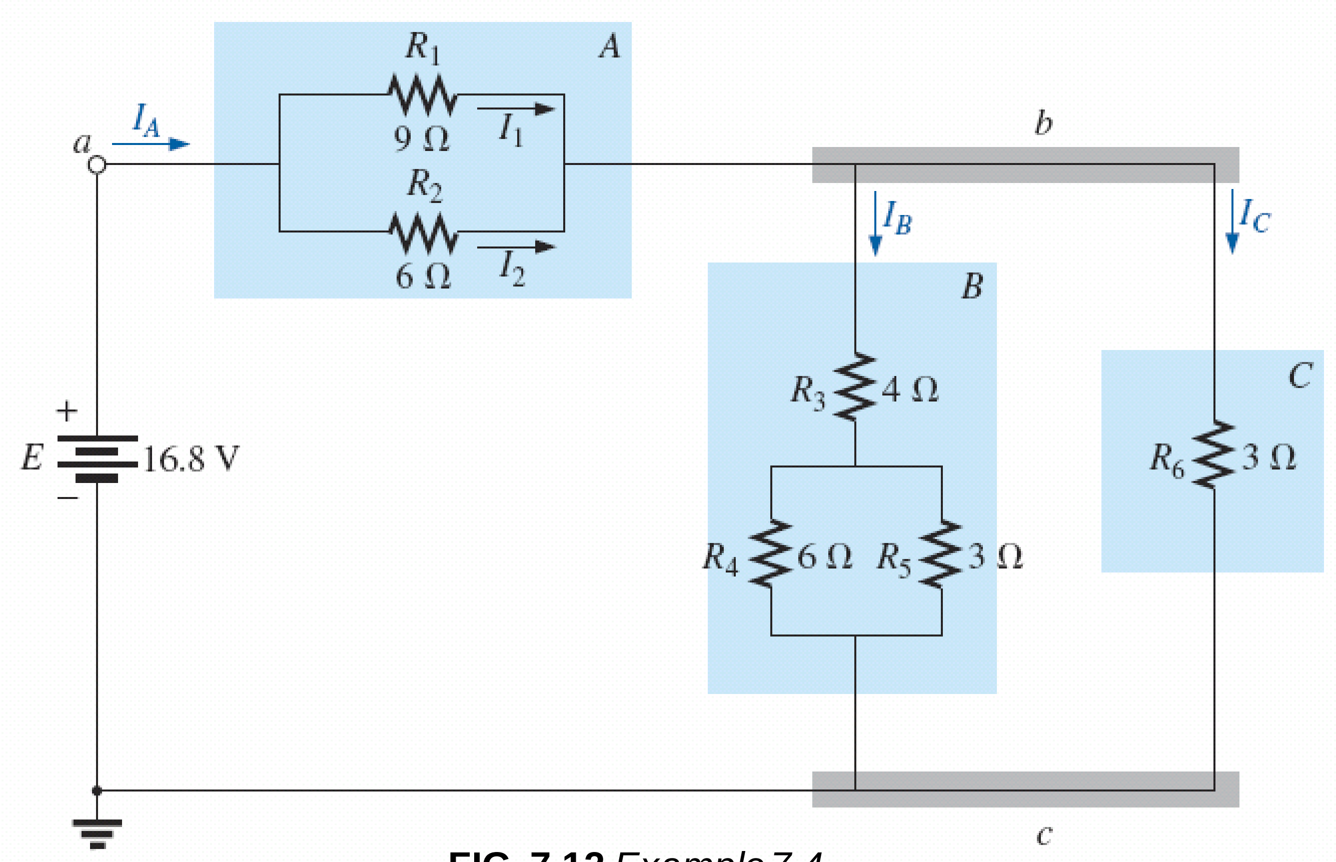


FIG. 7.12 *Example 7.4.*

- 1. Total resistance (RT)
- 2. Source current (IS)
- 3. (Branch current –(Current through every resistive element)
- 4. Voltage drop (across every resistive element)
- 5. power (across every resistive element)
- 6. KCL varify at node
- 7. KVL varify

