Chapter - Zero
Basics

* **Physical quantity** - The quantity that can be measured is called physical quantity

* Physical quantities are of two types

1) Fundamental quantity - Basic quantity
   Ex- mass, length, time
2) Derived quantity - which are derived from basic quantity.
   Ex- force = m×g
   Area = l×b

Fundamental quantity	S.I unit
1) Length	meter (m)
2) Mass	Kilogram (Kg)
3) Time	seconds (s)
4) Temperature	Kelvin (K)
5) Electric current	Ampere (A)
6) Amount of substance	mole (mol)
7) Luminous intesity	candela (cd)

Derived quantity	Formula	SI units
Speed/Velocity	$V = \frac{S}{t}$	m/s
Acceleration	$a = \frac{v}{t}$	m/s^2

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m/s

m/s^2

System of Units

	Length	Mass	Time
CGS	centimeter	gram	seconds
MKS (SI)	meter	Kilogram	seconds
FPS	foot	pound	seconds

SI unit - It is the international system of units

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Chapter - 1
Motion

* Motion - If an object changes its position with respect to (wrt) time and observer is said to be in motion
Ex - flying birds, moving vechiles

* Rest - When an object does not change position wrt to time and object observer is said to be at rest. Ex - a book kept on table, doors, windows

* Reference point - To describe the position of an object, we need to specify the point from where the object starts moving i.e orgin. This point is called reference point

* Scalar quantity - A quantity which has only magnitude and no specified direction. Ex - distance and speed

* Vector quantity - A quantity which has both magnitude and direction
Ex - displacement, velocity

★ Distance - The actual ~~distan~~ length of the path covered by a body irrespective of direction is its distance travelled
Symbol - S, SI unit - meter (m)

★ Displacement - The shortest distance between the initial and final position of body along the direction is its displacement
Symbol - S, S.I unit - meter (m)

Distance	Displacement
1) It is the actual length covered	1) It is the shortest distance
2) Scalar quantity	2) Vector quantity
3) It is always positive	3) It can be positive negative or zero
4) It is always greater or equal to ~~displacement~~ displacement	4) Never greater than distance

Questions

1) An object has moved through a distance Can it have zero displacement? If yes, support your answer with example

Ans. Yes, displacement can be zero, if the object goes back to its initial position. For ex- when you swing there is displacement but when you stop swinging and the swings position comes to rest it comes to its intial position. Thus, displacement becomes 0

3) Which of the following is true for displacement?

a) It cannot be zero
b) Its magnitude is greater than distance travelled by the object

Ans Both are not true

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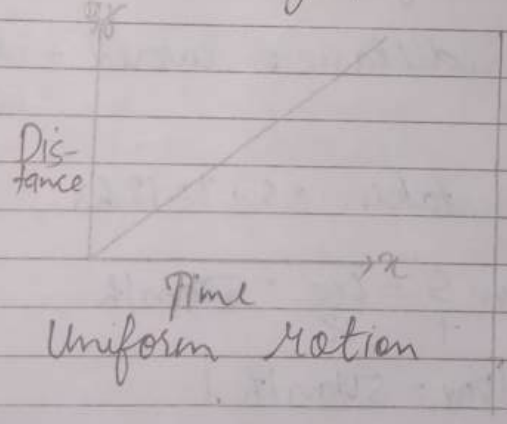
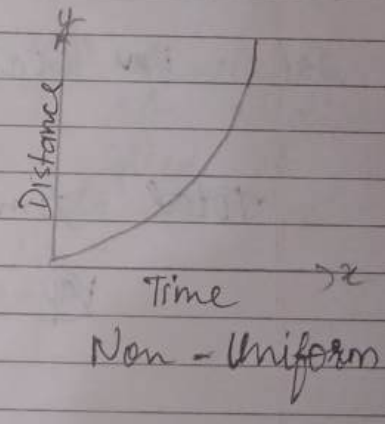
★ Uniform Motion - An object is said to be in uniform motion if it travels in equal distance in equal interval time.
Ex- Clock, Planets

★ Non - uniform motion - An object is said to be in non - uniform motion if it travels unequal distance in ~~un~~equal interval of time
Ex- Vechiles moving on road, children playing

