HW
1/9/21

HOME ASSIGNMENT

Exercise

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

Given, diameter of the track (d) = 200m.

Therefore circumference of the track ($\pi \cdot d$) = 200π metres.

Distance covered in 40 seconds = 200π metres.

Distance covered in 1 second = $200\pi/40$

Distance covered in 2 mins & 20 sec / 140 seconds = $140 \times \frac{200\pi}{40}$

$= \frac{20}{140} \times \frac{\cancel{200}^{5} \times 22}{\cancel{40} \times 7_{1}} = 2200$ metres.

No. of laps completed by the athelete in 140 seconds = $\frac{140}{40} = 3.5$

Therefore, the final position of the athelete (w.r.th respect to the initial position) is at the opposite end of the circular track. Therefore, the net displacement will be equal to the diameter of the track which is 200m.

Therefore the net distance covered by the athelete is 2200m and the total displacment of athelete is 200m.

2) Joseph jogs from one end A to the other end B of a straight 300m road in 2 mins 30 seconds & then turns around the jogs back to point C in another 1 minute. what are Joseph's average speeds & velocities in jogging
a) from A to B
b) from A to C.

Given, distance covered from point A to point B = 300 m
Distance covered from point A to point C = 300m + 100m = 400m
Time taken to travel from point A to point B = 2 min & 30 seconds
= 150 seconds.
Time taken to travel from point A to point C = 2 min 30 secs + 1 min
= 150 sec + 60 sec
= 210 seconds.

Displacement from A to B = 300 metres.
Displacement from A to C = 300 m - 100 m = 200 m.
Average speed = total distance travelled / total time taken.
Average velocity = total displacement / total time taken.
Therefore, the average speed while travelling from A to B
= 300/150 ms^{-1} = 2 m/s.
Average speed while travelling from A to C = 400/210 ms^{-1}
= 1.9 m/s
Average velocity while travelling from A to B = 300/150 ms^{-1}
= 2 m/s.
Average velocity while travelling from A to C = 200/210 ms^{-1}
= 0.95 m/s.

3) Abdul, while driving to school, computes the average speed for his trip to be 20 km.h^{-1}. on his return trip along the same route, there is less traffic & the average speed as 30 km.h^{-1}. what is the average speed for Abdul's trip?

Distance travelled to reach the school = distance travelled to reach home = d.

∴ Time taken to reach school = t_1

Time taken to reach home = t_2.

therefore, average speed while going to ~~school~~ school = $\frac{\text{total distance travelled}}{\text{total time taken}} = \frac{d}{t_1} = 20$ km/h

so, $t_1 = d/20$

Average speed while going home = $\frac{\text{total distance travelled}}{\text{total time taken}} = \frac{d}{t_2} = 30$ km/h

so, $t_2 = d/30$

Now the average speed for the entire trip is given by $\frac{\text{total distance}}{\text{total time taken}}$

$= \frac{(d+d)}{(t_1+t_2)}$ km/h $= \frac{d+d}{\frac{d}{20}+\frac{d}{30}}$ km/h $= \frac{120}{5}$ km/h $= 24$ km/h

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4) A motorboat starting from rest on a lake accelerates in a straight line at a constant rate of $3.0\ ms^{-2}$ for 8.0 s. How far does the boat travel during this time?

Given, initial velocity of the boat = 0 m/s.

Accⁿ = $3\ ms^{-2}$

Time = 8 s.

$s = ut + \frac{1}{2}at^2$

$\Rightarrow s = 0 \times 8 + \frac{1}{2} 3 \times (8)^2$

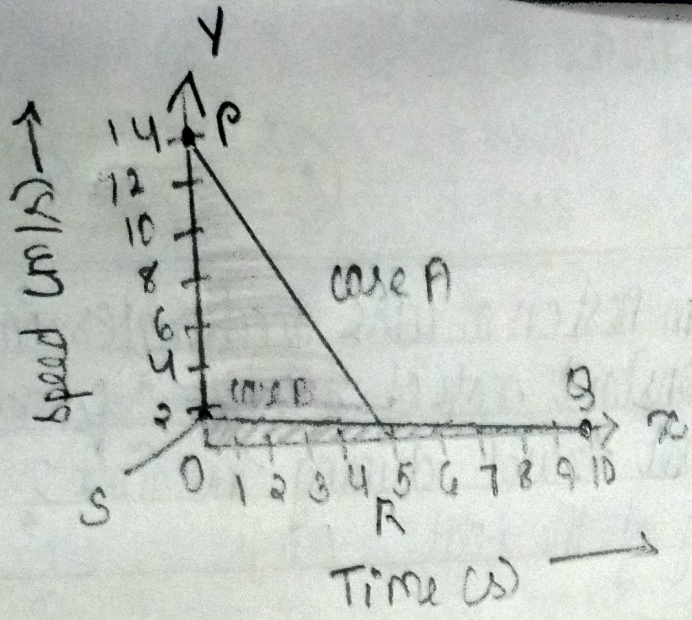
$\Rightarrow s = 0 + \frac{1}{2} \times 192^{96}$

$\Rightarrow s = 96$ metres

∴ The motor boat travelled a distance of 96 m in 8 sec.

5) A driver of a car travelling at 52 $Km.h^{-1}$ applies the brakes & accelerates uniformly in the opposite direction. The car stops in 5s. Another driver going at 3 $Km.h^{-1}$ in another car applies his brakes slowly & stops in 10s. On the same graph paper, plot the speed versus time graphs for the two cars. Which of the two cars travelled farther after the brakes were applied?

