PHYSICS

NCERT - FULL MARKS PHYSICS(TAMIL)

MOTION IN A STRAIGHT LINE

Example

1. A car is moving along a straight (OP). It moves from $O \rightarrow P$ in $18\,\text{sec}\,onds$ amd retuns from $P \rightarrow Q$ in 6 seconds, $where$OP=360 m

and OQ=240 m What are the car the average velcoty and average speed of the car in going (a) from $O \rightarrow P$ and back to Q ?

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2. The position of an object moving along x-axis is given by $x = a + bt^2$ where $a = 8.5m, b = 2.5ms^{-2}$ and t is measured in seconds. What is its velocity at $t = 0s$ and $t = 2.0s$. What is the average velocity between $t = 2.0s$ and $t = 4.0s$?

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3. MOTION WITH CONSTANT ANGULAR ACCELERATION

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4. A ball is thrown vertically upwards with a velcotiy of $20ms^{-1}$ from the top of a multi-storey building. The height of the point fromwher the ball is thrown if 25m from the ground. (a) How high the ball will rise ? And (b)

how long will it be before the ball hits the ground ? Take. $g = 10ms^{-2}$.

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5. Free-fall : Discuss the motion of an object under free fall. Neglect air resistance.

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6. Prove that the distances traversed during equal intervals of time by a body falling from

rest, stand to one another in the same ratio as the odd numbers beginning with unity [namely 1: 3: 5: .....].

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7. Stopping distance of vehicles : When brakes are applied to a moving vehicle, the distance it travels before stopping is called stopping distance. It is an important factor for road safety and depends on the initialy velocity (v_0) and the braking capacity, or deceleration $-a$

that is caused by the braking. Derive an expression for stopping distance of a vehicle in terms of v_0 and a.

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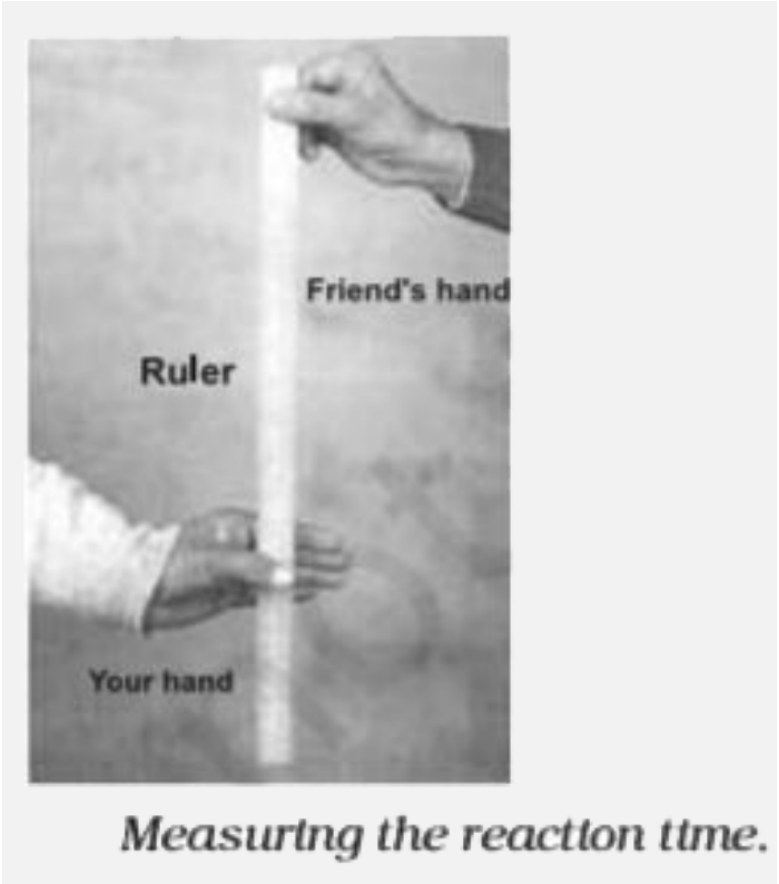
8. Reaction time : When a situation demands our immediate action, it takes some time before we really respond. Reaction time is the time a person takes to observe, think and act. For example, if a person is driving and suddenly a boy appears on the road, then the

time elapsed before he slams the brakes of the car is the reaction time. Reaction time depends on complexity of the situation and on an individual. You can measure your reaction time by a simple experiment. Take a ruler and ask your friend to drop it vertically through the gap between your thumb and forefinger (Fig.). After you catch it, find the distance d travelled by the ruler. In a particular case, d was found to be 21.0 cm. Estimate reaction

time.



