MOTION

(1) Given, diameter of the track (d) = 200m.
Therefore, circumference of the track ($\pi * d$) = 200π meters.
Distance covered in 40 secs. = 200π meters.
Distance covered in 1 sec. = $\frac{200\pi}{40}$.

Distance covered in 2 mins. & 20 secs. (140 secs.) = 140^{*}

200π / 140m. = $\frac{(140 \times 200 \times 22)}{(40 \times 7)}$ m = 2200 m.

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

Therefore, the final position of the athlete 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.

(2) Given, distance covered from Point A to Point B = 300m
Distance covered from point A to Point C = 300m + 100m = 400m.
Time taken to travel from Point A to Point B = 2 mins. & 30 secs. = 150 secs.
Time taken to travel from Point A to Point C = 2 min. 30 secs. + 1 min. = 210 secs.
Displacement from A to B = 300 m.
Displacement from A to C = 300m - 100m = 200m
Average speed = $\frac{\text{Total distance travelled}}{\text{Total time taken}}$
Average velocity = $\frac{\text{Total displacement}}{\text{Total time taken}}$
Therefore, the average speed while travelling from A to B = $\frac{300}{150}$ m/s = 1 = 2m/s.
Average speed = $\frac{400}{210}$ m/s = 1.9 m/s
Average velocity (A to B) = 2m/s.
Average velocity (A to C) = 0.95m/s.

(3) Avg. speed = $\frac{d}{t_1}$ = 20 kmph
while going
Avg. speed while going home = $\frac{d}{t_2}$ = 30 kmph.

$t_1 = \frac{d}{20}$ & $t_2 = \frac{d}{30}$.

Average speed $= \frac{(d+d) \text{ km}}{(t_1 + t_2)\text{ h}} = \frac{(d+d) \text{ km}}{\left(\frac{d}{20} + \frac{d}{30}\right)\text{ h}}$

$\frac{120}{\frac{24}{5}} \text{ kmh}^{-1} = 24 \text{ kmh}^{-1}$

Therefore, Abdul's average speed for the entire trip is 24 kmph.

(4) Given, initial velocity of the boat = 0 m/s.
Acceleration of the boat = 3 ms^{-2}
Time period = 8s
As per the 2nd motion equation, $s = ut + \frac{1}{2}at^2$.
Therefore, the total distance travelled by boat in 8 secs = $0 + \frac{1}{2}(3) \times (8)^2 = 96$m.

Therefore, the motorboat travels a distance of 96 m in a time frame of 8 secs.

(5) Displacement of the 1st car = area of $\triangle AOB$.
$= \left(\frac{1}{2}\right)(OB)(OA)$
But, OB = 5 secs. & OA = 52 kmh^{-1} = 14.44 m/s.
Therefore, the area of the $\triangle AOB$ is given by $\left(\frac{1}{2}\right) \times (5s) \times (14.44 \text{ ms}^{-1})$ = 36m.

Displacement of the 2nd car is given by the area of the ΔCOD: $= \left(\frac{1}{2}\right)(OD)(OC)$

But, $OC = 10$ secs & $OC = 3\,km/h = 0.83\,m/s$

Therefore, area of $\Delta COD = \left(\frac{1}{2}\right)(10s)(0.83ms^{-1})$.

(4.15m).

(6) (a) Since, the slope of line B is the greatest, B is travelling at the fastest speed.

(b) Since, the 3 lines don't intersect at a single point, the 3 objects never meet at the same point on the road.

(c) Since, there are 7 unit areas of the graph between 0 & 4 on the Y-axis, 1 graph unit equals $\frac{4}{7}$ km. Since, the initial point of object, C is 4 graph units away from the origin, its initial distance from the origin is $4 \times \frac{4}{7} = \frac{16}{7}$ km.

Therefore, total distance travelled by C in this time: $s = \left(\frac{16}{7}\right)$ km $= 5.71$ km.

(d) $C = \frac{9 \times 4}{7} = 5.14$ km.

(7) Given, $u = 0$

$s = 20m$

$a = 10ms^{-2}$

As per the 3rd motion equation,

Therefore,

$\Rightarrow 2 \times (10 ms^{-2}) \times (20 m) + 0$

$v^2 = 400 m^2 s^{-2}$

Therefore, $v = 20 ms^{-1}$

As per the first motion equation,

Therefore, $t = \frac{(v-u)}{a}$

$= \frac{(20-0) ms^{-1}}{10 ms^{-2}} = 2$ secs.

Therefore, the ball reaches the ground after 2 secs.

(8) (a) $\frac{1}{2} \times 4 \times 6 = 12$ meters

(b) 10^{th} sec.

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