

1.1 Measurement

1 THE SEVEN BASE UNITS IN THE INTERNATIONAL SYSTEM OF UNITS (SI)

Quantity	Name of base SI Unit	Symbol
Length	metre	m
Mass	kilogram	kg
Time	second	s
Electric current	ampere	A
Thermodynamic temperature	kelvin	K
Amount of substance	mole	mol
Luminous intensity	candela	cd

all of these
except the kg
can be
measured
in the lab.

Derived units

Volume

$$m^3$$

space

Speed

$$m|s^{-1}$$

force

$$N$$

(newton)

$$kg|m|s^{-2}$$

space space

frequency

$$Hz$$

(hertz)

$$s^{-1}$$

You need to be able to convert units (factor labelling)

How many seconds in a week?

$$\text{last year: } x s = 1 \text{ week} \left(\frac{7 \text{ days}}{1 \text{ week}} \right) \left(\frac{24 \text{ h}}{1 \text{ day}} \right) \left(\frac{3600 \text{ s}}{1 \text{ h}} \right)$$

$$\text{this year: } 1 \cancel{\text{ week}} \left(7 \cancel{\text{ days week}^{-1}} \right) \left(24 \cancel{\text{ h day}^{-1}} \right) \left(3600 \cancel{\text{ s h}^{-1}} \right)$$

$$= 604800 s$$

Very Large numbers / Very small numbers

We are limited by what we can visualize or we have experienced.

objects in this room $\sim 1\text{ m}$

strand of hair $\sim 0.1\text{ mm}$ or 10^{-4} m

distance to moon $\sim 10^9\text{ m}$

Can you visualize the speed of light?

$$c = 3.0 \times 10^8 \text{ m s}^{-1}$$

- light would travel back + forth across this room a million times every second (about).
- light takes 8 minutes to reach the Earth from the Sun.
- LHC (Large Hadron Collider)
 - 27 km long
 - protons travel at almost the speed of light.
 - travel around the collider 10,000 times a second.
- it takes light 4 years to get to the Earth from our nearest star and 100,000 years to cross Milky way.

You MUST KNOW these:

Distances:

Diameter of a proton

$$10^{-15} \text{ m}$$

Extent of the visible universe

$$10^{25} \text{ m}$$

Masses:

Mass of the electron

$$10^{-30} \text{ kg}$$

Mass of the universe

$$10^{50} \text{ kg}$$

Times:

Time for light to cross a nucleus

$$10^{-23} \text{ s}$$

Age of universe

$$10^{18} \text{ s}$$