

MOTION



WHAT IS MOTION ?

- An object is said to be in motion if it changes its position with respect to its surroundings in given time.
- Motion is always observed and measured with a point of reference.
- All living things show motion whereas non-living things show motion only when some force is acting on it.

EXAMPLE :

- 1. When an athlete is running on the ground then he is continuously changing his position with respect to the audience who are sitting at rest.
- 2. We are continuously changing our position since morning till night with respect to earth which is at rest.
- 3. The earth is continuously changing position with respect to sun which is at rest.

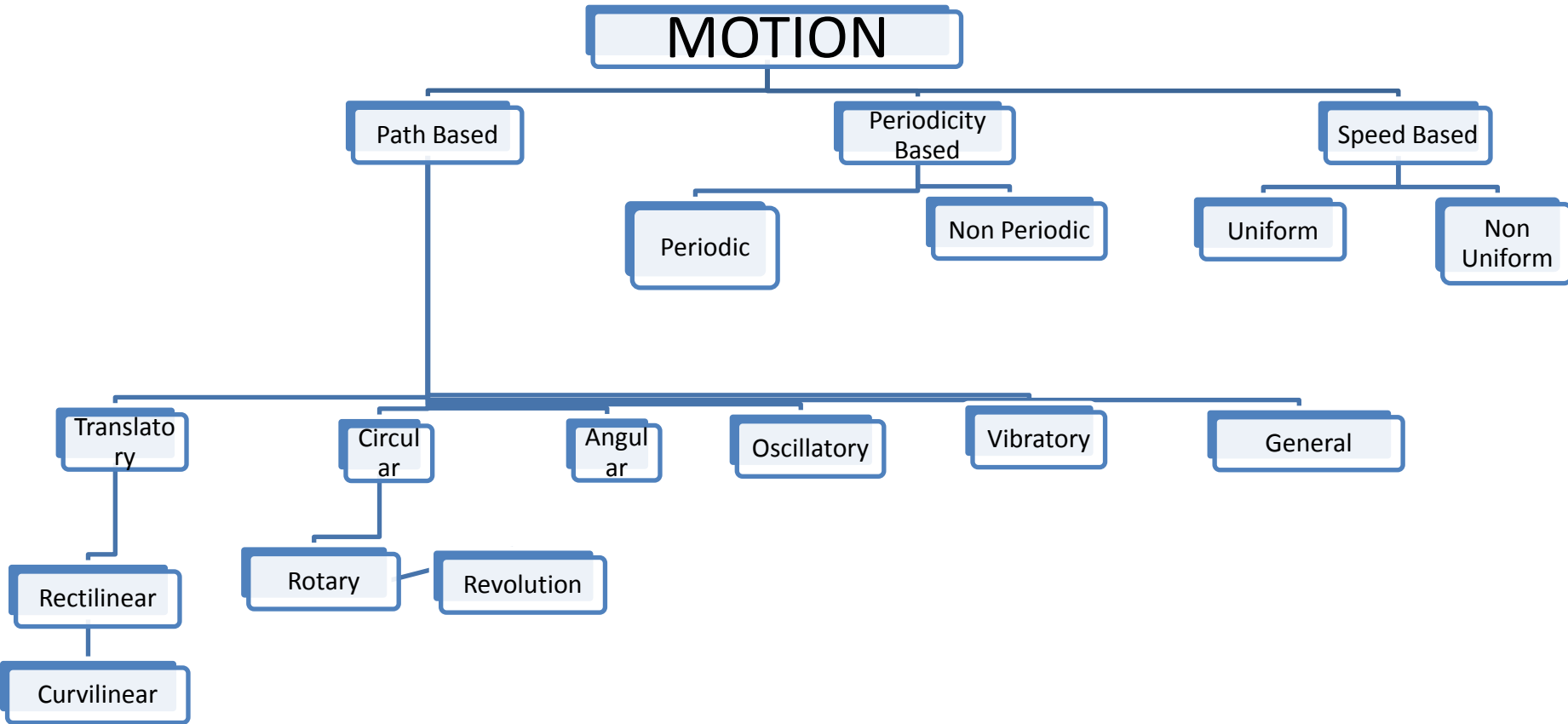
- **Mechanics** : it is an important branch of physics and deals with the effect of force on bodies.
- It is further divided into two parts
- **1. Dynamics** : In dynamics we discuss the motion of bodies under the action of forces.
- **2. Kinematics** : it deals with the study of motion of bodies Without any reference to the cause of motion.

Object in motion?

- If you are standing in one place, and your friend walks by you, are you moving relative to your friend? ◦
- Is your friend moving relative to you?
- Is either of you moving relative to the earth?

