Lectures of General Physics
Tishk International University
Dept. of Information Technology
First Year Students

Lecturer: Dr. Bestoon Mustafa
MSC of Nanoscale Science and Technology-Sheffield/UK
PhD in Medical Physics-SU/ERB
Department of Computer Engineering
e-mail: bestoon.taha@tiu.edu.iq

First Semester

1. Measurements and units
2. Coordinating System
3. Vector and Scalar quantities
4. Linear motion
5. Two dimensional motion
6. Coulomb's law and Electric Field
7. Electric Potential and potential difference

Second Semester

1. Capacitors and capacitance
2. Electric Current (AC and DC concept)
3. Magnetic Field
4. Kirchhoff's law of current and voltage

ASSESSMENT

- Quizzes (10%)
- Midterm exam (30%)
- Final exam (40%)
- Laboratory (20%)

Chapter One

Measurements and units

You will learn:

1. Standard and Units
2. Basic dimensional quantities
3. Converting units

What is physics?

- 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**.

Brunches of physics:

Name	Subjects	Example
Mechanics	Motion and its causes, interactions between objects	Falling, friction, weight, spinning
Thermodynamics	Heat and temperature	Melting, freezing, engines, refrigerators
Vibrations and Waves	Specific types of repetitive motions	Springs, pendulums, sound
Optics	Light	Mirrors, lenses, color, astronomy
Electromagnetism	Electricity, magnetism, and light	Electrical charge, circuitry, magnets and electromagnets
Relativity	Particles moving at any speed, including very high speeds	Particle collisions, particle accelerators, nuclear energy
Quantum mechanics	Behavior of submicroscopic particles	The atoms and its parts

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……….

Systems of Measurement

1. SI -- System International

- agreed to in 1960 by an international committee
- main system used in this course
- also called **mks** for the first letters in the units of the fundamental quantities**- m for meter, k for kilogram, and s for second**.

2. cgs -- Gaussian system

- named for the first letters of the units it uses for fundamental quantities (**c for centimeter, g for gram and s for second)**.

3. The British system or **English units:**

- Length: 1 inch =2.53 cm, force: 1 pound= 4.4482 Newt. and etc.)

Fundamental and Derived Units: SI

- Fundamental physical quantities and their units
- **Length [L]**: measures by **cm**, M, Km, miles, ft ,…
- **Mass [M]**: measured by **grams**, Kg, …
- **Time [T]**: measured by **Seconds**, minutes, and Hours
- **Electric current** [I]: measured by **Ampere**

NOTE: Non-SI units in a few applications are in very common use, such as the measurement of blood pressure in millimeters of mercury (mm Hg). Whenever non-SI units will be tied to SI units through conversions.

- Derived quantities and their units
- All other physical quantities, such as force and electric charge, can be expressed as algebraic combinations of length, mass, time, and current (for example, **speed** is **length divided by time**); these units are called derived units.

Other examples of derived quantities

Length	L	m (SI)
Area	L^2	m^2 (SI)
Volume	L^3	m^3 (SI)
Velocity (speed)	L/T	m/s (SI)
Acceleration	L/T^2	m/s^2 (SI)

Question?

- What is the dimensional analysis of density equation?

mass

$$\rho = \frac{m}{V}$$

density

volume

Quick Quiz 1.1

True or False: Dimensional analysis can give you the numerical value of constants of proportionality that may appear in an algebraic expression.

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**

So:

1 mile = 1609 m = 1.609 km

1 ft = 0.3048 m = 30.48 cm

1m = 3.281 ft

1m =100 cm=1000mm

1 in = 0.0254 m = 2.54 cm

Example 1. Scotch tape

What is the width of the tape?

½ inch = 2.54/2=1.27 cm
=12.7 mm

Example 2 (HW). Trip to Canada

Legal freeway speed limit in Canada is 100 km/h.
What is it in miles/h?

Example 3. Air fan

18``

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

1 in = 2.54 cm

So, 18 in =18 x 2.54

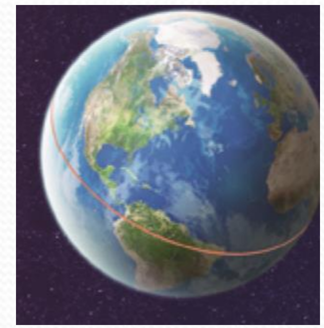
= 45.72 cm

Prefixes

Prefix	Symbol	Multiplier	Scientific Notation	Example
femto-	f	0.000000000000001	10^{-15}	Femtosecond (fs)
pico-	p	0.000000000001	10^{-12}	picometer (pm)
nano-	n	0.000000001	10^{-9}	Nanobrain
micro-	µ	0.000001	10^{-6}	Microgram (µg)
milli-	m	0.001	10^{-3}	Milliamps (mA)
centi-	c	0.01	10^{-2}	Centimeter (cm)
deci-	d	0.1	10^{-1}	Deciliter (dL)
kilo-	k	1000	10^{3}	Kilometer (km)
mega-	M	1 000 000	10^{6}	Meganerd
giga-	G	1 000 000 000	10^{9}	Gigameter (Gm)
tera-	T	1 000 000 000 000	10^{12}	Terahertz (THz)

Examples of using Prefixes

Distance from Earth to nearest second star	40 Pm
Mean radius of Earth	6.4 Mm
Length of a housefly	5 mm
Size of living cells	10 mm
Size of an atom	0.1 nm



$$1\ \text{Å} = \frac{1}{10\,000}\ \text{micron}$$

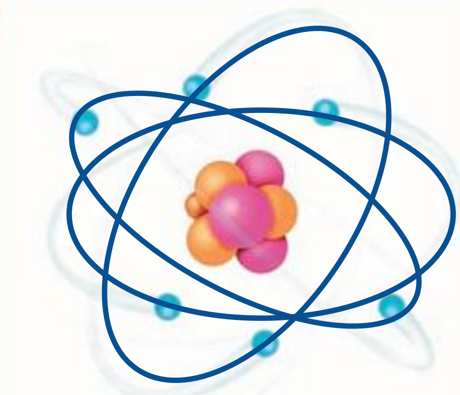


Figure 1.9 The diameter of an atom is about 1 Å

Example 4 An aspirin tablet contains 325 mg of acetylsalicylic acid. Express this mass in grams.

Given:

m = 325 mg

Find:

m (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 5. 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 nm

Find:

Number in 1 mm, N=?

Solution:

N x L = 1 mm
N = 1 mm / L

Recall that prefix "nm" implies 10^{-9} m
1 mm = 10^{-3} m

L = 50 nm = 50 x 10^{-9} m , length of a bacteria

N = 1 mm /50 nm = 10^{-3} m /50 x 10^{-9} m
N = 0.02 x 10^{6}
N = 2 x 10^{4} = 20 000
N= The number of bacteria in 1 mm is 20 000

END OF CHAPTER ONE