Chapter 4

One Dimensional Motion

Dav - 1

"Study of motion and rest"

Kinematics	Dynamics	Statics
"it is a branch if mechanics in which we study relationship between variables of motion without studying cause of motion"	"it is another branch of mechanics in which we study Cause of motion".	" it is a branch of mechanics in which we study mechanical Equilibrium.

KINEMATICS

Rest and motion:-

Rest: "if position of any object or particle is not changing with respect to any observer then this object is said to be at rest"

Motion: "if position of any object or particle is changing with respect to any observers then this object is said to be in motion"

"Absolute rest and absolute motion is impossible"

Sate of rest and motion depends upon reference frame (State of observer)

Type of motion

(1) One dimensional (1-D) motion:

If position of any object is changing any of x axis, or y-axis or z axis.

All 1-D motion will be always straight line motion"

(2) Two dimensional (2-D) motion (Motion in a plane)

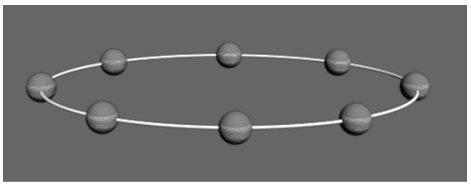
X-Y plane

Z- X plane

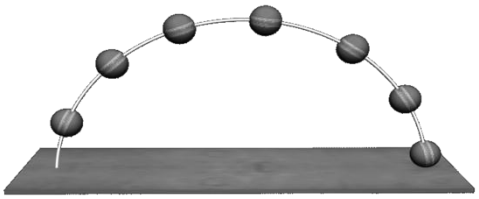
Y-Z plane

" If position of Any object is changing in x –y or y-z or z-x plane"

Example:



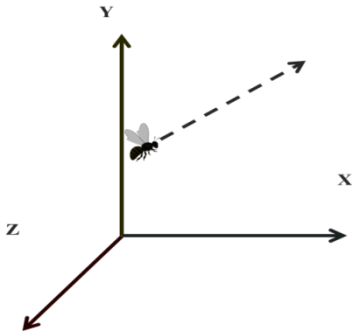
Horizontal circular motion



Projectile motion

2-D motion may be straight line motion"

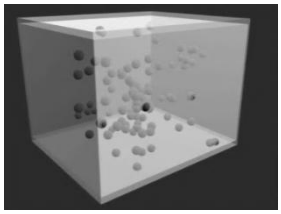
"Writing on board or copy is also 2-D event"



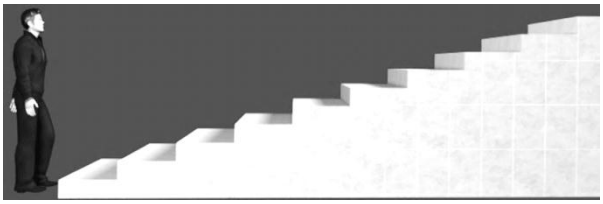
(3) Three dimensional (3-D) motion:-

" if position of any object is changing along all 3 – axis (x-y z)"

Example:-



Human can move in 1-D, 2-D, or 3-D motion"



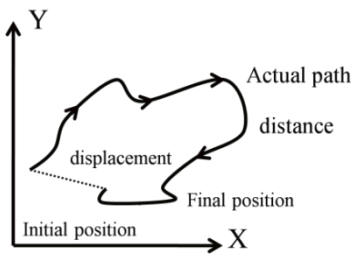
BASIC TERMS IN KINEMATICS

(1) Displacement:

"length of straight line drawn between initial and final position of any object"

"Shortest path between initial and final position of any object"

It is vector quantity so it may be +, - , zero.



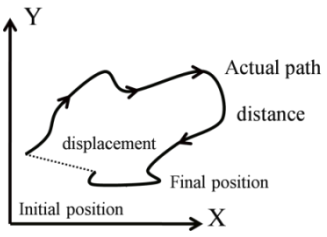
(2) Distance:-

"length of actual path travelled by any object" It is scalar quantity so it will be always positive.

Distance $\geq$ Displacement

$\frac{Distance}{displacement} \geq 1$

For straight line motion distance will equal to displacement.



