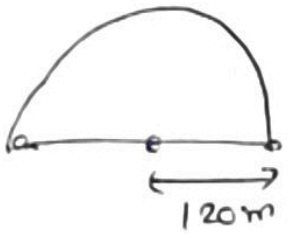
Task

WS-4

① Given The ~~etc~~ cyclist is revolving in a circular path of radius $r = 120$

Time taken for half rotation = 1 min = 60 sec.



∴ Total displacement = $2r \Rightarrow 2 \times 120$

$\Rightarrow 240$ m

∴ Average velocity = $\frac{\text{Total displacement}}{\text{Total time}}$

$= \frac{240\ m}{60\ sec} = 4\ m\ sec^{-1}$

... which drives for north with a

(2)

Given that a motorist drives for north with

a speed = 85 kmph.

in Time = 35 min = $\frac{35}{60}$ hrs

∴ His displacement s_1 = speed × time

$= 85 \times \frac{35}{60}$

$= 49.56$ km.

He then continued his journey towards north

covered a distance (d) = 130 km.

∴ Total displacement = $s_1 + d$

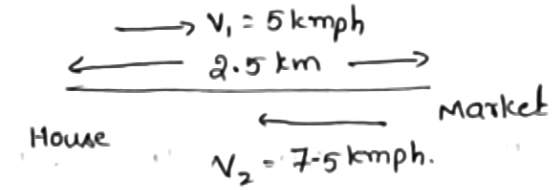
$= 49.56 + 130$

$= 179.56$ km

$\simeq 179.6$ km.

(3)

(3)



clearly the person is covering first half of the distance [House - Market] with a speed V_1 and remaining half of the distance [Market - house] with a speed V_2

$$\therefore \langle \text{speed} \rangle = \frac{2V_1V_2}{V_1+V_2}$$

$$= \frac{2\times5\times7.5}{5+7.5}$$

$$= 6 \text{ kmph} = 6\times\frac{5}{18} \text{ m/s} = \frac{5}{3} \text{ m/s}$$

(4)

Given displacement of the particle

$$x = 4t^3 - 3t + 2.$$

$$\therefore \langle \text{velocity} \rangle = \frac{dx}{dt} = \frac{d}{dt}[4t^3 - 3t + 2]$$

$$= 4\frac{d}{dt}t^3 - 3\frac{dt}{dt} + \frac{d}{dt}(2)$$

$$\left[\because \frac{d}{dx}x^n = nx^{n-1} \;;\; \frac{d}{dx}(\text{constant}) = 0\right]$$

$$\therefore \langle \text{velocity} \rangle = 4[3t^{3-1}] - 3 + 0$$

$$= 12t^2 - 3$$

At $t = 3$ sec $\Rightarrow \langle \text{velocity} \rangle = 12(3)^2 - 3$

$$= 108 - 3 = 105 \text{ m/s}$$

(6) Given in $t_1 = 4$ sec → Distance travelled $d_1 = 16$ m

$t_2 = 2$ sec → Distance travelled $d_2 = 16$ m

$$\therefore \quad \langle \text{speed} \rangle = \frac{\text{Total distance}}{\text{Total distime}}$$

$$= \frac{d_1 + d_2}{t_1 + t_2}$$

$$= \frac{16 + 16}{4 + 2} = \frac{32}{6} = 6.33 \text{ m/s}.$$

(5)

Total distance she swimmed = 180m

Total time taken = 1 min = 60sec

$$\therefore \quad \langle \text{speed} \rangle = \frac{\text{Total distance}}{\text{Total time}}$$

$$= \frac{180}{60} = 3 \text{ m/s}$$

(10)

After 2 turns around a rectangular track The runner back to his starting point.

