PHYSICS

BOOKS - HC VERMA

REST AND MOTION : KINEMATICS

Example

1. An old person moves on a semi circulasr track of radius 40.0 m during a moirning walk. If he starts at one end of the track and reaches

at the other end, find the distance covered and the displacement of the person.

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2. The distance travelled by a particle in time t is given by $s = \left(2.5\frac{m}{s^2}\right)t^2$. Find a. the average speed of the particle during the time 0 to 5.0 s, and b. the instantaneous speed at t=5.0 is

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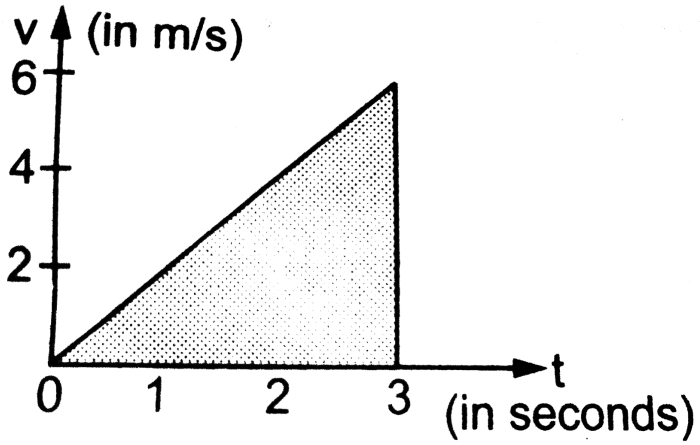
3. Figure shows the speed versus time graph for a particle. Find the distance travelled by the particle during the time t=0 to t=3s.



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4. A table clock has its minute hand 4.0 cm long. Find the average velocity of the tip of the minute hand a. between 6.00 a.m. to 6.30 a.m.

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5. A particle starts with an initial velocity 2.5 m/s along the positive x direction and it accelerates uniformly at the rate $0.50\frac{m}{s^2}$. A. Find the distance travelled by it in the first two seconds. b.How much time does it take to

reach the velocity $7.5\frac{m}{s}$? c. How much distance will it cover in reaching the velocity 7.5 m/s?

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6. A particle having initial velocity u moves with a constant acceleration a for a time t. a. Find the displacement of the particle in the last 1 second . b. Evaluate it for $u = 5m/s, a = 2m/s^2$ and $t = 10s.$

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7. A ball is thrown up at a speed of 4.0 m/s. Find the maximum height reached by the ball. Take $g = 10m/s^2$.

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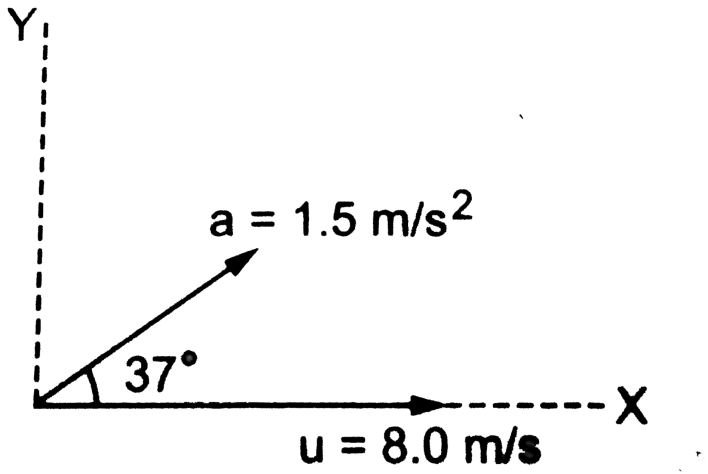
8. A particle movesin the X-Y plane with a constasnt acceleration of $1.5\frac{m}{s^2}$ in the direction making an angle of 37^0 with the X-axis.At t=0 the particle is at the orign and its velocity is 8.0 m/s along the X-axis. Find the

velocity and the position of the particle at t=4.0 s.



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9. A ball is thrown from a field with a speed of 12.0 m/s at an angle of 45^0 with the horizontal.

At what distance will it hit the field again ?

Take $g = 10.0\frac{m}{s^2}$

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10. A swimmer can swim in still water at a rate 4.0 km/h. If he swims in a river flowing at 3.0 km/h and keeps his direction (with respect to water) perpendicular to the current, find his velocity with respect to the ground.

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11. A man is walking on a level road at a speed of 3.0 km/h. Rain drops fall vertically wth a sped of 4.0 km/h. Find the velocity of the raindrops with respect to the man.

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Worked Out Examples

1. A man at a speed of 6 km/hr for 1 km and 8 km/hr for the next 1 km. What is t his average speed for the walk of 2 km?

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2. The I.Sc lecture theatre of a college is 40 ft wide and has door at a corner.A teacher enters t 12.00 noon through the door and makes 10 rounds along the 40 ft wall back and forth during the eriod and finally leaves the class - room at 12.50 p.m. through the samedoor. compute his average speed and average velocity.

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3. The position of a particle moving on X-axis is given by

$x = At^3 + Bt^2 + Ct + D.$

The numerical values of A,B,C,D are 1,4,-2 and 5 respectively and I units are used. Find a. the dimensions of A,B, C and D b. the velocity of the particle at t=4s, the acceleration of he particle at t=4s, d. The average velocity during the interval t=0 to t=4s, the average accelerationduring the interval t=0 to t=4s.

