

SCIENCE • CLASS 9

CHAPTER 4

Describing Motion Around Us

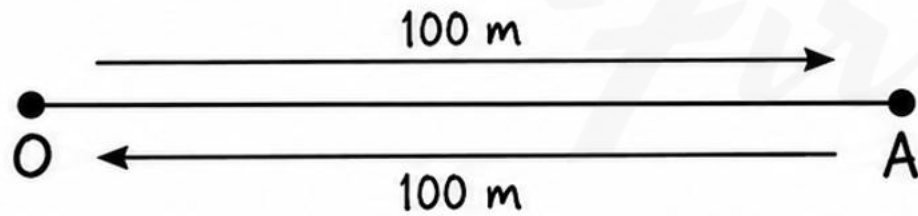
NCERT SOLUTIONS



RETURN JOURNEY AND FUEL USE

Pause and Ponder - Questions 1 and 2

Question 1: An athlete runs from O to A, 100 m away, and then returns along the same straight track. When will her displacement be zero? What will the total distance be then?



Solution:

Displacement becomes zero when she returns to her starting point O.

$$\text{Distance} = 100 \text{ m} + 100 \text{ m} = 200 \text{ m}$$

$$\text{Displacement} = 0 \text{ m}$$

Question 2: Fuel used by a vehicle depends on (i) total distance travelled or (ii) displacement. Justify.

Answer: (i) Total distance travelled.

Reason: A vehicle uses fuel throughout its journey, even when it returns to its starting point and its displacement is zero. For similar driving conditions, more distance usually needs more fuel. Actual fuel use also depends on speed, traffic and load.

A BALL ON AN INCLINED TRACK

Pause and Ponder - Question 3

Question: A ball rolls down the straight inclined track O-A-B-C-D. Is this straight-line motion? Can we represent it on a horizontal position line with O as origin? Compare total distance and displacement magnitude at A, B, C and D.

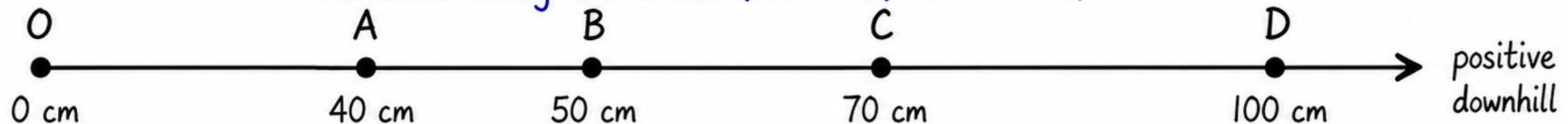
Given: OA = 40 cm, AB = 10 cm, BC = 20 cm, CD = 30 cm.

Solution: Yes. A straight path need not be horizontal. We can draw a horizontal coordinate line to represent positions along the track, taking downhill as positive. This is a representation, not a horizontal projection.

Position	Distance from O	Displacement from O
A	40 cm	+40 cm
B	50 cm	+50 cm
C	70 cm	+70 cm
D	100 cm	+100 cm

Answer: Distance equals displacement magnitude at every listed point because the ball moves in one direction without turning back.

Positions along the track (schematic; not to scale)



AVERAGE SPEED OF A ROAD TRIP

Pause and Ponder - Question 4

Question: During a family road trip, you drive 200 km north in 3 h and then 200 km south in 2 h. Find the average speed and average velocity for the entire trip.

Solution:

$$\text{Total distance} = 200 \text{ km} + 200 \text{ km} = 400 \text{ km}$$

$$\text{Total time} = 3 \text{ h} + 2 \text{ h} = 5 \text{ h}$$

$$\begin{aligned}\text{Average speed} &= \frac{\text{total distance}}{\text{total time}} \\ &= \frac{400 \text{ km}}{5 \text{ h}} = 80 \text{ km/h}\end{aligned}$$

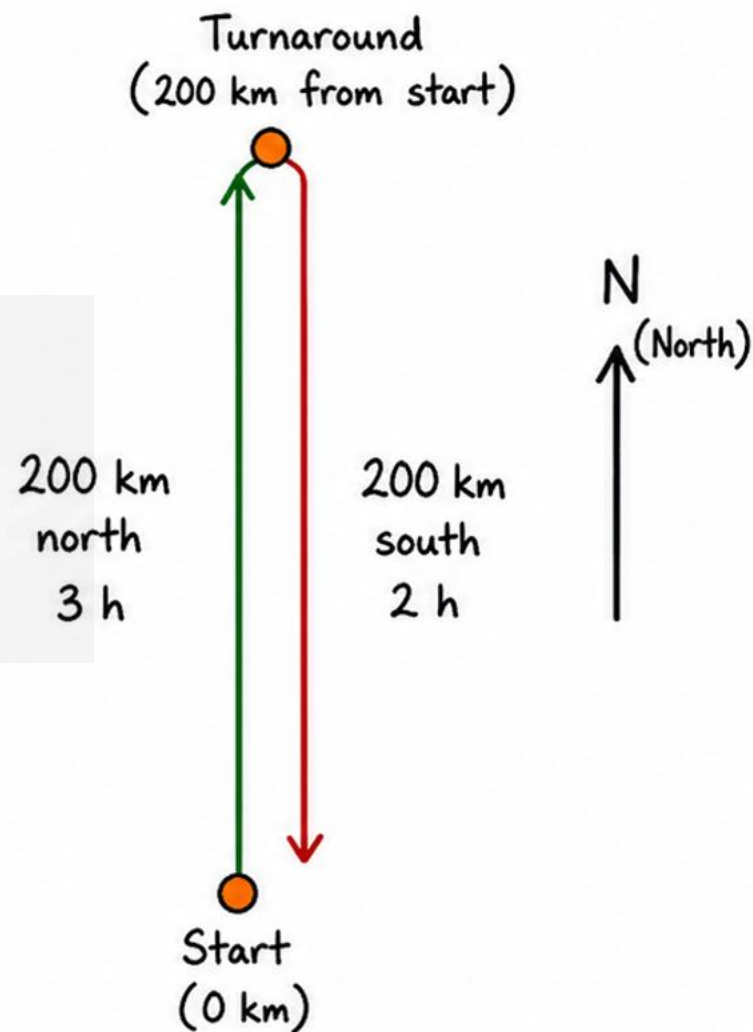
Taking north as positive:

$$\text{Displacement} = +200 \text{ km} - 200 \text{ km} = 0 \text{ km}$$

$$\begin{aligned}\text{Average velocity} &= \frac{\text{displacement}}{\text{total time}} \\ &= \frac{0 \text{ km}}{5 \text{ h}} = 0 \text{ km/h}\end{aligned}$$

Answer: Average speed = 80 km/h; average velocity = 0 km/h.

Reason: You travelled a non-zero distance but returned to the starting point.



WHEN SPEED AND VELOCITY DIFFER

Pause and Ponder - Question 5

- (i) When is the magnitude of average velocity equal to average speed?

Answer: When the object moves along a straight line without reversing direction during the time interval.



Reason: Total distance then equals displacement magnitude. Both are divided by the same time.

$$\text{Average speed} = \frac{\text{distance}}{\text{time}}$$

$$\text{Magnitude of average velocity} = \frac{\text{displacement magnitude}}{\text{time}}$$

- (ii) When is average velocity zero while average speed is not zero?

Answer: When the object moves and returns to its starting position during the time interval.



Reason: The displacement is zero, but the total distance travelled is positive.

$$\text{Average velocity} = \frac{0}{\text{time}} = 0$$

$$\text{Average speed} = \frac{\text{positive distance}}{\text{time}} > 0$$



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