Physics for Scientists and Engineers I

PHY 2048, Section 4

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Chapter 0 - Introduction

I. General

II. International System of Units

III. Conversion of units

IV. Dimensional Analysis

V. Problem Solving Strategies

I. Objectives of Physics

- Find the limited number of fundamental laws that govern natural phenomena.

- Use these laws to develop theories that can predict the results of future experiments.

-Express the laws in the language of mathematics.

- Physics is divided into six major areas:

1. Classical Mechanics (PHY2048)
2. Relativity
3. Thermodynamics
4. Electromagnetism (PHY2049)
5. Optics (PHY2049)
6. Quantum Mechanics

II. International System of Units

QUANTITY	UNIT NAME	UNIT SYMBOL
Length	meter	m
Time	second	s
Mass	kilogram	kg
Speed		m/s
Acceleration		m/s^2
Force	Newton	N
Pressure	Pascal	$Pa = N/m^2$
Energy	Joule	J = Nm
Power	Watt	W = J/s
Temperature	Kelvin	K

POWER	PREFIX	ABBREVIATION
10^{15}	peta	P
10^{12}	tera	T
10^{9}	giga	G
10^{6}	mega	M
10^{3}	kilo	k
10^{2}	hecto	h
10^{1}	deka	da
10^{-1}	deci	D
10^{-2}	centi	c
10^{-3}	milli	m
10^{-6}	micro	μ
10^{-9}	nano	n
10^{-12}	pico	p
10^{-15}	femto	f

III. Conversion of units

Chain-link conversion method: The original data are multiplied successively by conversion factors written as unity. Units can be treated like algebraic quantities that can cancel each other out.

Example: 316 feet/h → m/s

$$\left(316\frac{feet}{h}\right)\cdot\left(\frac{1\,h}{3600s}\right)\cdot\left(\frac{1\,m}{3.28\,feet}\right)=0.027\,m/s$$

IV. Dimensional Analysis

Dimension of a quantity: indicates the type of quantity it is; **length [L], mass [M], time [T]**

Dimensional consistency: both sides of the equation must have the same dimensions.

Example: $x=x_0+v_0t+at^2/2$

$$[L]=[L]+\frac{[L]}{[T]}[T]+\frac{[L]}{[T^2]}[T^2]=[L]+[L]+[L]$$

Note: There are no dimensions for the constant (1/2)

Table 1.6

Units of Area, Volume, Velocity, Speed, and Acceleration

System	Area (L^2)	Volume (L^3)	Speed (L/T)	Acceleration (L/T^2)
SI	m^2	m^3	m/s	m/s^2
U.S. customary	ft^2	ft^3	ft/s	ft/s^2

Significant figure → one that is reliably known.

Zeros may or may not be significant:

- Those used to position the decimal point are not significant.
- To remove ambiguity, use scientific notation.

Ex: 2.56 m/s has 3 significant figures, 2 decimal places.
0.000256 m/s has 3 significant figures and 6 decimal places.
10.0 m has 3 significant figures.
1500 m is ambiguous → 1.5×10^3 (2 figures), 1.50×10^3 (3 fig.), 1.500×10^3 (4 figs.)

Order of magnitude → the power of 10 that applies.