Measuring the reaction time.

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9. Two parallel rail tracks run north-south Train A moves north with a speed of $54kmh^{-1}$ and train B moves south with a speed of $90kmh^{-1}$. What is the

a. relative velocity of B with respect to A?

b. relative of a monkey running on the roof of the train A against its motion (with its velocity of $18kmh^{1}$ with respect to the train A) as observed by a man standing on the ground?

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Exercises

1. In which of the following exmples of motion, can the body be considered approxinmately a point object :

(a) a railway carriage moving without jerks between two two stations.

(b) a mondey sistting on top of a man cycling smoothly on a circulat track. (c) a spinning cricket ball that turns sharply on hitting the round . (d) a tumbling beake theat has slopped off the edge of a table ?

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2. The position-time (x-t) graphs for two children A and B returning from their school O to their homes P and Q respectively are shown in Fig. Choose the correct entries in the brackets below ,

(a) (A/B) lives closer to the school than (B/A)

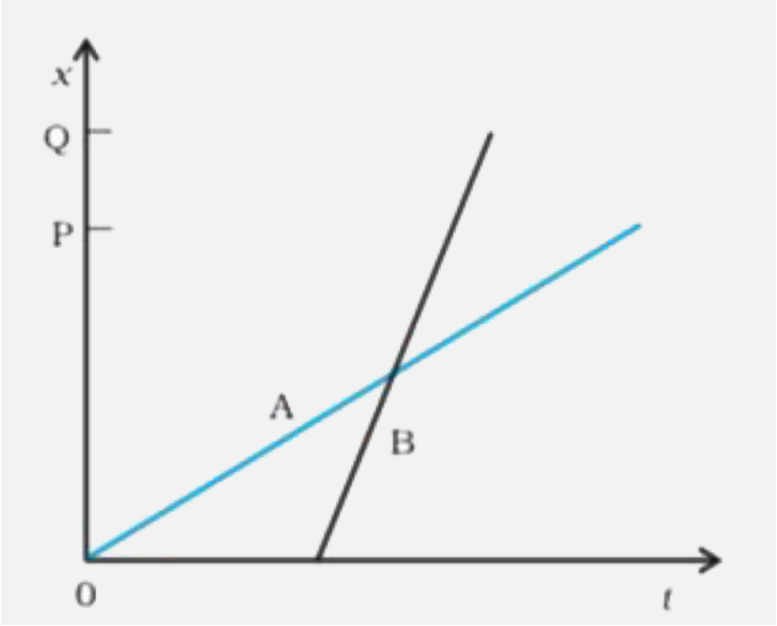
(b) (A/B) starts from the school earlier than (B/A)

(c) (A/B) walks faster than (B/A)

(d) A and B reach home at the (same/different)

time

(e) (A/B) overtakes (B/A) on the road (once/twice).



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3. A woman starts from her home at 9.00 a. m., walks with a speed of $5kmh^{-1}$ on straight road up to her office $2.5km$away, stays at the office up to $5.00p.\,m.$, and returns home by an auto with a speed of $25kmh^{-1}$. Plot the position-time graph of the woman taking home as origin.

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4. A drunkard walking in a narrow lane takes 5 steps forward and 3 steps backward, followed again by 5 steps forward and 3 steps backward, and so on. Each step is 1 m long and requires 1 s. Plot the $x - t$ graph of his motion. Determine graphically and otherwise how long the drunkard takes to fall in a pit 13 m away from the start

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5. A jet airplance travelling at the speed of $500 km^{-1}$ ejects its products of combustion at the speed of $1500 kmh^{-1}$ relative to the jet plane. What is the speed of the burnt gases with respect to observer on the ground ?