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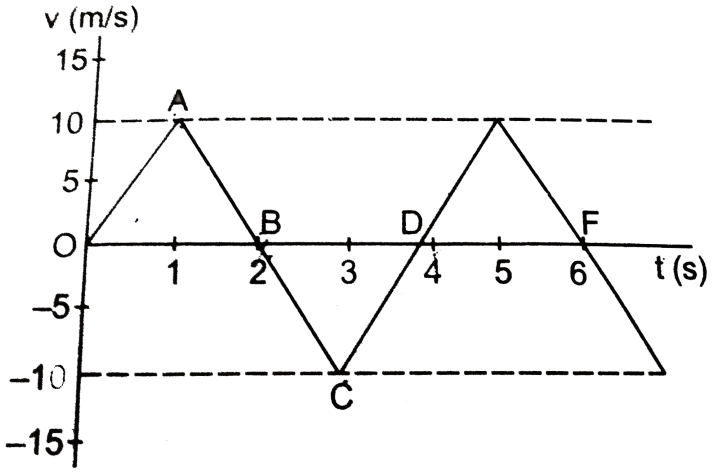
4. From the veloicty time graph of a particle given in figure describe the motion of the particle qualitively int eh interval 0 to 4s. Find a. the distance travelled during first two seconds, b. during the time 2s to 4s, c. during the time 0 to 4s d. displacement during 0 to 4 s. e. acceleration at t=1/2 and f. acceleration at

t=2s



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5. A particle starts from rest with a constant acceleration. At a time t second, the speed is found to be 100 m/s and one second later the speed becomes 150 m/s. Find a. the

acceleration and b. the distance travelled during the $(t+1)^{th}$ second.

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6. A boy stretches a stone against the rubber tape of a catapult or gulel (a device used to detach mangoes from the tree by boys in Indian villages) through a distance of 24 cm before leaving it. The tape returns to its normal position accelerating the stone over the stretched length. The stone leaves the

gulel with a speed 2.2 m/s. Assuming that the acceleration is constant while the stone was being pushed by the tape, find its magnitude.

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7. A police inspector in a jeepis chasing a pickpocket on a straightroad. The jeep is going at its maximum speed v (assumed uniform). The pickpocket rides on the motorcycle of a waiting friend when the jeepis at a distance of a waiting friend when the jeep is at a distance

d away, and the motorcycle starts with a constant acceleration a. Show that the pickpocket will be caught it $v \geq \sqrt{2ad}$.

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8. A car is moving at a constant speed of 40 km/h along a straight road which heads towards a large vertical wall and makes a sharp 90^0 turn by the side of the wall. A fly flyingat constant speed of 100 km/h, starts from the wall towrds the car t an instant when

the car is 20 km away,flies until it reaches the glasspane of the car and returns to teh wll at teh same speed. It continues to fly between the car and teh wall time the car makes the 90^0 turn. a. What is the total distance the fly has travelled during the period?b. How many trips has it made between the car and the wall?

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9. A ball is dropped from a height of 19.6 m above the ground. It rebounds from the ground and raises itself up to the same height. Take the starting point as the origin and vertically downward as the positive X-axis. Draw approximate plots of x versus t, v versus t and a versus t. Neglect the small interval during which the ball was in contact with the ground.

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10. A stone is dropped from a balloon going up with a uniform velocity of 5.0 m/s. If the balloon was 50 m high when the stone was dropped, find its height when the stone hits the ground. Take $g = 10\frac{m}{s^2}$.

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11. A football ils kicked with a velocity of 20 m/s at an angle of 45^0 wilth the horizontal. A. Find the time taken by the ball to strike the ground. b.Find the maximum height it reaches. C. How

far away from the kick dows it hit the ground?

Take $g = 10\frac{m}{s^2}$.

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12. A helicopter on flood relief mission, flying horizontally with a speed u at an altitude H, has to driop a food packet for a victim standing on the ground. At what distance from the victim should the packet be dropped? The victim stands in the vertical plane of the helicopters's motion.

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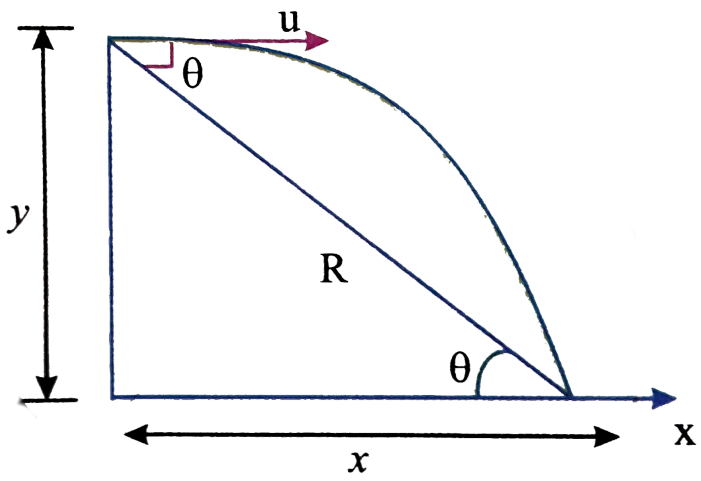
13. A particle is projected horizontally with a speed u from the top of plane inclined at an angle θ with the horizontal. How far from the point of projection will the particle strike the plane ?