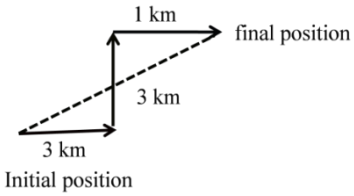
UNDERSTANDING OF DISPLACEMENT AND DISTANCE

Example:-

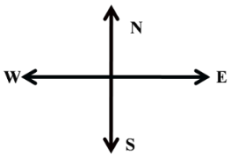
"A person is moving 3 km towards east then take left turn and move 3 km towards north then person take a right turn and move 1 km further due east and stops.

(i) What will be the total distance travelled by person.

(ii) What will be the net displacement of the person.



Solution: As we study in vectors and scalars.



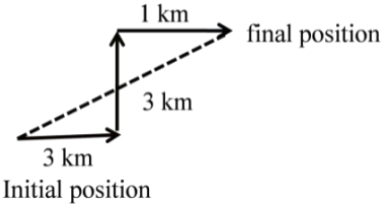
(i) Distance: length of actual path so distance = 3 km + 3 km + 1 km = 7 km

(ii) Displacement: length of straight line

First method: disp. $(\vec{S}) = 3\hat{i} + 3\hat{j} + 1\hat{i} = 4\hat{i} + 3\hat{j}$

$\text{disp}|\hat{S}| = \sqrt{4^2 + 3^2} = 5$ km

Direction: $\tan\theta \equiv \frac{3}{4}$ $\theta = 37°$ with east direction.



Second method

$|\text{disp.}| = 3^2 + (3+1)^2$

Applying Pythagoras = 5 km

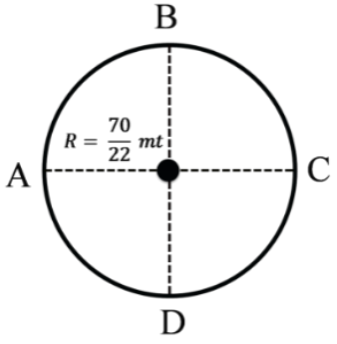
Example: 2 An object is moving in a circular path of radius of $\frac{70}{22}$ meter shown in figure Find magnitude of distance and displacement.

(i) From A to B

(ii) From A to C

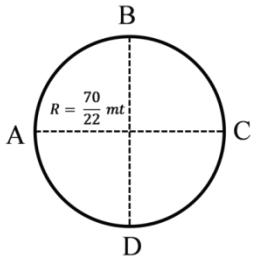
(iii) From A to D

(iv) From A to A



Solution

A to B



Distance $= \frac{2\pi R}{4}$

$= \frac{\pi R}{2}$

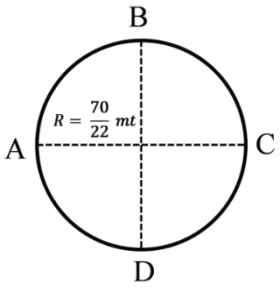
$= \frac{22}{7} \times \frac{70}{22 \times 2}$

= 5 meter

Displacement $= R\sqrt{2}$

$= \frac{70}{22}\sqrt{2}$mt

A to D



Distance $= 2\pi R - \frac{2\pi R}{4} = \frac{3}{4} \times 2\pi R$

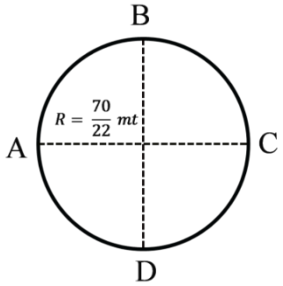
$= \frac{3}{4} \times 2 \times \frac{22}{7} \times \frac{70}{22}$

= 15 meter

Displacement $= R\sqrt{2}$

$= \frac{70}{22}\sqrt{2}$meter

A to C



Distance $= \frac{2\pi R}{2}$

$= \frac{\pi R}{2}$

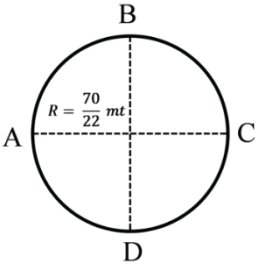
$= \frac{22}{7} \times \frac{70}{22}$

= 10 meter

Displacement $= 2R$

$= 2 \times \frac{70}{22} = \frac{70}{11}$ meter

A to A



Distance = $2\pi R$

$= 2 \times \frac{22}{7} \times \frac{70}{22}$

= 20mt

Displacement = 0