The speed v/s time graphs for the two cars can be plotted as follows:



The total displacement of each car can be obtained by calculating the area beneath the speed-time graph

Therefore, displacement of the 1st car = area of $\triangle AOB$

$$= \frac{1}{2} \times OB \times OA$$

$$52 \text{ km.h}^{-1} = 14.44 \text{ m/s}$$

So, the area of $\triangle AOB = \frac{1}{2} \times 5 \text{ seconds} \times 14.44 \text{ ms}^{-1}$

$$= 36 \text{ metres}.$$

Now the displacement of the second car is given by the area of $\triangle COD = \frac{1}{2} \times OD \times OC$

$$3 \text{ km/h} = 0.83 \text{ m/s}$$

Area of $\triangle COD = \frac{1}{2} \times 10 \text{ s} \times 0.83 \text{ m/s} = 4.15 \text{ metres}$

So the first car is displaced by 36 metres & the second car is displaced by 4.15 metres.

∴ The 1st car travelled farther after applying brakes.

Q) Fig. 8.11 shows the distance-time graph of three objects A, B & C. Study the graph & answer the following questions :

a) Which of the three is travelling the fastest ?

Speed = Distance / time

Slope of graph = y axis / x

∴ speed = slope of the graph

Since slope of object B is greater than objects A & C, it is travelling the fastest.

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

All 3 objects A, B & 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 ?

On the distance axis :

7 small boxes = 4 km

1 small box = 4/7 km.

Initially object C is 4 block away from the origin

∴ Initially distance of object C from origin = 16/7 km.

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

Distance covered by C = $8 - \frac{16}{7} = \frac{40}{7} = 5.714$ km

Hence C has travelled a distance of 5.714 km when B passes A.

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

Distance covered by B at the time it passes C = 4 boxes $= \frac{4}{7} \times 9 = \frac{36}{7} = 5.143$ km

Hence B has travelled a distance of 5.143 km when B passes A.

7) A ball is gently dropped from a height of 20m. If its velocity increases uniformly at the rate of 10 m/s², with what velocity will it strike the ground? After what time will it strike the ground?

Distance covered by the ball, $s = 20$ m.

Accln, $a = 10$ m/s²

$u = 0$

According to the third law of motion,

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

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

$$\Rightarrow v^2 = 0 + 400$$

$$\Rightarrow v = \sqrt{400}$$

$$\Rightarrow v = 20 \text{ m/s}.$$

According to the 1st eqn of motion:

$$v = u + at$$

$$\Rightarrow 20 = 0 + 10 \times t.$$

$$\Rightarrow 20 = 10t$$

$$\Rightarrow t = 2s.$$

Hence the ball strikes the ground after 2s with a velocity of 20 m/s.

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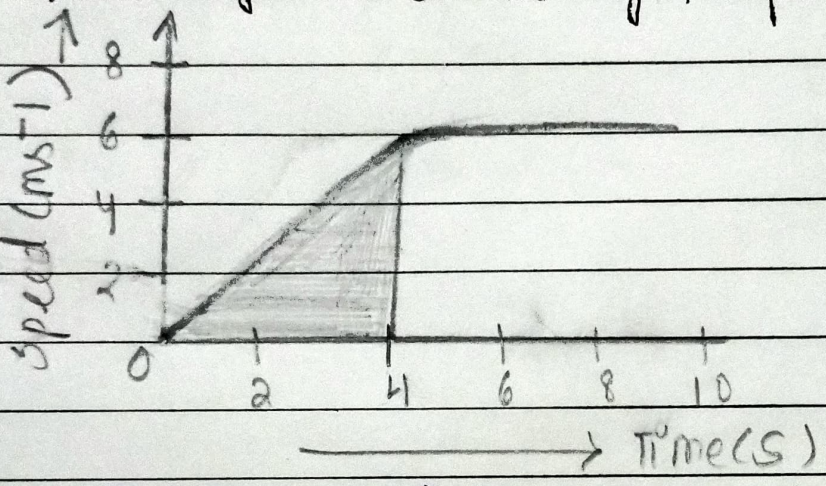
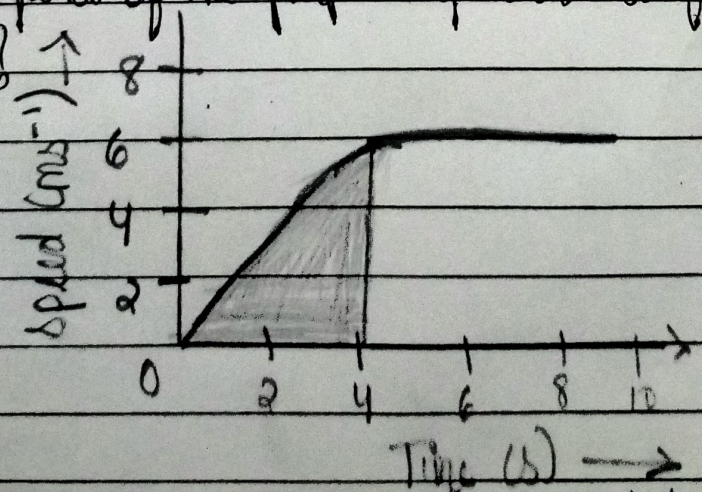
8) The speed-time graph for a car is shown in Fig. 8.12.

a) Find how far does the car travel in first 4 seconds, shade the area on the graph that represents the distance travelled by the car during the period.



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

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



The part of the graph in red colour between time 6s to 10s represents uniform motion of the car.