Distance time graph



Uniform Motion



Non - Uniform

★ Speed - It is the distance travelled in per unit time

$$\text{Speed} = \frac{\text{Distance}}{\text{Time}}$$

$$V = \frac{s}{t}$$

V = speed
s = distance
t = time

SI unit = $V = \frac{s}{t}$ = m/s

* Average speed = $\frac{\text{Total distance covered}}{\text{Total time taken}}$

$V_{av} = \frac{s}{t}$

Question

A bus covers a distance of 250 Km in 5 hrs in morning and 350 km in seven hrs in evening Find its averge speed

Sol Total distance covered = 250 + 350
= 600 km

Total time taken = 5 + 7 = 12 hr

$V_{av} = \frac{s}{t} = \frac{600}{12} = 50 km/h$

$V_{av} = 50 km/h$.

Holiday Homework

1) a) Identify the kind of motion in the following cases

i) A car moving with constant speed turning around a curve.

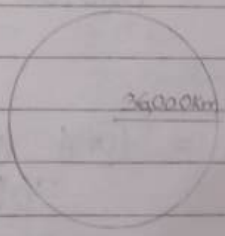
Ans Uniform Circular Motion

ii) An electron orbitting around nucleus

Ans Uniform Circular Motion

b) An artificial satellite is moving in a circular orbit of radius 36,000km calculate its speed if its takes 24 hours to revolve

Ans



Given, Radius of circular path = 36,000km

Distance = $2\pi r$

$= 2 \times \frac{22}{7} \times 36000\,km$

$= \frac{44}{7} \times 36000$

$= 6.285714 \times 36000$

Distance = $226,285.714285\,km$ approx

Time = 24 hr

Speed = $\frac{\text{Distance}}{\text{Time}}$

$V = \frac{S}{t}$

$= \frac{2,26,285.714285}{24}$

$V = 9,4285.571428\,km/hr$ approximately

2) Define average speed

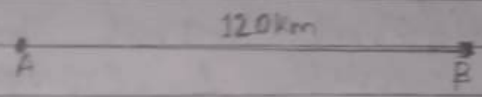
Ans 2 Average speed is defined as the total distance covered by total time taken

Average Speed = $\frac{\text{Total distance covered}}{\text{Total time taken}}$

$V_{av} = \frac{S}{t}$

b) A bus travels a distance of 120km with a speed of 40km/hr and returns with a speed of 30km/hr. Calculate the average speed for the entire journey

Ans:



Given.

Distance covered while going = 120km

Speed = 40km/hr

$$\text{Time} = \frac{\text{Distance}}{\text{Speed}}$$

$$t = \frac{120\ \text{km}}{40\ \text{km/hr}}$$

$$t = 3\text{hr}$$

Distance covered while returning = 120km

Speed = 30km/hr

$$\text{Time} = \frac{\text{Distance}}{\text{Speed}}$$

$$t = \frac{120\ \text{km}}{30\ \text{km/hr}}$$

$$t = 4\text{hr}$$

Total time taken = 3+4 = 7hr

Total distance covered = 120+120 = 240km

$$\text{Average Speed} = \frac{\text{Total Distance}}{\text{Total Time}}$$

$V_{av} = \frac{34.29}{240}$

$V_{av} = 34.29 \text{ km/hr}$ Approx.

3) Define uniform and non-uniform motion with 1 example each

Ans Uniform Motion - An object moving a equal distance in equal interval of time is said to be in uniform motion

Ex- A car moving in a straight line with constant speed.

Non Uniform Motion - An Object moving unequal distance in equal interval of time is said to be in non-uniform motion

Ex- Bird Flying

4) What does the odometer of automobile measure?

Which of the following is moving faster? Justify your answer

a) A scooter moving with a speed of 300m/min

b) A car moving with a speed of 36 km/hr

Ans An odometer is used in automobiles to find the ~~total distance~~ speed of the vechile
A car moving with the speed of 36km/hr is faster the scooter moving with the speed of 300m/min because if convert scooter's speed in km/hr it is 18Km/hr which is half of the car so car is moving faster than scooter.

5) A car travels from A stop A to stop B with the speed of 30km/hr and then returns back to A with the speed of 50km/hr. Find

a) displacement of car
b) distance travelled by car
c) Average speed of car

Ans a) Displacement is zero because car gave back to its initial point i.e. stop A

Ans b) Since distance between ~~point~~ stop A to B is not given we cannot tell the actual total distance covered but if we assume from stop A to B be d we can say that total distance will be 2d because the car move from stop A to B and then again to A.

