HW 2/10/21

CHAPTER-8:- MOTION

EXERCISES

Q1. An athlete completes one round of a circular track of diameter 200 m in 40s. what will be the distance covered and the displacement at the end of 2 minutes 20s?

Ans) Diameter of circular track (D) = 200m

So, Radius of circular track (r) = 200/2 = 100m

Time taken by the athlete for one round (t) = 40s

Distance covered in one round (s) = $2\pi r = 2 \times \frac{22}{7} \times 100$

Speed of the athlete (v) = $\frac{\text{Distance}}{\text{Time}}$

$= (2 \times 2200) / (7 \times 40)$

$= \frac{4400}{7 \times 40}$

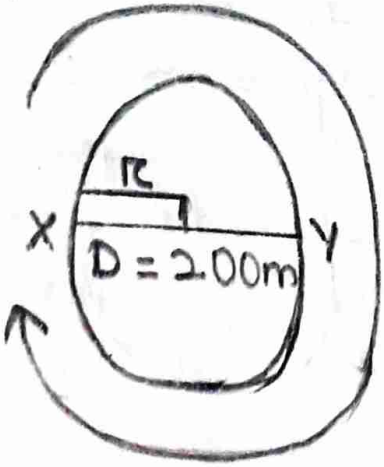
∴ Distance covered in 140s = speed (s) x Time (t)

$= 4400/(7 \times 40) \times (2 \times 60 + 20)$

$= 4400 \times 140 / 7 \times 40 = 2200$ m

Number of round in 40s = 1 round

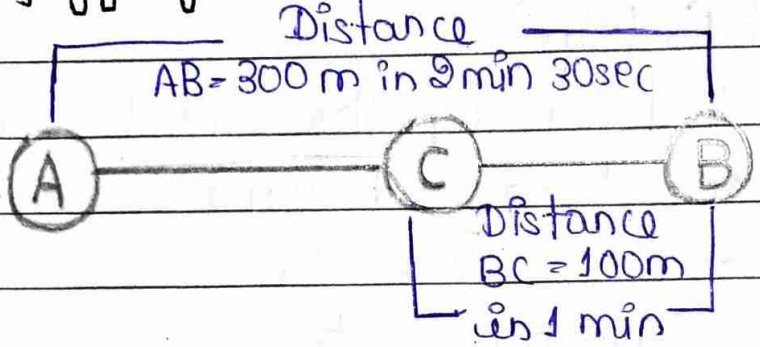
Number of round in 140s = 140/40 = $3\frac{1}{2}$



After taking start from position X, the athlete will be at position Y after $3\frac{1}{2}$ round as shown in the figure.

∴ Displacement of the athlete w.r.t initial position at x = xy = Diameter of circular track = 200m.

Q2. Joseph jogs from one end A to the other end B of a straight 300m road in 2 mins 30sec's and then turns around and jogs 100m back to point C in another 1 minute. What are Joseph's average speeds and velocities in jogging (a) from A to B and (b) from A to C?



Ans) (a) Total distance covered from A to B = 300m

Total time taken = 2×60+30s = 150s

∴ Average speed from A to B = Total distance / Total time
= 300/150 m/s = 2 m/s

∴ Velocity from A to B = Displacement AB / Time
= 300/150 m/s = 2 m/s

(b) Total distance covered from A to C = AB + BC = 300mt + 100m = 400m.

Total time taken from A to C = 150s + 60s = 210s

∴ Average speed from A to C = Total distance / Total time
= 400/210 m/s = 1.904 m/s

Displacement from A to C = 300 − 100 = 200m

Time taken for displacement from A to C = 210 s

∴ Velocity from A to C = Displacement / Time
= 200/210 m/s = 0.952 m/s

Q3. Abdu, while driving to school, computes the average speed for his trip to be 20 km/hr. On his return trip along the same route, there is less traffic and the average speed is 30 km/hr. what is the average speed for Abdu's trip?

Ans) Distance travelled to reach the school = Distance travelled to reach home = d (say)

Time taken to reach school = t_1

Time taken to reach home = t_2

So, average speed while going to school = Total ~~time taken~~ distance travelled / total time taken
= d/t_1 = 20 kmph

Average speed while going home = total distance travelled / total time taken = d/t_2 = 30 kmph

Therefore, $t_1 = d/20$ and $t_2 = d/30$

Now, the average speed for the entire trip is given by total distance travelled / total time taken
= $(d+d)/(t_1+t_2)$ kmph
= $(d+d)/(d/20 + d/30)$ kmph
= 120/5 km/hr = 24 km/hr

∴ Abdu's average speed for the entire trip is 24 km/hr.