- Answer: You are moving relative to your friend, and your friend is moving relative to you!
- You are both moving relative to the sun!

- We can classify these different types of motion based on a ***path, periodicity,*** and the ***speed*** of an object.
- Based on the path followed by an object, there are five types of motion – translatory, rotatory, circular, oscillatory and vibratory motion.
- Based on the periodicity, there are two types of motion – periodic and non-periodic motion.
- Finally, based on speed, there are two types of motion – uniform and non-uniform motion.



1

PATH BASED MOTION

- As brought out earlier, there are six types of motion, based on the path. These are translatory, rotatory, circular, oscillatory, vibratory and general motion.

A. TRANSLATORY MOTION

The motion in which all points of a moving body move uniformly along a straight line is called translatory motion. In this motion all parts move in the same distance, direction, and speed.



- Some other examples of translatory motion are:
- An apple falling from a tree,
- the boy walking on a road,
- the motion of a box when pushed from one corner of the room to the other, etc.

(A-i) RECTILINEAR MOTION

- If a body moves in a straight line it is called a Rectilinear motion.
- when a body moves in a straight line then the linear motion is called rectilinear motion. eg., an athlete running a 100 meter race along a straight track is said to be a linear motion or rectilinear motion.

Examples of Rectilinear or Linear Motion



An apple falling from a tree



Pushing of box



March past by student on straight path

- Some other examples of rectilinear or linear motion are:
- A stone falling straight toward the surface of the [earth](#),
- A car moving on a straight road,
- The [motion](#) of bullet fired from the gun, etc.



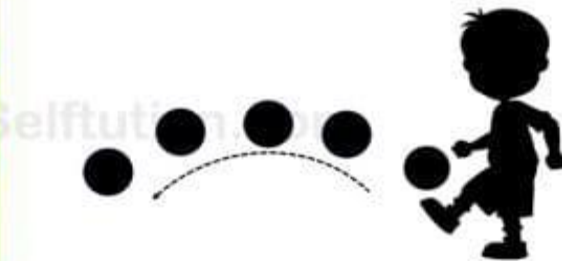
(A-ii) CURVILINEAR MOTION

- If a body moves along a curved path then it is said to have curvilinear motion.
- Some other examples of curvilinear motion are:
- The [motion](#) of cycle while taking a turn on the road,
- The revolution of the [earth](#) around the sun.
- A path followed by a javelin thrown by an athlete, etc.

Examples of Rectilinear or Linear Motion



A car moving on the curved road



Ball Kicked by a boy

Some other examples of curvilinear motion are:

- The [motion](#) of cycle while taking a turn on the road,
- The revolution of the [earth](#) around the sun.
- A path followed by a javelin thrown by an athlete, etc.



