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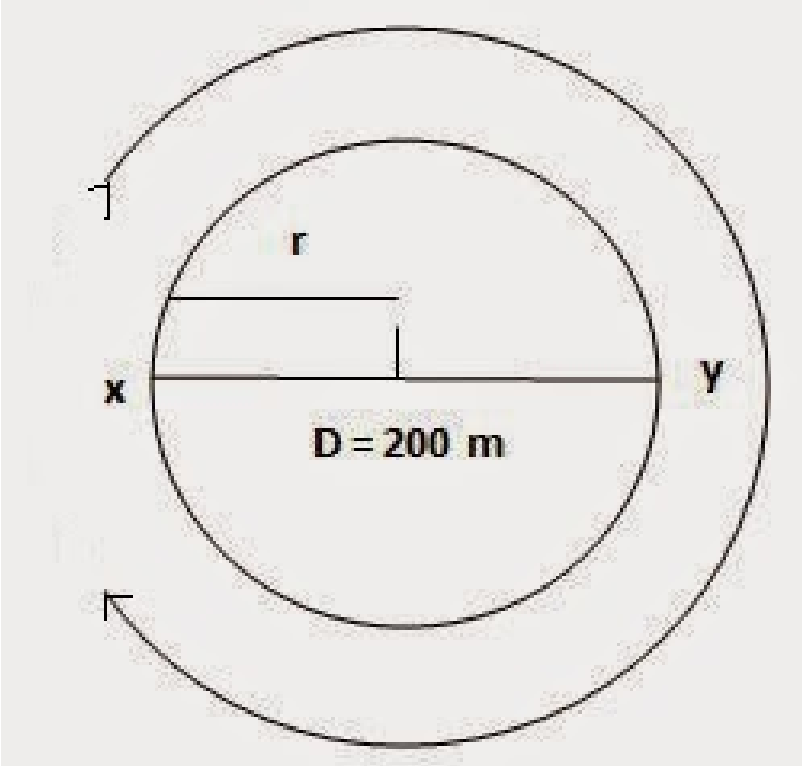
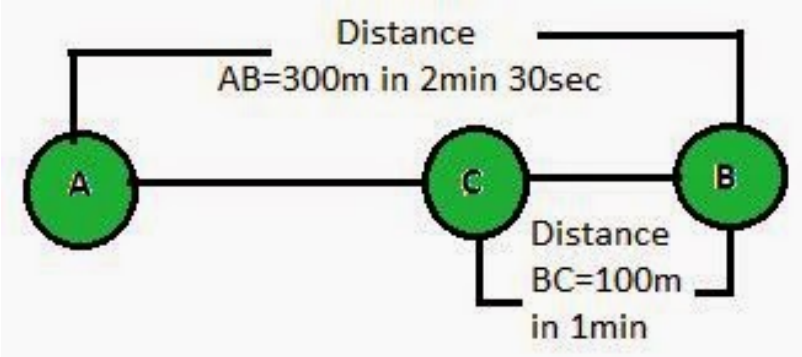
Excercise

1. An athlete completes one round of a circular track of diameter 200 m in 40 s. What will be the distance covered and the displacement at the end of 2 minutes 20 s?
Answer:
Diameter of circular track (D) = 200 m
Radius of circular track (r) = 200 / 2=100 m
Time taken by the athlete for one round (t) = 40 s
Distance covered by athlete in one round (s) = 2p r
= 2 × (22 / 7) × 100
Speed of the athlete (v) = Distance / Time
= (2 × 2200) / (7 × 40)
= 4400 / 7 × 40
Therefore, Distance covered in 140 s = Speed (s) × Time(t)
= 4400 / (7 × 40) × (2 × 60 + 20)
= 4400 / (7 × 40) × 140
= 4400 × 140 /7 × 40
= 2200 m
Number of round in 40 s =1 round
Number of round in 140 s =140/40
$=3\,^{1}/_{2}$
After taking start from position X,the athlete will be at postion Y after $3\,^{1}/_{2}$ rounds as shown in figure



Hence, Displacement of the athlete with respect to initial position at x= xy
= Diameter of circular track
= 200 m

2. Joseph jogs from one end A to the other end B of a straight 300 m road in 2 minutes 30 seconds and then turns around and jogs 100 m 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?
Answer: Total Distance covered from AB = 300 m
Total time taken = 2 × 60 + 30 s
= 150 s