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6. A car moving along a straight highway with speed of $16 kmh^{-1}$ is brought to a stop within a distance of 200 m. What is the retardation of

the car (assumed uniform), and how long does it take for the car to stop?

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7. Two trains A and B of length 400 m each are moving on two parallel tracks with a uniform speed of $72kmh^{-1}$ in the same direction, with A ahead of B. The dirver of B decides to overtake A and accelerates by $1ms^{-2}$. If after 50s, the guard of B just brushed past the

driver of A, what was the original distance between them ?

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8. On a two lane road , car (A) is travelling with a speed of $36kmh^{-1}$. Tho car B and C approach car (A) in opposite directions with a speed of $54kmh^{-1}$ each . At a certain instant , when the distance (AB) is equal to (AC), both being $1km$, $(B)decides \rightarrow overtake$ A before

C does , What minimum accelration of car (B) is required to avoid and accident.

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9. Two towns A and B are connected by a regular bus service with a bus leaving in either direction every T min. A man cycling with a speed of $20kmh^{-1}$ in the direction A to B notices that a bus goes past him every $18\ \min$ in the direction of his motion, and every $6\ \min$ in the opposite direction. What is

the period T of the bus service and with what speed (assumed constant)do the buses ply on the road?

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10. A player throwsa a ball upwards with an initial speed of $29.4ms^{-1}$.

(i) What is the direction of acceleration during the upwared motion of the ball?

(ii) What are the velocity and acceleration of the ball at the highest point of its motion?

(iii) Choose the x=0 and t=0 to be the location and time of the ball at its highest point, vertically downward direction to be the positive direction of X-axis, and give the signs of positive, velocity and acceleration of the ball during its upward, and downward motion.

(iv) To what height does the ball rise and after how long does the ball return to the player's hand?(Take $g = 9.8ms^{-2}$, and neglect air resistance).

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11. Read each staremnt below carefully and state with reasons and expamples if it is true or false ,

(a) with zero speed at an instant may have non-zero accelration at that instant

(b) with zero speed may have non-zero velocity

(c) with positive constant speed must have zero accleration

(d) with positive value of acceleration must be speeding up.

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12. A ball is dropped from a height of a height of 90 m on a floor. At each collsion with the floor , the ball loses one - tenth of its speed . Plot the speed -time graph of its motion between t 0 to 12 s.

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13. Explain clearly, with ezamples, the difference between :

(a) magnitude of displacemnt (sometimes called distance) overand

interval of time, and the total length of the path coverd by a particle over the same interval.

(b) magnitude of average velocity over an intercal of time , and the average speed

over the same interval. [Average speed of a particle over an interval of time is defined as the toal path length

divided by the time intrval]. Show in both (a) and (b) that the second quantity is either greater than or equal to first.

When is the equality sing true ? [For

simplocity, consider one- dimensional motion only]

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14. A man walks on a straight road from his home to a moardet $3km$ away with a speed of $6km/h$. Finding the market closed, he instantly turns and walks back with a speed of $9km/h$. What is the (a) magnitude of average velocity and (b) averge speed of the man, over

the interval of time (i) $0 \rightarrow 30$ min , (ii) $0 \rightarrow 50$ min , (iii) $0 \rightarrow 40$ min ?

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15. In abave questions 13 and 14, we have carefully distinguished between average speed and magnitude of average velocity. No such distainction is necessary when we considedr speed and magnitude of velocity. The instantneoud speed if alwary equal to the magnitude of nistantaneous velocity. Why ?