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14. For a projectile, projected at an angle, the resultant velocity is :

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15. A bullet is fired from a rifle which recoils after firing. The ratio of kinetic energy of the rifle to that of the bullet is:

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16. A man can swim in still water ast a speed of 3 km/h. He wants to cross a river that flows at 2 km/h and reach the point directly oposite to his starting point. A. In which diretionshoeld he try to swim (that is, find the angle his body makes wilth the river flow)? b. How much time will he take to cross the river if the river is 500 m wide?

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17. A man can swim at a speed of 3 km/h in still water. He wants t cross a 500 m wide river flowing at 2 km/h. He flow at an angle of 120 with the river flow while swimming. A. Find the time he takes to cross the river. b.At what point on the opposite bank will he arrive?

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18. A man standing on a road has to hold his umbrella at 30^0 with the vertical to keep the

rain away. The throws the umbrella and starts running at 10 km/h. He finds that raindrops are hitting his head vertically. Find the speed of raindrops with respect to a. the road, b. the moving man.

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19. A man running on the horizontal road at $8kmh^{-1}$ find the rain appears to be falling vertically. He incresases his speed to $12kmh^{-1}$ and find that the drops make angle 30^2 with

the vertical. Find the speed and direction of the rain with respedt to the road.

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20. Three particles A, B and C are situated at the vertices of an equilateral triangle ABC of side d at time $t = 0$. Each of the particles moves with constant speed v. A always has its velocity along AB, B along BC and C along CA. At what time will the particles meet each other?

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Question For Short Answer

1. Galileo was punished by the Church for teaching that the sum is stationary and the earth moves around it. His opponents held the view that the earth is stationary and the sun moves around it. If the absolute motion has no meaing,are the two view points not equally correct or equally wrong?

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2. When a particle moves with constant velocity, its average velocity, its instantaneous velocity and its speed are all equal. Comment on this statement.

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3. A car travels at a speed of 60 km/hr due north and the other at a speed of 60 km/hr due east. Are the velocities equal? If no, which

one is greater ? If you find any of the questions irrelevant, explain.

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4. A ball is thrown vertically upward at a speed of 10 m/s. When it has reached one half of its maximum height. How high does the ball rise? (g=10ms^(-2)`)

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5. The velocity of a particle is towards west at an instant. Its acceleration is not towards west, not towards east, not towards north and not towards south. Give an example of this type of motion.

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6. Which element has smallest size?

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7. A particle at rest starts moving in a horizontal straight line with uniform acceleration The ratio of the distance covered during the fourth and the third second is

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8. Taking little amount of alcohol is good to health. Do you agree with this statement?

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9. A food packet is dropped from a plane going at an altitude of 100 m. What is the path of the packet as seen from the plane? What is the path as seen from the ground? If someone asks what is the actual path, what will you answer?

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10. Give examples where a. the velocity of a particle is zero but its acceleration is not zero. b.the velocity is opposite in direction to the

acceleration, c. the velocity is perpendicular to the acceleration.

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11. Figure shows the x coordinate of a particle as a function of time. Find the signs of

v_x and a_x at $t = t_1$,$t = t_2$ and $t = t_3$.

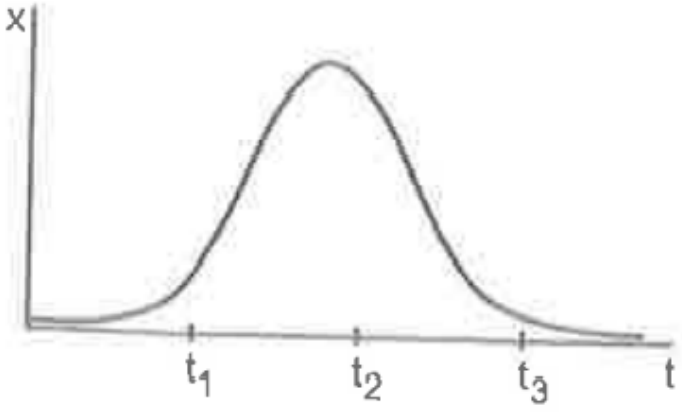

Figure 3-Q1

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12. A player hits a baseball at some angle. The ball goes high up in space. The player runs and catches the ball before it hits the ground.

Which of the two (the player or the ball) has greater displacement?

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13. The increase in the speed of a car is proportional to the additional petrol put into the engine. Is it possible to accelerate a car without putting more petrol or less petrol into the engine?

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14. A man moving in rain holds his umbrella inclined to the vertical even though the rain drops are falling vertically downwards. Why?

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Objective 1

1. A motor car is going due north at a speed of 50 km/h. It makes a 90^0 left turn without changing the speed. The change in the velocity of the car is about

A. 50 km/h towards west

B. 70 km/h towards south-west

C. 70 km/h towards north-west

D. zero

Answer: B

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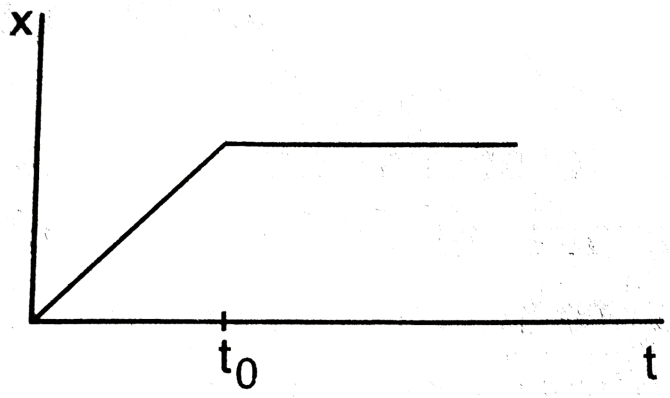
2. Figure shows the displacement time graph of a particle moving on the X-axis