BLOCK DIAGRAM APPROACH

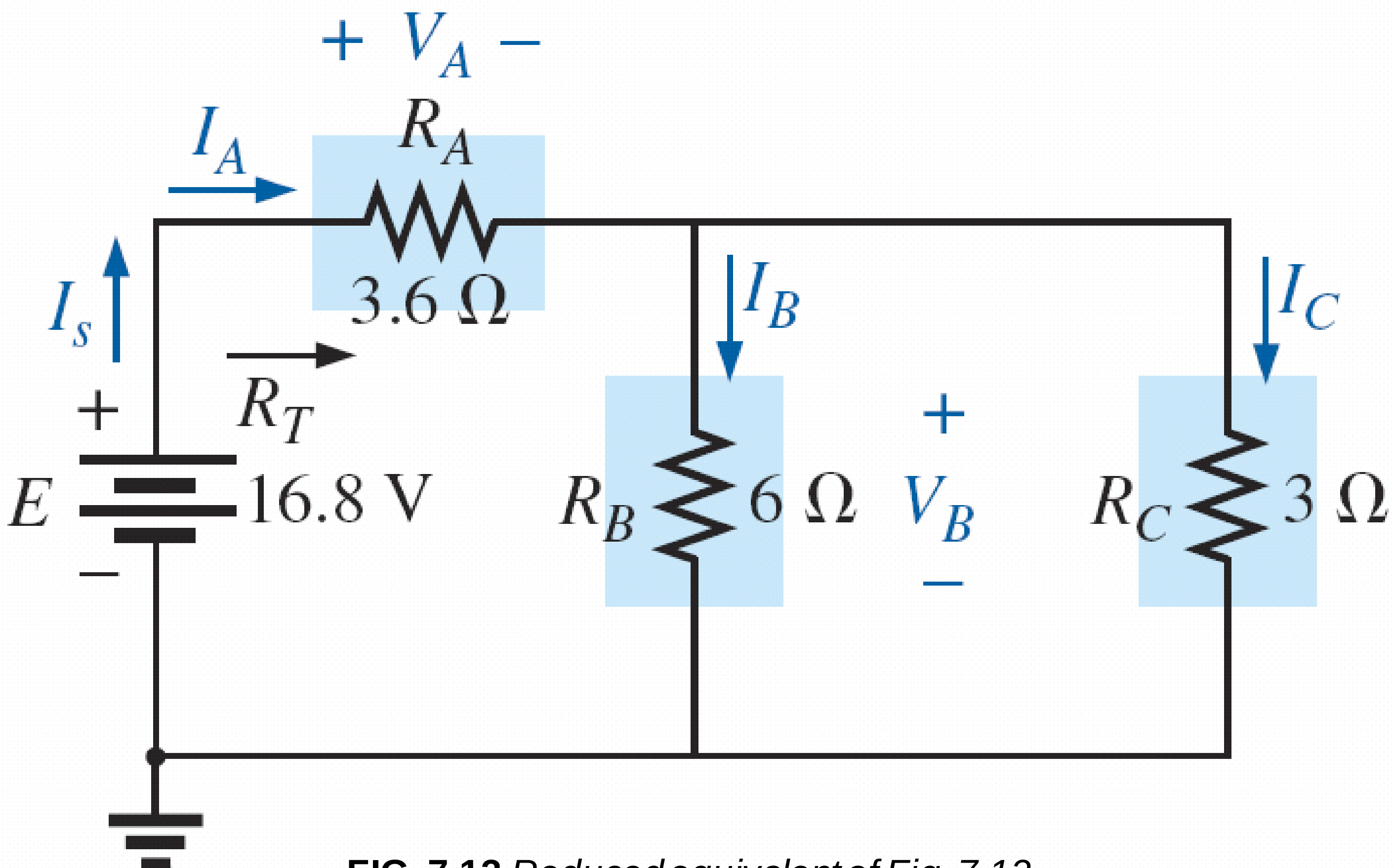


FIG. 7.13 *Reduced equivalent of Fig. 7.12.*

DESCRIPTIVE EXAMPLES

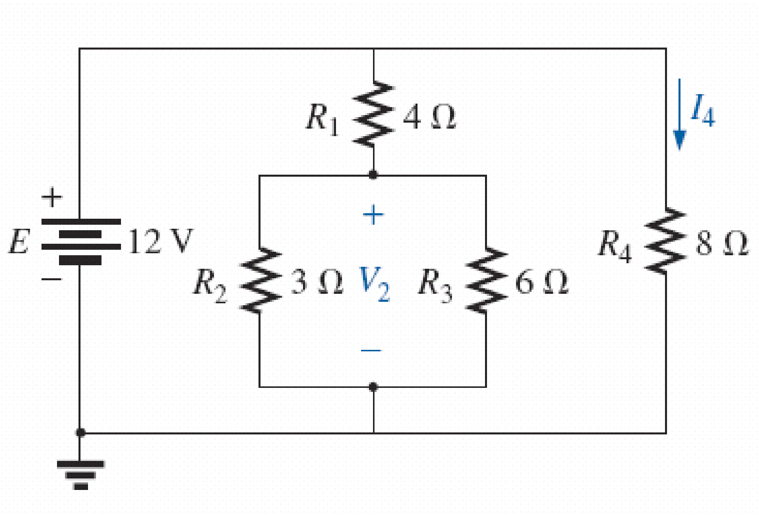


FIG. 7.14 *Example 7.5.*

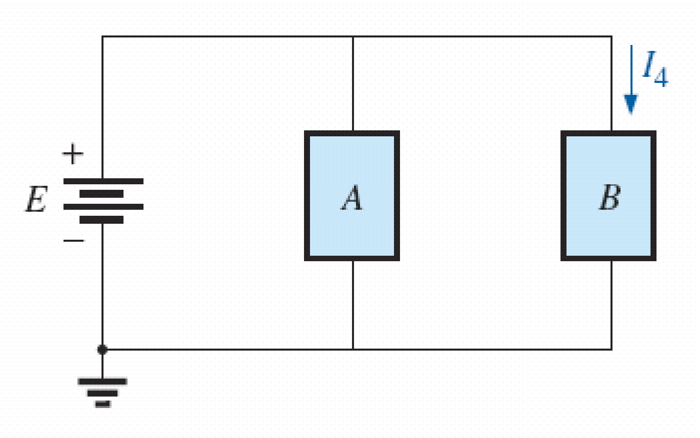


FIG. 7.15 *Block diagram of Fig. 7.14.*

DESCRIPTIVE EXAMPLES

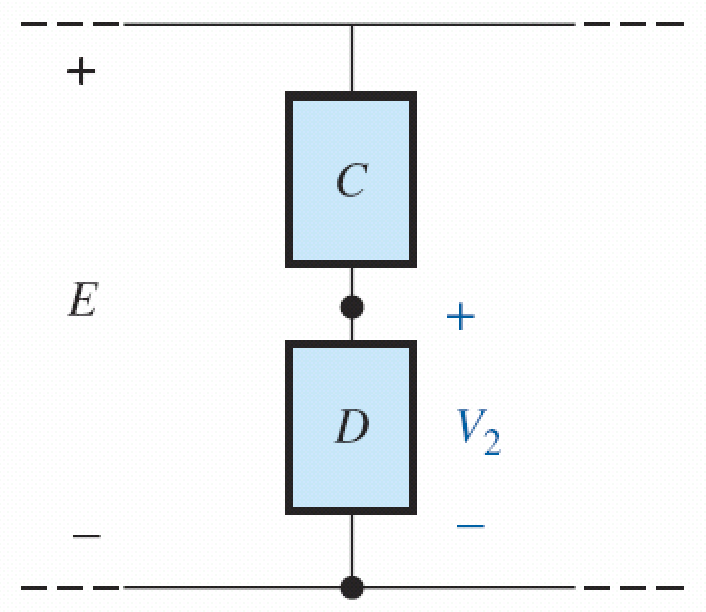


FIG. 7.16 *Alternative block diagram for the first parallel branch in Fig. 7.14.*