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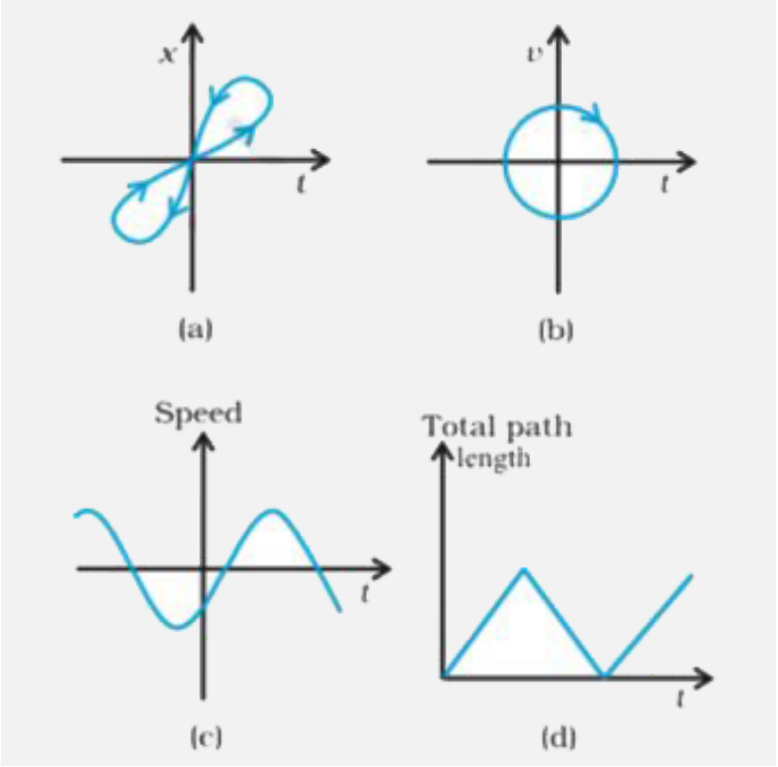
16. Look at the graphs (a) to (d) (Fig.) carefully and state, with reasons, which of these cannot possibly represent one-dimensional motion of

a particle.



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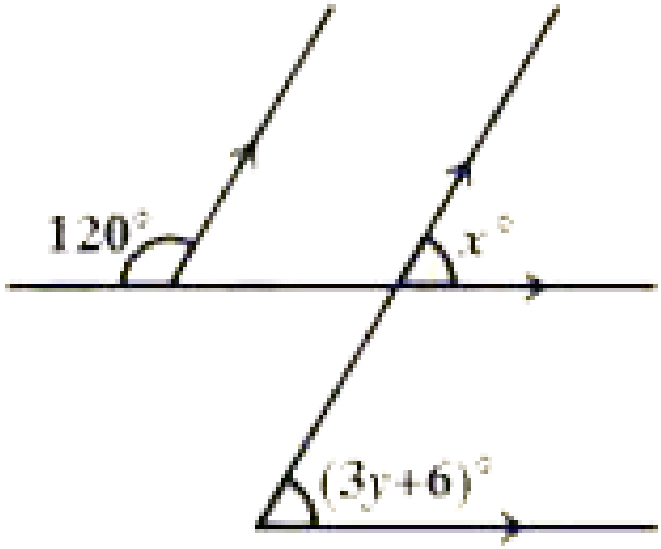
17. Find the value of x and y from the figure.



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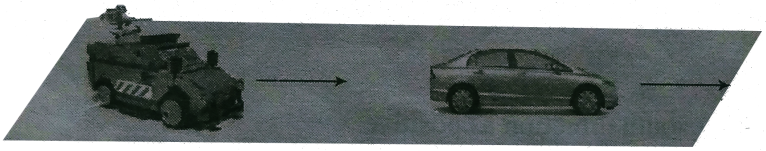
18. A police van moving on a highway with a speed of $30kmh^{-1}$ Fires a bullet at a thief's car speeding away in a same direction with a speed of $192kmh^{-1}$. If the muzzle speed of the buller is $150ms^{-1}$, with what speed does the bullet hit thief's car? .



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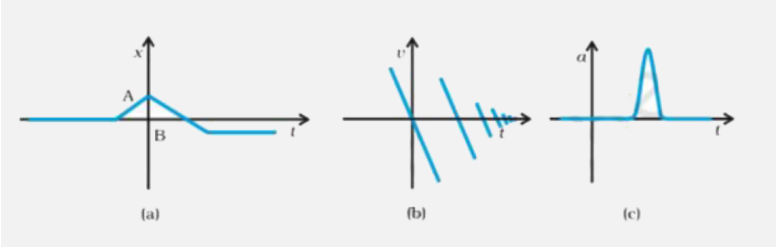
19. Suggest a suitable physical situation for each of the following graphs (Fig.)



