🔹 What is Motion?

🟦 Motion means change in position of an object with time.
If an object changes its position compared to a reference point, it is said to be in motion.

✅ Examples:

- Birds flying
- Cars moving
- Atoms vibrating
- Earth revolving around the Sun

🟦 **Important Note:** Motion is relative — a person inside a moving bus sees fellow passengers at rest but a person standing outside sees the whole bus moving.

🔬 **Activity 7.1:** Are walls moving or at rest?
→ Depends on reference point.

🔬 **Activity 7.2:** Train appears to move though it's still → Why?
→ The nearby train is moving; it's a relative perception.

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🔹 7.1 Describing Motion

To describe motion, we use a reference point (origin) and say how far & in which direction something is located.

🟦 Example:
School is 2 km north of the railway station → railway station is the reference point.

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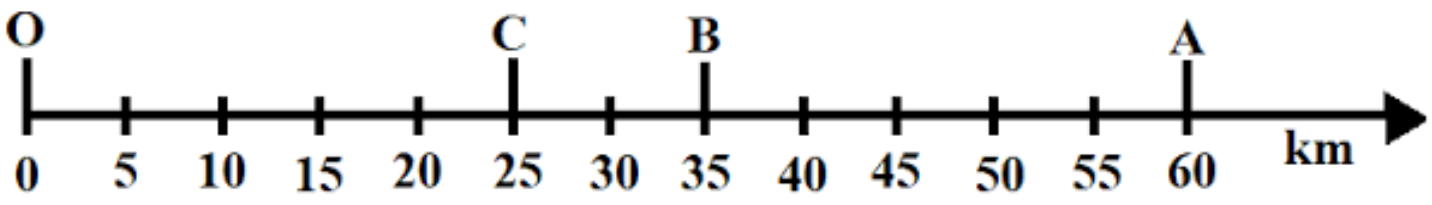
🔸 7.1.1 Motion Along a Straight Line

Motion in one direction (straight path) is the simplest type.

🟦 Distance: Total path length travelled (no direction involved).
🟦 Displacement: Shortest distance from starting to final position (includes direction).

🔬 **Activity 7.3:** Walk along basketball court sides, then measure actual straight-line distance (displacement).
→ Displacement is shorter.



📷 *Fig. 7.1: Object moving on straight line path (O → A → B → C)*

🔬 **Activity 7.4:** Car travels 1850 km → this is distance. Use map to measure displacement.

🟦 Key point:
Displacement can be zero even if distance ≠ 0.
(e.g., going from O to A and back to O → displacement = 0)

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🔸 7.1.2 Uniform & Non-uniform Motion

🟦 **Uniform Motion:**
Object covers equal distances in equal intervals of time.
(e.g., 5 m in every second)

🟦 **Non-uniform Motion:**
Object covers unequal distances in equal time intervals.
(e.g., moving in traffic)

🔬 **Activity 7.5:** Examine Table 7.1 and identify uniform/non-uniform motion.

🟦 Table 7.1 – Motion data of object A & B

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🔹 7.2 Measuring the Rate of Motion

🟦 **Speed:**
Distance travelled per unit time
Speed = Distance / Time

🟦 Units: m/s, km/h, cm/s

🟦 **Average Speed:**
= Total distance travelled / Total time taken

🟦 **Velocity:**
Speed in a given direction.
If direction changes, velocity changes even if speed is same.

🧮 Formula:
Average Velocity = (Initial velocity + Final velocity) / 2
$v_{av} = (u + v)/2$

🔬 **Activity 7.6:** Walk from home to bus stop. Estimate distance using your average speed.

🧮 Example: Usha swims 180 m in 1 min round trip →
Average Speed = 3 m/s, Average Velocity = 0 m/s (displacement = 0)

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🔹 7.3 Rate of Change of Velocity (Acceleration)

🟦 Acceleration:
Change in velocity per unit time

🧮 Formula:
a = (v - u)/t

- Positive if speed increases
- Negative if speed decreases (deceleration)

🟦 Units: m/s²

🔬 Activity 7.7: Use thunder & lightning delay to estimate distance
(Distance = speed of sound × time gap)

🧮 Example:
Rahul accelerates to 6 m/s in 30 s → a = 0.2 m/s²
Then decelerates to 4 m/s in 5 s → a = −0.4 m/s²

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🔷 7.4 Graphical Representation of Motion

Graphs show how one quantity changes with another (like speed with time).

