# EXERCISE SOLUTION

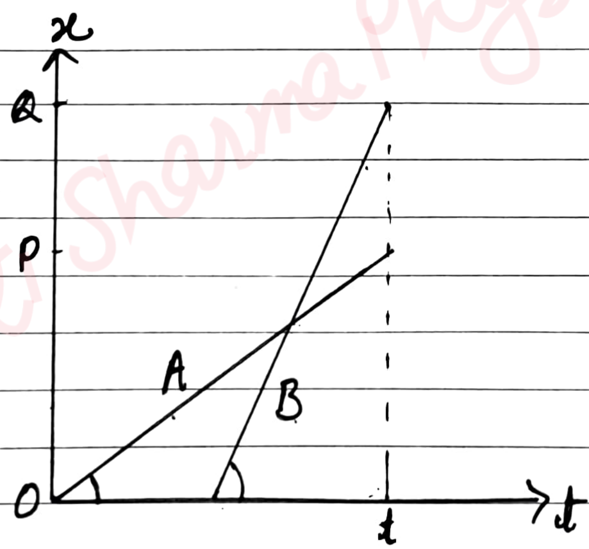
1(a) Yes, because the size of railway carriage is very small as compared to the distance between two stations.

(b) Yes, because monkey is very small as compared to the circular track.

(c) No, because turning of ball is not smooth. Thus the distance covered by the ball is not large enough to consider the ball as a point object.

(d) No, because the distance covered by the tumbling beaker is not much larger.

2.




(a) Because $OP < OQ$, hence <u>A</u> lives closer to school than <u>B</u>

(b) When $x = 0$, $t = 0$ for A but for B, $t$ has some non-zero value. Therefore

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Topic.............................................Date..................



A starts from the school earlier than B.

(c) Slope of graph for B > slope for A. Therefore speed of B > speed of A. i.e.
B walks faster than A

(d) Since 't' is same for both A and B for P and Q position, we can see.
A and B reach home at the same time.

(e) $x-t$ graph for A and B intersect only once. Hence
B overtakes A on the road once.

3. Time taken by woman to reach the office

$$= \frac{\text{distance}}{\text{speed}} = \frac{s}{v}$$

$$= \frac{2.5}{5} = \frac{1}{2} \text{ hr} = 30 \text{ min}$$

Therefore she reaches the office at 9.30 a.m.
She stays at the office between 9.30 to 5.00 pm
Now
time taken for the return journey