Q4. A motorboat starting from rest on a lake accelerates in a straight line at a constant rate of $3.0 m/s^2$ for 8Os. How far does the boat travel during this time?

Ans) Given, $u = 0$, $a = 3.0 m/s^2$, $t = 8$ sec

we know that Distance, $s = ut + \frac{1}{2}at^2$

$= \frac{1}{2} \times 3 \times 8^2 = \frac{1}{2} \times 3 \times 64 = 96 m$

$= 96 m$

∴ The boat travelled 96m far during this time.

Q5. A driver of a car travelling at 52 km/hr applies the brakes and accelerates uniformly in the opposite direction. The car stops in 5s. Another driver going at 3 km/hr in 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. Which of the 2 cars travelled farther after the brakes were applied?

Ans) PR and SQ are the speed-time graph for given 2 cars with initial speeds 52 km/hr and 3 km/hr respectively.

Distance travelled by first car before coming to rest

= Area of ΔOPR

$= \frac{1}{2} \times 5s \times 52 kmph = \frac{1}{2} \times 5s \times 14.44$

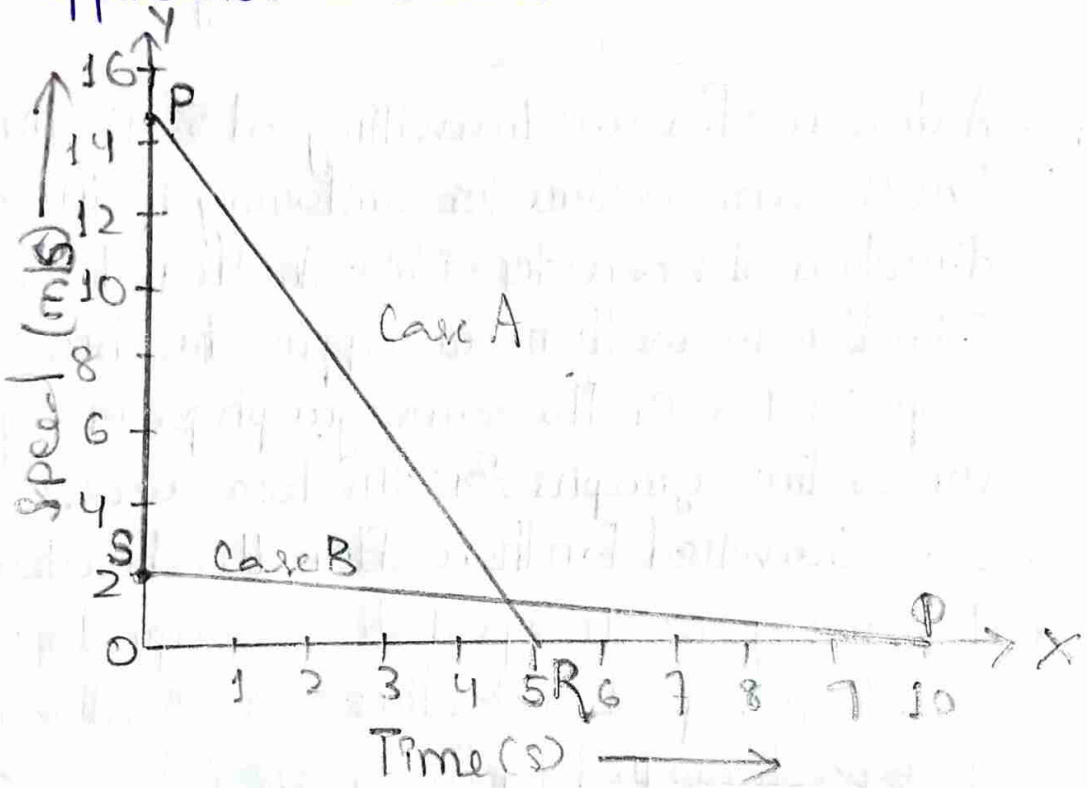
$= 36.11 m$

Distance travelled by second car before coming to rest = Area of ΔOSQ.

$= \frac{1}{2} \times 10s \times 3\ kmph = \frac{1}{2} \times 10s \times 0.83\ m/s$

$= 4.15\ m$

∴ The first car is displaced by 36m whereas the second car is displaced by 4.15m. So, the first car (which was travelling at 52 kmph) travelled farthest post the application of brakes.