DESCRIPTIVE EXAMPLES

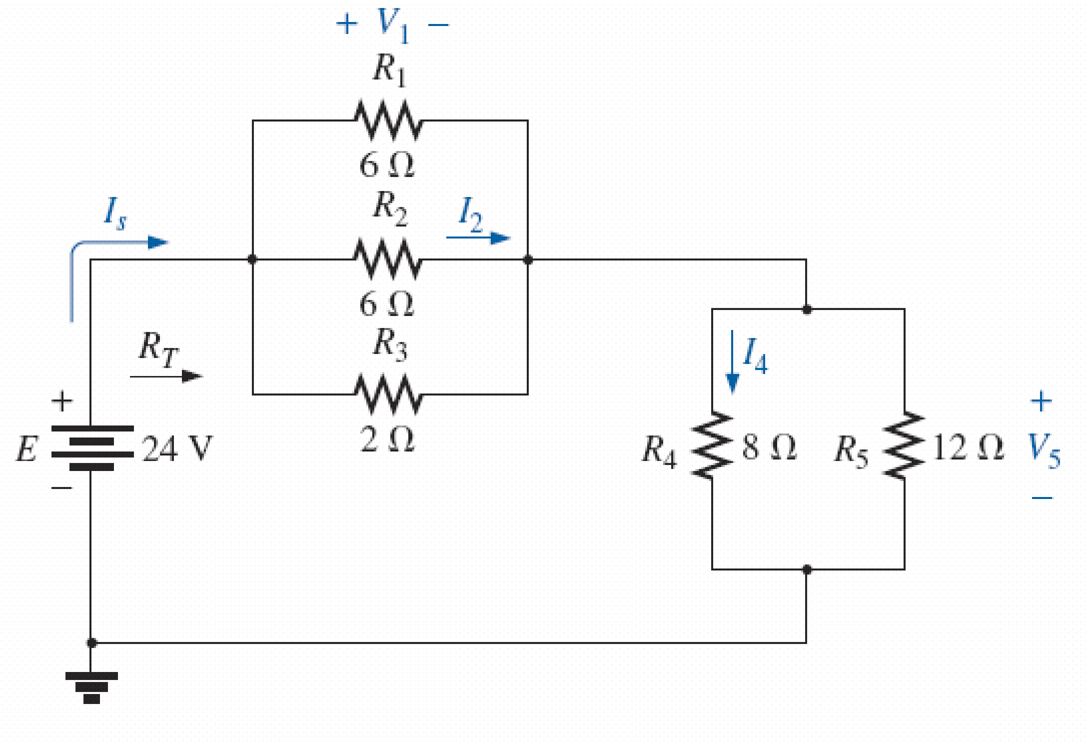


FIG. 7.17 *Example 7.6.*

DESCRIPTIVE EXAMPLES

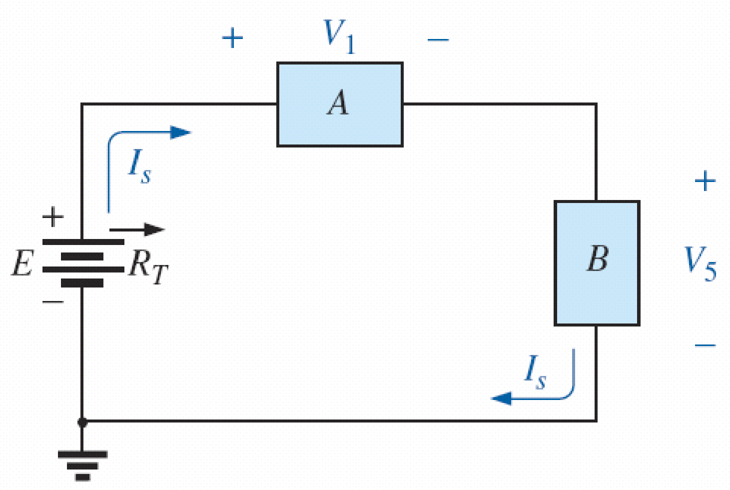


FIG. 7.18 *Block diagram for Fig. 7.17.*

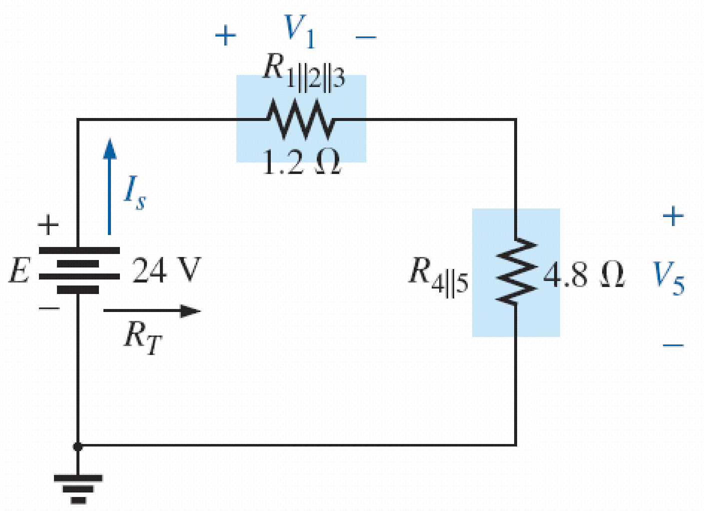


FIG. 7.19 *Reduced form of Fig. 7.17.*

DESCRIPTIVE EXAMPLES