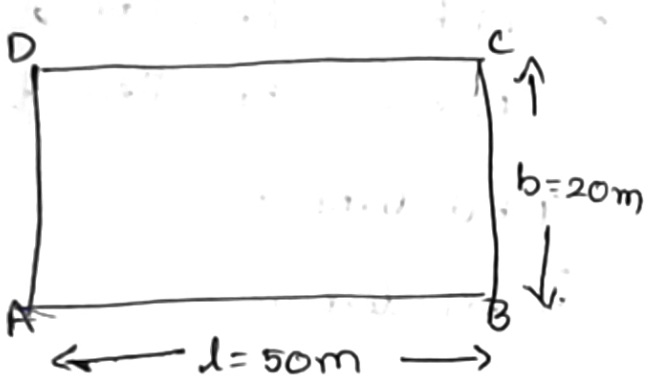
$\therefore$ Initial position = Final position

$\Rightarrow$ Displacement = Final Position − Initial position

$= 0$

$$\therefore \langle \text{velocity} \rangle = \frac{\text{Total displacement}}{\text{Total time}} = \frac{0}{100} = 0.$$

(9)



For one rotation

Total distance = circumfere

= 2 [l+b]

= 2 [50+20] = 2x

= 140 m.

For Two rotations

Total distance = 2 x 140

= 280 m.

Total time = 100 sec

$$\therefore \quad \langle \text{speed} \rangle = \frac{\text{Total distance}}{\text{Total time.}}$$

(10) $\langle \text{velocity} \rangle = 0$ $= \frac{280}{100} = 2.8 \text{ m/s}$

(11) we know that $\text{Time} = \frac{\text{distance}}{\text{speed.}}$

(2) Given for one revolution time taken = 4sec

(i) Along AB Distance = $\frac{1}{4}$ × Circumference

$= \frac{1}{4} \times 2\pi r = \frac{\pi r}{2}$

For $\frac{1}{4}^{th}$ rotation time = 1 sec

$\langle speed \rangle = \frac{T.d}{T.t} = \frac{\pi r}{2}$

(ii) Along AC (half rotation)

Distance = $\frac{1}{2}$ × Circumference

$= \frac{1}{2} \times 2\pi r = \pi r$

Time = 2 sec

$\langle speed \rangle = \frac{T.d}{T.t} = \frac{\pi r}{2}$

(iii) For one complete rotation

Distance = Circumference = $2\pi r$

Time = 4 sec

$\langle speed \rangle = \frac{T.d}{T.t} = \frac{2\pi r}{4} = \frac{\pi r}{2}$

2nd continuation

For $\frac{1}{4}$ of rotation

Displacement = $AB = \sqrt{R^2+R^2} = \sqrt{2}\,R$

$\langle \text{velocity} \rangle = \frac{\text{Total displacement}}{\text{Total time}}$

$= \frac{\sqrt{2}\,R}{T}$

(8)

(i) Speed of train = $\frac{\text{Distance}}{\text{time}} = \frac{240}{4} = 60$ kmph

(ii) Speed of car = $\frac{120}{3} = 40$ kmph

(iii) Speed of bus = $\frac{3\text{ km}}{\frac{1}{2}\text{ hr}} = 6$ kmph

Total distance travelled = 240 km + 120 km + 3 km

= 363 km

Total time = 4 hr + 3 hr + $\frac{1}{2}$ hr = 7.5 hr

$\langle \text{speed} \rangle = \frac{\text{T.d}}{\text{T.t}} = \frac{363}{7.5} = 48.4$ kmph

T bayk

(4)

According to given data

Nithin cover 300m in 15sec. where as Jathin cover 600m in 1min → 60sec

Speed of Nithin = $\frac{300}{15}$ = 20 m/s

Speed of Jathin = $\frac{600}{60}$ = 10 m/s

∴ Nithin win race

(5)

(a) Given athlet speed = 10 m/s

(b) bicycle speed = 20m/min = $\frac{20}{60} = \frac{1}{3}$ = 0.33 m/s

(c) scooter speed = 30 kmph = $30 \times \frac{5}{18}$ m/s = 8.33 m/s

a > c > b.

