HW

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MOTION

EXERCISES

1 An athlete completes one round of a circular track of diameter 200m in 40s. What will be the distance covered and the displacement at the end of 2 minutes and 20 s?

Ans Diameter of Circular Track, $2r = 200m$

Circumference of circular track $= 2\pi r$

$s = \pi(2r) = \frac{22}{7} \times 200 = \frac{4400}{7}$ m.

Time for completing one round = 40s

Time for which the athlete ran = 2 min 20s = 140s.

Distance covered by athlete in 40s = $s = \frac{4400}{7}$ m

Distance covered in 1s = $\frac{4400}{7 \times 40}$

i Distance covered by athlete in 140s = $\frac{4400}{7} \times \frac{140}{40}$

$= 2200$ m.

ii As athlete returns to initial point in 40s, displacement = 0

No. of rounds in 40s = 1

No. of rounds in 140s = $\frac{140}{40} = 3\frac{1}{2}$ rounds.

Displacement = Diameter of Circular Track = 200m.

Displacement after 140s = 200m.

2 Joseph jogs from one end A to the other end B of a straight 300m road in 2 mins 50s and then turns around and jogs 100m back to point C in

another 1 min. What are Joseph's average speeds and velocities in jogging? a - A-B ; b - A-C

Ans a. Distance covered = 300m.

Time taken = 2 min 50s = 170s.

Average speed (V_{av}) = $\frac{\text{Distance covered}}{\text{Time}} = \frac{300}{170} = 1.76 m/s$.

Average velocity (V_{av}) = $\frac{\text{Displacement}}{\text{Time}} = \frac{300}{170} = 1.76 m/s$.

b Distance covered = 300 + 100 = 400m.

Time Taken = 170 + 60 = 230s.

Average Speed (V_{av}) = $\frac{\text{Distance}}{\text{Time}} = \frac{400}{230} = 1.74 m/s$.

Average Velocity (V_{av}) = $\frac{\text{Displacement}}{\text{Time}} = \frac{200}{230} = 0.869 m/s$

#3 Abdul while driving to school computes the average speed for his trip to be 20km/h. On his return trip along the same route, there is less traffic and the average speed is 40km/h. What is the average speed for Abdul's trip?

Ans Let distance be S. Let t_1 be the time for his trip from home to school. Let t_2 be the time for his return trip.

$t_1 = \frac{S}{v_1} = \frac{S}{20} h$, and $t_2 = \frac{S}{v_2} = \frac{S}{40} h$.

Total time of trip = $T = t_1 + t_2 = \frac{S}{20} + \frac{S}{40} = \frac{3S}{40} h$.

Total Distance Covered = 2S.

Average speed (V_{av}) of Abdul = $\frac{\text{Total Distance}}{\text{Total Time}} = \frac{2S \times 40}{3S} = 26.6$ km/h

4 A motorboat starting from rest on a lake accelerates in a straight line at a constant rate of $3m/s^2$ for 8 s. How far does the boat travel during this time?

