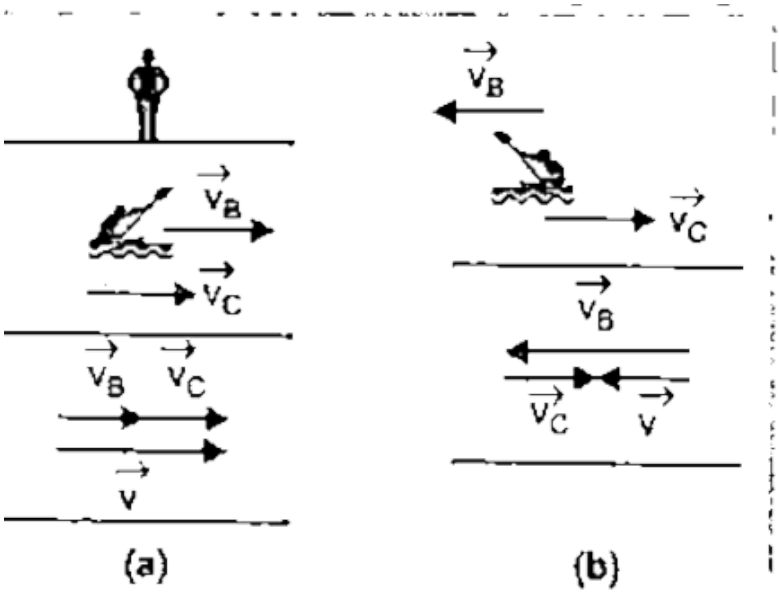
PHYSICS

BOOKS - SHREE BALAJI PHYSICS (HINGLISH)

DESCRIPTION OF MOTION

Illustration



1.

A boat moves with velocity $\vec{V}_B$ in still water [Fig(a)]. Velocity measured

by observer on ground will be $\vec{V}_B$ but if water flows at a certain rate it will make the bota move faster or slower depending on whether The boat moves along the steam or opposite to te strem. the velocity measured by an observer on the shore is the vector sum of the velocity of the boat $\vec{V}_B$ and the current velocity $\vec{V}_C$.

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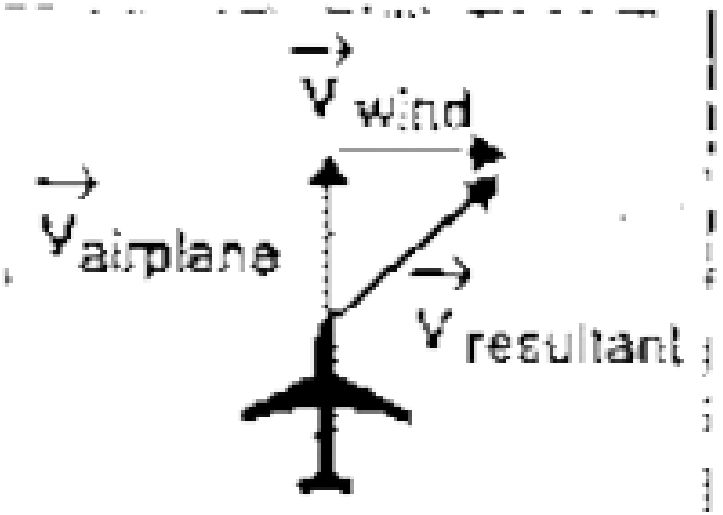
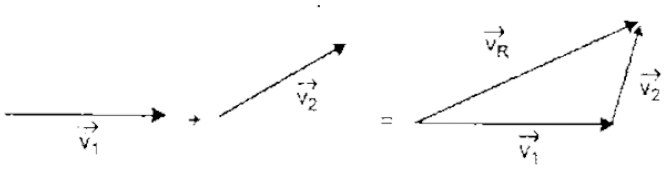
2.



Similarly if an airplane moves in a wind its resultant velocity will be a conbination of its own velocity and velocity of wind.

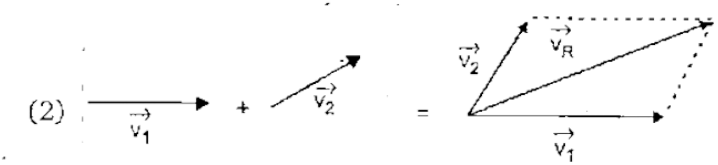
$\vec{v}_{\text{resultant}} = \vec{v}_{\text{airplane}} + \vec{v}_{\text{wind}}$

(1).



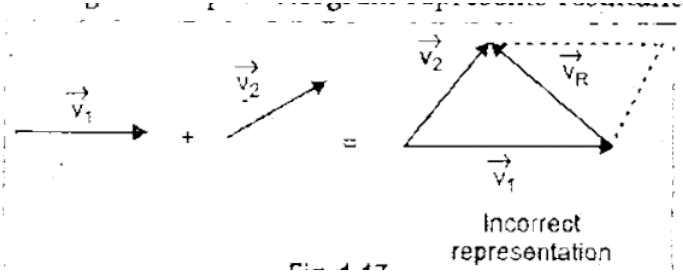
vectors to be added are placed tail to tip.