$$= \frac{\text{distance}}{\text{speed}}$$

$$= \frac{2.5}{25} = \frac{1}{10} \text{ hr} = 6 \text{ min.}$$

Hence she reaches at home at 5.06 p.m

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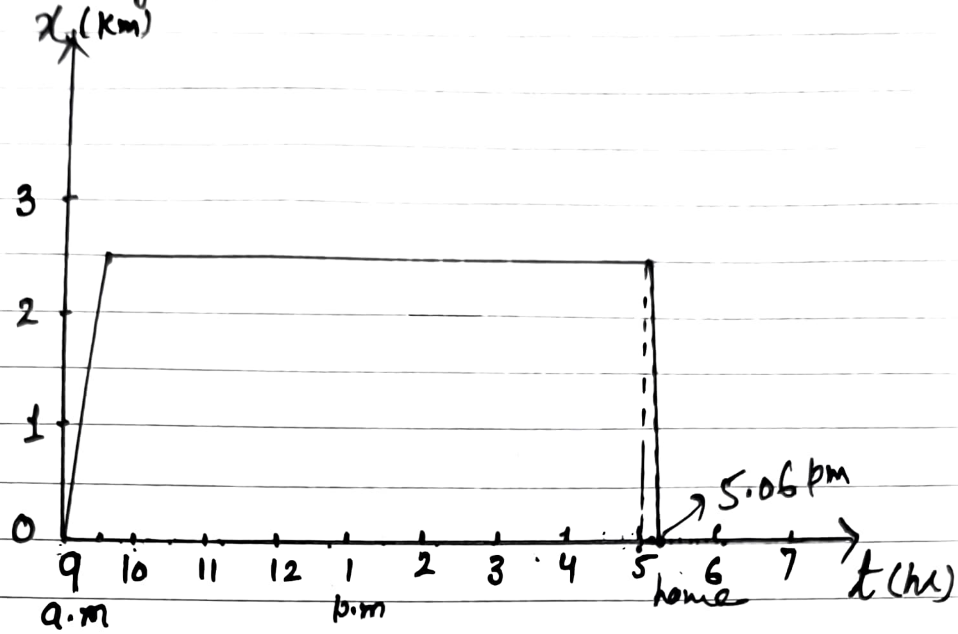
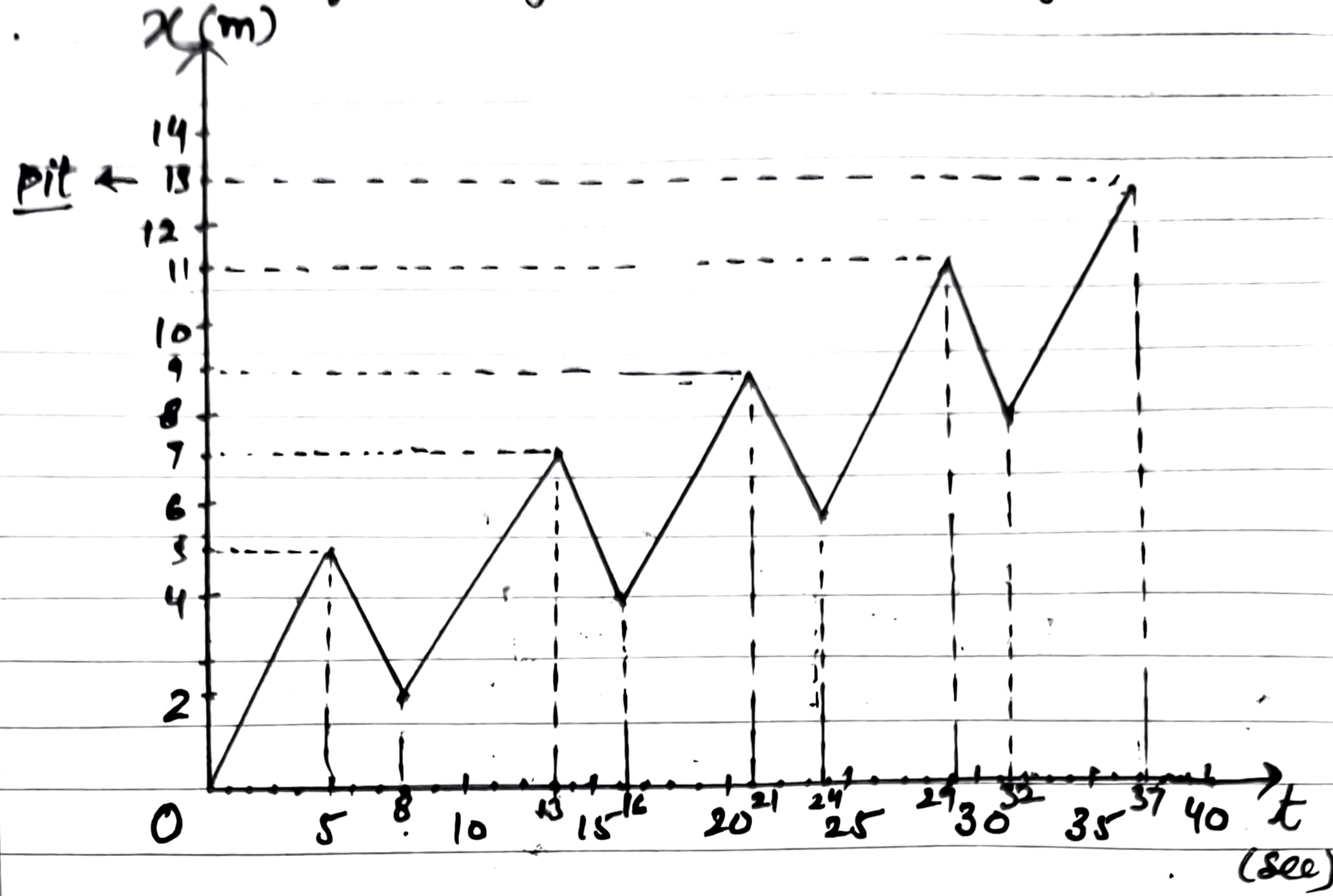
The x-t graph for the woman's motion




4. The drunkard takes 5 steps forward and 3 steps backward and so on.
Each step is 1 m long and requires time 1 sec.
So,
time taken to travel 2 m = 8 sec.
∴ time taken to travel 8 m = $\frac{8}{2} \times 8 = 32$ sec.