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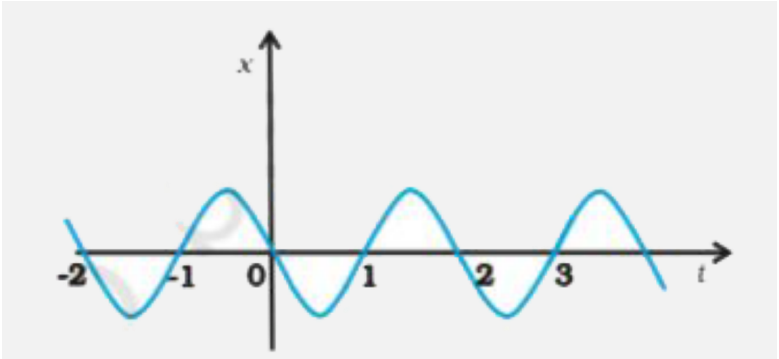
20. Figure. gives the x-t plot of a particle executing one-dimensional simple harmonic motion. (You will learn about this motion in more detail in Chapter14). Give the signs of

position, velocity and acceleration variables of the particle at $t = 0.3s, 1.2s, -1.2s$.



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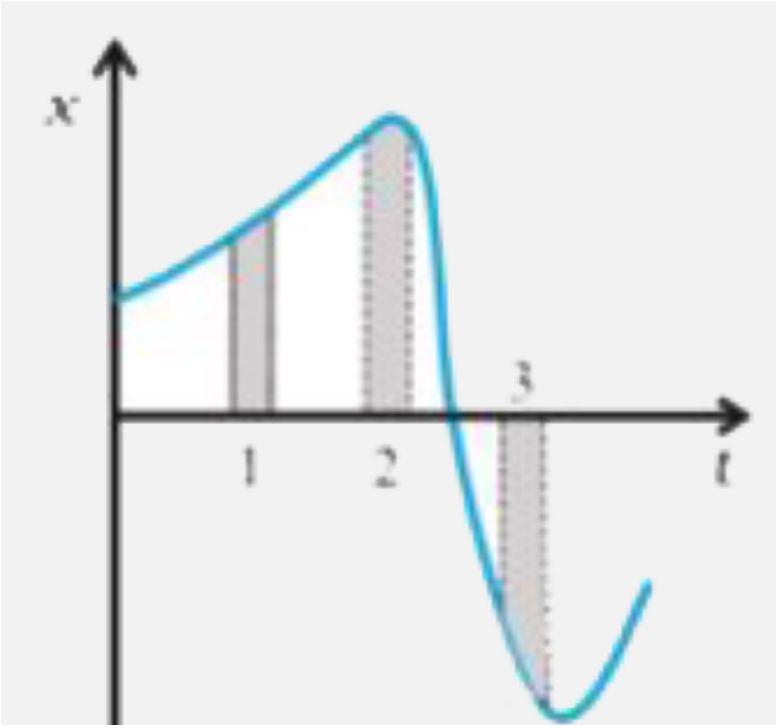
21. Figure. gives the x-t plot of a particle in one-dimensional motion. Three different equal intervals of time are shown. In which interval is the average speed greatest, and in which is it

the least ? Give the sign of average velocity for each interval.



