



Tishk International University
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Chapter one

Measurements and units

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GENERAL PHYSICS I (PHY1)

Week 1

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Date

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Outline



- Definition of physics
- Branches of physics
- Units in Physics
- Systems of measurement
- Prefixes
- Unit conversion

Objectives



- To understand the standard of Units in Physics
- To be able to measure dimensional quantities (1D, 2D and 3D)
- Learning to use prefixes with dimensional quantities
- To learn how to converting units from one system to another

- Physics is the **branch of science** which deals with **matter and its relation to energy**.
- It involves study of physical and natural phenomena around us. Examples of these phenomena are formation of rainbow, occurrence eclipse, the fall of things from up to down, the cause of sunset and sunrise, formation of shadow and many more.
- Physics divided into **classical physics** and **modern physics**.

Definition of physics

Name	Subjects	Example
<u>Mechanics</u>	Motion and its causes, interactions between objects	Falling, friction, weight, spinning
Thermodynamics	Heat and temperature	Melting, freezing, engines, refrigerators
<u>Vibrations and Waves</u>	Specific types of repetitive motions	Springs, pendulums, sound
Optics	Light	Mirrors, lenses, color, astronomy
<u>Electromagnetism</u>	Electricity, magnetism, and light	Electrical charge, circuitry, magnets and electromagnets
Relativity	Particles moving at any speed, including very	Particle collisions, particle accelerators,

Branches of physics

Relationship between physics and other subjects

1. PHYSICS AND MATHEMATICS

Many physics formulae are expressed mathematically.

2. PHYSICS AND BIOLOGY

Knowledge of lenses in physics is used in microscopic images to study biological cells.

3. Physics and Chemistry.

Physics has helped to explain forces within atoms and therefore atomic structure.

4. Physics and Geography

Accurate use of instruments and physics concepts can explain formation of rainfall, pressure variations and etc.

5. Physics and Technology.

Some areas of technology are:

In medicine: X-rays, lasers, scanners which are used in diagnosis and treatment of diseases.

Communication: Satellite communication, internet, fiber optics.

In industrial applications: In the area of defense, physics has many applications e.g. war planes.

etc.....

Units

- In mechanics we use four fundamental quantities called **dimensions**. These are **length, mass, force, and time**.
- SI Units: The International System of Units, abbreviated SI is accepted in the United States and throughout the world.

QUANTITY	DIMENSIONAL SYMBOL	SI UNITS		
		UNIT	SYMBOL	
Mass	M	Base units	kilogram	kg
Length	L		meter	m
Time	T		second	s
Force	F		newton	N

- Force (N) = mass (kg) x acceleration (m/s²)

Measurement Systems

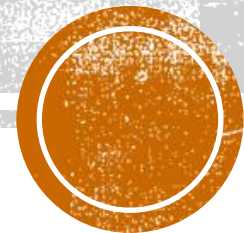
Common systems:

- **SI (International System of Units)** — global engineering standard
- **CGS** (centimeter, gram, second)
- **British/Imperial** (feet, pounds, seconds)

We use SI throughout this course.

Quantity	Unit Name	Symbol
Length	mete	m
Mass	kilogram	kg
Time	second	s
Electric current	ampere	A
Temperature	kelvin	K
Amount of substance	mole	mol
Luminous intensity	candela	cd

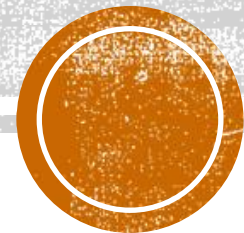
The Seven SI Base Units



These are the foundation for all derived units.

Quantity	Unit	Formula
Area	m^2	L^2
Volume	m^3	L^3
Velocity	m/s	$L T^{-1}$
Acceleration	m/s^2	$L T^{-2}$
Force	Newton (N)	$kg \cdot m/s^2$
Pressure	Pascal (Pa)	N/m^2
Energy	Joule (J)	$N \cdot m$

SI Derived Units



Scientific Notation

- Used for extremely large or small numbers.
- **Large example:**
Earth–Sun distance $\approx 1.5 \times 10^{11} \text{ m}$
- **Small example:**
Electron mass $\approx 9.11 \times 10^{-31} \text{ kg}$
- Writing in scientific notation makes calculations easier and aligns with SI prefixes.