(7)

For $x = x_1 \rightarrow v_1$ $\quad x_2 \xrightarrow{\text{speed}} v_2$

$$\langle \text{speed} \rangle = \frac{\text{Total distance}}{\text{Total time}}$$

T.d $= x_1 + x_2$; Total time $= t_1 + t_2$

$$= \frac{x_1}{v_1} + \frac{x_2}{v_2}$$

$$\langle \text{speed} \rangle = \frac{x_1 + x_2}{\frac{x_1}{v_1} + \frac{x_2}{v_2}}$$

(a) $x = 20\%$ $\quad x_1 = \frac{20}{100} = \frac{1}{5}x$ $\quad x_2 = 100 - x\,\% = 80\% = \frac{4}{5}x$

$$\langle \text{speed} \rangle = \frac{\frac{x}{5} + \frac{4x}{5}}{\frac{x}{5v_1} + \frac{4x}{5v_2}} = \frac{5v_1v_2}{v_2 + 4v_1} = \frac{10v_1v_2}{2v_2 + 8v_1}$$

(b) $x = 30\% \Rightarrow x_1 = \frac{30}{100}x = \frac{3}{10}x$; $x_2 = 100 - x = 70\%$.

$x_2 = \frac{70}{100}x = \frac{7}{10}x$

$$\langle \text{speed} \rangle = \frac{x}{\frac{3x}{10v_1} + \frac{7x}{10v_2}} \Rightarrow \frac{10v_1v_2}{3v_2 + 7v_1}$$

(c) $x = 40\% \Rightarrow x_1 = \frac{40}{100}x = \frac{2}{5}x$; $x_2 = (100 - x)\% = \frac{60}{100}x = \frac{3}{5}x$

$$\langle \text{speed} \rangle = \frac{x}{\frac{2x}{5v_1} + \frac{3x}{5v_2}} = \frac{5v_1v_2}{2v_2 + 3v_1}$$

(d) $x = 50\% \Rightarrow x_1 = 50\%\,x = \frac{1}{2}x$ $\quad x_2 = (100 - 50)\% = \frac{x}{2}$

$$\langle \text{speed} \rangle = \frac{x}{\frac{x}{2v_1} + \frac{x}{2v_2}} = \frac{2v_1v_2}{v_2 + v_1}$$

$$\text{Time} = \frac{\text{Total distance}}{\text{Average speed}} = \frac{300\ \text{km}}{60} = 5\ \text{hrs}$$

L Task

CUQ's

(6) The total distance covered by ant is = 2 cm + 1.5 cm + 2.5 cm + 3 cm

= 9 cm

The total time taken = 1 + 1 + 1 + 1 = 4 sec.

$$\text{< speed >} = \frac{\text{Total distance}}{\text{Total time}} = \frac{9}{4} = 2.25\ \text{cm/sec}$$

$$= 2.25 \times 10^{-2}\ \text{m/s}$$

(9) Given radius of circular path = 200 m

Time taken for half revolution = 5 min = 5 × 60 = 300 sec

$$\text{< speed >} = \frac{\text{Total distance}}{\text{Total time}} = \frac{\pi r}{300}$$

$$= \frac{22}{7} \times \frac{200}{300} = \frac{44}{7 \times 3} = \frac{44}{21}\ \text{m/s}$$

The distance covered for half rotation = $\frac{1}{2}$ (circumference)

$$= \frac{1}{2} \times 2\pi r = \pi r$$

SAQ's

(1) Given in a time $t_1 = 2$ sec, An object moves of $S_1 = 10$ m

$$\langle \text{velocity} \rangle = \frac{S_1}{t_1} = \frac{10}{2} = 5 \text{ m/s}$$

in a time $t_2 = 8$ sec, Distance covered $S_2 = 20$ m

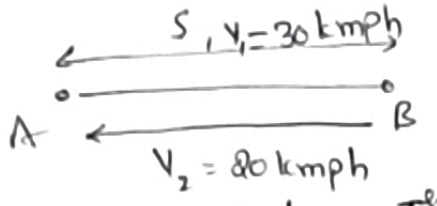
$$\langle \text{velocity} \rangle = \frac{S_2}{t_2} = \frac{20}{8} = 2.5 \text{ m/s}$$

Total distance covered $= S_1 + S_2 = 10 + 20 = 30$ m

Total time taken $= t_1 + t_2 = 2 + 8 = 10$ sec

$$\langle \text{velocity} \rangle = \frac{\text{Total distance}}{\text{Total time}} = \frac{30 \text{ m}}{10 \text{ sec}} = 3 \text{ m}$$

(2)