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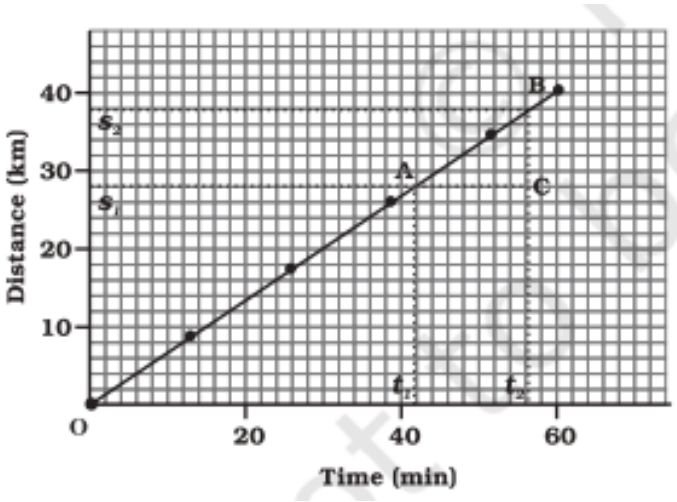
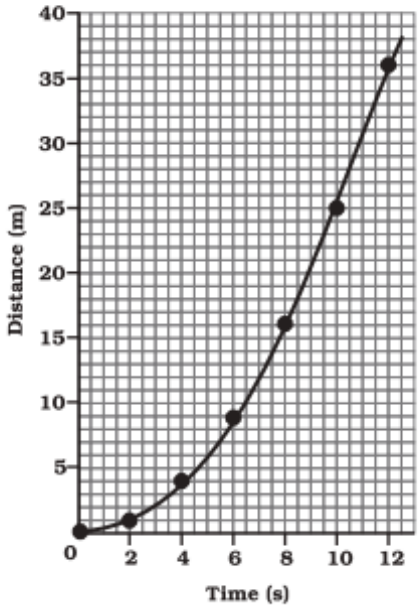
🔸 7.4.1 Distance–Time Graph

🟦 For Uniform Motion: Straight line
🟦 For Non-uniform Motion: Curved line



📷 *Fig. 7.3 – Distance-time graph for uniform motion*



📷 *Fig. 7.4 – Distance-time graph for non-uniform motion*

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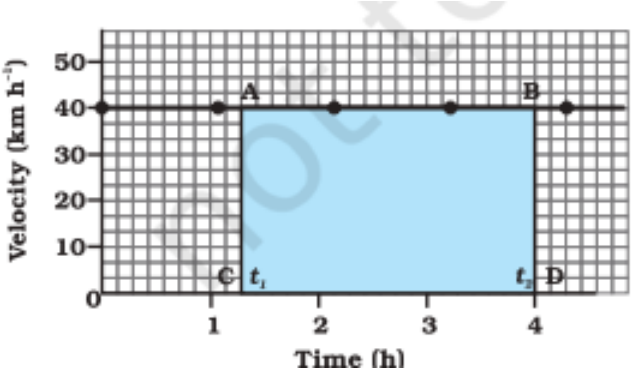
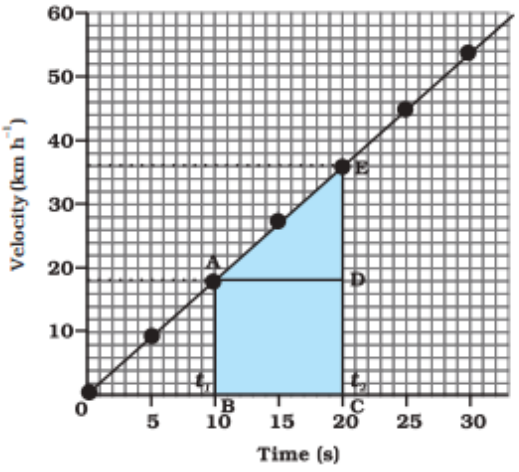
🔸 7.4.2 Velocity–Time Graph