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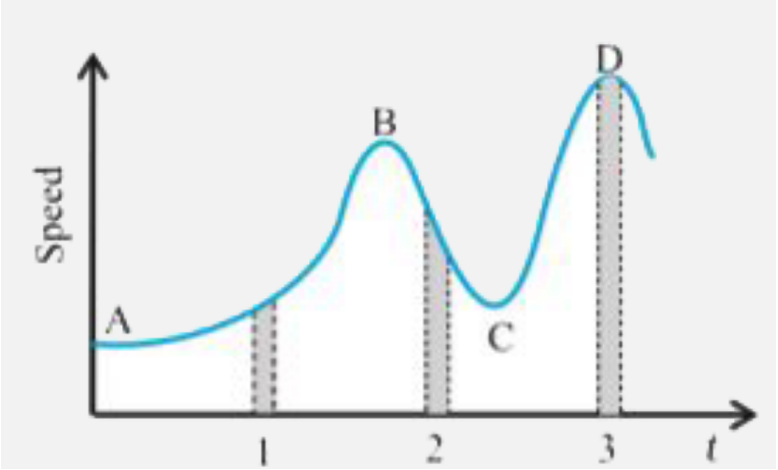
22. Figure. gives a speed-time graph of a particle in motion along a constant direction. Three equal intervals of time are shown. In which interval is the average acceleration greatest in magnitude ? In which interval is the average speed greatest ? Choosing the positive direction as the constant direction of motion, give the signs of v and a in the three intervals. What are the accelerations at the

points A, B, C and D ?



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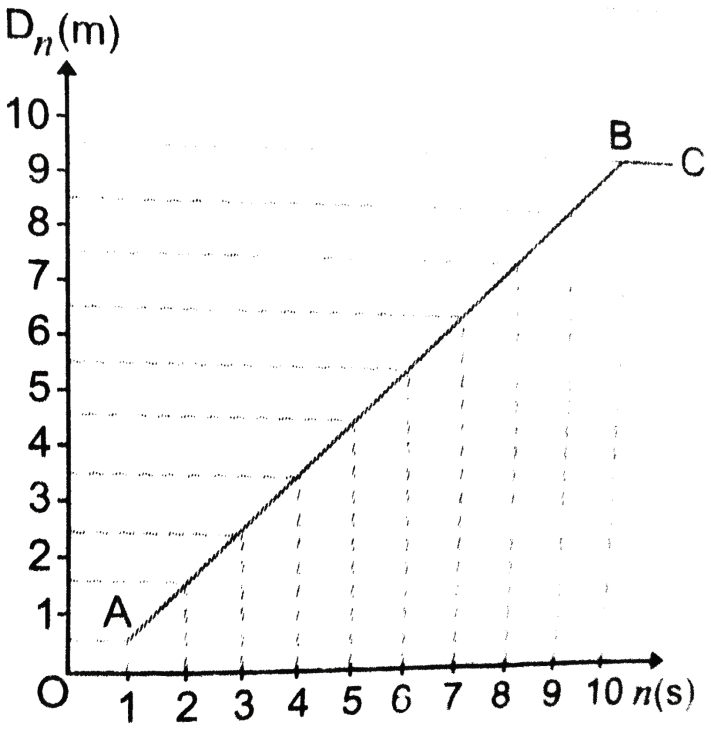
23. A three wheeler starts from rest, accelerates uniformly with $1ms^{-2}$ on a straight road for $10s$ and then moves with uniform velocity . Plot a graph between the

distance covered by the vehicle during the nth second (n = 1,2,3, ...) versus (n) What do you expect the plot to be during accelerated motion: a straight line or a parabola ?



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Additional Exercises

1. A boy standing on a stationary lift (open from above) throws a ball upwards with the maximum initial speed he can, equal to $49ms^{-1}$. How much time does the ball take to return to his hands ? If the lift starts moving up with a uniform speed of $5ms^{-1}$ and the boy again throws the ball up with the maximum speed he can , how hoes the ball take to return to his hands ?