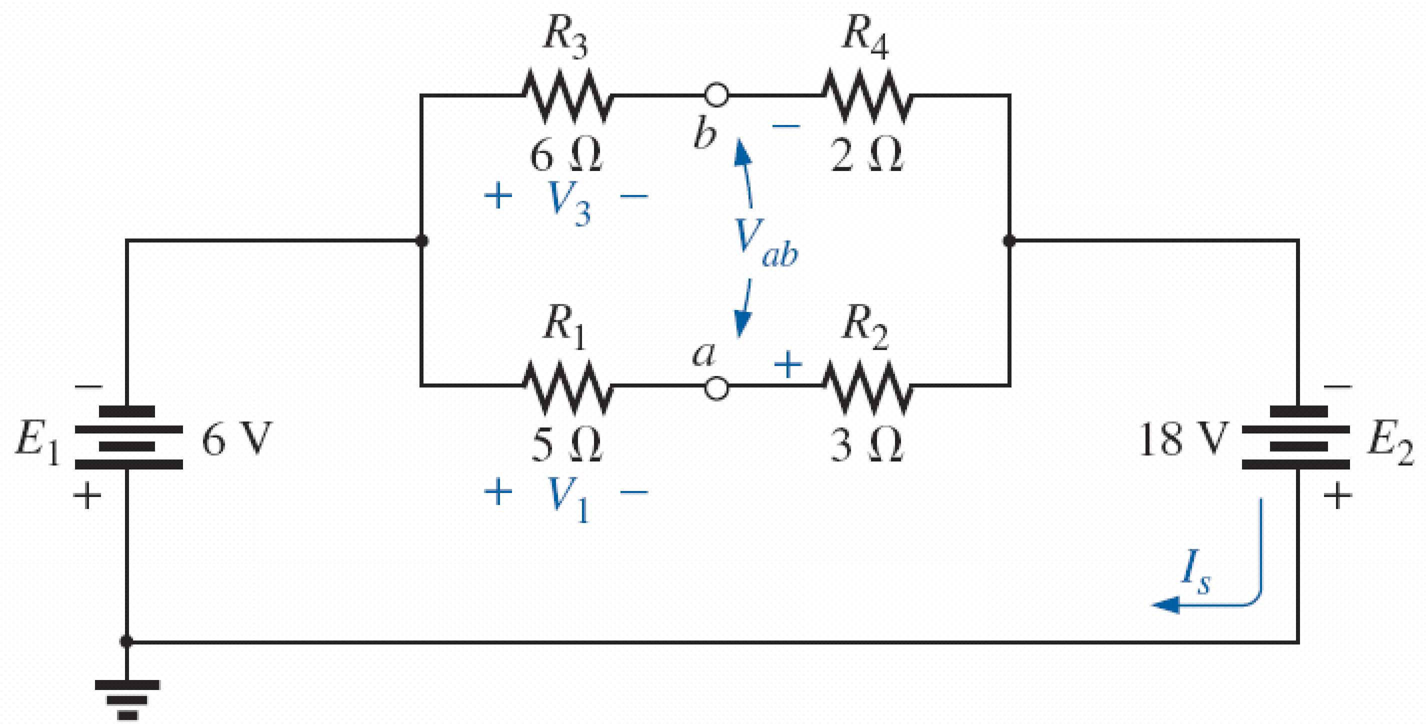


FIG. 7.20 *Example 7.7.*

DESCRIPTIVE EXAMPLES

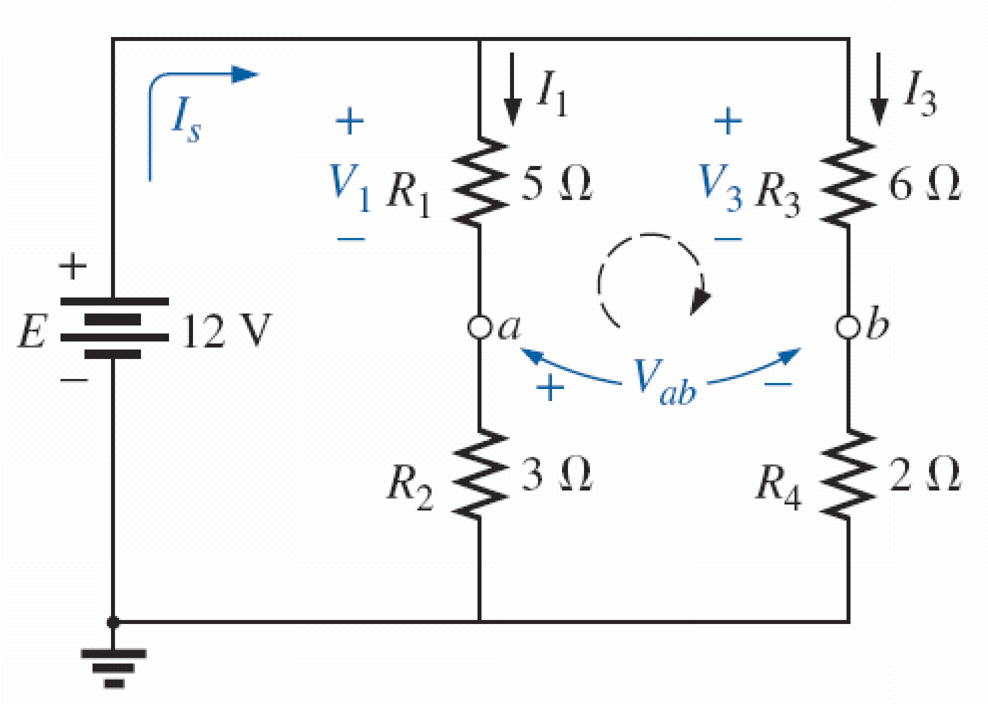


FIG. 7.21 *Network in Fig. 7.20 redrawn.*

DESCRIPTIVE EXAMPLES

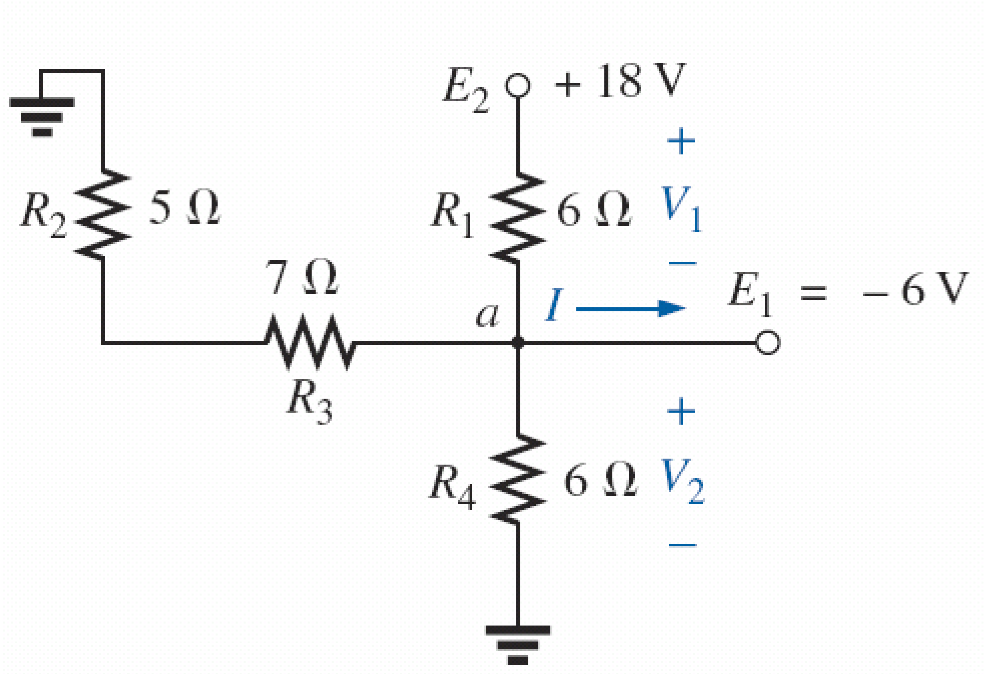


FIG. 7.22 *Example 7.8.*

DESCRIPTIVE EXAMPLES