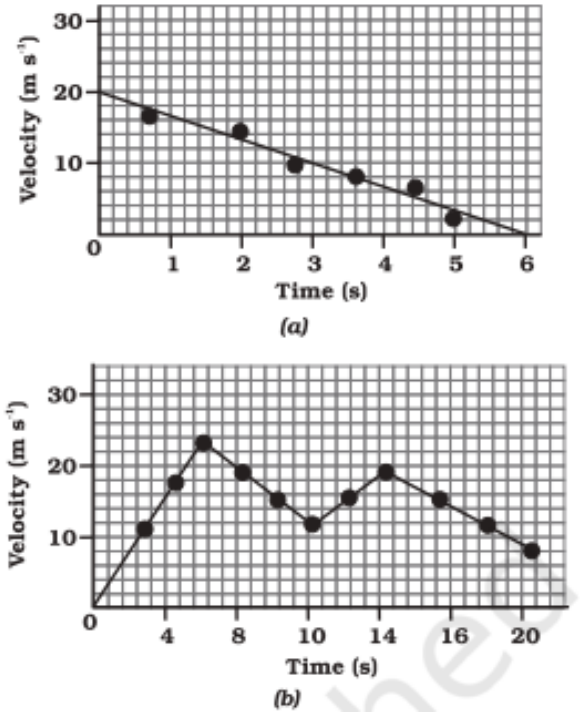
🟦 For Uniform Motion: Horizontal straight line (constant velocity)
🟦 For Uniform Acceleration: Straight inclined line
🟦 Area under graph = distance/displacement



📷 *Fig. 7.5 – Velocity-time graph for constant velocity*



📷 *Fig. 7.6 – Graph for uniform acceleration*



📷 *Fig. 7.7 – Graphs for non-uniform acceleration*

🔬 **Activity 7.9:** Plot train travel between A-B-C and interpret using distance-time graph

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🔷 7.5 Equations of Motion

For motion with uniform acceleration:

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

Where:

- u = initial velocity
- v = final velocity
- s = displacement
- a = acceleration
- t = time

🧮 Example:
Train accelerates from 0 to 72 km/h in 5 min
→ a = 1/15 m/s²
→ s = 3 km

🔬 Activity 7.10: Compare distance-time for Feroz vs Sania using graph

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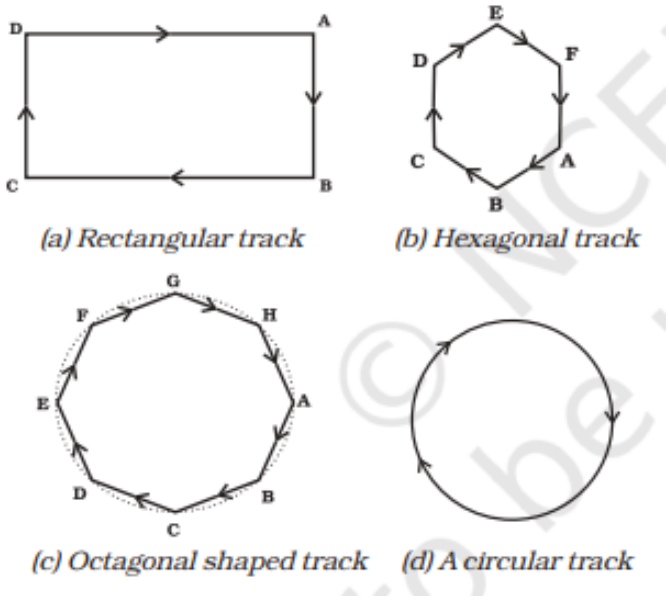
🔹 7.6 Uniform Circular Motion

🟦 **Definition:**
Motion in a circular path with constant speed but changing direction.

🟢 Even if speed is constant, direction keeps changing → acceleration exists!

🧮 Speed in a circle = (2πr)/t



📷 *Fig. 7.8 – Different shaped tracks*

🔬 **Activity 7.11:** Swing stone in circular path, release, observe it flies tangentially → direction was constantly changing during circular motion.

✅ Examples of circular motion:

- Moon revolving around Earth
- Earth orbiting Sun
- Cyclist on a circular track
- Satellites, hammer throw, etc.

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📚 **Summary – What You Have Learnt:**

- Motion = change in position with time
- Distance ≠ Displacement
- Speed is scalar, velocity is vector
- Acceleration = change in velocity/time
- Uniform motion = equal distance in equal time
- Circular motion with constant speed = accelerated motion
- Equations of motion describe uniformly accelerated motion
- Graphs help understand motion patterns