A. the particle is continuously going in positive x direction

B. the particle is at rest

C. the velocity increases up to a time t_0, and the becomes constant

D. the particle moves at a constant velocity up to a time t_0 and then stops.

Answer: D

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3. A particle has a velocity u towards east at $t = 0$. Its acceleration is towards west and is constant. Let x_A and x_B be the magnitude of displacements in the first 10 seconds and the next 10 seconds

A. $x_A < x_B$

B. $x_A = x_B$

C. $x_A > x_B$

D. the information is insufficient to decide the relation of $x_A with x_B$.

Answer: D

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4. A person travelling on a straight line moves with a uniform velocity v_1 for some time and with uniform velocity v_2 for the next equal time. The average velocity v is

A. $v = \frac{v_1 + v_2}{2}$

B. $v = \sqrt{v_1 v_2}$

C. $\frac{2}{v} = \frac{1}{v_1} + \frac{1}{v_2}$

D. $\frac{1}{v} = \frac{1}{v_1} + \frac{1}{v_2}$

Answer: A

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5. A person travelling on a straight line moves with a uniform velocity v1 for a distance x and

with a uniform velocity v2 for the next equal distance. The average velocity v is given by

A. $v = \frac{v_1 + v_2}{2}$

B. $v = \sqrt{v_1 v_2}$

C. $\frac{2}{v} = \frac{1}{v_1} + \frac{1}{v_2}$

D. $\frac{1}{v} = \frac{1}{v_1} + \frac{1}{v_2}$

Answer: C

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6. A stone is released from an elevator going up with an acceleration a. The acceleration of the stone after the release is

A. a upward

B. (g-a) upward

C. (g-a)downward

D. g downward

Answer: D

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7. A person standing near the edge of the top of a building throws two balls A and B. The ball A is thrown vertically upward and B is thrown vertically downward with the same speed. The ball A hits the ground with speed v_A and the ball B hits the ground wiht a speed v_B. We have

A. $v_A < v_B$

B. $v_A < v_B$

C. $v_A = v_B$

D. the relation between v_A and v_B depends on height of the building above the ground.

Answer: C

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8. In a projectile motion the velocity

A. is always perpendicular to the acceleration

B. is never perpendicular to the acceleration

C. is perpendicular to the acceleration for one instant only

D. is perpendicular to the acceleration for two instants

Answer: C

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9. Two bullets are fired simultaneously, horizontally and with different speeds from the same place. Which bullet will hit the ground first ?

A. the faster one

B. the slower one

C. both will reach simultaneously

D. depends on the masses

Answer: C

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10. The range of a projectile fired at an angle of 15° is 50 m. If it is fired with the same speed at an angle of 45° its range will be

A. 25m

B. 37m

C. 50m

D. 100m

Answer: D

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11. Two projectiles A and B are projected with angle of projection 15^0 for the projectile A and 45^0 for the projectile B. If R_A and R_B be the horizontal range for the two projectile then.

A. $R_A < R_B$

B. $R_A = R_B$

C. $R_A > R_B$

D. the information is insufficient to decide the relation of $R_A with R_B$

Answer: D

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12. A river is flowing from west to east at a speed of 5 metres per minute.A man on the south bank of the river, capable of swimming at 10 metres per minute in still water, wants to swim across the river in the shortest time. He should swim in a direction.

A. due north

B. 30^0 east of north

C. 30^0 north of west

D. 60^0 east of north

Answer: A

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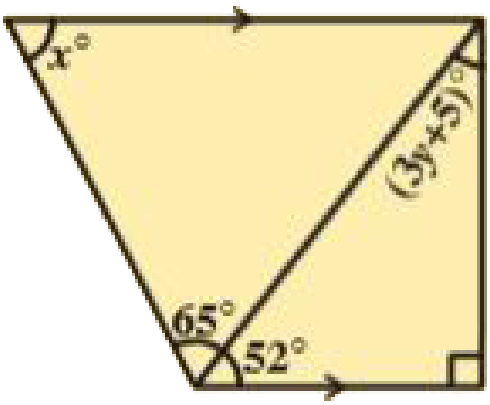
13. From the figure find x and y.



A. $2u \cos \theta$

B. $\dfrac{u}{\cos \theta}$

C. $2\dfrac{u}{\cos \theta}$

D. $u \cos \theta$

Answer: B

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Objective 2

1. Consider the motion of the tip of the minute hand of a clock. In one hour

A. the displacement is zero

B. the distance covered is zero

C. the average speed is zero

D. the average velocity is zero

Answer: A::D

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2. A particle moves along the X-axis as $x = u(t - 2s) + a(t - 2s)^2$.

A. a) the initial velocity of the particle is u

B. b) the acceleration of the particle is a

C. c) the acceleration of the particle is 2a

D. d) at t=2 s particle is at the origin.

Answer: C::D

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3. Pick the incorrect statement about the factors affecting ionization energy

A. Average speed of a particle in a given time is never less than the magnitude of the avrage velocity

B. It is possible to have a situation in which $\left|\frac{\overrightarrow{dv}}{dt}\right| \neq 0$ but $\frac{d}{dt}\left|\overrightarrow{v}\right| = 0.$

C. the average velocity of a particle is zero inn a time interval. It is possible that eh instantaneous velocity is never zero in the interval.