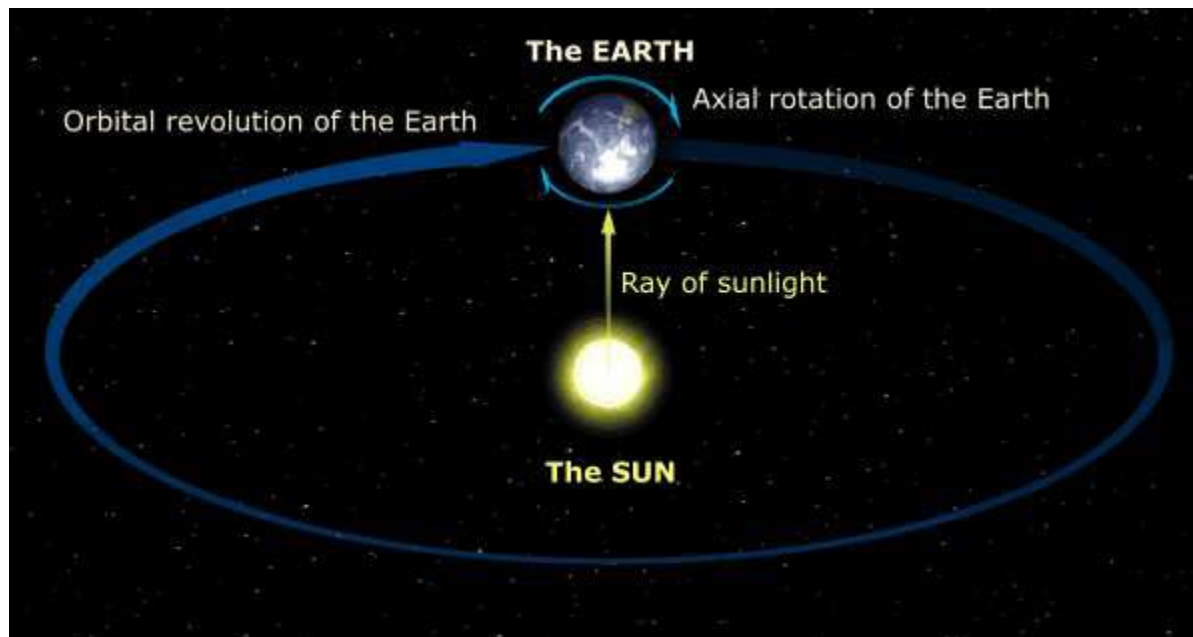
(B) CIRCULAR MOTION

- An object is said to be in circular motion when it moves around a fixed point called axis.



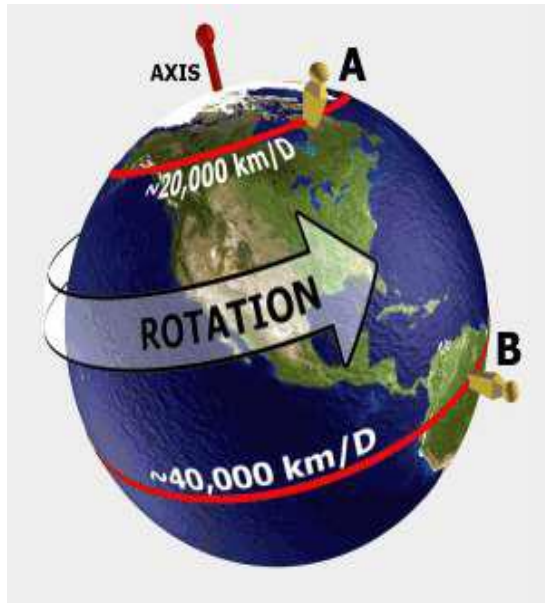
(B-i) REVOLUTION

- When a body as a whole moves in a circular path its motion is called revolution and the body is said to revolve.



(B-ii) ROTATORY MOTION

- When a body undergoes translatory motion in such a way that its parts cover different distances in a given time it is said to have rotatory motion.



(C)Angular Motion

Angular motion is produced by the application of a force acting at some distance from an axis, that is, by torque.

Angular motion is far more common than linear motion in sport because angular motion occurs whenever levers (bones) rotate around axes (joints).



(D) OSCILLATORY MOTION

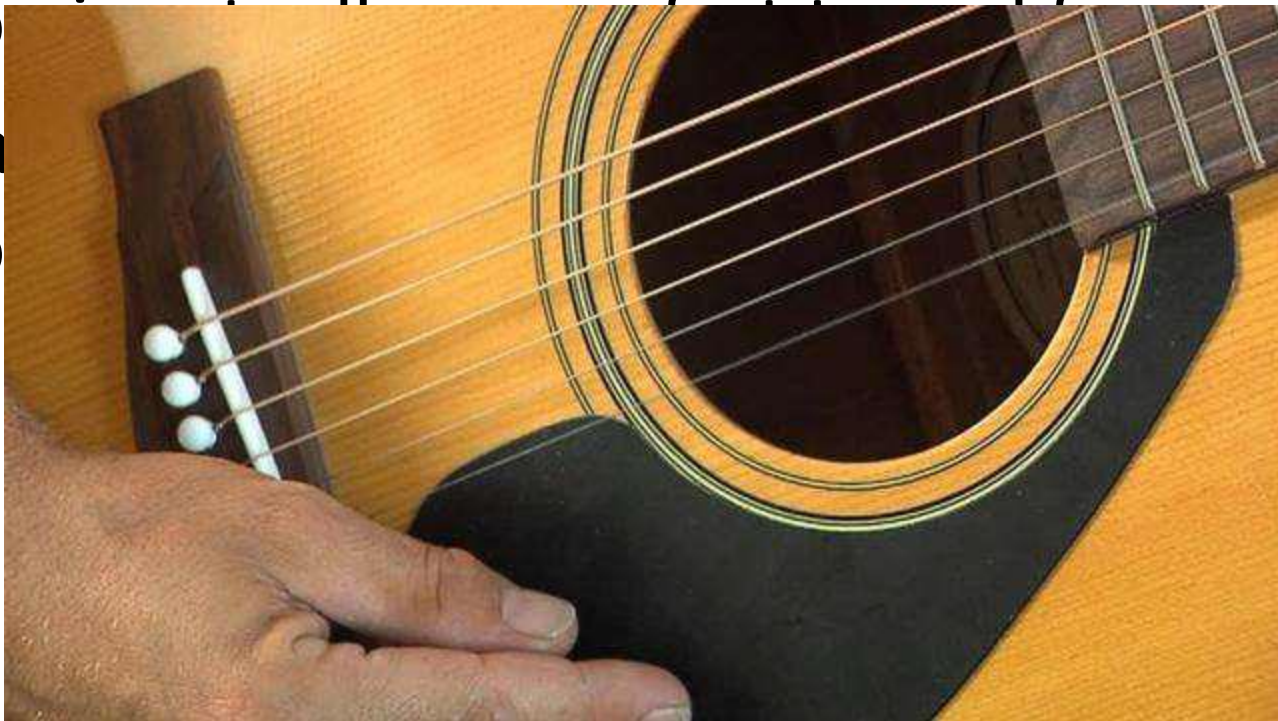
- When a body moves to and fro about a fixed point it is said to be oscillatory motion.