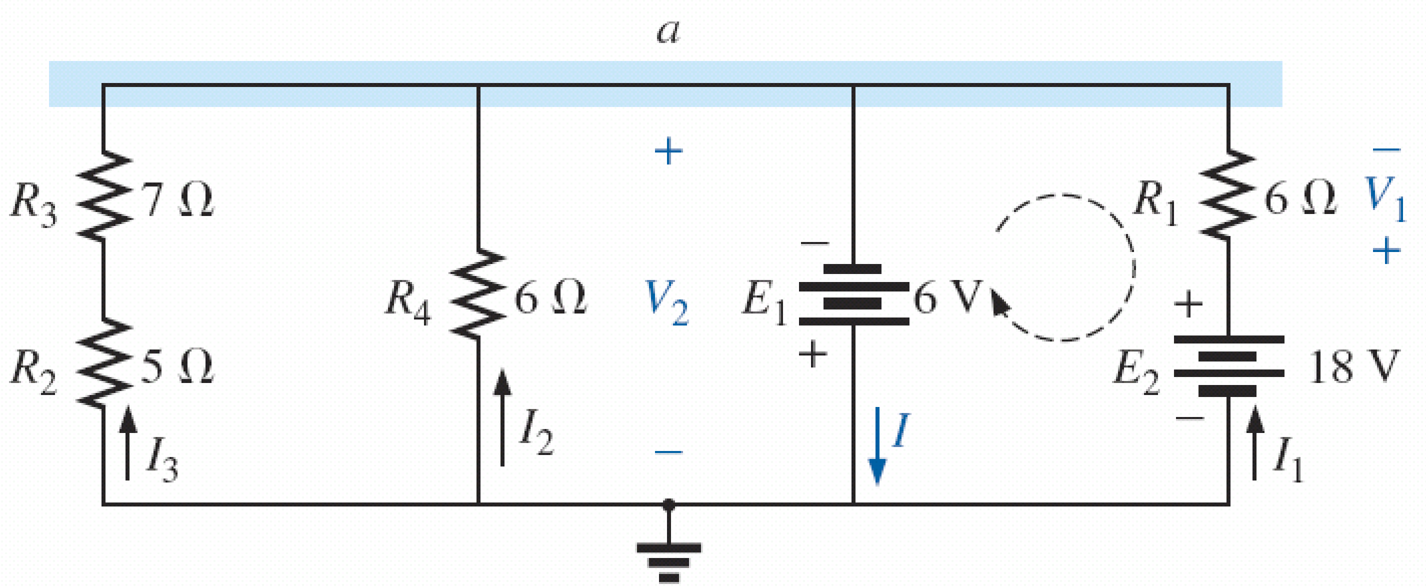


FIG. 7.23 *Network in Fig. 7.22 redrawn.*

DESCRIPTIVE EXAMPLES

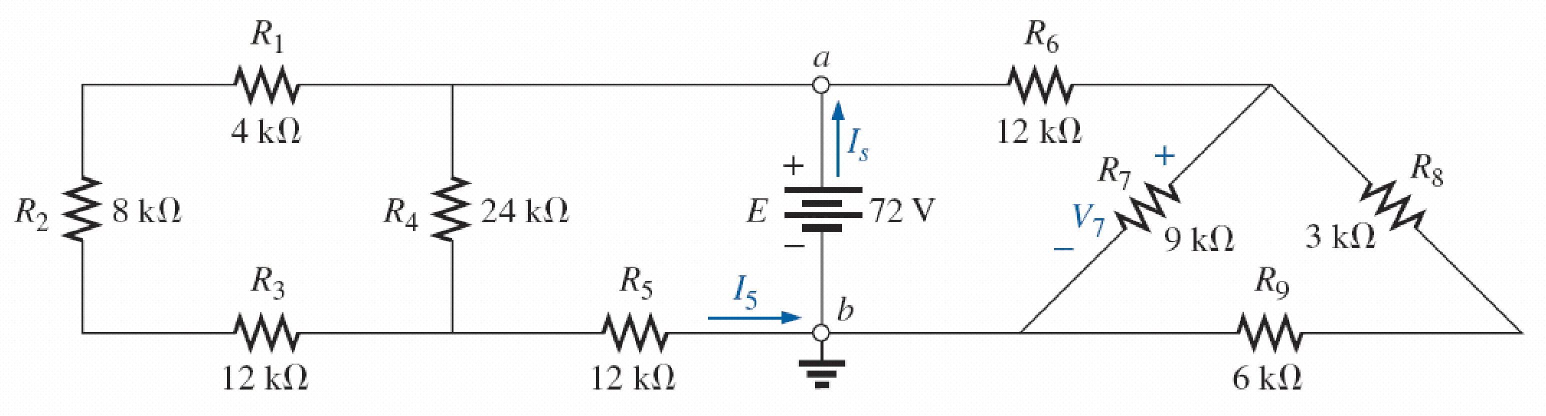


FIG. 7.26 *Example 7.10.*

DESCRIPTIVE EXAMPLES

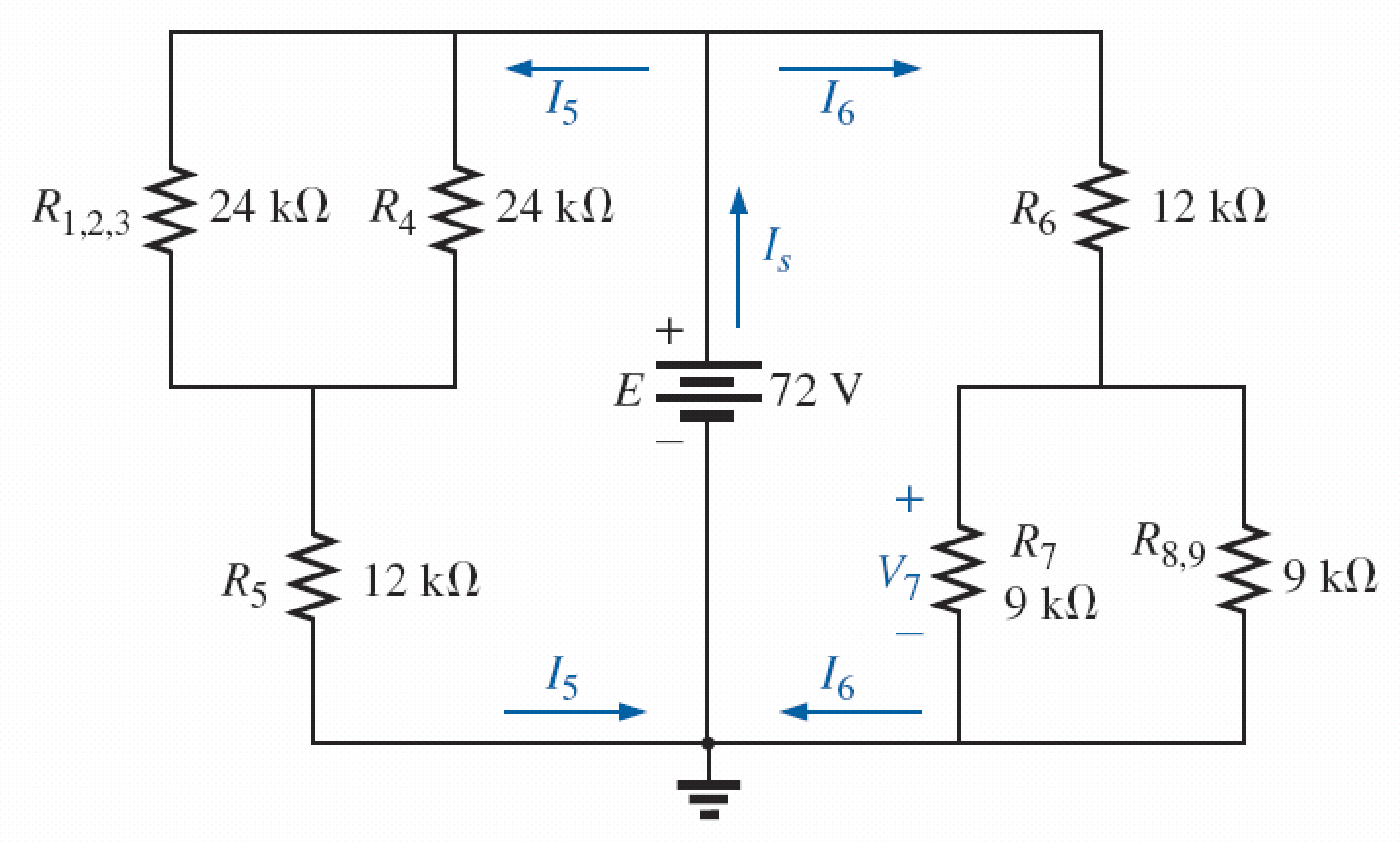


FIG. 7.27 *Network in Fig. 7.26 redrawn.*

DESCRIPTIVE EXAMPLES