D. The average velocity of a particle moving on a straight line is zero in a time interval. It is possible that the instantaneous velocity is never zero in

the interval. (Infinite accelerations are not allowed).

Answer: A::B::C

4. An object may have

A. varying speed without having varying velocity

B. varying velocity without having varying speed

C. nonzero cceleration without having varying velocity

D. non zero acceleration without having varying speed.

Answer: B::D

5. Mark the correct statements for a particle going on a straight line:

A. If the velocity and acceleration have opposite sign, the object is slowing down.

B. If the position andvelocity have opposite sign, the particle is moving towards the origin.

C. If the velocity is ero at an instant, the acceleration should also be zero at that instasnt.

D. If the velocity is zero for a time interval, the acceleration is zero at any instant within the time interval.

Answer: A::B::D

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6. The velocity of a particle is zero at t=0

A. The accelerationat t=0 must be zero

B. the acceleration at t=0 maybet zero

C. If the acceleratin is zero from t=0 to t=10 s, the speed is also zero in this interval.

D. If the speed is zer4o from t=0 to t=10 s the acceleration is zero in this interval.

Answer: B::C::D

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7. Mart the correct statements:

A. The magnitude of the velocity of a particle is equal to its speed.

B. The magnitude of average velocity in an interval is equal to its average speed in that interval.

C. It is possible to have a situation in which the speed of a particle is always zero but the averge speed is not zero.

D. It is possible to have a situation in which the speed of the particle is never zero but the average speed in an interval is zero

Answer: A

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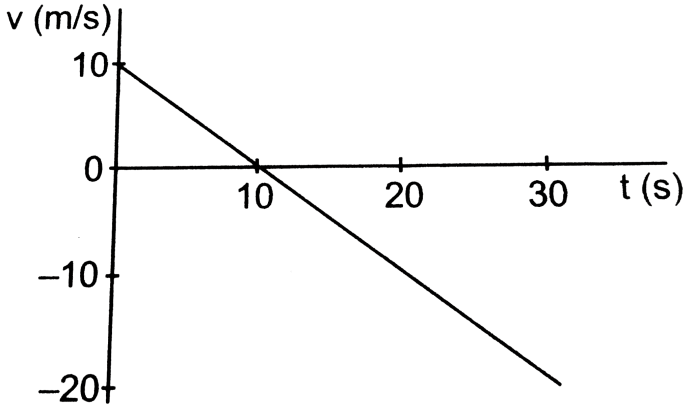
8. The velocity time plot for a particle moving on straight line is shown in the figure.



A. a) The particle has a constant acceleration

B. b) The particle has never turned around

C. c) The particle has zero displacement.

D. d) The average speed in the interval 0 to 10 s is the same as the average speed in

the interval 10 s to 20s.

Answer: A::D

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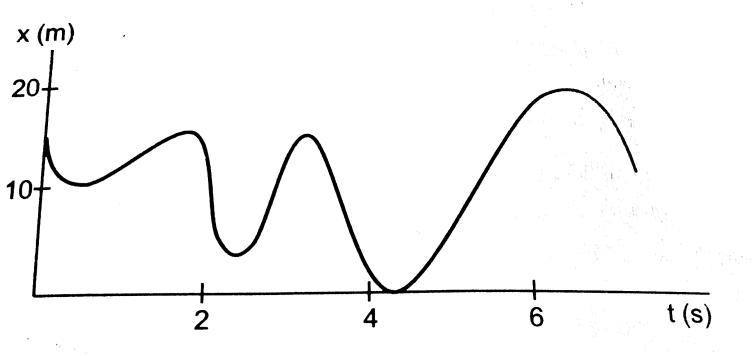
9. Figure shows the position of a particle moving on the X-axis as a function of time.



A. The particle has come to rest 6 times

B. The maximum speed is at t=6 s.

C. The velocity remains positive for t=0 to t=6s.

D. The average velocity for the total period shown is negative

Answer: A

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10. The accleration of a particle as seen from two frames S_1 and S_2 have equal magnitudes $4\ m/s^2$

A. The frames must be at rest with respect to each other.

B. The frames may be moves with respect to each other but neigther should be accelerates with respect to the other.

C. The acceleration of S_2 with respect to S_1 may either be zero or `8 m/s^2.

D. The acceleration of S_2 with respect to S_1 may be anything between zero and $8\frac{m}{s_2}$

Answer: D

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Exercises

1. A man goes 10 m due east and then 24 m due north. Find the distance of his current position from the starting point ?

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2. A particle starts from the origin, goes along the X-axis to the point (20m, 0) and then returns along the same line to the point (-20m,0). Find the distance and displacement of the particle during the trip.

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3. It is 260 km from Patna to Ranchi by air and 320 km by road.an aeroplane takes 30 minutes to go from Patna to Ranchi whereas a delux bus takes 8 hours. a.Find the verge speed of the plane. b.Find the verage speed of the bus. C. Find the average velocity of the plane. d. Find the average velocity of the bus.

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4. When a person leaves his home for sightseeing by his car, the meter reads 12352 km. When he returns home after two hours the reading is 12416 km. A. What is the average speed of the car during this period? B. What is the average velocity?

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5. A boy takes 2 second to reach the maximum speed of 18 km/h from rest. What is the

magnitude of his average acceleration ?