(E) VIBRATORY MOTION

- Sometimes the whole object does not show to and fro motion but a part of it shows motion, such a motion is called vibratory motion. This motion is called vibratory motion.

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(F) GENERAL MOTION

Irregular motion of a body in which the direction is not fixed is called Random Motion



General motion

- When an object possesses two or more types of motions at the same time, then such a motion is called multiple motion.
- It is combination of linear and angular motion.
- It is also called as Mixed motion.
- examples: When a spin bowler delivers a ball, the ball has a motion of spin(rotatory motion)while it moves toward the batsman(translatory motion).

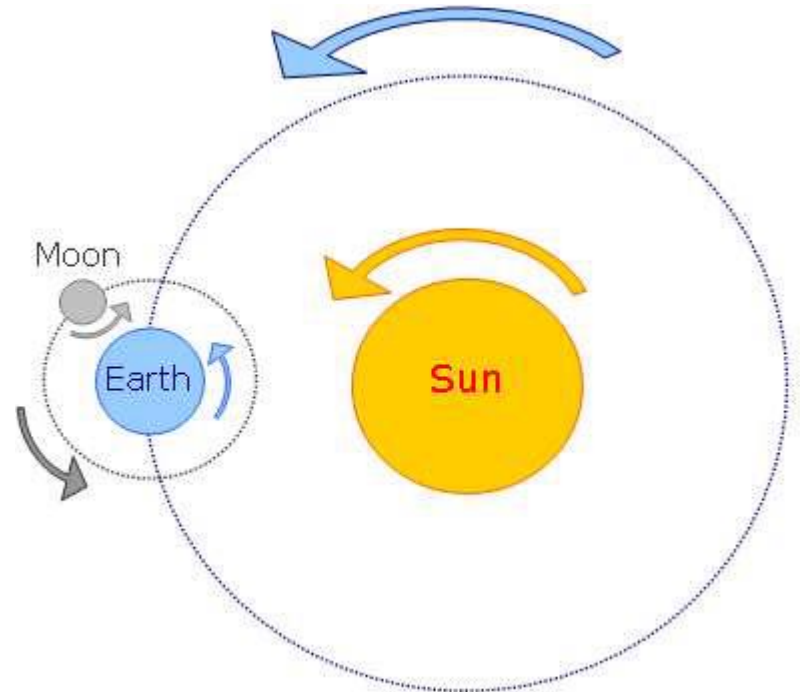
- Most common in sports:
- Running and walking is good example. In these activities trunk moves in a linear pattern as result of angular motion of legs and arms.

2

PERIODICITY

(A) PERIODIC MOTION

- • When the same motion repeats itself after equal intervals of
- time ,we call it periodic motion.

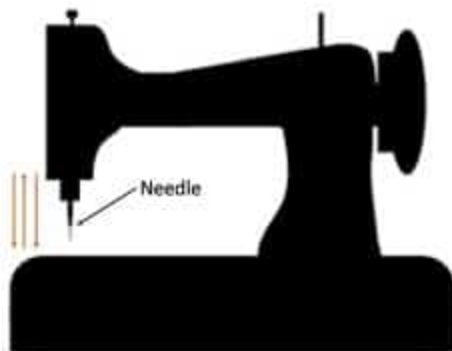


The periodic motion is the type of motion that gets repeated after a regular interval of time.

Some periodic motion examples are:

- The [earth](#) completes one round around the sun in $356\frac{1}{4}$ days and this [motion](#) gets repeated after every $356\frac{1}{4}$ days. Thus, it is a periodic motion.
- The moon revolves around the [earth](#) and completes one revolution in 27 days and then repeats its motion.
- The pendulum of the clock repeats its motion every 2 seconds.
- The motion of the needle of a sewing machine.

It will be interesting for you to know, that circular and oscillatory [motion](#) is repetitive. Therefore, they come under the category of periodic motion.



