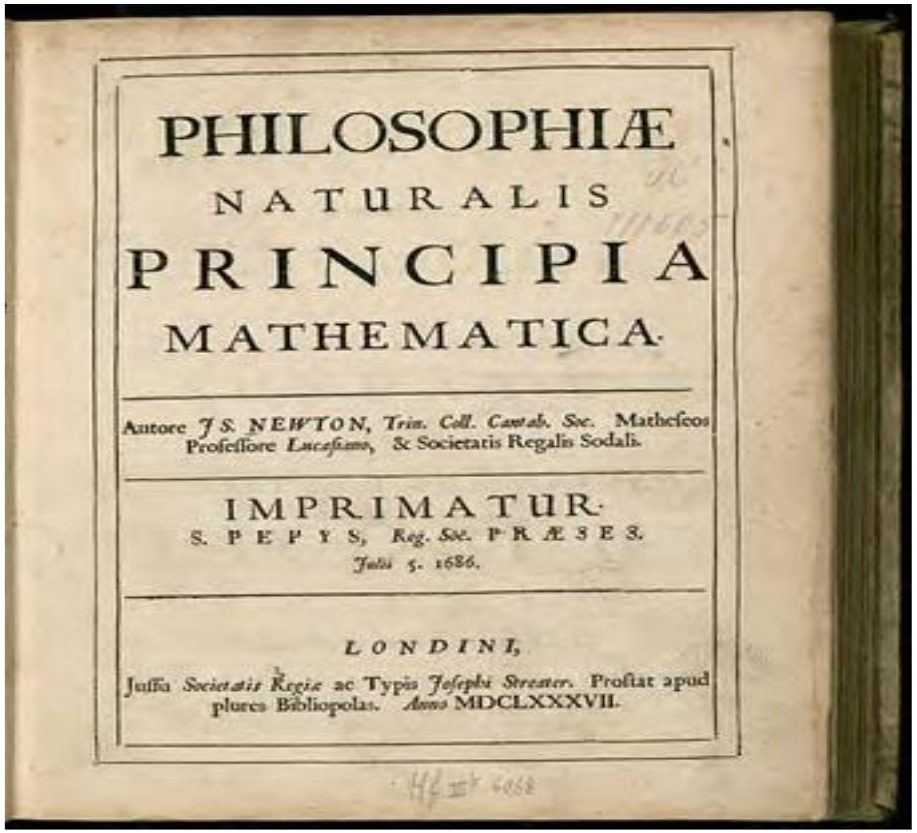
MOTION

One purpose of physics is to study the motion of object-how fast they move, and how far they move in a given amount of time.NASCAR engineers are fanatic about this aspects of physics as they determinate the performance of their cars before and during a race. Geologists use this physics to measure tectonic-plate motion as they attempt to predict earthquakes.

Physical basic of Mechanics.Kinematics

The section of physics which is engaged in studying of laws of a mechanical motion, is termined as a mechanics. The classical mechanics consists of three basic section:

Kinematics- gives the mathematical description of a motion of body without reason causing this motion
Dynamics- studies a motion of bodies taking into account force operating on them
Statics- studies laws of composition of forces and a requirement of balance of bodies



PHILOSOPHIÆ
NATURALIS
PRINCIPIA
MATHEMATICA.

Autore J S. NEWTON, Trin. Coll. Cantab. Soc. Matheseos Professore Lucasiano, & Societatis Regalis Sodali.

IMPRIMATUR.
S. PEPYS, Reg. Soc. PRÆSES.
Julii 5. 1686.

LONDINI,
Jussu Societatis Regiæ ac Typis Josephi Streater. Prostat apud plures Bibliopolas. Anno MDCLXXXVII.

Picture 1

- The first serious attempts to develop a theory of motion were made by Greek astronomers and philosophers
- A major development in the theory was provided by Isac Newton in 1687 when he published his "Philosophuae Naturalis Principia Mathematica"
- Today, mechanics is of vital importance to students from all disciplines