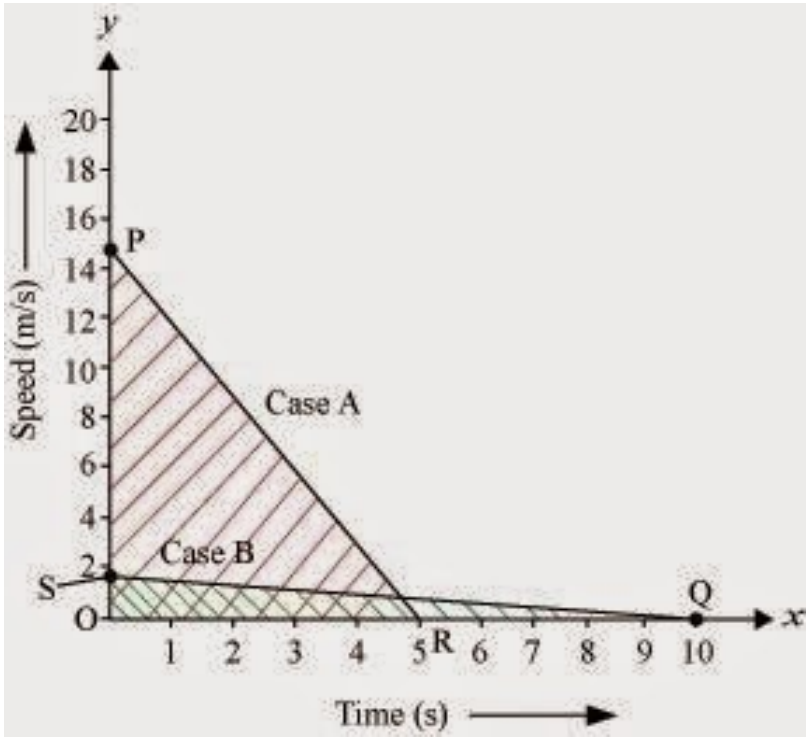
Therefore, Average Speed from AB = Total Distance / Total Time
= 300 / 150 m s^{-1}
= 2 m s^{-1}
Therefore, Velocity from AB =Displacement AB / Time = 300 / 150 m s^{-1}
= 2 m s^{-1}
Total Distance covered from AC = AB + BC
= 300 + 200 m
Total time taken from A to C = Time taken for AB + Time taken for BC
= (2 × 60 + 30) + 60 s
= 210 s
Therefore, Average Speed from AC = Total Distance /Total Time
= 400 /210 m s^{-1}
= 1.904 m s^{-1}
Displacement (S) from A to C = AB - BC
= 300-100 m
= 200 m
Time (t) taken for displacement from AC = 210 s
Therefore, Velocity from AC = Displacement (s) / Time(t)
= 200 / 210 m s^{-1}
= 0.952 m s^{-1}

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 and the average speed is 40 km h^{-1}. What is the average speed for Abdul's trip?
Answer:
The distance Abdul commutes while driving from Home to School = S
Let us assume time taken by Abdul to commutes this distance = t_1
Distance Abdul commutes while driving from School to Home = S
Let us assume time taken by Abdul to commutes this distance = t_2
Average speed from home to school v_{1av} = 20 km h_{-1}
AAverage speed from home to school v_{2av} = 20 km h_{-1}
Also we know Time taken form Home to School t_1 =S / v_{1av}
Similarly Time taken form School to Home t_2 =S/v_{2av}
Total distance from home to school and backward = 2 S
Total time taken from home to school and backward (T) = S/20 + S/30
Therefore, Average speed (V_{av}) for covering total distance (2S) = Total Distance/Total Time

= 2S / (S/20 +S/30)
= 2S / [(30S+20S)/600]
= 1200S / 50S
= 24 kmh^{-1}

4. A motorboat starting from rest on a lake accelerates in a straight line at a constant rate of 3.0 m s^{-2} for 8.0 s. How far does the boat travel during this time?
Answer: Given Initial velocity of motorboat, u = 0
Acceleration of motorboat, a = 3.0 m s^{-2}
Time under consideration, t = 8.0 s
We know that Distance, $s = ut + (1/2)at^2$
Therefore, The distance travel by motorboat = $0 \times 8 + (1/2)3.0 \times 8^2$
= (1/2) × 3 × 8 × 8 m
= 96 m

5. A driver of a car travelling at 52 km h^{-1} applies the brakes and accelerates uniformly in the opposite direction. The car stops in 5 s. Another driver going at 3 km h^{-1} in another car applies his brakes slowly and stops in 10 s. 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?
Answer: As given in the figure below PR and SQ are the Speed-time graph for given two cars with initial speeds 52 kmh^{-1} and 3 kmh^{-1} respectively.



Distance Travelled by first car before coming to rest = Area of triangle OPR
= (1/2) × OR × OP
= (1/2) × 5s × 52 kmh^{-1}
= (1/2) × 5 × (52 × 1000) / 3600) m
= (1/2) × 5 × (130 / 9) m
= 325 / 9 m
= 36.11 m
Distance Travelled by second car before coming to rest = Area of triangle OSQ
= (1/2) × OQ × OS
= (1/2) × 10 s × 3 kmh^{-1}
= (1/2) × 10 × (3 × 1000) / 3600) m
= (1/2) × 10 x (5/6) m
= 5 × (5/6) m

= 25/6 m
= 4.16 m

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