(B) Non - Periodic

- The non-periodic motion is the type of motion that does not repeat itself after a regular interval of time.
- For examples,
- The motion of footballer during a match.
- A ball rolling down the ground gradually slows down and finally stops,
- The motion of sea waves, etc.

3. SPEED BASED

As brought out earlier, there are two types of [motion](#), based on Speed. These are uniform and non-uniform motion.

(3-A) Uniform

- If a moving body travels the equal distance in an equal interval of time, its motion is said to be uniform. Thus, for the uniform motion, the speed of the moving body remains constant. Let us understand this by an example,



A man drives a car from city A to another city B. Distance between city A and city B is 90 km. If the man covers a distance of the first 30 km in 0.5 hrs, the next 30 km in 0.5 hrs and the last 30 km also in 0.5 hrs, then it means he drove at a constant speed of 60 km/hr.

Thus, we can say in the present case the motion of the car was uniform throughout the journey.

Some other examples of uniform [motion](#) are:

The revolution of the [earth](#) around the sun.

The revolution of the moon around the [earth](#).

A movement of hands of a clock.

(3-B) Non-Uniform

- If a moving body travels the unequal distance in an equal interval of time or equal distance in unequal time intervals, its motion is said to be non-uniform. Thus, for the non-uniform [motion](#), the speed of the moving body does not remain constant. Let us understand this by an example,



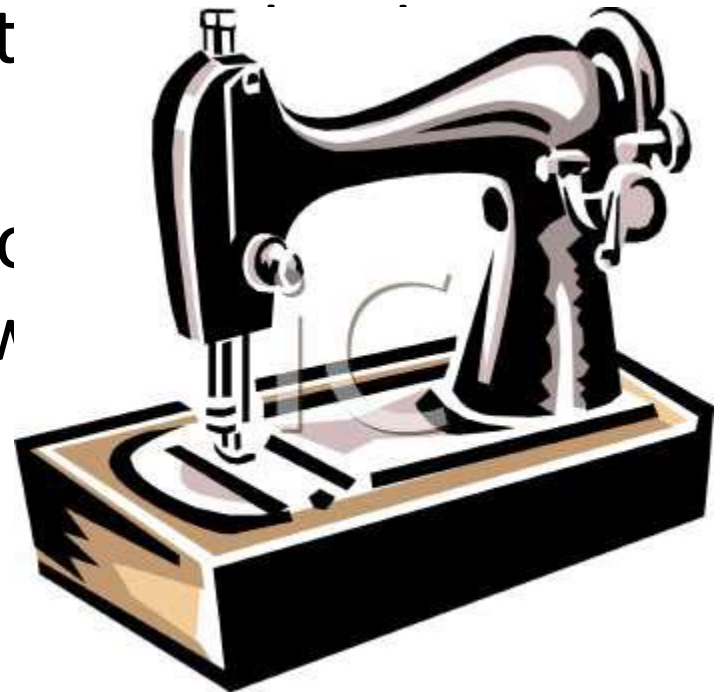
A man drives a car from city A to another city B. Distance between city A and city B is 90 km. If the man covers a distance of the first 30 km in 1.0 hrs, the next 30 km in 0.5 hrs and the last 30 km in 0.25 hrs, then it means he drove at a varying speed of 30 km/hr, 60 km/hr and 120 km/hr.

Thus, in the present case the motion of the car was non-uniform.

Objects/Actions having more than one type of motion

- Drawing water from well : In this case the pulley on which rope is put has circular motion and bucket has linear motion
- Frisbee: In this the frisbee has rotational motion as well as linear motion as it moves

- Sewing machine : Needle and the wheel have circular motion



MANY TYPES OF MOTION

- Motion of Earth: Earth revolves around the sun, thus showing circular motion. It rotates around the axis showing rotatory motion. Both the above motions are repeated after a fixed interval of time, so it shows periodic motion too.
- Bicycle : When a person rides a bicycle, the cycle and the rider shows translatory motion whereas the wheels show translatory motion.
- Screw: When a screw is screwed into a box it shows both rectilinear and rotatory motion

SCALARS AND VECTORS

- The motion of objects can be described by words - words such as distance, displacement, speed, velocity, and acceleration. These mathematical quantities which are used to describe the motion of objects can be divided into two categories. The quantity is either a vector or a scalar. These two categories can be distinguished from one another by their distinct definitions:
- Scalars are quantities which are fully described by a magnitude alone.
eg: displacement , velocity , force ,acceleration etc.,
- Vectors are quantities which are fully described by both a magnitude and a direction.
eg : distance , mass ,time ,volume etc



Thank You