Ans) Average speed = Total distance / Total time

Total distance = 2d

Time taken to go from Stop A to B = Distance / Speed

$$t_1 = \frac{d}{30}$$

Time taken to go from Stop B to A = Distance / Speed

$$t_2 = \frac{d}{50}$$

Total time taken = $\frac{d}{30} + \frac{d}{50}$

$$= \frac{d}{30} \times \frac{5}{5} + \frac{d}{50} \times \frac{3}{3}$$

$$= \frac{5d}{150} + \frac{3d}{150}$$

$$= \frac{8d}{150} \quad \frac{4d}{75}$$

$$= \frac{4d}{75}$$

$$V_{av} = \frac{2d}{4d/75}$$

$$= \frac{2d}{4d} \times 75 \quad 37.5$$

$$V_{av} = 37.5 \text{ km/hr}$$

6) A circular track had a circumference of 3140m with AB as one of its diameter A scooterist moves from A to B alone the circular path with uniform speed of 10m/s Find

a) distance covered by the scooterist
b) displacement of the scooterist, and
c) time taken by the scooterist in reaching from A to B

Ans) Given,
Circumference of path = ?
Speed of scooterist = 10m/s

Ans a) Distance covered = $\frac{1}{2}$ × Circumference

$= \frac{1}{2} \times 3140$

$= 1570$m

Ans b) ~~Displace~~

Ans b) Displacement = $\frac{\text{Circumference}}{\pi}$

$= \frac{3140}{3.14} \times 100$

$= 1000m$

Ans c) Time = $\frac{\text{Distance}}{\text{speed}}$

$= \frac{3140}{10} \mid \frac{1570}{157s}$

$= 314s$ or 2min 37s

7) a) Differentiate between uniform linear motion and uniform circular motion?

Ans

Uniform Circular Motion	Uniform linear Motion
1) When an object moves with a constant speed along a circular path	1) When an object moves with a constant speed along a straight path
2) Acceleration is zero	2) Acceleration change due to continues change in direction
3) Ex- Car moving along a straight line with constant speed	3) Ex- Planets orbitting around the sun

b) Write any four examples of uniform circular motion.

c) Is uniform circular motion accelerated motion

Ans: a)

Uniform Linear (Straight)	Uniform Circular
1) ~~Circular~~ Path	1) Circular Path
2) No accelaration/ zero accelaration	2) Accleration changes continously due to change in direction
3) Velocity is always same as speed	3) Constant change in Velocity
4) Ex- Car moving in a straight path with a constant speed	4) Second's hand of clock moving along with constand speed

Ans: b) 1) A satellite orbitting around the earth in a circular path

2) A car moving along a circular path ~~with~~ with a constant speed

3) Celling fan's Blades moving on a particular speed

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4) An nucleus orbitting the nucleus of atom

Ans) Uniform ~~circ~~ circular motion is an accelerated motion because the velocity changes due to change in direction

Ans)

1)

2)

3)

4)

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* Velocity - Displacement produced per unit time

$$\text{Velocity} = \frac{\text{Displacement}}{\text{Time}}$$

$$\boxed{V = \frac{s}{t}}$$

SI unit $= V = \frac{s}{t}$ m/s

$$\boxed{\text{Average Velocity} \Rightarrow \frac{v+u}{2}}$$

where,
v = final velocity
u = initial velocity

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Ans)

Speed	Velocity
1) It is distance per unit time	It is displacement produced per unit time
2) Scalar quantity	Vector quantity
3) Always positive	~~Always~~ It can be Negative Positive or Zero.
4) Always greater equal to Velocity	Never greater than Speed

2) Under what condition(s) is the magnitude of average velocity of object equal to its average speed?

Ans Only when the object moves in a straight line

3) What does the odometer of an automobile measure?

Ans Odometer tells / measures the distance travelled by the vehicle.

4) What - - - - motion?

