

# Chapter 1

## Introduction

## Hints on Problem Solving

- First
  - Make a sketch
  - Mark on it what you want to know
  - Identify what you are trying to determine
    - This will help you organize your thoughts

## Hints on Problem Solving

- Second
  - Identify principles involved in the problem
  - Look for relationships that connect unknown and known quantities

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## Hints on Problem Solving

- Third
  - Decide which equations should be used
  - Substitute known information into selected equations and solve for unknown quantity

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## Hints on Problem Solving

- Fourth
  - Check answer by substituting it into original equation
  - Ask yourself, “Does the answer seem reasonable?”

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## Hints on Problem Solving

- Finally
  - Is it in the “right ballpark”?
  - Are units on both sides of the equations correct?

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## SI System of Units

- Length
  - Meter (m)
- Mass
  - Kilogram (kg)
- Time
  - Second (s)

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## SI System of Units

- Electric Current
  - Ampere (A)
- Temperature
  - Kelvin (K)
- Amount of a substance
  - Mole (mol)

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## Relative Size of the Units

- 1 meter is about 1 yard
- 1 inch is about 2½ centimeters
- 1 newton is about the force required to lift a ½-pound weight

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## Relative Size of the Units

- Raising a ½-pound weight 1 meter in 1 s requires about 1 watt
- Room temperature is about 35 degrees Celsius or about 300 degrees kelvin

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## Converting Units

- Convert 60 miles/hour to km/hr
- Convert 60 miles/hour to m/s
- A circle has radius of 6 inches
  - Determine the area in square meters

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## Power of Ten Notation

- For very large and very small numbers
  - $35\ 000 = 3.5 \times 10^4$  or  $35 \times 10^3$
  - $458\ 000 = 4.58 \times 10^5$  or  $458 \times 10^3$
  - $0.000\ 042 = 4.2 \times 10^{-5}$  or  $42 \times 10^{-6}$
  - $0.000\ 159 = 1.59 \times 10^{-4}$  or  $159 \times 10^{-6}$

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## Powers of Ten

- To multiply numbers in power of 10 notation
  - Multiply their base numbers
  - Add their exponents (e.g.,  $10^3 \times 10^5 = 10^8$ )

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## Powers of Ten

- To divide numbers in power of 10 notation
  - Divide their base numbers
  - Subtract their exponents (top - bottom)  
(e.g.,  $10^9/10^3 = 10^6$ )

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## Power of Ten Notation

- To add or subtract, adjust all numbers to same power of ten
- It does not matter what exponent you choose, as long as they are all the same

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## Power of Ten Notation

- For example
  - $3 \times 10^4 + 5 \times 10^3 = 35 \times 10^3$  (changing both powers of 10 to 3)
- Or
  - $3 \times 10^4 + 5 \times 10^3 = 3.5 \times 10^4$  (changing both powers of 10 to 4)

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## Power of Ten Notation

- Raising a number to a power is a form of multiplication
- $(4 \times 10^3)^2 = (4 \times 10^3)(4 \times 10^3)$   
 $= 16 \times 10^6$
- Fractional powers represent roots

$$9^{\frac{1}{2}} = \sqrt{9}$$

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## Prefixes

- Scientific Notation
  - $24\,700 = 2.47 \times 10^4$
  - $0.000\,046 = 4.6 \times 10^{-5}$

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## Prefixes

- Engineering Notation
  - Uses only powers that are factors of 3
    - $24\,700 = 24.7 \times 10^3$
    - $0.000\,046 = 46 \times 10^{-6}$

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## Prefixes

- Metric Prefixes are used for convenience

Power of 10	Prefix	Symbol
$10^{12}$	tera	T
$10^9$	giga	G
$10^6$	mega	M
$10^3$	kilo	k
$10^{-3}$	milli	m
$10^{-6}$	micro	$\mu$
$10^{-9}$	nano	n
$10^{-12}$	pico	p

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## Significant Digits and Numerical Accuracy

- Significant digits
  - Digits that carry information
  - It is a common error to show more digits of accuracy than are warranted

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## Significant Digits and Numerical Accuracy

- Number of significant digits in a result due to multiplication or division is the same as the number of significant digits in the number with the least number of significant digits.

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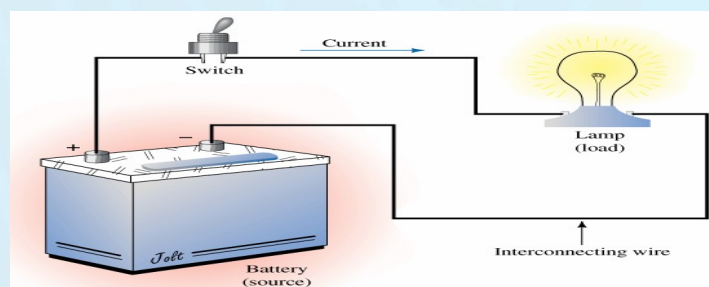
## Circuit Diagrams

- Electric circuits
  - Use batteries and resistors as components
  - Circuit diagrams are used on paper
- Three types are used
  - Pictorial, block, and schematic

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## Pictorial Diagrams

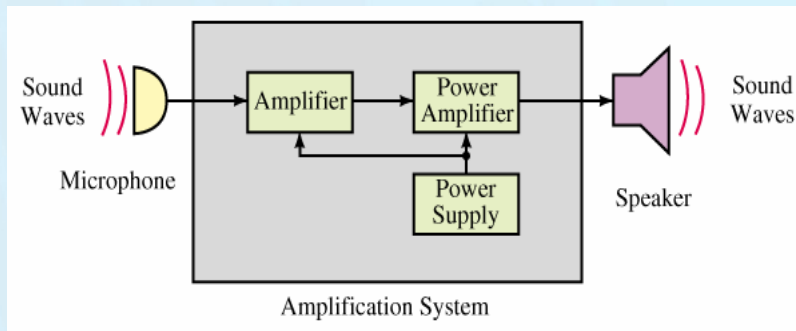
- Help visualize circuits by showing components as they actually appear



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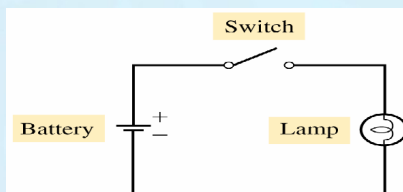
## Block Diagrams

- Blocks represent portions of a system

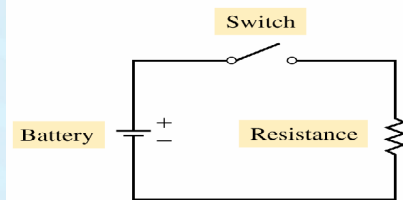


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## Schematic Diagrams



(a) Schematic using lamp symbol



(b) Schematic using resistance symbol

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## Aids to Circuit Analysis

- Prepackaged Simulation Software
  - PSPICE, Electronics Workbench
- Math Software
  - MathCAD, MATLAB
- Programming Languages
  - BASIC, C, C++, FORTRAN, Assembly

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## Aids to Circuit Analysis

- Graphing Programs
  - PSI Plot
  - Axium
- Electronic Calculators
  - TI-86
  - TI-89

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