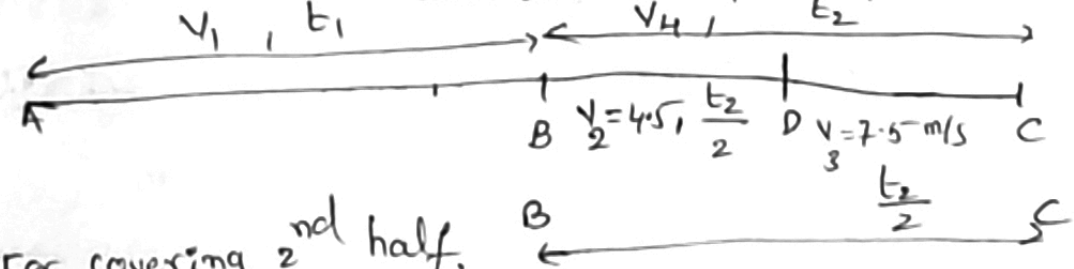


For the entire Journey of motor cyclist, 1st half [A→B] is covered with a speed V_1, 2nd half [B→A] is covered with a speed V_2.

$$\langle \text{speed} \rangle = \frac{2V_1V_2}{V_1 + V_2} = \frac{2 \times 30 \times 20}{30 + 20}$$

$$= \frac{2 \times 30^{6} \times 20}{\cancel{50}} = 24 \text{ kmph}$$

(3) Given that the first half of the distance is covered with a speed $V_1 = 3$ m/s



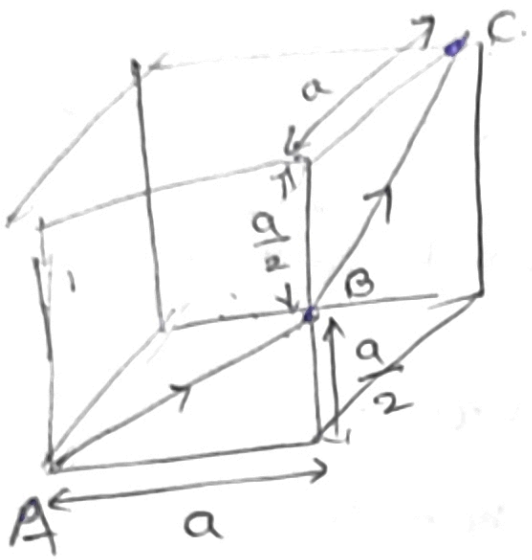
For covering 2nd half of the distance, the effective velocity becomes

$$V_4 = \frac{V_2 + V_3}{2} = \frac{4.5 + 7}{2}$$

For Total Journey $V_4 = \frac{12}{2} = 6$ m/s

$$\therefore \langle \text{velocity} \rangle = \frac{2V_1V_4}{V_1 + V_4} = \frac{2 \times 3 \times 6}{3 + 6} = \frac{4}{\cancel{12} \times \cancel{6}} = 4 \text{ m/s}$$

(4)



The shortest distance (or) minimum distance covered by the ant to reach diagonally opposite corner is AC

From Fig $AC = AB + BC$

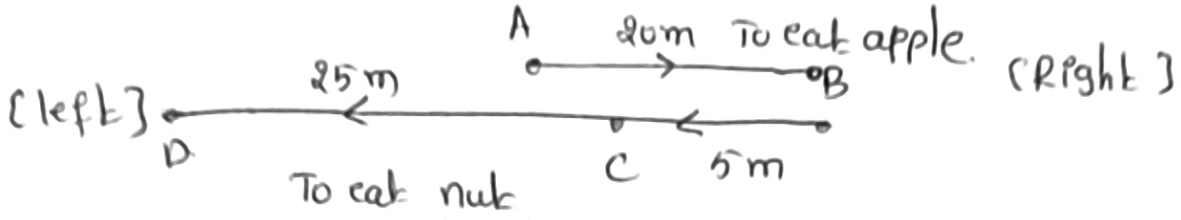
$$= \sqrt{a^2 + \left(\frac{a}{2}\right)^2} + \sqrt{a^2 + \left(\frac{a}{2}\right)^2}$$

$$\Rightarrow 2\sqrt{a^2 + \left(\frac{a}{2}\right)^2} = 2\sqrt{a^2 + \frac{a^2}{4}}$$

$$\Rightarrow 2\sqrt{\frac{5a^2}{4}} = 2\frac{\sqrt{5}a}{2} = \sqrt{5}a$$

(5)

Direction of motion of Pig



Total distance travelled = 20 + 5 + 25

= 50 m

Total time taken = 300 sec

Total Displacement = shortest distance between final and initial position.