Ans If an object is in uniform motion its speed is constant but direction may change so the path can be straight, circular, curved or zig-zag

5 During an experiment - - - 3×10^8 m/s

Sol Time = 5 minute = $5 \times 60 = 300$ sec
Speed = 3×10^8 m/s
Distance = $3 \times 10^8 \times 300$
= $900 \times 10^8 = 9 \times 10^{10}$ m

6) The - - - - - - - m/s

Ans Distance = 2400 - 2000
= 400 Km

Time = 8 hr

Speed = $\frac{D}{T}$

= $\frac{400}{8}$ 50

= 50 Km/hr

Convert into m/s

$25\cancel{50} \times \frac{5}{\cancel{18}9} = \frac{\cancel{125}}{9}$

Speed = 13.8 m/s

7) Usha swims - - - - Usha.

Ans Total distance covered = 180m

Time = 1 min × 60 = 60 sec

Speed = $\frac{\text{Distance}}{\text{Time}}$

= $\frac{3\cancel{180}\text{ m}}{\cancel{60}\text{ c}}$

= 3 m/s

Average velocity = $\frac{\text{Displacement}}{\text{Time}}$

= $\frac{0}{60}$

= 0 m/s

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★ Accleration - Rate of change of velocity is called acceleration

$a = \frac{v-u}{t}$ where, a = acceleration
u = initial velocity
v = final velocity
t = time

$S.I\ unit = a = \frac{v}{t} = \frac{m/s}{s} = m/s^2$

Intext Question

i) When will you say a body is in a) uniform acceleration? ii) non - uniform accleration?

Ans Uniform Accleration

When an object/body changes its velocity uniformly i.e. increases or decreases equally in equal interval of time

Non - Uniform Accleration

When the body changes its velocity at different rates, then it is said to be in non - uniform acceleration

9) A

Ans

3 A

Ans

2) A bus - - - - - - bus

Ans $u = 80\text{km/hr}$

$v = 60\text{km/hr}$

$t = 5\text{sec}$

$u = \frac{80^{40}}{36_{18}} \times \frac{5}{9} = \frac{200}{9}\ \text{m/s}$

$v = \frac{60}{18} \times \frac{5}{9} = \frac{150}{9}\ \text{m/s}$

$a = \frac{v-u}{t}$

$= \frac{\frac{150}{9} - \frac{200}{9}}{5}$

$= \frac{-50}{9 \times 5}$

$= \frac{-50}{45}$ or $1.\overline{1}\ \text{m/s}^2$

3 A train - - - - acceleration

Ans $u = 0$

$v = 40\text{Km/hr}$

$v = \frac{2040}{18} \times \frac{5}{9} = \frac{400}{9}$

$t = 10 \times 60$

$= 600\text{sec}$

$a = \frac{v-u}{t}$

$a = \frac{400-0}{9 \times 600}$

$a = \frac{100}{5400}$

$a = \frac{1}{54}\ \text{m/s}^2$

or 0.0185

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Equation of Motion

For a motion in uniform acceleration there are equation They are-

1) $v = u + at$
2) $s = ut + \frac{1}{2}at^2$
3) $2as = v^2 - u^2$

where, v = final velocity
u = intial velocity
s = distance
t = time
a = accleration

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Example 5: A train - - - - - - velocity

Ans $u = 0$

$v = 72 km/hr$

$= 472 \times \frac{5}{18}$

$= 20 m/s$

$t = 5 min$

$= 5 \times 60 = 300 sec$

$a = ?$

$a = \frac{v-u}{t}$

$= \frac{20-0}{300}$

$= \frac{20}{300} \frac{1}{15}$

$\boxed{a = 1/15 m/s^2}$

$s = ut + \frac{1}{2}at^2$

$= 0 \times 300 + \frac{1}{2} \times \frac{1}{15} \times 9000 \frac{3000}{6000}$

$s = 3000 m$

$2as = v^2 - u^2$

$2 \times \frac{1}{15} \times s = (20)^2 - (0)^2$

$\frac{2 \times 1}{15} \times s = 400 - 0$

$2s = 400 \times 15$

$2s = 6000$

$s = \frac{3000}{2}$

$\boxed{s = 3000m}$

Example 6: A car - - - - time.