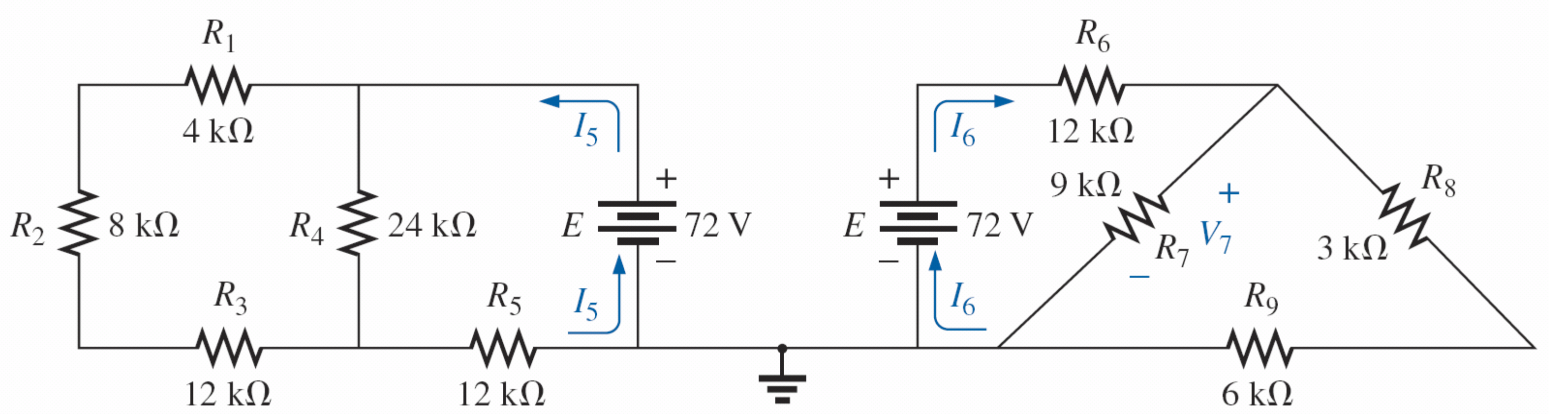


FIG. 7.28 *An alternative approach to Example 7.10.*

DESCRIPTIVE EXAMPLES

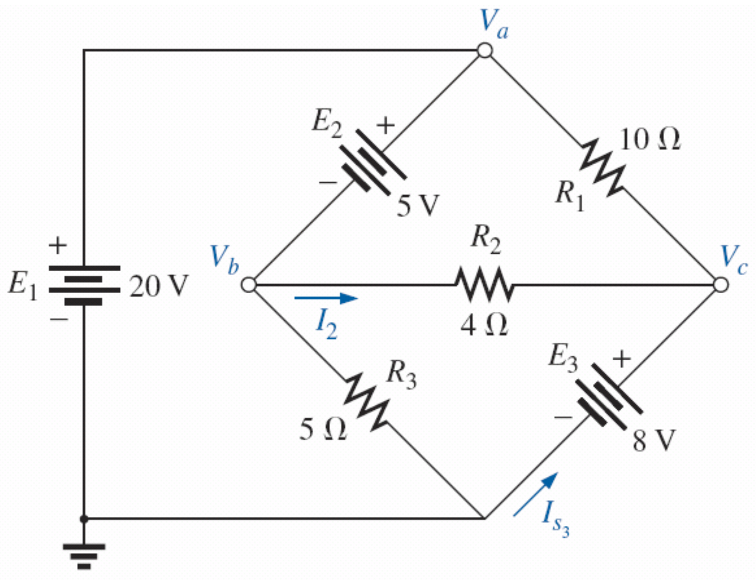


FIG. 7.29 *Example 7.11.*

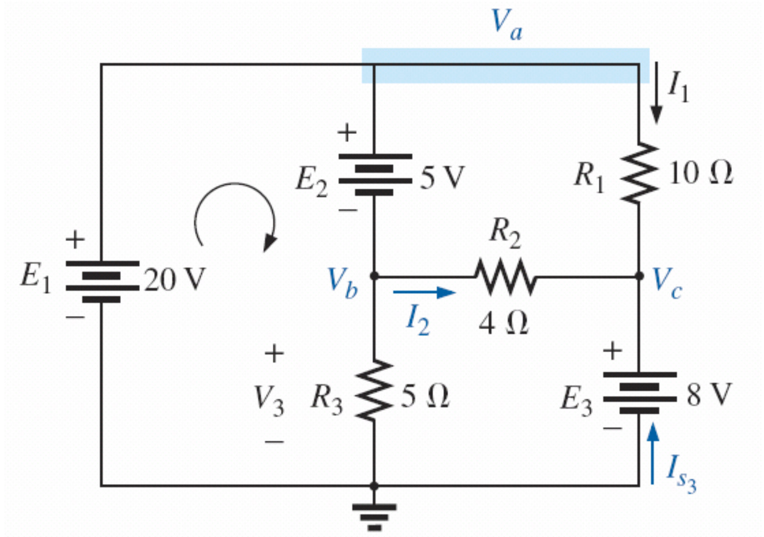


FIG. 7.30 *Network in Fig. 7.29 redrawn to better define a path toward the desired unknowns.*