Q6.(a) Which of the three is travelling the fastest?

Ans) Object B is travelling the fastest as the slope is more steepest. Speed = $\frac{\text{Distance}}{\text{Time}}$, slope of graph = $\frac{y\ axis}{x\ axis}$

∴ Speed is equal to slope of graph. = Distance/Time

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

Ans) All three objects A, B and C never meet at a single point. Thus, they were never at the same point on road

(c) How far has C travelled when B passes A?

Ans) 7 square box = 4km

∴ 1 square box = 4/7 km

C is 4 blocks away from origin therefore initial distance of C from origin = 16/7 km

Distance of C from origin when B passes A = 8 km

Thus, Distance travelled by C when B passes A = 8 - 16/7

= (56 - 16)/7 = 40/7

= 5.714 km

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

Ans) Distance travelled by B by the time it passes C = 9 square boxes

$9 \times \frac{4}{7} = \frac{36}{7} = 5.143$ km

Q7. A ball is gently dropped from a height of 20m. If its velocity increases uniformly at the rate of $10 m/s^2$ with what velocity will it strike the ground? After what time will it strike the ground?

Ans) Let, the final velocity with which ball will strike the ground be 'v' and time it takes to strike the ground be 't'

Initial velocity of ball, u = 0

Distance or height of fall, $s = 20\,m$

Downward acceleration, $a = 10\,m/s^2$

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

$\Rightarrow v^2 = 2as + u^2$

$\Rightarrow v^2 = 2 \times 10 \times 20 \times 0 = 400$

$\Rightarrow \boxed{v = 20\,m/s^2}$

$\therefore$ Time taken by the ball to strike, $v = u + at$

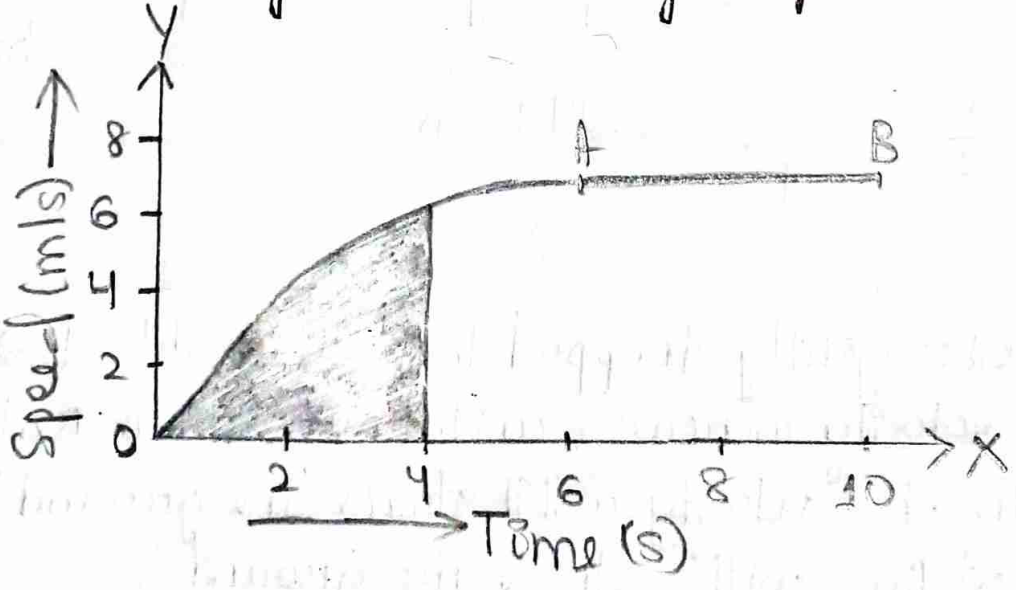
$\Rightarrow 20 = 0 + 10t$

$\Rightarrow 20 = 10t$

$\Rightarrow \boxed{t = 2s}$

Q8.(a) Find how far does the car travel in the first 4sec. Shade the area that represents the distance travelled by the car during the period.

Ans)



The shaded area which is equal to $1/2 \times 4 \times 6 = 12\,m$ represents the distance travelled by the car in the first 4s.

Date
Page 91

(b) which part of the graph represents uniform motion of the car? between time

Ans) The part of the graph AB_1 (6s to 10s) represents uniform motion of the car.