In the last 5 sec man will cover 5 steps. i.e the distance = 13 m (= 8+5) m
and time taken to cover 13 m = 32 + 5
= 37 sec.
Hence man will take 37 sec to fall into a pit 13 m away.

The x - t graph for the motion of drunkard



2.5 (New book)

Topic ........ Date ........ 

3.6 Initial speed of the car $u = 126$ KmH

$$= \frac{126 \times 1000}{60 \times 60} \text{ m/s}$$

$$= 126 \times \frac{5}{18}$$

$$= 7 \times 5$$

$$u = 35 \text{ m/s}$$

Final speed $v = 0$

distance covered $s = 200$ m

use

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

$$(0)^2 - (35)^2 = 2 \times a \times 200$$

or $$a = -\frac{(35)^2}{2 \times 200} = \frac{-1225}{400}$$

$$= -3.06 \text{ m/s}^2$$ Ans

Now we use

$$v = u + at$$

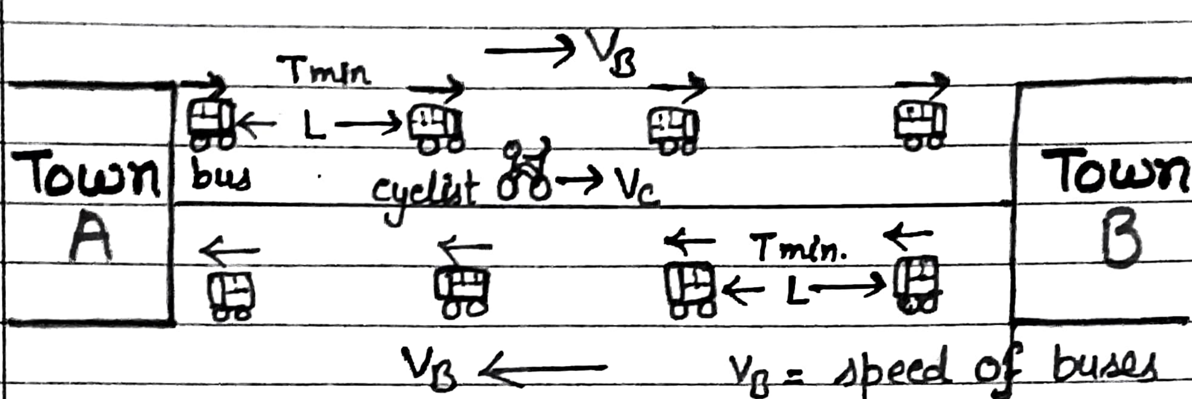
$$0 = 35 - 3.06 \times t$$

or $$t = \frac{35}{3.06} = 11.4 \text{ sec}$$

Ans

3.9 × (not in new book)

## NCERT Exercise




$V_B$ = speed of buses

$V_c$ = speed of cyclist

Let the speed of bus $= V_B$

Distance travelled by bus in T min $= L$

Speed of cyclist $V_c = 20$ km/h

For the buses leaving from town A

$$L = V_B \times \frac{T}{60} \text{ Km} \qquad \left[\because T \text{ min} = \frac{T}{60} \text{ hrs}\right]$$

w.r. to cyclist

$$L = (V_{BC}) \times \frac{18}{60} \qquad [V_{BC} = \text{Relative speed of bus w.r. to cyclist}]$$

or $$L = (V_B - V_c) \times \frac{18}{60} \quad -(1) \qquad [V_B \text{ and } V_c \text{ have same direction}]$$

For the buses leaving from town B

$$L = V_B \times \frac{T}{60}$$

w.r. to cyclist

$$L = V_{BC} \times \frac{6}{60}$$

$$L = (V_B + V_c) \times \frac{6}{60} \quad -(2) \qquad [V_B \text{ and } V_c \text{ have opposite direction}]$$

Topic........ Date........

