Physics 101: Mechanics
Lecture 1

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Classical Mechanics

- Classical mechanics deals with the movement of objects
  Classical mechanics: theory that predicts qualitatively and quantitatively the results of experiments for objects that are NOT
  - Too small: atoms and subatomic particles - Quantum mechanics
    Too fast: objects close to the speed of light - Special Relativity
    Too dense: black holes, the early universe - General Relativity
- Classical mechanics deals with the movement of objects that are relative to atoms and move at speeds much slower than the speed of light

Chapter 1 Measurement

- Being quantitative in Physics requires measurements
- How tall is Mehmet Okur? How about
- his weight?
  - Height: 2.11 m (6 ft 11 in)
  - Weight: 113 kg (260 lbs)

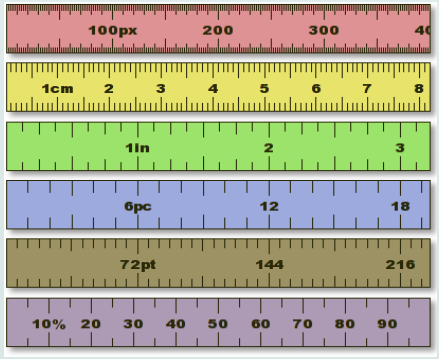
- Number + Unit
  - "thickness is 10.does not have any physical me
  - Both numbers and units needed to
  - any significant physical quantity

Type Quantities

- You can measure many things: distance, speed, energy, time, strength ...
- These are related to each other: speed = distance / time
- Choose three basic quantities:Choose three basic quantities:
  - LENGTH
  - MASS
  - TIME
- Define other units in terms of these.

SI Unit for 3 Basic Quantities

- Many possible choices for units of Length, Mass, Time
- In 1960, standards bodies control and define Système Internationale (SI) unit as,
  - LENGTH: Meter
  - MASS: Kilogram
  - TIME: Second



Fundamental Quantities and SI Units

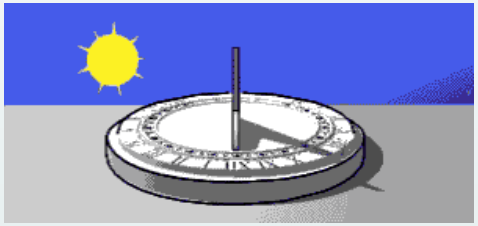
Length	meter	m
Mass	kilogram	kg
Time	second	s
Electric Current	ampere	A
Thermodynamic Temperature	kelvin	K
Luminous Intensity	candela	cd
Amount of Substance	mole	mol

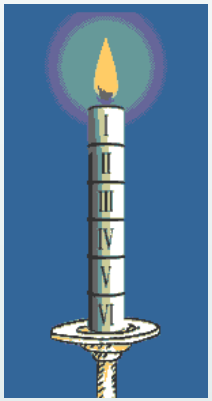
SI Length Unit: Meter

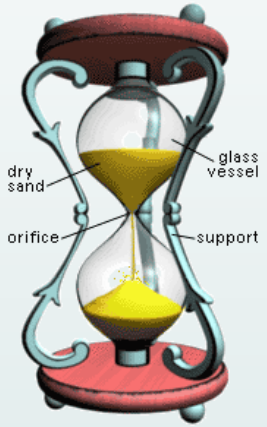
- French Revolution Definition, 1792
- 1 Meter = XY/10,000,000
- 1 Meter = about 3.28 ft
- 1 km = 1000 m, 1 cm = 1/100 m, 1 mm = 1/1000 m
- Current Definition of 1 Meter: the distance traveled by light in vacuum during a time of 1/299,792,458 second.

distance *XY* = 1 quadrant of the Earth

SI Time Unit: Second







- 1 Second is defined in terms of an “atomic clock”– time taken for 9,192,631,770 oscillations of the light emitted by a ^{133}Cs atom.
- Defining units precisely is a science (important, for example, for GPS):
  - This clock will neither gain nor lose a second in 20 million years.

SI Mass Unit: Kilogram

- 1 Kilogram – the mass of a specific platinum-iridium alloy kept at International Bureau of Weights and Measures near Paris. (Seeking more accurate measure: http://www.economist.com/news/leaders/21569417-kilogram-it-seems-no-longer-kilogram-paris-worth-mass)
- Copies are kept in many other countries.
- Mehmet okur is 113 kg, equivalent to weight of 113 pieces of the alloy cylinder.

Figure 1
Physics for Scientists and Engineers 6th Edition, Thomson Brooks/Cole © 2004; Chapter 1

Length, Mass, Time

Table 1.1 Table 1.2,
Physics for Scientists and Engineers 6th Edition, Thomson Brooks/Cole © 2004; Chapter 1

Prefixes for SI Units

- 3,000 m = 3 × 1,000 m
  = 3 × 10^3 m = 3 km
- 1,000,000,000 = 10^9 = 1G
- 1,000,000 = 10^6 = 1M
- 1,000 = 10^3 = 1k

- 141 kg = ? g
- 1 GB = ? Byte = ? MB

If you are rusty with scientific notation, see appendix B.1 of the text

10^x	Prefix	Symbol
x=18	exa	E
15	peta	P
12	tera	T
9	giga	G
6	mega	M
3	kilo	k
2	hecto	h
1	deca	da

Prefixes for SI Units

10^x	Prefix	Symbol
x=-1	deci	d
-2	centi	c
-3	milli	m
-6	micro	μ
-9	nano	n
-12	pico	p
-15	femto	f
-18	atto	a

- $0.003\ s = 3 \times 0.001\ s$
  $= 3 \times 10^{-3}\ s = 3\ ms$
- $0.01 = 10^{-2}$ = centi
- $0.001 = 10^{-3}$ = milli
- $0.000\ 001 = 10^{-6}$ = micro
- $0.000\ 000\ 001 = 10^{-9}$ = nano
- $0.000\ 000\ 000\ 001 = 10^{-12}$
  = pico = p
- 1 nm = ? m = ? cm
- 3 cm = ? m = ? mm

Derived Quantities and Units

- Multiply and divide units just like numbers
- Derived quantities: area, speed, volume, density ……
  - Area = Length $\times$ Length — SI unit for area = m^2
  - Volume = Length $\times$ Length $\times$ Length — SI unit for volume = m^3
  - Speed = Length / time — SI unit for speed = m/s
  - Density = Mass / Volume — SI unit for density = kg/m^3

Summary

- The three fundamental physical quantities of mechanics are length, mass and time, which in the SI system have the units meter (m), kilogram (kg) and second (s), respectively
- The method of dimensional analysis is very powerful for solving physics problems.
- Units in physical equations should always be consistent. Convert units is a matter of multiplying the amount given by a fraction, with a unit in the numerator and its equivalent in the other units in the denominator, arrange so that unwanted units in the given amount are canceled in favor of the desired units .