Phys 100 2024

Lecture 6

Fri: HW by 5pm

Mon: Read. 2.4, 3.1 → 3.2

Solar system recap

We provided models of the solar system and showed how they needed to be compared to observations. Observations of planetary motion, sizes and phases all agree with the heliocentric model. Why are these important

- they lead to an understanding of the workings of the solar system
- detailed understanding of motion of Earth, Moon, planets was long important for timekeeping and the associated navigation

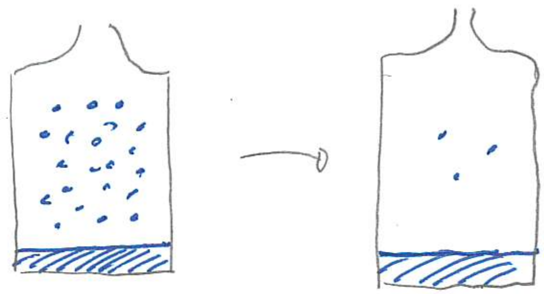
Atomic picture

We won't cover this in detail (see Ch2) but consider a balloon, inflated by water vapor

Quiz 1

The explanation is:

1) steam is a gas
2) as it cools, steam condenses
   ⇒ removes molecules from gas
3) much lower pressure



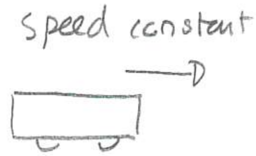
After heating

DEMO: PhET Phase change

VIDEO: Bearded Science Guy

Measurements and units

Physics often describes situations in terms of measureable quantities, and relates these. For example consider driving. We can describe how far we might travel in a car



in next amount of time how far

speed
60 mph   3 hrs   ⇒ distance = ?

In this example

$$\text{distance} = 60\,\text{mph} \times 3\,\text{hr} = 180\,\text{mi}$$

number quantities

Almost always these numbers have units (e.g. miles, hrs, mph) and we have to describe the measurements in terms of relevant units. We usually have many choices.

Units

Suppose that we measure lengths or distances. For example the width of a letter sheet. We get either

8.5 inches   or   21.6 centimeters

These refer to the same length but the numbers are different because each unit (inch or centimeter) corresponds to a different length. When we describe the result of a measurement we must produce

(same number) AND (UNIT USED)

The preferred units in physics are the metric (SI) units.

Basic units are:

quantity	unit	abbreviation
time	second	s
length	meter	m
mass	kilogram	kg

Thus for the same person

height = 1.75 meters = 1.75m ≈ 5ft 9in

mass = 70 kilograms = 70kg ≈ 154 lb.

The standard units are not always convenient because there are very many length scales

Demo: Slide with lengths in m

So we have a system of "derived" units to manage this. These are related to the basic unit in multiples of 10. For example

$$\underbrace{1000 \text{ meters}}_{1000\text{m}} = \underbrace{1 \text{ kilometer}}_{1\text{ km}}$$

To convert we do:

$$\text{distance (in km)} = \frac{\text{distance (in meters)}}{1000}$$

or

$$\text{distance (in m)} = 1000 \times \text{distance (in km)}$$

DEMO: Second distance slide

The system extends as:

$$1 \text{ kilo unit} = 1000 \text{ unit}$$

$$1 \text{ centi unit} = \frac{1}{100} \text{ unit} = 0.01 \text{ unit}$$

$$1 \text{ milli unit} = \frac{1}{1000} \text{ unit} = 0.001 \text{ unit}$$

The latter implies

$$1000 \text{ milli unit} = 1 \text{ unit.}$$

Quiz1 80% - 90%

Example: The width of a letter sheet is 21.6cm. Convert this to a) meters, b) millimeters and c) kilometers.

Answer: a) $21.6\text{ cm} = 21.6 \times 1\text{cm} = 21.6 \times 0.01\text{m} = 0.216\text{m}$

b) Alternative strategy $1000\text{mm} = 1\text{m} \Rightarrow 1 = \frac{1000\text{mm}}{1\text{m}}$.

Then $0.216\text{m} = 0.216\text{m} \times \frac{1000\text{mm}}{1\text{m}} = 216\text{mm}$

c) $0.216\text{m} = 0.216\text{m} \times \frac{1\text{km}}{1000\text{m}} = 0.000216\text{m}$ ∎