From eq$^n$ (1) and (2)

$$(V_B - V_c)\frac{\cancel{18}^{3}}{60} = (V_B + V_c)\frac{\cancel{6}}{\cancel{60}}$$

or $3(V_B - V_c) = V_B + V_c$

or $3V_B - V_B = 3V_c + V_c$

or $2V_B = 4V_c$

or $V_B = 2V_c$

$= 2 \times 20$ $\quad [\because V_c = 20\ km/h]$

$V_B = 40\ km/h$ Ans

Now put the value of $V_B$ in relation

$\cancel{L = V_B \times 18}$

$$L = (V_B - V_c) \times \frac{18}{60} \quad [eq^n (1)]$$

$$L = (40-20) \times \frac{18}{60} = \frac{\cancel{20} \times \cancel{18}^{6}}{\cancel{60}_{3}}$$

or $L = 6\ km$

Now by using $L = V_B \times \frac{T}{60}$

$$T = \frac{60 \times L}{V_B} = \frac{60 \times 6}{40}$$

$T = 9$ min

Ans

Topic.................................................. Date..............................

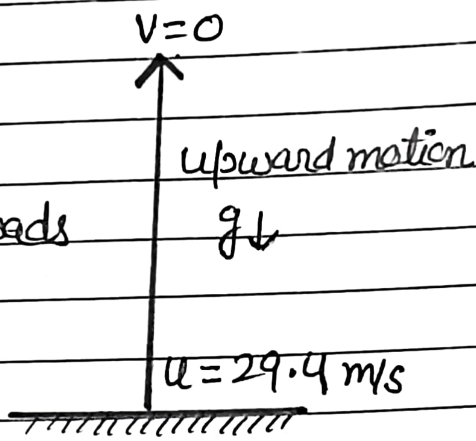
2.6

~~3.10~~ (a)

for vertical motion

Acceleration due to gravity (g) is always in downward direction.

(b)




Velocity at highest point

$v=0$

and $g=9.8\ m/s^2$ vertically downwards

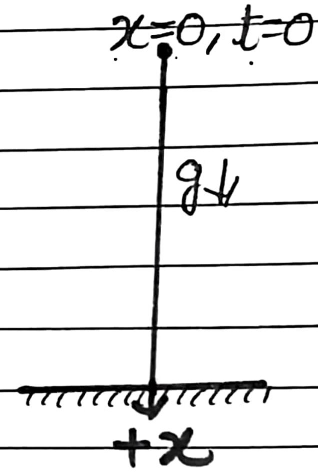
(c)

During upward motion

(i) Position is +ve

(ii) velocity is -ve

(iii) $acc^n$ due to gravity g is +ve (a=g)




During downward motion

(i) Position is +ve

(ii) Velocity is +ve

(iii) g is +ve

(d) $u=-29.4\ m/s,\ V=0,\ a=g=9.8\ m/s^2$

by $v^2=u^2+2a(x-x_0)$

$0=(-29.4)^2+2\times 9.8\,(x-x_0)$

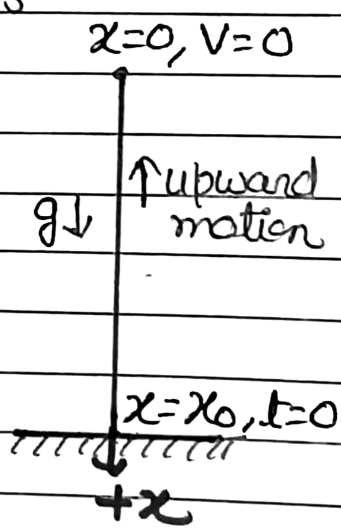
or $x-x_0=-\dfrac{29.4\times \cancel{29.4}\,3}{2\times \cancel{9.8}}$

or $x-x_0=-\dfrac{88.2}{2}=-44.1$

Or $0-x_0=-44.1$ $[x=0]$

or $x_0=44.1\ m$

i.e ball rise upto 44.1 m.

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Also,

$$v = u + at$$

$\therefore \quad 0 = -29.4 + 9.8 \times t$

or $\quad t = 3$ sec

total time in which ball return to the player's hand $= 2t$

$= 2 \times 3 = 6$ sec Ans

2.7

~~3.11~~ (a) True

At highest point of the motion the body is at rest for a moment but the acceleration due to gravity (g) is vertically downwards.

(b) False

If a particle has non-zero velocity, it must have speed.