Fig. 1.15



Correct representation

Vectors to be added are placed tail such that they represent consecutive sides of a parallelogram. Diagonal of parallelogeam represent resultant.



Incorrect representation

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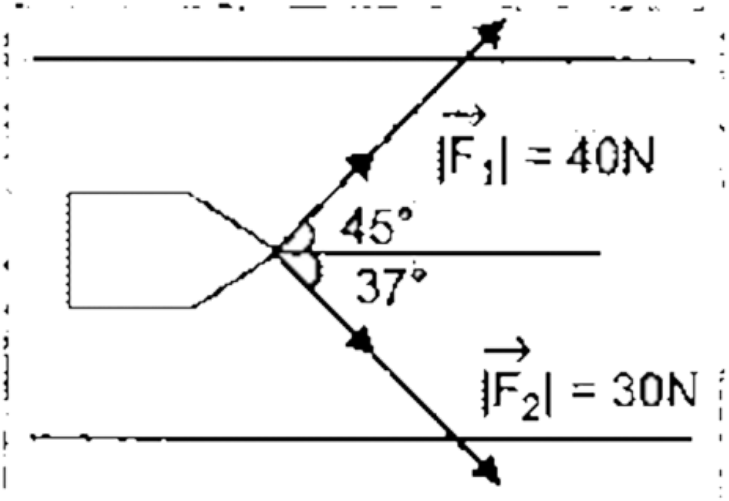
3.



A boat is tied to river bank with ropes as shown in figure. Force exterted by ropes on boat is shown in figure. What are x and y-components of $\vec{F}_1$ and $\vec{F}_2$ vectors?

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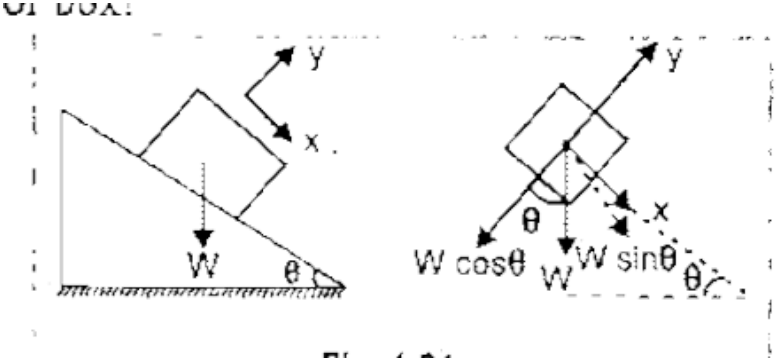

4.

A box of mass m is placed on a smooth frictionless incline weight of an object acts in vectical direction. Consider x and y-axis parallel and perpendicuar to incline what are x and y-components of weight W of box?

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5. A man rows a boat with a speed 10 m/s along N-E direction. The shore line is 15° south of east. . What are components of the velocity vector

along and perpendicular to shore?

