Chapter – 9: Motion and Time

- Motion - straight line, circular, periodic
- Some motion – slow – other motions – fast

Slow or Fast

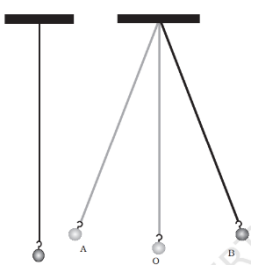
- Some vehicles – move faster than others – even same vehicle – may move faster or slower
- Vehicles moving in straight line – easy to decide – faster or slower
- Distance – travelled by an object – given time period – helps in deciding
- You went to drop off your friend – bus starts moving – you start pedaling
- After 5 minutes – distance covered by bus – much more than distance covered by you
- Faster vehicle – higher speed
- 100-metre race – easy to decide – highest speed – person – taking shortest time – highest speed

Speed

- Higher speed meaning – fixed distance in shorter time – OR – longer distance in fixed time
- Easiest way – decide speed – compare distances in given time
- Speed – distance covered by object – unit (fixed) time
- Suppose – car moving at 50 kilometers per hour – BUT – car does not move at constant speed
- Speed – increases slowly – decreases slowly
- When car moving at 50 kmph – it means – car covers 50 kilometers in 1 hour – whatever speed it moves with
- This speed – average speed – throughout the chapter
- Speed – total distance covered divided by total time taken
- Speed = $\frac{Total\ Distance\ Covered}{Total\ Time\ Taken}$

Measurement of Time

- Now a days – clocks used – older days – no clocks present – BUT – used shadows in days – approximate time
- Ancestors – noticed many events – repeat periodically (definite interval of times)
- Sun rises every day in morning – time between one sunrise and next – one day
- One new moon to next – one month
- Year – time taken by earth – complete one revolution of sun
- Often – measure time intervals – much shorter than day
- Clocks, watches – most common measuring device
- Working of clocks – much complex – BUT – all of them – use periodic motion
- Most known periodic motion – simple pendulum
- Simple pendulum – consist – small metallic ball – hanged from a stand by a thread
- Metallic ball – called as bob



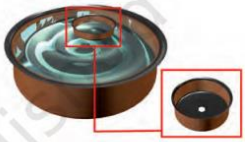
- Pendulum – 1st at rest – take the bob slightly to one side – release it – moves to and fro – this to and fro motion – oscillatory motion
- Pendulum – completes one oscillation when bob – starts from O, moves to A, moves to B, then back to O
- Time taken – complete one oscillation – time period
    - Set up simple pendulum – length of string – 1 metre
    - Switch off fans – bob comes to rest – mark it as mean position
    - Using stopwatch, table clock, wristwatch – measure time period
    - Set the pendulum in motion – move it slightly to side – release it – DO NOT PUSH
    - Record time at mean position – record time for 20 oscillations
    - Divide the time taken by 20 – obtain time for 1 oscillation – time period
- Time period – approximately same – all observations
- Now a days – most clocks – electric circuit – called quartz – much more accurate

Units of Time and Speed

- Basic unit of time – second (s) – larger units – minutes (min) and hours (h) – related to each other
- Speed = distance / time – basic unit – m / s – other units – m / min or km / h
- Symbols – all units – written in singular
- Example – 50 km is right – 50 kms is wrong
- Different units used – different needs
- Example – express age – years instead of days – express time taken to reach home from school – minutes or hours instead of years
- Time taken – saying ‘two thousand and one’ – nearly one second
- Pulse – healthy adult at rest – 72 times per minute – slightly higher for children
- Different time measuring devices – different parts of world
- Sundial, water clocks, sand clocks – different designs – different parts of world

(a) Sundial at Jantar Mantar, Delhi

(b) Sand clock



(c) Water clock

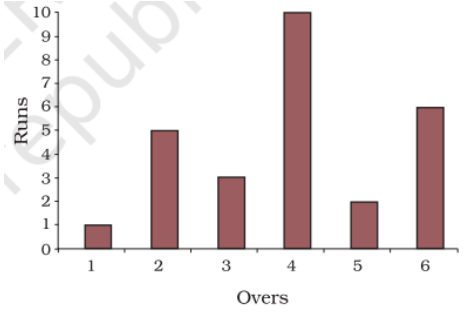
Measuring Speed

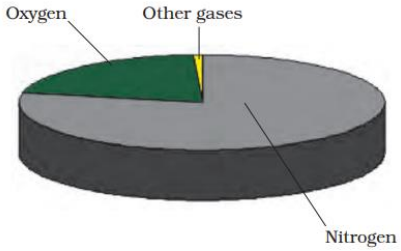
- After learning – measure time and distance – calculate speed
    - Draw straight line – ask your friend to stand 1 m away
    - Ask your friend – roll a ball slowly
    - Note the time – balls crosses the line – when it comes to rest – measure time
    - Measure distance – between line and place where ball stops
    - Calculate speed – distance / time