(c) True

When a particle is moving with uniform velocity acceleration is zero. ($\because a = \frac{\Delta v}{\Delta t}$)

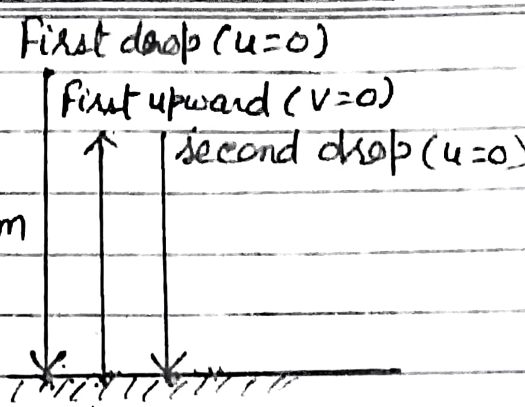
(d) False

It depends on the coordinate system taken to explain the motion of the particle.

2.8

Topic.................................................... Date............................

~~3.12~~




When the ball falls from 90 m height -
(First drop)

$u = 0, \quad h = 90\ m, \quad g = 10\ m/s^2$

by

$$v^2 = u^2 + 2gh$$

$$v^2 = 0 + 2 \times 10 \times 90$$

or

$$v = \sqrt{2 \times 900}$$

or $v = 30\sqrt{2}\ m/s = 30 \times 1.414 = 42420 = 42.4\ m/s$

by $v = u + gt$

$$t = \frac{v}{g} = \frac{30\sqrt{2}}{10} = 3\sqrt{2} = 3 \times 1.414 = 4.24\ sec$$

When ball starts first upward motion -
(First rise)

$u = 90\%$ of $30\sqrt{2}$, $v = 0$

$$= \frac{90}{100} \times 30\sqrt{2} = 27\sqrt{2} = 27 \times 1.414$$

or $u = 38.1\ m/s$

by ~~$v = u + gt$~~

$$0 = 38.1 - 10t \qquad [g \rightarrow -g]$$

or $t = 3.81\ sec$

When the ball falls second time
(Second drop)

$t = 3.81$ sec

$u = 90\%$ of $27\sqrt{2}$ (velocity after collision)

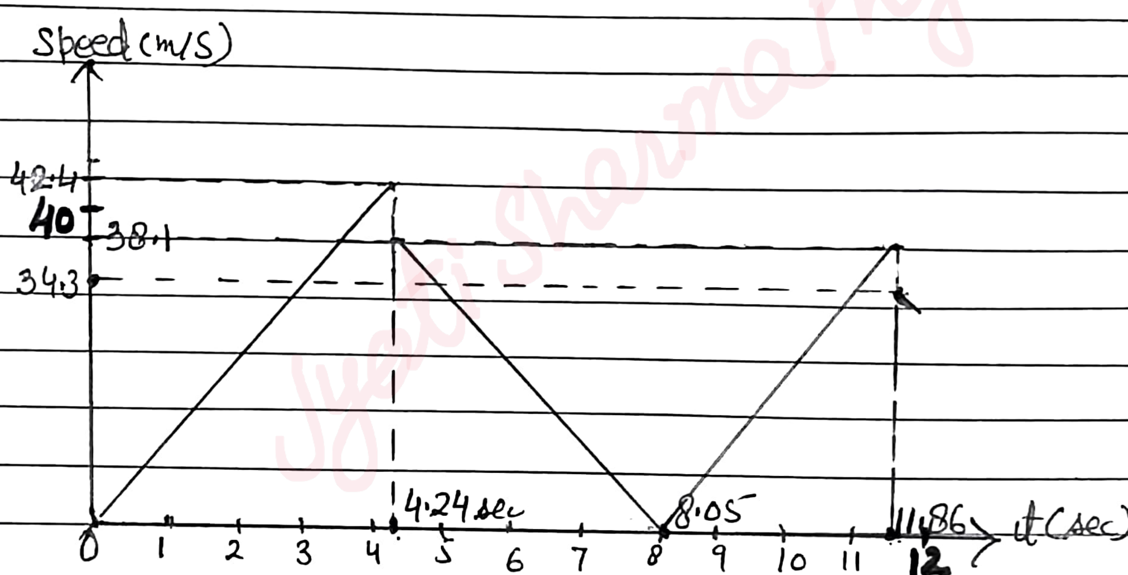
$= \frac{90}{100} \times 27\sqrt{2} = 24.3\sqrt{2}$ m/s $= 34.3$ m/s

Now the total time taken by the ball

$t_T = 4.24 + 3.81 + 3.81$

$t_T = 11.86$ sec

Thereafter body starts second upward motion

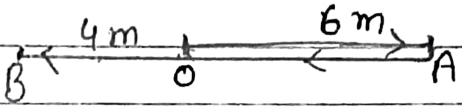



$4.24 + 3.81 = 8.05$ sec

Topic........................................................................Date.............................