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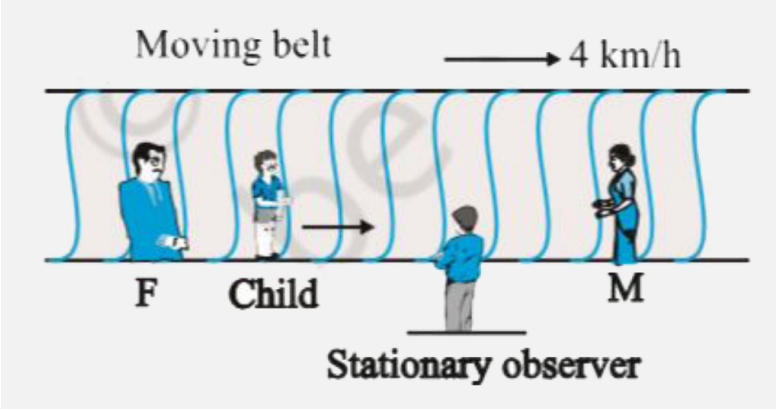
2. On a long horizontally moving belt (Fig.), a child runs to and fro with a speed $9kmh^{-1}$ (with respect to the belt) between his father and mother located 50 m apart on the moving belt. The belt moves with a speed of $4kmh^{-1}$. For an observer on a stationary platform outside, what is the

(a) speed of the child running in the direction of motion of the belt ?.

(b) speed of the child running opposite to the direction of motion of the belt ?

(c) time taken by the child in (a) and (b) ?

Which of the answers alter if motion is viewed by one of the parents ?



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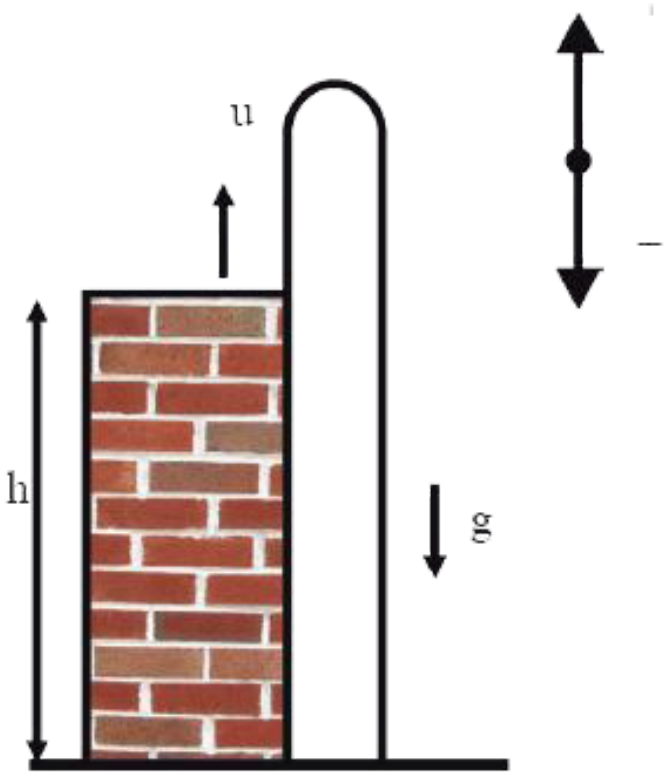
3. A stone is thrown vertically up from the tower of height 25m with a speed of 20 m/s What time does it take to reach the ground ?

$(g = 10m/s^2)$



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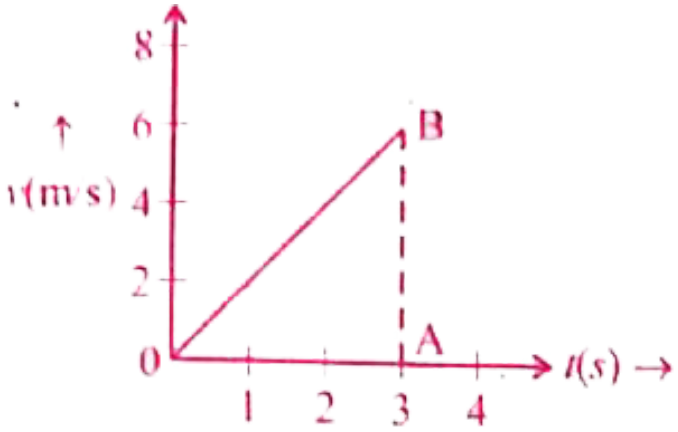
4. Find the distance travelled by the particle during the time t = 0 to t = 3 second from the figure .



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5. Prove that the point of intersection of the tangents at t_1 and t_2 on the parabola $y^2 = 4ax$ is (at1t2,a(t1+t2))

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