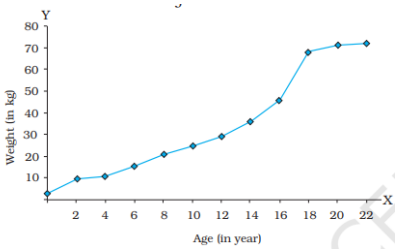
- Rockets – launching satellites – obtain speeds – 8 km / h – tortoise speed – 8 cm / s
- You know speed – calculate distance travelled in given time
- Distance – speed x time
- Lots of meters – fitted on vehicles
- One of them – represents speed in km / h – speedometer
- Another meter – measures distance – odometer
- School picnic – Paheli – noted odometer reading – every 30 minutes
- Many questions raised – how far is the picnic spot? – speed of bus? – how far till 9:45 AM?
- Teacher explained – solve this problem – distance-time graph

Distance-Time Graph

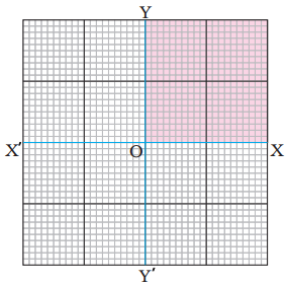
- Newspapers, magazines, various forms of graphs – makes it interesting
- Different graphs – bar graph, pie chart, line graph







- Distance-time graph – line graph
  - Take a sheet of paper – draw 2 perpendicular lines
  - Mark – horizontal line – XOX' – x-axis – vertical line – YOY' – y-axis
  - Intersection of x-axis and y-axis – O – origin
  - Both quantities – shown along these 2 axes
- Positive values of x-axis – along OX – positive values of y-axis – along OY
- This chapter – only positive values are taken – shaded portion of the graph

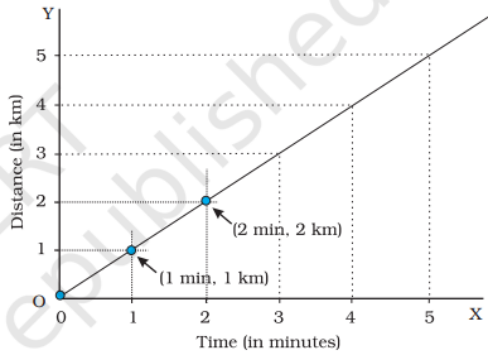


S. No.	Time (min.)	Distance (km)
1.	0	0
2.	1	1
3.	2	2
4.	3	3
5.	4	4
6.	5	5

- Steps to make a graph
  - Draw 2 perpendicular lines – OX and OY
  - Decide quantity – shown along x-axis and y-axis – this case – time along x-axis – distance along y-axis
  - Choose scale – represent time and distance
    - Time – 1 min = 1 cm
    - Distance – 1 km = 1 cm
  - Mark time and distance on axes – according to scale
  - Mark points on graph – set of values – distance, time

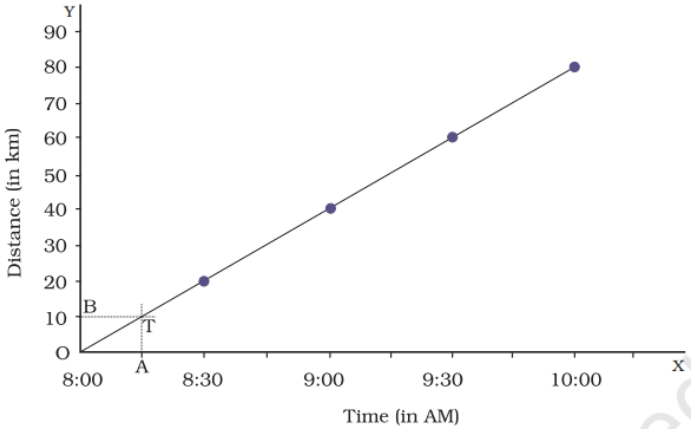
- Observation at time – 0 min – 0 km – mark at origin
- Observation at time – 1 min – 1 km – mark on graph
    - Draw line parallel to y-axis from 1 min
    - Draw line parallel to x-axis from 1 km
    - Mark the point at intersection

- Join all points – straight line – distance-time graph is ready
- This graph – straight line – indicates constant speed
- Speed changes continuously – graph – any shape



- Generally – choice of scales – not simple
- We may choose – different scales – different axes
- Example –
    - Paheli went to picnic on a bus
    - Distance covered by bus – 80 km
    - If scale taken – 1 km = 1 cm – axis – 80 cm long – not possible
    - Scale taken – 10 km = 1 cm – axis – 8 cm long

Time (AM)	Odometer reading	Distance from the starting point
8:00 AM	36540 km	0 km
8:30 AM	36560 km	20 km
9:00 AM	36580 km	40 km
9:30 AM	36600 km	60 km
10:00 AM	36620 km	80 km



- Point to remember – choosing scale –
    - Difference between highest and lowest values
    - In between values – easy to mark them
    - Utilize maximum part of graph paper
    - Example –
        - Graph paper – 25 cm x 25 cm
        - Scale chosen –
            - 5 km = 1 cm
            - 6 min = 1 cm
- Distance-time graph – provides lots of information
- Table recording distance and time – shows distance at in between times
- Distance-time graph – shows distance at any time
- Suppose – find distance at 8:15 –
    - Mark 8:15 on the graph – point A
    - Draw a line parallel to y-axis from A – intersect line graph at T
    - Draw a line parallel to x-axis from T – intersect y-axis at B
- Point B – distance travelled by bus upto 8:15 AM – 10 km