2.9
~~3.13~~ (a) Magnitude of displacement can be equal or less than path length but cannot be greater than path length.

e.g.




Suppose a body moves from 'O' to A then 'A' to 'B'. Here displacement $= -4$ m
and path length $= 6+6+4 = 16$ m
We can see mag. of displacement $= 4$ m
and path length $= 16$ m
both can be equal for 1d motion only.

(b) for above case let the total time $= 10$ sec.
Mag. of Average velocity $= \frac{4}{10} = 0.4$ m/s

and average speed $= \frac{16}{10} = 1.6$ m/s

i.e average speed can be greater or equal to the mag. of average velocity but cannot be less than mag. of velocity.
both can be equal for 1d motion only.

2.10
~~3.14~~. (a) Given distance of market $s = 2.5$ Km
Speed of man while going to market $V_1 = 5$ Km/h
" " " " returning to home $V_2 = 7.5$ Km/h

Time taken to reach the market

$$t_1 = \frac{S}{V_1} = \frac{2.5}{5} = \frac{1}{2} \text{ hr} = 30 \text{ min}$$

Time taken to reach home from market

$$t_2 = \frac{S}{V_2} = \frac{2.5}{7.5} = \frac{1}{3} \text{ hr} = 20 \text{ min}$$

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Topic............................................................Date..............................

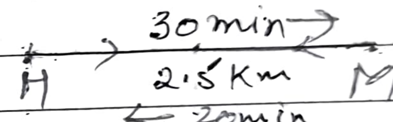
Average velocity = $\frac{\text{Total displacement}}{\text{Total time}}$

and
Average Speed = $\frac{\text{Total distance}}{\text{Total time}}$

(i) 0 to 30 min
In 30 min. man reaches to market.
therefor

$|\text{Average velocity}| = \frac{2.5}{0.5} = 5 \text{ Km/h}$

$\text{Average speed} = \frac{2.5}{0.5} = 5 \text{ Km/h}$



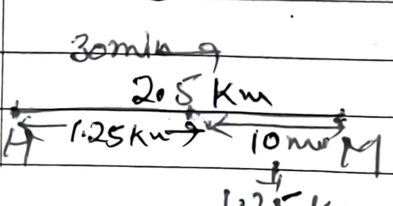

(ii) 0 to 50 min
In 50 min. man reaches to home.
i.e displacement = 0
So
Average velocity = 0
and

$\text{Average speed} = \frac{2.5+2.5}{50/60}$ $\left[\because 50 \text{ min} = \frac{50}{60} \text{ hr}\right]$

$= \frac{5 \times 6}{5} = 6 \text{ Km/h}$

(iii) 0 to 40 min
In first 30 min. man reaches market.
In remaining 10 min he covers distance with speed of 7.5 Km/h.

i.e $S = 7.5 \times \frac{10}{60} = \frac{7.5}{6} = 1.25 \text{ Km}$

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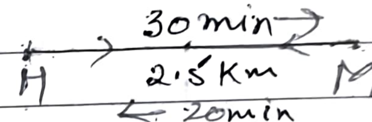
Average velocity = $\frac{\text{Total displacement}}{\text{Total time}}$

and
Average Speed = $\frac{\text{Total distance}}{\text{Total time}}$

(i) 0 to 30 min
In 30 min. man reaches to market.
therefor
$|\text{Average velocity}| = \frac{2.5}{0.5} = 5 \text{ Km/h}$

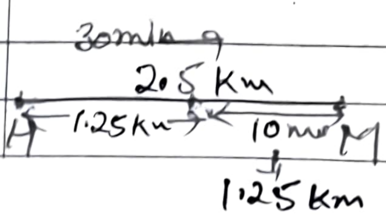
Average speed $= \frac{2.5}{0.5} = 5 \text{ km/h}$




(ii) 0 to 50 min
In 50 min, man reaches to home.
i.e displacement = 0
So
Average velocity = 0
and
Average speed $= \frac{2.5+2.5}{50/60}$ $\left[\because 50 \text{ min} = \frac{50}{60} \text{ hr}\right]$

$= \frac{5 \times 6}{5} = 6 \text{ Km/h}$

(iii) 0 to 40 min
In ~~first~~ 30 min. man reaches market.
In remaining 10 min he covers distance with speed of 7.5 Km/h.
i.e $S = 7.5 \times \frac{10}{60} = \frac{7.5}{6} = 1.25 \text{ km}$



Topic.................................................................................. Date.................................