Ans $u = 18km/hr$

$= \frac{18 \times 5}{18}$

$= 5m/s$

$v = 36 km/hr$

$= \frac{36 \times 5}{18}$

$= 10m/s$

$t = 5s$

$a = \frac{v-u}{t}$

$= \frac{10-5}{5}$

$= \frac{5}{5}$

$\boxed{a = 1m/s^2}$

$v = u + at$

$10 = 5 + a \times 5$

$10 - 5 = a \times 5$

$\frac{5}{5} = a$

$\boxed{a = 1m/s^2}$

$s = ut + \frac{1}{2}at^2$

$= 5 \times 5 + \frac{1}{2} \times 1 \times (5)^2$

$= 25 + \frac{1}{2} \times 1 \times 25$

$= 25 + \frac{1}{2} \times 25$

$\boxed{s = 37.5m}$

$2as = v^2 - u^2$

$2 \times 1 \times s = (10)^2 - (5)^2$

$2s = 100 - 25$

$s = \frac{75}{2} = 37.5$

$\boxed{s = 37.5m}$

Example: 7 The brakes - - - - - -

Ans $a = -6 m/s^2$

$v = 0$

$t = 2s$

$u = ?$

$v = u + at$

$0 = u + (-6) \times 2$

$0 = u - 12$

$0 + 12 = u$

$\boxed{u = 12m}$

$s = ut + \frac{1}{2} at^2$

$s = 12 \times 2 + \frac{1}{2} \times (-6) \times (2)^2$

$s = 24 + \frac{1}{2} \times (-6) \times 4$

$s = 24 - 12$

$\boxed{s = 12m}$

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1) A bus - - - - - - - travelled

Ans $u = 0$

$a = 0.1 m/s^2$

$t = 2 min$

$= 2 \times 60$

$= 120 s$

$v = u + at$

$= 0 + 0.1 \times (120)$

$= 12.0$

$\boxed{v = 12 m/s}$

$2as = v^2 - u^2$

$2 \times 0.1 \times s = (12)^2 - (0)^2$

$2 \times 0.1 \times s = 144 - 0$

$0.2 \times s = 144$

$s = \frac{144}{0.2} \times 10$

$\boxed{s = 720 m}$

$s = ut + \frac{1}{2} at^2$

$= 0 \times 120 + \frac{1}{2} \times 0.1 \times (120)^2$

$= \frac{1}{2} \times 0.1 \times 14400$

$\boxed{s = 720 m}$

2) A train - - - - - rest

Ans $u = 90\ km/hr \times \frac{5}{18}$

$= \frac{90}{18} \times 5$

$\boxed{u = 25\ m/s}$

$v = 0$

$a = -0.5\ m/s^2$

$2as = v^2 - u^2$

$2 \times (-0.5) \times s = (0)^2 - (25)^2$

$(-1) \times s = 0 - 625$

$s = +625 \times (-1)$

$\boxed{s = +625\ m}$

5 $v = u + at$

$0 = 25 + 0.1 \times t$

$0 - 25 = 0.1 \times t$

$\frac{-25}{0.1} = t$

$\boxed{-2.5}$

3) A trolley - - - - - - start?

Sol $a = 2\ cm/s^2$

$t = 3s$

$v = 0$

$v = u + at$

$= 0 + 2 \times 3$

$\boxed{v = 6\ cm/s}$

4) A racing - - - - - start?

Ans $a = 4 m/s^2$
$t = 10s$
$u = 0$
$v = u + at$
$= 0 + 4 \times 10$
$\boxed{v = 40 m/s}$

$2as = v^2 - u^2$
$s = \frac{v^2 - u^2}{2a}$
$s = \frac{(40)^2 - (0)^2}{2 \times 4}$
$s = \frac{1600}{8}$
$\boxed{s = 200m}$

$s = ut + \frac{1}{2}at^2$
$= 0 \times 10 + \frac{1}{2} \times 4 \times (10)^2$
$= 2 \times 100$
$\boxed{s = 200m}$

5) A stone - - - - - there?

Ans $u = 5 m/s$
$v = 0$
$a = -10 m/s^2$

$t = 2s$

$a = \frac{v - u}{t}$
$-10 = \frac{0 - 5}{t}$
$-10 = \frac{-5}{t}$

$v = u + at$
$0 = 5 + (-10) \times t$
$0 - 5 = (-10) \times t$
$\frac{-5}{-10} = t$
$\boxed{t = 0.5s}$

$$2as = (v)^2 - (u)^2$$

$$s = \frac{(0)^2 - (5)^2}{2a}$$

$$s = \frac{0 - 25}{2 \times (-10)}$$

$$s = \frac{+25}{+20}$$

$$s = \frac{5}{4}$$

$$\boxed{s = 1.25\,m}$$