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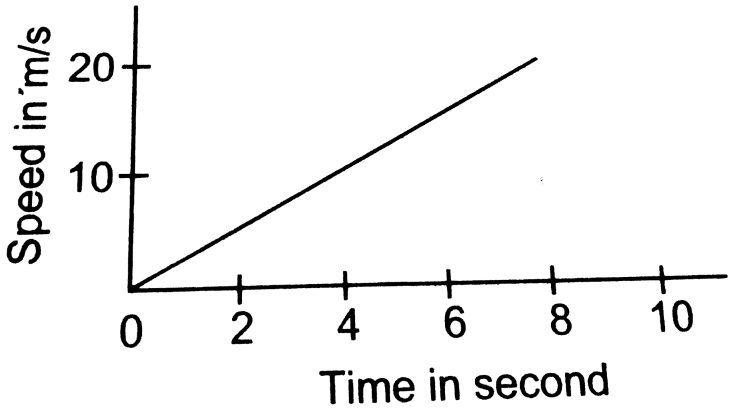
6. The speed of a car as a function of time is shown in figure.



Find the distance travelled by the car in 8 seconds and its acceleration.

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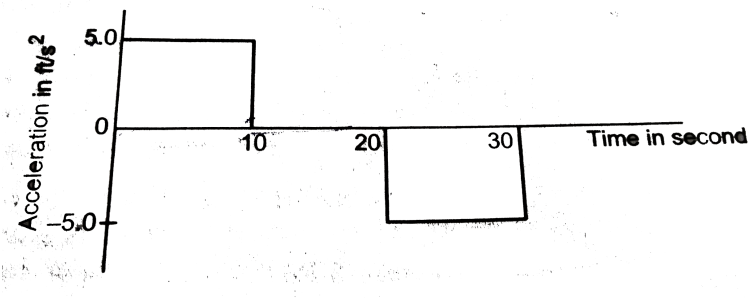
7. The acceleration of a cart started at t=0 varies with time as shown in figure. Find the distance travelled in 30 seconds and draw the position time graph.



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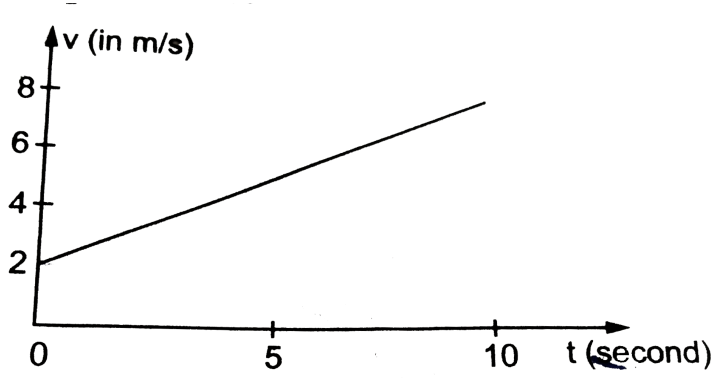
8. figure



shows the graph of velocity versus tie for a particle going along the X-axis. Find a. the acceleration, b. The distance travelled in 0 to 10 s and c. the displacement in 0 to 10 s.

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9. Figure shows the graph of the x-coordinates of a particle going along the X-axis as a function of time. Find a. the average velocity during 0 to 10s.

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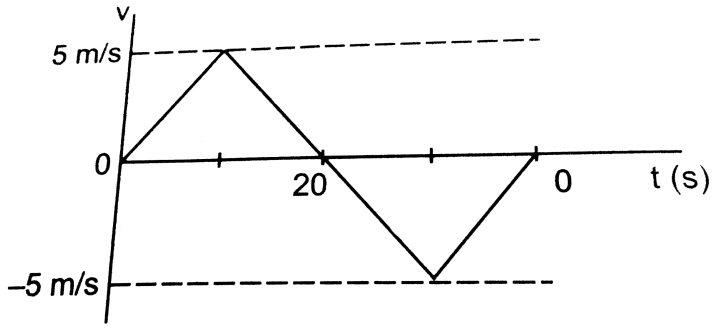
10. From the velocity time plot shown in figure find the distance travelled by the particle dureing the first 40 seconds. Also find the

average velocity during this period.



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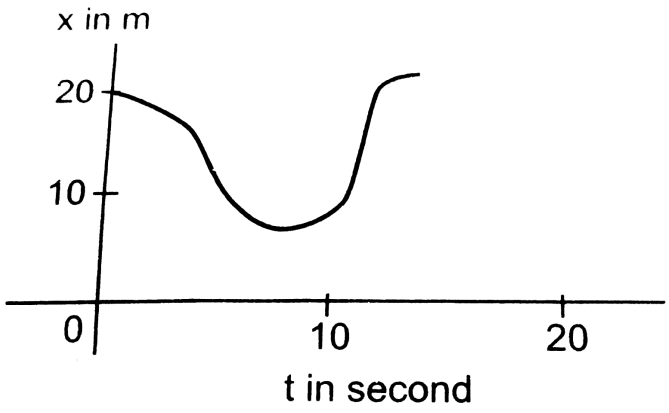
11. Figure shows x-t graph of a particle. Find the Time T such that the average velocity of

the particle during the period 0 to T is Zero.