So |Average velocity| $= \dfrac{2.5 - 1.25}{40/60}$

$= \dfrac{1.25 \times \cancel{6}^{3}}{\cancel{4}_{2}}$

$= \dfrac{3.75}{2} = 1.875$ Km/h

and

Average speed $= \dfrac{2.5 + 1.25}{40/60}$

$= \dfrac{3.75 \times \cancel{6}^{3}}{\cancel{4}_{2}} = \dfrac{11.25}{2}$

$= 5.625$ Km/h

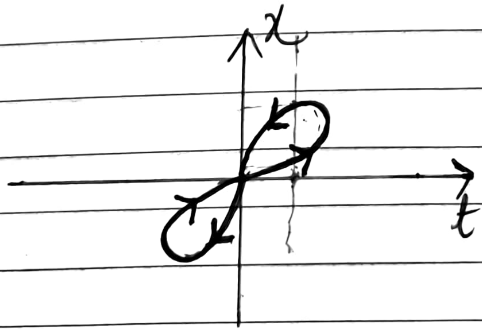
2.11 ~~3.15~~ Instantaneous velocity of a particle is velocity at any instant of time. In small interval of time |displacement| = distance

Therefore.

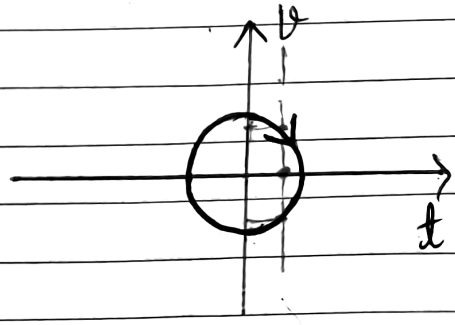
|Instantaneous velocity| = Instantaneous speed

Instantaneous velocity/speed $= \lim_{\Delta t \to 0} \dfrac{\Delta x}{\Delta t} = \dfrac{dx}{dt}$

2.12 ~~3.16~~

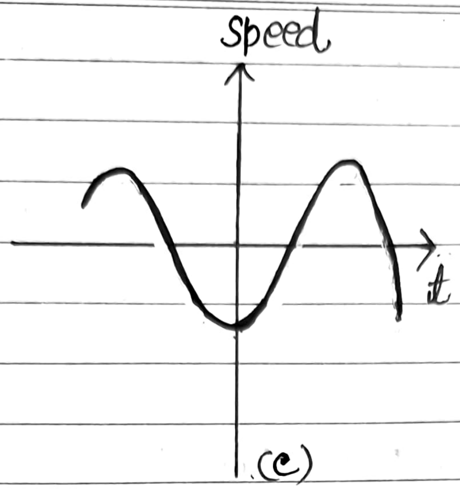


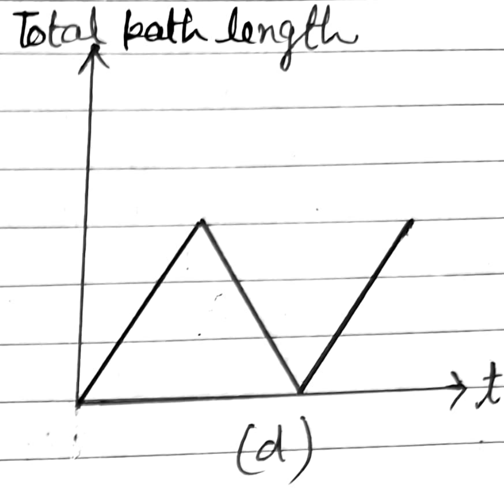

(a)




(b)

Topic.......................................................................Date...................................