= D − A

⇒ ~~25 − 5~~

= 30 − 20

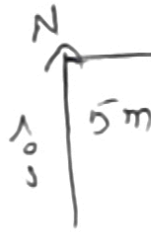
= 10 m

(6)

$$\langle \text{velocity} \rangle = \frac{\text{Total displacement}}{\text{Total time}} = \frac{10}{300} = 0.033 \text{ m/s}$$

$$\langle \text{speed} \rangle = \frac{\text{Total distance}}{\text{Total time}} = \frac{50}{300} = \frac{1}{6} \text{ m/s}$$

(7) The directions of motion of a body are represented as shown below



$\therefore$ The Displacement = vector form = $4\hat{i} + 5\hat{j}$ m

$\therefore$ |Displacement| = $\sqrt{4^2+5^2} = \sqrt{41} = 6.4$ m

(8)

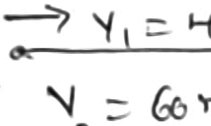
Total distance travelled = 100 m

Time taken = 14.4 sec.

$$\langle \text{velocity} \rangle = \frac{\text{Total distance}}{\text{Time taken}} = \frac{100}{14.4} = 6.94$$

(9) Here the Body travels total distance = 2(AB)

The Ist half of the distance [A→B] is covered with speed 40 m/s and 2nd half of the distance [B→A] covered with a speed of 60 m/s



$$\langle \text{speed} \rangle = \frac{\text{Total distance}}{\text{Total time}}$$

$$\langle \text{speed} \rangle = \frac{2v_1v_2}{v_1+v_2} = \frac{2\times40\times60}{40+60} = \frac{80\times60}{100} = 48 \text{ m/s}$$

Advanced

LTask

(1)

Total distance covered = 3 km = 3×10^3 m = 3×10^5 cm

time = 5 min = $5 \times 60 = 300$ sec

hr) = $\frac{5}{60} = \frac{1}{12}$ hrs

(a) speed = $\frac{d}{t} = \frac{3 \times 10^5 \text{ cm}}{300} = 1000$ cm/sec

(b) speed = $\frac{3000}{300} = 10$ m/s ($1 \text{ m/s} = \frac{18}{5}$ kmph)

(c) speed = $10 \times \frac{18}{5}$ kmph = 36 kmph

(2)

$v_{car} = 45$ kmph = $\frac{45 \times 10^3}{60}$ $\frac{\text{km}}{\text{min}}$

(a) $t = 1$ hr → Distance = $v \times t = 45 \times 1 = 45$ km

(b) $t = 1$ min → $D = \frac{45 \times 10^3}{60} = 750$ m/min

(c) 45 kmph = $45 \times \frac{5}{18}$ m/s = 12.5 m/s

(3)

$r = 7\,m$: time = 2sec.

half rotation Distance $= \frac{1}{2}(2\pi r)$

$= \frac{22}{7} \times 7 = 22\,m$

Displacement $= 2r = 2 \times 7 = 14\,m$

speed $= \frac{\text{distance}}{\text{time}} = \frac{22}{2} = 11\ m/s$

velocity $= \frac{\text{Displacm}}{\text{time}} = \frac{14}{2} = 7\ m/s$

(7)

Given car taken T sec to complete $\frac{1}{4}$ rotat

For Full rotation = 4T sec

For half rotation = 2T sec.

For one rotation: Displacement = 0

$\langle \text{velocity} \rangle = \frac{\text{Displacem}}{\text{time}} = \frac{0}{T} = 0$

Total distance = Circumference of a circle

$= 2\pi R.$

$\langle \text{speed} \rangle = \frac{2\pi R}{4T} = \frac{\pi R}{2T}$

For half rotation Displacement $= 2R$

$\langle \text{velocity} \rangle = \frac{\text{Displacem}}{\text{time}} = \frac{2R}{2T} = \frac{R}{T}$