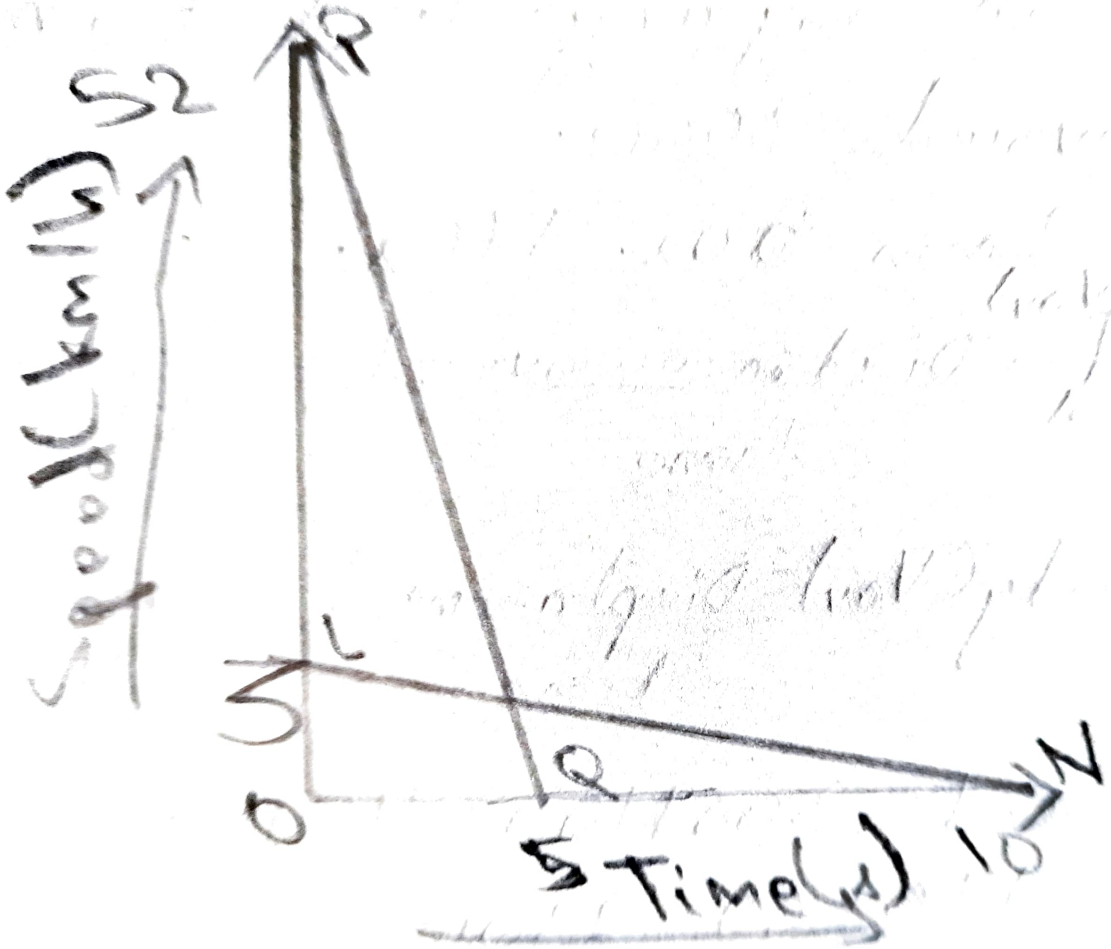
Ans Initial velocity of boat, $u = 0$.
Acceleration, $a = 3.0 m/s^2$.
Time, $t = 8$ s.
Distance covered, s = Using the relation $s = ut + \frac{1}{2}at^2$
we have, $s = 0 \times 8 + \frac{1}{2} \times 3 \times 8^2 = 96m$.

5 The driver of a car travelling at 52km/h applies the brakes and accelerates uniformly in the opposite direction. The car stops in 5s. Another driver going at 3km/h, another car applies his brakes slowly and stops in 10s. On the same graph paper, plot the speed versus time graphs for the two cars travelled farther after the brakes were applied?

Ans Refer the diagram in previous page.
i Distance covered by car moving at 52km/h
= area of $\Delta POQ = \frac{1}{2} \times POX OQ = \frac{1}{2} \times \frac{36}{10} \times 10 = 36m$.

ii Distance covered by car moving at 3km/h
= Area of $\Delta OLN = \frac{1}{2} \times LOX ON = \frac{1}{2} \times \frac{83}{100} \times 10 = \frac{83}{20} = 4.15m$.

Hence, the car moving at 52km/h travels more distance on the application of brakes.



SPEED - TIME GRAPH

a. Which of the three is travelling the fastest?

Ans Car B is travelling the fastest.

b. Are all three ever at the same point on the road?

Ans No, they are never at the same point.

c. How far has C travelled when B passes A?

Ans When Car B passes Car A, Car C has covered 6km (Approx.)

d. How far has B travelled by the time it passes C?

Ans Car B and C meet each other at point Q. Till then, B has travelled 5.7km (Approx.).

7. A ball is gently dropped from a height of 20m. If its velocity increases uniformly at the rate of 10m/s, with what velocity will it strike the ground? After what time will it strike the ground?

Ans Initial velocity of ball = $u = 0$.

Distance through which the ball falls = $s = 20$m.

Acceleration = $a = 10 m/s^2$.

$v^2 - u^2 = 2as$ or $v^2 - 0 = 2 \times 10 \times 20 = 400$ or $v = 20 m/s$

$v = u + at \Rightarrow 20 = 0 + 10 \times t$ or $t = 2s$.

8a. Shade the area on the graph that represents the distance travelled by the car during the first four seconds.

Ans During first four seconds, car is moving with non-uniform acceleration. Area of shaded portion

represents distance travelled.

b Which part of the graph represents uniform motion of the car?

Ans The straight line portion of the graph represents uniform motion of the car.