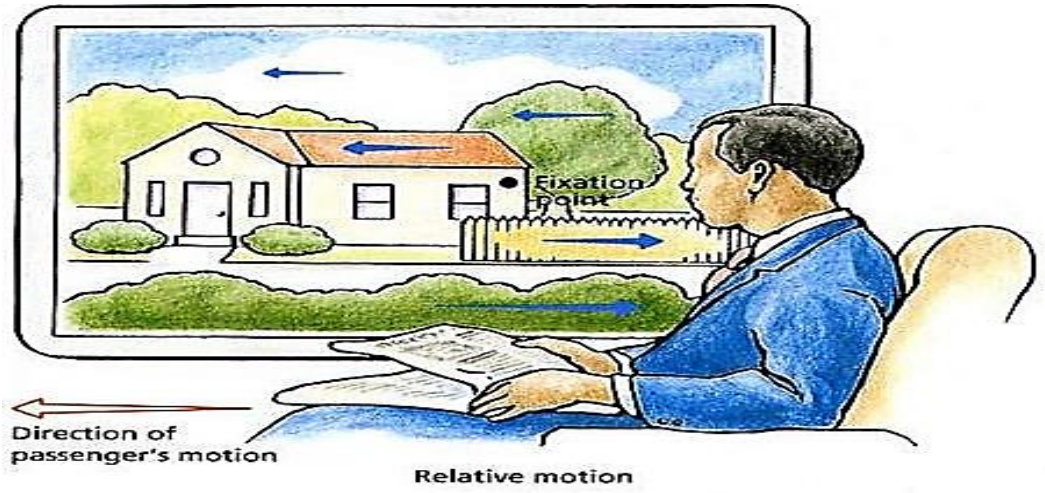
Issac Newton's monumental work, Philosophiae Naturalis Principia Mathematica, published in 1687 (picture 1).

Mechanical motion

Mechanical motion is one of the key topics in **physics**. In physics, **motion** is change in position of a body with respect to a another body (reference body). Body is in motion if it changes position relative to a reference body. If the position of a body is not changing with respect to reference body, the body is said to be in rest.

Example:
Sitting at your desk, how fast are you moving?
Relative to the ground: You are not moving relative to the ground.
Relative to the Sun: $2{,}97 \cdot 10^4$ m/s. That's big difference, but since the Earth is orbiting the Sun at this speed, an observer standing on the Sun would say that you are moving at $2{,}97 \cdot 10^4$ m/s.
Both of these answer are correct when is observing from different reference body.

Mechanical motion is relative (because it looks quite different when is observed in relation to the different reference body). To describe mechanical motion, we can choose any reference body. Best way to do it is to choose the reference body in relation to which the motion is simpliest.



Picture 2: The passenger can use a house as a reference body to decide if the train is moving.

Material point

The motion of each point of a body need not to be specified when the size of a body is small in comparison with the distance travel by it or in comparison with the distance from the body to other bodies.A material point is a body whose size can be neglected under the given conditions of motion.

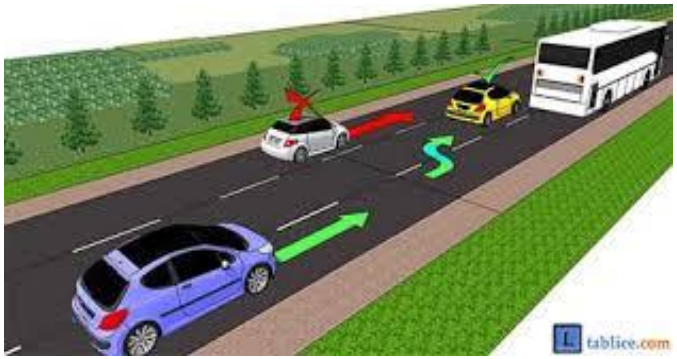
Material point is an idealisation that can be mapped on certain physical system in some circumstances. Planets, for example, are so far away from each other and from the Sun, that their motion can be treating as material point. (the radius of the Earth, is about 1/24 000 of the distance between the Earth and the Sun). But planet-moon system can no longer be analysed in these terms, because the body are sufficiently close to see each other's dimension, and that has a profound effect on the dynamics of a planet-moon system.

For example, suppose that a boy going to school covers the distance of one kilometre.He can be threated as a material point in this motion, because he is small in comparison with the distance he travels.But when the same boy does his morning exercises, he can't be as a material point.

Picture 5: Plane is approaching to the airport.
Radar shows him as material point

Trajectory

Line, described by a material point in its motion in space, called the trajectory. Depending on the trajectory shape distinguish a linear and curvilinear motion of a point. If the trajectory represents a straight line, then the motion is linear (picture 3). If the trajectory represents a curve line, then the motion is curvilinear (picture 4),



picture 3

picture 4

Distance(s) is length of trajectory traveled by material point during its motion. Distance is scalar quantity.The SI unit for distance is metre(m). If the motion consists in many parts,then the total distance is the sum of the distance in each part of the motion.