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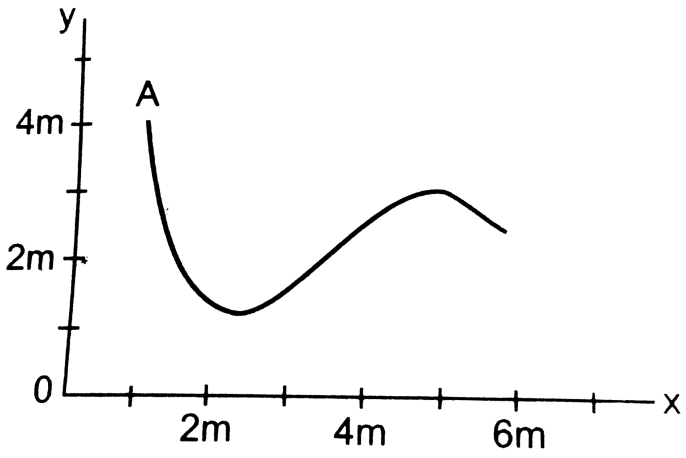
12. A particle starts from a point A and travels along the solid curve shown in figure. Find approximately the position B of the particle such that the average velocity between the

positions A and B has the same direction as the instantaneous velocity at B.



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13. An object having a velocity 4.0 m/s is accelerated at the rate of $1.2\frac{m}{s^2}$ for 5.0s. Find

the distance travelled during the period of acceleration.

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14. A person travelling at 43.2 km/h applies the brake giving a deceleration of $6.0\frac{m}{s^2}$ to his scooter. How far will it travel before stopping?

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15. A train starts from rest and moves with a constant accelerationof $2.0\frac{m}{s^2}$ for half a minute. The brakes are then applied and the train comes to rest in one minute. Find a. the total distance moved by the train, b. the maximum speed attained by the train and c. the position(s) of the train at half the maximum speed.

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16. A bullet travelling with a velocity of 16 m/s penetrates a tree trunk and comes to rest in 0.4 m. Find the time taken during the retardation.

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17. A bullet going with speed 350 m/s enters in a concrete wall and penetrates a distance of 5 cm before coming to rest . Find the deceleration ?

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18. A particle starting from rest moves with constant acceleration. If it takes 5.0 s to reash the speed 18.0 km/h find a. the average velocity during this period, and b. the distance travelled by the particle during this period.

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19. A driver takes 0.20 second to apply the brakes (reaction time). If he is driving car at a

speed of $54kmh^{-1}$ and the brakes cause a deceleration of $6.0ms^{-1}$? Find the distance travelled by car after he sees the need to put the brakes.

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20. A police jeep is chasing a culprit going on a motorbike. The motorbike crosses a turning at a speed of 72 km/h.

The jeep follows it at a speed of 90 km/h, crossing the turning ten seconds later than

the bike. Assuming that they travel at constant speeds, how far from the turning will the jeep catch up with the bike?

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21. A car travelling at 60 km/h overtakes another car travelling at 42 km/h. Assuming each car to be 5.0 m long, find the time taken during the overtake and the total road distance used for the overtake.

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22. A ball is projected vertically up with a speed of 50 m/s. Find the maximum height , the time to reach the maximum height, and the speed at the maximum height $(g = 10m/s^2)(AS_1)$

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23. A ball is dropped from a balloon going up at a speed of 7 m/s. If the balloon was at a height 60 m at the time of dropping the ball,

how long will the ball take in reaching the ground?

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24. A stone is thrown vertically upward with a speed of 28 m/s. (a) Find the maximum height reached by the stone. (b)Find its velocity one second before it reaches the maximum height.

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25. A person sitting on the top of a tall building is dropping balls at regular intervals of one second. Find the positions of the 3rd, 4th and 5th ball when the 6th ball is being dropped.

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26. A healthy young man standing at a distance of 7 m from 11.8 m high building sees a kid slipping from the top floor. With what

speed (assumed uniform) should he run to catch the kid at the arms height (1.8m)?

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27. An NCC parade is going at a uniform speed of 6 km/h through a place under a berry tree on which a bird is sitting at a height of 12.1 m. At a particular instant the bird drops a berry. Which cadet (ie the distance from the tree at the instant) will receive the berry on his uniform?

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28. A ball is dropped from a height. If it takes 0.2s to cross the last 6m before hitting the ground, find the height from which it is dropped. Take $g = 10 \frac{m}{/} s^2 (AS_1)$

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29. A ball is dropped from a height of 5 m onto a sandy floor and penetrates the sand up to 10

cm before coming to rest. Find the retardation of the ball in sand assuming it to be uniform.

30. An elevator is descending with uniform acceleration.To measure the acceleration, a person in the elevator drops a coin at momen the elevator strts. The coin is 6 ft asbove the floor of the elevator at the time it is dropped. The person observes that the coin strikes the

floor in 1 second. Calculate these dta the acceleration of the elevator.

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31. A 10 kg ball is dropped from a height of 10m. Find (a) the initial potential energy of the ball. (b) the kinetic energy just before it reaches the ground, and (c) the speed just before it reaches the ground.

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32. A ball is thrown at a speed of 40 m/s at an angle of 60^0 with the horizontal. Find a. the maximum height reached and b. the range of te ball. Take $g = 10\frac{m}{s^2}$.

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33. A ball whose Kinetic Energy is E is projected at an angle of 45° to the horizontal. The kinetic energy of the ball at the highest point of its flight will be

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34. A gun is fired from a place which is at distance 1.2 km from a hill. The echo of the sound s heard back at the same place of firing after 8 second. Find the speed of sound.

