



General Physics for Medical Sciences

Chapter 1

Introduction, Measurements, Estimating

Dr. Mai Khaleel

Ms. Anwar Bakeer

Topics		Textbook
❖ Introduction and basic concepts ❖ Newton's laws of motion ❖ Static equilibrium ❖ Elasticity ❖ Temperature and pressure ❖ Fluids	❖ Electric forces, fields and potentials ❖ Resistance, resistivity and nerve conduction ❖ Sound ❖ Light ❖ Nuclear Physics	Giancoli, D. C. (2014). Physics: Principles with Applications (7th ed.). Pearson Education. References: a– Serway, R. A., & Jewett, J. W. (2004). Physics for Scientists and Engineers with Modern Physics (6th ed.). Thomson Brooks/Cole Publishing. b– Benson, H. (1991). University Physics. John Wiley & Sons.

Assessment Methods and Grading System

Assessment method	Grade
Homeworks	20
Quizzes	10
Midterm Exam	30
Final Exam	40
Total	100

➤ Quiz

- Every **Saturday at 6:00 PM.**
- Covers the material taught during the week.

➤ Homework

- Posted every **Thursday at 6:00 PM**
- Submission **closes Wednesday at 12:00 PM.**

Systems of Units

Physical quantities can be divided, based on their units, into two categories: **base quantities** and **derived quantities**.

❑ Base Quantities:

We define the base quantities as follows:

1. The base quantities are independent of each other.
2. The base quantities can be measured accurately.
3. All other quantities can be derived from them.

For now, we are interested in three base quantities:

Length (distance), **Time**, and **Mass**

❖ Systems of Units

Several systems of units have been used over the years. The most important systems are:

➤ The International System of Units (**SI-system or MKS-system**)

Quantity	Unit Name	Unit Symbol
Length	meter	m
Mass	kilogram	kg
Time	second	s

➤ The cgs System of Units

Quantity	Unit Name	Unit Symbol
Length	centimeter	cm
Mass	gram	g
Time	second	s

Systems of Units

Physical quantities can be divided, based on their units, into two categories: **base quantities** and **derived quantities**.

❑ Derived Quantities:

All physical quantities that can be derived from the base quantities are called **derived quantities**.

Some examples of derived quantities include: **speed, velocity, acceleration, force, ...**

Example:

The area of a rectangle is defined as length times width.
What is the unit of the area?

Solution

$$\textit{Area} = \textit{length} \times \textit{width}$$

$$A = l \times w$$

$$\textit{unit}(A) = \textit{unit}(l) \times \textit{unit}(w)$$

$$\textit{unit}(A) = m \times m$$

$$\textit{unit}(A) = m^2$$

Unit Prefixes

TABLE 1–4 Metric (SI) Prefixes

Prefix	Abbreviation	Value
yotta	Y	10^{24}
zetta	Z	10^{21}
exa	E	10^{18}
peta	P	10^{15}
tera	T	10^{12}
giga	G	10^9
mega	M	10^6
kilo	k	10^3
hecto	h	10^2
deka	da	10^1

TABLE 1–4 Metric (SI) Prefixes

Prefix	Abbreviation	Value
deci	d	10^{-1}
centi	c	10^{-2}
milli	m	10^{-3}
micro [†]	μ	10^{-6}
nano	n	10^{-9}
pico	p	10^{-12}
femto	f	10^{-15}
atto	a	10^{-18}
zepto	z	10^{-21}
yocto	y	10^{-24}

Converting Units

Any physical quantity we measure such as length, speed, or electric current **consists of two parts**:

- **a number**
- **and a unit.**

Sometimes, a quantity is given in one set of units, but we need it in another.

Example: We measure that a shelf is 21.5 inches wide, and we want to express this in centimeters.

❖ Conversion Factor

To convert between units, we use a conversion factor, which is defined as:

$$1 \text{ in} = 2.54 \text{ cm} \quad \longrightarrow \quad 1 = \frac{2.54 \text{ cm}}{1 \text{ in.}}$$

Solution

$$\begin{aligned} 21.5 \text{ in.} &= 21.5 \text{ in.} \times \frac{2.54 \text{ cm}}{1 \text{ in.}} \\ &= 54.6 \text{ cm} \end{aligned}$$

Converting Units

EXAMPLE 1–4 **Apartment area.** You have seen a nice apartment whose floor area is 880 square feet (ft^2). What is its area in square meters?

APPROACH We use the same conversion factor, $1 \text{ in.} = 2.54 \text{ cm}$, but this time we have to use it twice.

SOLUTION Because $1 \text{ in.} = 2.54 \text{ cm} = 0.0254 \text{ m}$, then

$$1 \text{ ft}^2 = (12 \text{ in.})^2 (0.0254 \text{ m/in.})^2 = 0.0929 \text{ m}^2.$$

So

$$880 \text{ ft}^2 = (880 \text{ ft}^2)(0.0929 \text{ m}^2/\text{ft}^2) \approx 82 \text{ m}^2.$$

Converting Units

EXAMPLE 1–5 **Speeds.** Where the posted speed limit is 55 miles per hour (mi/h or mph), what is this speed (a) in meters per second (m/s) and (b) in kilometers per hour (km/h)?

APPROACH We again use the conversion factor $1 \text{ in.} = 2.54 \text{ cm}$, and we recall that there are 5280 ft in a mile and 12 inches in a foot; also, one hour contains $(60 \text{ min/h}) \times (60 \text{ s/min}) = 3600 \text{ s/h}$.

SOLUTION (a) We can write 1 mile as

$$\begin{aligned} 1 \text{ mi} &= (5280 \cancel{\text{ft}}) \left(12 \frac{\cancel{\text{in.}}}{\cancel{\text{ft}}} \right) \left(2.54 \frac{\cancel{\text{cm}}}{\cancel{\text{in.}}} \right) \left(\frac{1 \text{ m}}{100 \cancel{\text{cm}}} \right) \\ &= 1609 \text{ m.} \end{aligned}$$

We also know that 1 hour contains 3600 s, so

$$\begin{aligned} 55 \frac{\text{mi}}{\text{h}} &= \left(55 \frac{\cancel{\text{mi}}}{\cancel{\text{h}}} \right) \left(1609 \frac{\text{m}}{\cancel{\text{mi}}} \right) \left(\frac{1 \cancel{\text{h}}}{3600 \text{ s}} \right) \\ &= 25 \frac{\text{m}}{\text{s}}, \end{aligned}$$

(b) Now we use $1 \text{ mi} = 1609 \text{ m} = 1.609 \text{ km}$; then

$$\begin{aligned} 55 \frac{\text{mi}}{\text{h}} &= \left(55 \frac{\cancel{\text{mi}}}{\text{h}} \right) \left(1.609 \frac{\text{km}}{\cancel{\text{mi}}} \right) \\ &= 88 \frac{\text{km}}{\text{h}}. \end{aligned}$$