Prefix	Symbol	Factor	Example
Tera	T	10^{12}	THz
Giga	G	10^9	GHz
Mega	M	10^6	MW
Kilo	k	10^3	km
Centi	c	10^{-2}	cm
Milli	m	10^{-3}	mg
Micro	μ	10^{-6}	μm
Nano	n	10^{-9}	nm
Pico	p	10^{-12}	pm
Femto	f	10^{-15}	fs

Prefixes

Unit Conversions

- When units are not consistent, you may need to **convert to appropriate ones.**
 - Units can be treated like algebraic quantities that can **cancel each other out**
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- $1 \text{ m} = 100 \text{ cm} = 1000 \text{ mm}$
 - $1 \text{ in} = 2.54 \text{ cm}$
 - $1 \text{ ft} = 0.3048 \text{ m}$
 - $1 \text{ mile} = 1.609 \text{ km}$
 - $1 \text{ km} = 1000 \text{ m}$

Unit Conversion Techniques

Use the factor-label method:

- Example:
Convert 50 km/h to m/s:
- $50 \times \frac{1000}{1} \times \frac{1}{3600} = 13.89 \text{ m/s}$
- Units cancel systematically.



Example: Prefixes



18"

The picture shows an air fan.
What is the width of the fan
in cm?

$$1 \text{ in} = 2.54 \text{ cm}$$

$$\begin{aligned} \text{So, } 18 \text{ in} &= 18 \times 2.54 \\ &= 45.72 \text{ cm} \end{aligned}$$

Example: An aspirin tablet contains 325 mg of acetylsalicylic acid.
Express this mass in grams.

Given:

$$m = 325 \text{ mg}$$

Find:

$$m \text{ (grams)}=?$$

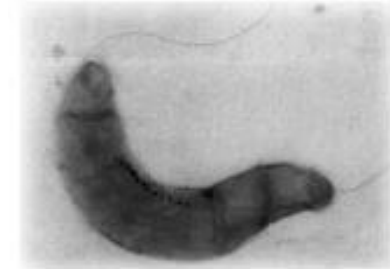
Solution:

Recall that prefix “milli” implies 10^{-3} , so

$$m = 325 \text{ mg} = 325 \times 10^{-3} \text{ g} = 0.325 \text{ g}$$

Example: Length of a bacteria

A bacteria has 50 nm length. If they are lined up end to end, how many bacteria take place in 1 mm?



Given:

$$L = 50 \text{ nm}$$

Find:

Number in 1 mm,
N=?

Solution:

$$N \times L = 1 \text{ mm}$$

$$N = 1 \text{ mm} / L$$

Recall that prefix
“nm” implies 10^{-9} m
 $1 \text{ mm} = 10^{-3} \text{ m}$

$$L = 50 \text{ nm} = 50 \times 10^{-9} \text{ m} , \text{ length of a bacteria}$$

$$N = 1 \text{ mm} / 50 \text{ nm} = 10^{-3} \text{ m} / 50 \times 10^{-9} \text{ m}$$

$$N = 0.02 \times 10^6$$

$$N = 2 \times 10^4 = 20 \text{ 000}$$

N= The number of bacteria in 1 mm is 20 000

Conclusion

- Physics come with various branches and fields.
- In physics, most of the quantities come with a unit of units, Units are converted from one system to another.
- Measurements achieved with different systems such as IS and British unit system.
- Prefixes are tools used to simplify numbers.



References (in APA style)



- ✓ Young, H. D., Freedman, R. A., & Ford, A. L. (2014). *University physics with modern physics* (p. 822). New York: Pearson.
- ✓ Sommerfeld, A. (2016). *Mechanics: Lectures on theoretical physics, Vol. 1* (Vol. 1). Elsevier.