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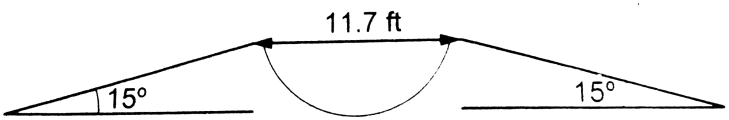
35. Figure shows a 11.7 ft wide ditch with the approach roads at and angle of 15^0 with the horizontal. With what minimum speed should

a mororbike be moving on the road so that it safely croses the ditch?



Assume that the length of thebike is 5 ft, and it leaves the road when the front part runs out of the approch road.

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36. A person standing on the top of a cliff 171 ft high has to throw a packet to his friend

standing on the ground 228 ft horizontally away. If he throws the packet directly aiming at the friend with a speed o 15.0 ft/s, how short will the packet fall?

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37. A projectile is fired at an angle of 45° with the horizontal. Elevation angle of the projectile at its highest point as seen from the point of projection is

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38. The expression for maximum height attained when the body is projected at an angle with the horizontal is :

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39. A bomb is dropped from a plane flying horizontally with uniform speed. Show that the bomb will explode vertically below the plane.Is the statement true if the plane flies with uniform speed but not horizontally?

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40. A boy standing on a long railroad car throuws a ball straight upwards. The car is moving on the horizontal road with an acceleration of $1\frac{m}{s^2}$ and the projectioon velocity inte vertical direction is 9.8 m/s. How far behind the boy will the ball fall on the car?

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41. A staircase contains three steps each 10 cm high and 20 cm wide figure. What should be the minimum horizontal velocity of a bal rolling off the upper most plane so as to hit directly the lowest plane?

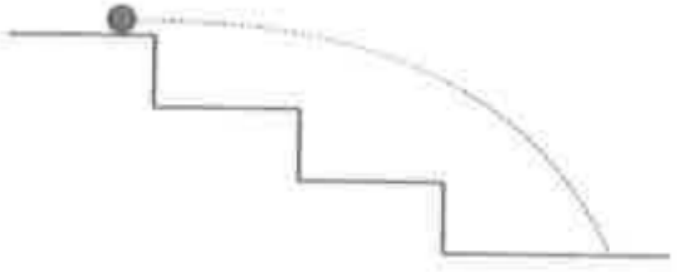

Figure 3-E9

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42. A person is standing on a truck moving with a constant velocity of 14.7 m/s o a hrozontal road. The man throws a ball in such a way that it returns to the truck after the truck has moved 58.8 m. Find the speed and the angle of projection. a. as seen from the truck b. as seen fromt the road.

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43. The benches of a gallery in a cricket stadium are 1 m wide and 1 m high. A batsman

strikes the ball at a level one meter above the ground and hits a mammoth sixer. The ball starts at 35 m/s at an angle of 53^0 with the horizontal. The benches are perpendicular to the plane of motion and the first bench is 110 m from the batsman. On which bench will the ball hit?

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44. A man is sitting on the shore of a river. He is in the line of a 1.0 m long boat and is 5.5 m

away from the centre of the boat. He sishes to throw an apple into the boat. If he can throuw the apple only wihta speed of 10 m/s, find the minimum and maximum angles of projection for successful shot. Assume that the point of projection and the edge of the boat are in the same horizontal level

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45. A $400m$ wide river is flowing at a rate of $2.0ms^{-1}$. A boat is sailing with a velocity of

$10ms^{-1}$ with respect to the water, in a direction perpendicular to the river.

(a) Find the time taken by the boat to reach the opposite bank.

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46. A swimmer wishes to cross a $500m$ river flowing at $5kmh^{-1}$. His speed with respect to water is $3kmh^{-1}$. The shortest possible time to cross the river is.

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47. A swimmer wishes to cross a 500 m wide river flowing at 5 km/h. His speed with respect to water is 3 km/h. Consider the situation of the previous problem. The man has to reach the other shore at the point directly opposite to his starting point. If the reaches the other shore somewhere else, he has to walk down to this point. Find the minimum distance that he has to walk.

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48. An aeroplane has to go from a point A to another point B, $500km$ away due 30° east of north. Wind is blowing due north at a speed of $20m/s$. The air-speed of the plane is $150m/s$. (a) Find the direction in which the pilot should head the plane to reach the point B. (b) Find the time taken by the plane to go from A to B.

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49. Two friends A and B are standing a distance x apartin an open field and wind is blowing from A to B.A beats a drum and B hears the sound t_1 timed after he sees the event. A and B intechange their positions and te experiment is repeated. This time B hears teh drum t_2 time after he sees the event. Calculte teh velocity of sound in still air v and the velocity of wind u. Neglect the tiem light takes in travelling between the friends.

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50. Two friends A and B are standing a distance x apart in an open field and wind is blowing from A to B. A beats a drum and B hears the sound t_1 timed after he sees the event. A and B interchange their positions and the experiment is repeated. The velocity of sound in still air is v and the velocity of wind is u. This time B hears the drum t_2 time after he sees the event. Suppose A and B change their positions in such a way that the line joining them becomes perpendicular to the direction of wind while maintaining the separation x.

What will be the time lag B finds between seeing and hearing the drum beating by A?

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51. Six particles situated at the corners of a regular hexagon of side a move at a constant speed v. Each particle maintains a direction towards the particle at the next corner. Calculate the time the particles will take to meet each other.

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