APPLICATIONS

Boosting a Car Battery, Electronic Circuits

AMMETER, VOLTMETER, AND OHMMETER DESIGN

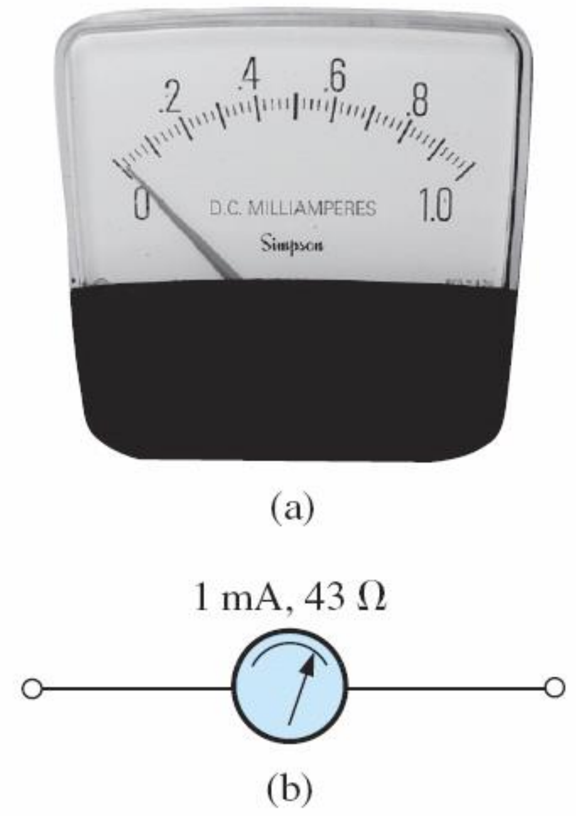


FIG. 7.47 *Iron-vane movement; (a) photo, (b) symbol and ratings.*

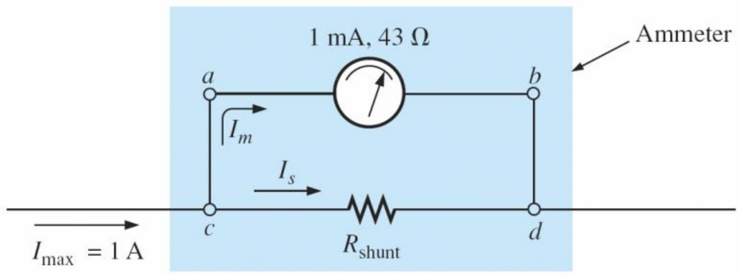


FIG. 7.48 *Basic ammeter.*

AMMETER, VOLTMETER, AND OHMMETER DESIGN

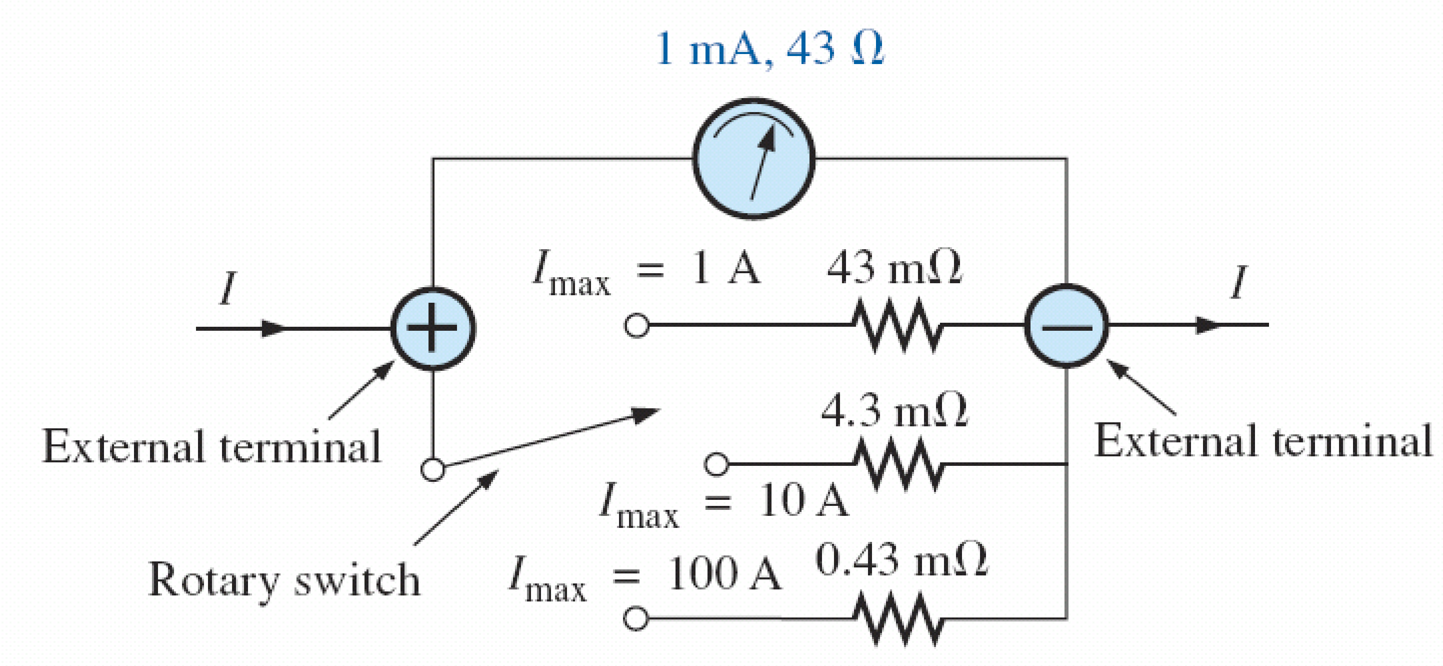


FIG. 7.49 *Multirange ammeter.*

AMMETER, VOLTMETER, AND OHMMETER DESIGN

The Voltmeter