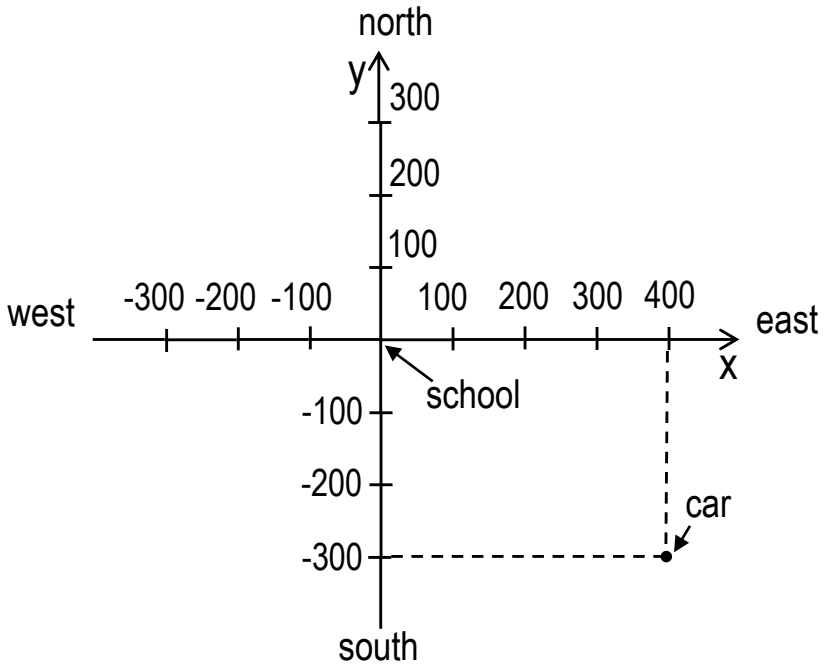
Chris walked 200 yards to Cherry's house. He left Cherry's house and walked 50 yards to the store. After leaving the store he walked to same path home.

What was the total distance traveled by Chris?

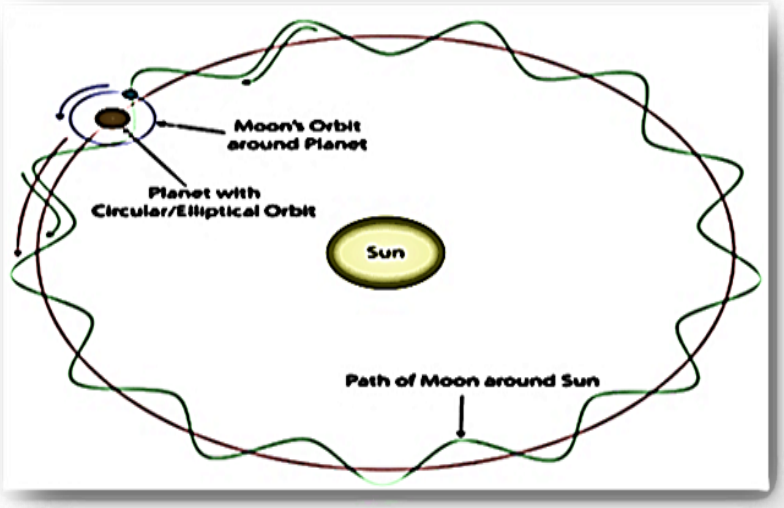
Reference system

To determinate the position of the body during its motion it is not enough to choose appropiate reference body. Body position and changes in body position are determinate relative to conventient reference system. Reference system is formed by three crossly perpendicular axes x,y,z, and in the origin is reference body.

If we say that the car is 500 meters away from the school (picture 6), of course we do not know where he is , because there are many positions that are 500m away from the school . But if we say that the car is 300 meters away to the south and 400m to the east , then we know exactly where it is.



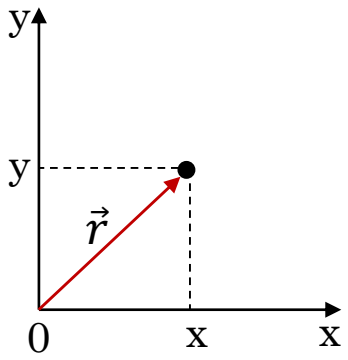
Picture 6



Picture 7

Shape of trajectory depends on the reference system from which we observed the motion (picture 7).

Position vector of the Material point



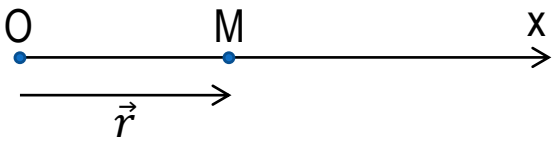
Picture 8

Another general way of locating the body is with a position vector.
The position vector of the material point ($\vec{r}$) is a vector which connects the origin and the given point, is directed from the origin to the given point.

The position of material point is determined by two coordinates x and y (picture 8) .The relationship between the number of values radius-vector and the coordinates of the point: $r = \sqrt{x^2 + y^2}$

If the body is moving, the coordinates *x*, *y* are functions of time: x=x(t), y=y(t). That means that position vector is also function of time: r(t)=(x=x(t)y=y(t)).

If a material point is moving in a straight line, we can make one of the coordinate axes coincide with this line and specify the position of the point M at any instant by a single coordinate, viz. The distance from this point M to the point chosen as the origin. The motion of the body in this case can be described by using just one coordinate axis (picture 9)



Picture 9