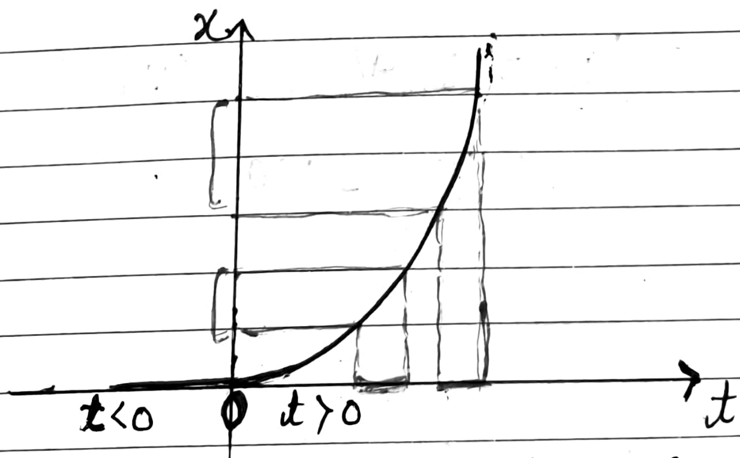

(a) Not possible because graph shows two different values of position(x) for one value of time.

(b) Not possible because for one value of time there are two different velocities.

(c) Not possible because speed cannot be -ve.

(d) Not possible because total path length cannot decrease with time.

2.13
~~3.17~~




No, according to graph particle is not in the motion for $t<0$.
As the graph is for one dimensional motion, it cannot represent parabolic motion. So it is not

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Topic........................................Date........................

correct to say that particle is moving on parabolic path for $t > 0$.
The graph can represent the motion of freely falling particle under gravity.

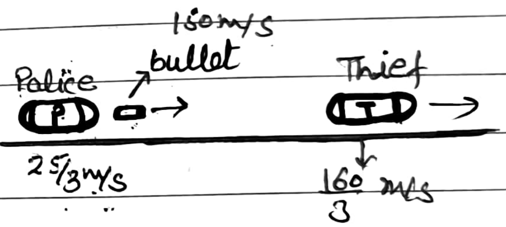
2.14 ~~3.18~~. Given,

Speed of police van
$$V_p = 30\ Km/h = 30 \times \frac{5}{18} = \frac{25}{3}\ m/s$$

Speed of thief's car
$$V_t = 192\ km/h = 192 \times \frac{5}{18} = \frac{160}{3}\ m/s$$

Speed of bullet $V_b = 150\ m/s$

$\therefore$ Speed of bullet for thief
$$V_{bP} = V_p + V_b \qquad (V_b \rightarrow \text{speed of bullet})$$
$$= \frac{25}{3} + 150$$




$$= \frac{475}{3}\ m/s$$

Now relative speed of bullet w.r.to thief's car

$$V_{bt} = V_{bP} - V_t \qquad [\because \text{both are in same dir}^n]$$
$$= \frac{475}{3} - \frac{160}{3}$$
$$= \frac{315}{3}$$
$$V_{bt} = 105\ m/s$$

Hence, bullet hit the theif's car with speed of 105 m/s.

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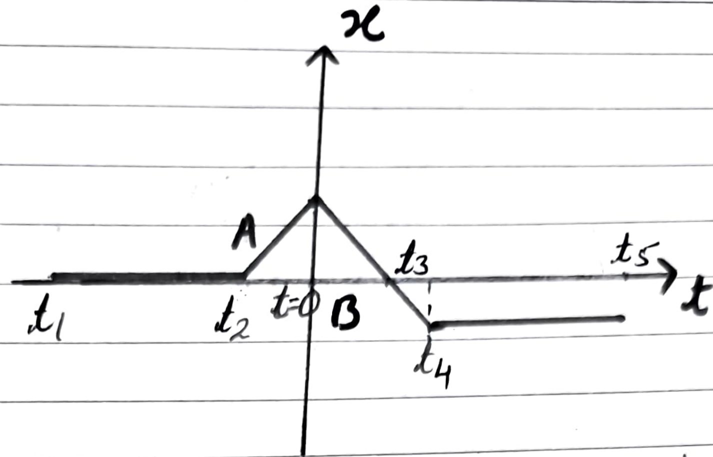
2.15

~~3.19~~ (a)




The x-t graph shows that

from $t_1$ to $t_2$ particle is at rest.
from $t_2$ to $t=0$ particle moves with uniform velocity.
from $t=0$ to $t_3$ particle moves with uniform velocity in opposite direction and reaches its initial position.
from $t_3$ to $t_4$ particle continues its uniform motion in -ve x axis.
from $t_4$ to $t_5$ particle is in rest again.

Physical situation
The graph may represent a physical situation as a ball at rest on a smoth floor is kicked, it rebounds from a wall with reduced speed and moves to the opposite wall which stops it.