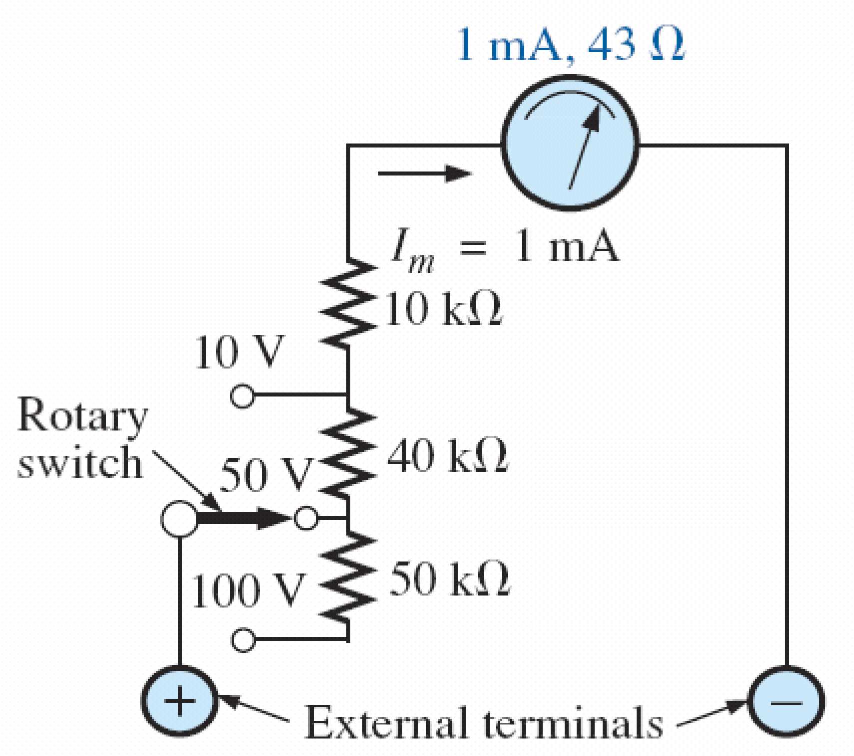


FIG. 7.51 *Multirange voltmeter.*

AMMETER, VOLTMETER, AND OHMMETER DESIGN

The Ohmmeter

- In general, ohmmeters are designed to measure resistance in the low, middle, or high range.
- The most common is the **series ohmmeter,** designed to read resistance levels in the midrange.

AMMETER, VOLTMETER, AND OHMMETER DESIGN

The Ohmmeter

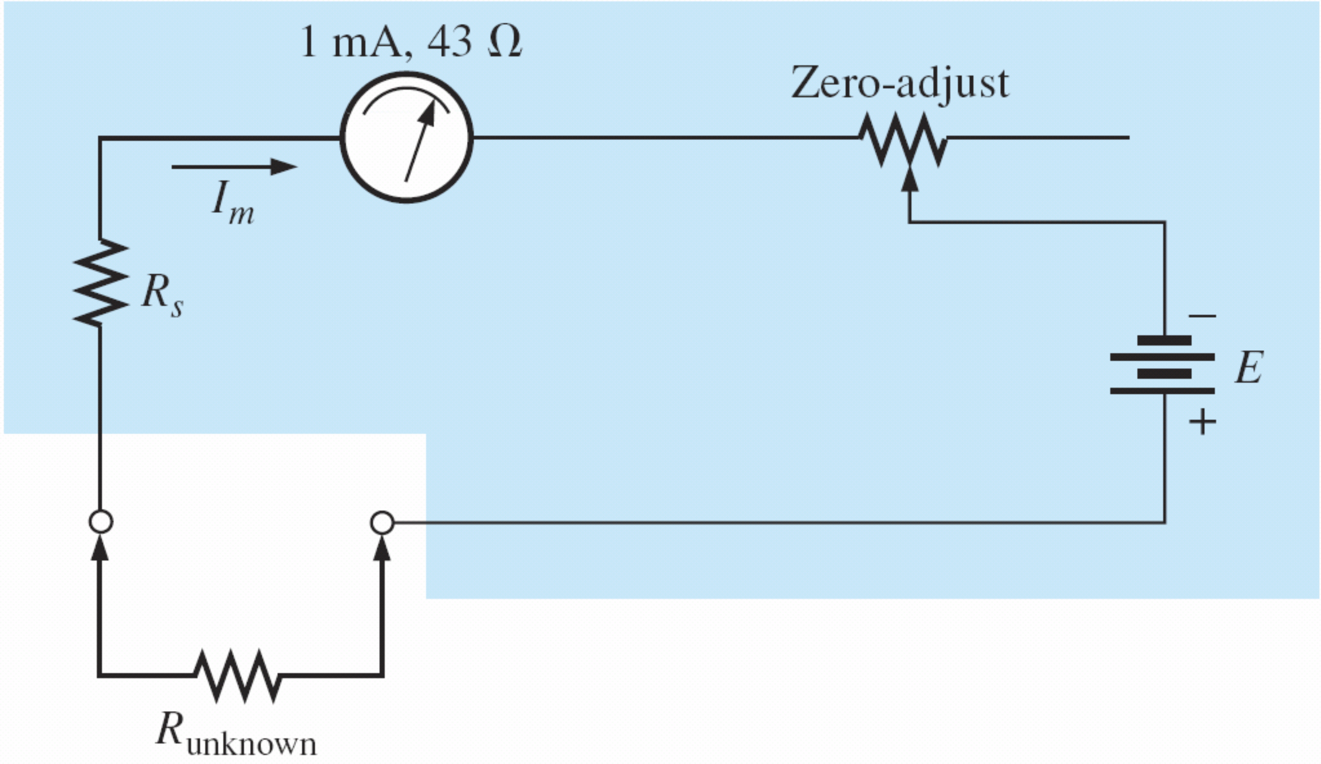


FIG. 7.52 *Series ohmmeter.*