

General Physics (1)

1

Chapter 01 – Physics And Measurements

SI Units

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29-Sep-25

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Basic Quantities and Their Units

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Quantity	SI Unit
Length	meter
Mass	kilogram
Time	second
Temperature	Kelvin
Electric Current	Ampere
Luminous Intensity	Candela
Amount of Substance	mole

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Quantities Used in Mechanics

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- In mechanics, three **basic quantities** are used:
 - Length
 - Mass
 - Time
- **Derived quantities:** all other quantities in mechanics that can be expressed in terms of the three fundamental quantities.
 - Velocity (m/s)
 - Acceleration (m/s^2)
 - Force ($Newton = kg.m/s^2$)

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Prefixes

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- Prefixes correspond to **powers of 10**.
- Each prefix has a specific name.
- Each prefix has a specific abbreviation.
- The prefixes can be **used** with any basic units.
- They are multipliers of the basic unit.
- Examples:
 - $L = 1\text{ mm} = 10^{-3}\text{ m}$
 - $m = 1\text{ mg} = 10^{-3}\text{ g}$
 - $t = 1\text{ ks} = 10^3\text{ s}$

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Prefixes, cont.

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Power	Prefix	Abbreviation	Power	Prefix	Abbreviation
10^{-24}	yocto	y	10^1	deka	da
10^{-21}	zepto	z	10^2	hecto	h
10^{-18}	atto	a	10^3	kilo	k
10^{-15}	femto	f	10^6	mega	M
10^{-12}	pico	p	10^9	giga	G
10^{-9}	nano	n	10^{12}	tera	T
10^{-6}	micro	μ	10^{15}	peta	P
10^{-3}	milli	m	10^{18}	exa	E
10^{-2}	centi	c	10^{21}	zetta	Z
10^{-1}	deci	d	10^{24}	yotta	Y

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Basic and Derived Units

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- Derived quantities can be expressed as a mathematical combination of fundamental quantities.
- Examples:
 - Area
 - A product of two lengths
 - Speed
 - A ratio of a length to a time interval
 - Density
 - A ratio of mass to volume

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Basic Quantities and Their Dimension

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- Dimensions are often denoted with square brackets.
 - Length [L]
 - Mass [M]
 - Time [T]

- Velocity (L/T)
- Acceleration (L/T^2)
- Force (*Newton* = $M \cdot L/T^2$)

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Conversion of Units

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- 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.
- Always include units for every quantity, you can carry the units through the entire calculation.
 - Will help detect possible errors

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Prefixes - 1

Friday, 29 January, 2021 21:10

Lecturer: Mustafa Al-Zyout, Philadelphia University, Jordan.

- R. A. Serway and J. W. Jewett, Jr., *Physics for Scientists and Engineers*, 9th Ed., CENGAGE Learning, 2014.
- J. Walker, D. Halliday and R. Resnick, *Fundamentals of Physics*, 10th ed., WILEY, 2014.
- H. D. Young and R. A. Freedman, *University Physics with Modern Physics*, 14th ed., PEARSON, 2016.
- H. A. Radi and J. O. Rasmussen, *Principles of Physics For Scientists and Engineers*, 1st ed., SPRINGER, 2013.

A right circular cylinder with a radius of (2.3 cm) and a height of (1.4 m) . Determine its volume in m^3 .

Solution:

$$V = \pi R^2 h = \pi (2.3 \times 10^{-2})^2 (1.4) = 2.3 \times 10^{-3} \text{m}^3$$

Changing units - 1

Friday, 29 January, 2021 21:12

Lecturer: Mustafa Al-Zyout, Philadelphia University, Jordan.

-  R. A. Serway and J. W. Jewett, Jr., *Physics for Scientists and Engineers*, 9th Ed., CENGAGE Learning, 2014.
-  J. Walker, D. Halliday and R. Resnick, *Fundamentals of Physics*, 10th ed., WILEY, 2014.
-  H. D. Young and R. A. Freedman, *University Physics with Modern Physics*, 14th ed., PEARSON, 2016.
-  H. A. Radi and J. O. Rasmussen, *Principles of Physics For Scientists and Engineers*, 1st ed., SPRINGER, 2013.

A car is traveling at a speed of 72 km/h. What is the corresponding speed in units of (m/s)?

Solution

To convert the speed from the kilometres per hour unit to meters per second unit, we write:

$$\begin{aligned}v &= 72 \frac{\text{km}}{\text{hr}} = 72 \frac{\text{km}}{\text{hr}} \times \frac{1000 \text{ m}}{1 \text{ km}} \times \frac{1 \text{ hr}}{60 \text{ min.}} \times \frac{1 \text{ min.}}{60 \text{ s}} \\&= \frac{72 \times 1000 \text{ m}}{60 \times 60} \frac{1}{\text{s}} \\&= 20 \text{ m/s}\end{aligned}$$

Changing units - 2

Sunday, 13 June, 2021 14:57

Lecturer: Mustafa Al-Zyout, Philadelphia University, Jordan.



R. A. Serway and J. W. Jewett, Jr., *Physics for Scientists and Engineers*, 9th Ed., CENGAGE Learning, 2014.



J. Walker, D. Halliday and R. Resnick, *Fundamentals of Physics*, 10th ed., WILEY, 2014.



H. D. Young and R. A. Freedman, *University Physics with Modern Physics*, 14th ed., PEARSON, 2016.



H. A. Radi and J. O. Rasmussen, *Principles of Physics For Scientists and Engineers*, 1st ed., SPRINGER, 2013.

The world land speed record of 763 mi/h was set on October 15, 1997. Express this speed in meters per second. (1 mi. is equivalent to 1609 m)

Solution

To convert the speed from the miles per hour unit to meters per second unit, we write:

$$\begin{aligned} v &= 763 \frac{\text{mi}}{\text{hr}} = 763 \frac{\text{mi}}{\text{hr}} \times \frac{1609 \text{ m}}{1 \text{ mi}} \times \frac{1 \text{ hr}}{60 \text{ min.}} \times \frac{1 \text{ min.}}{60 \text{ s}} \\ &= \frac{763 \times 1609 \text{ m}}{60 \times 60} \frac{1}{\text{s}} \\ &= 341 \text{ m/s} \end{aligned}$$