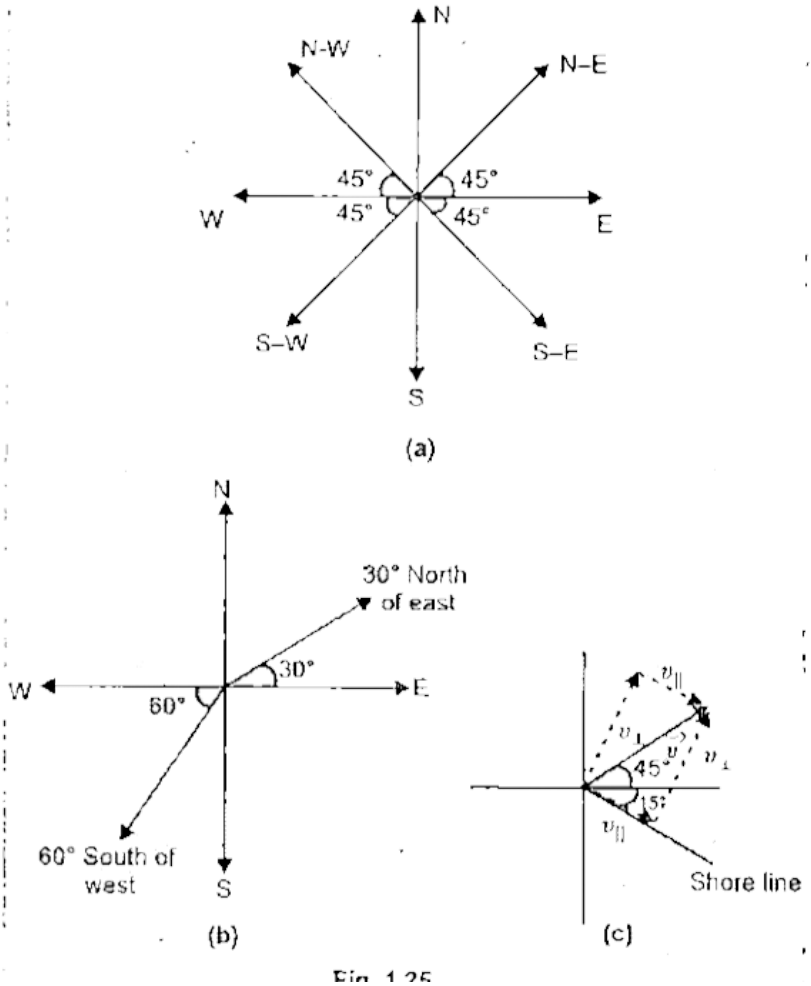

Fig. 1.25

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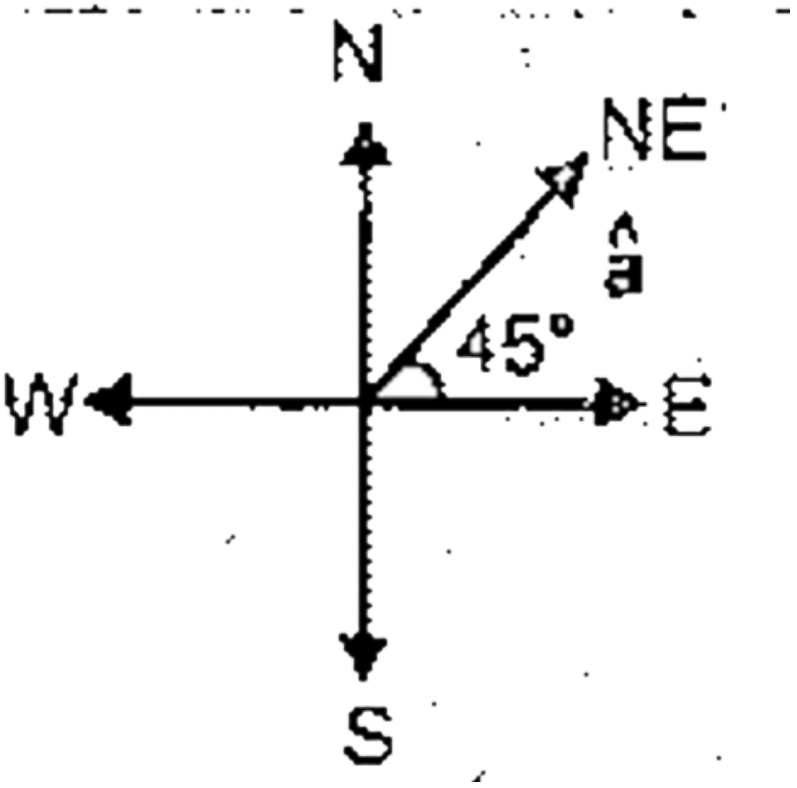
6. Write unit vector in direction of N-E, N-W, S-W andS-E.



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7. A boat is moving in direction $-4\hat{i}+3\hat{j}$ with ,a speed of 10 rn/s. Write velocity vector of boat in unit vector notation. Direction of motion of

boat is along unit vector :

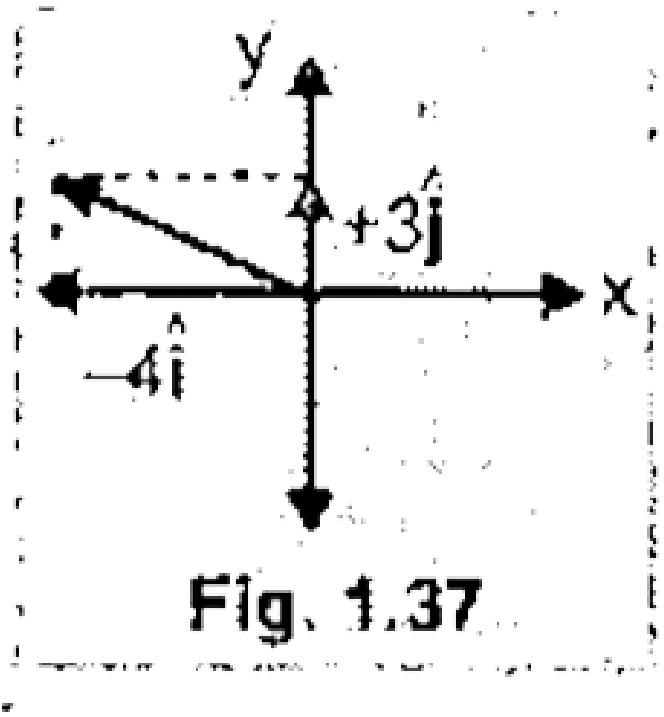

Fig. 1.37

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8. A hill is inclined at 0 with horizontal. Write a unit vector in direction parallel and perpendicular to hill, in standard x-y-coordinate system

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Example

1. A bird ,moves with velociry 20 m/ s in a direction making an, :angle of 60° with the eastern line and 60° with verticalj lupward~present the velocity vector in rectan!(Ular form.

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2. Two vectors, both equal in magnitude, hav. e their resultant!! !equal in magnitude of the either vector. Find the angle between the vectors.

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3. The sum of the magnitudes of two forces acting at a point is 18 and the magnitude of their resultant is 12. If the resultant is at 90° with the force of smaller magnitude, What are the magnitudes of forces?

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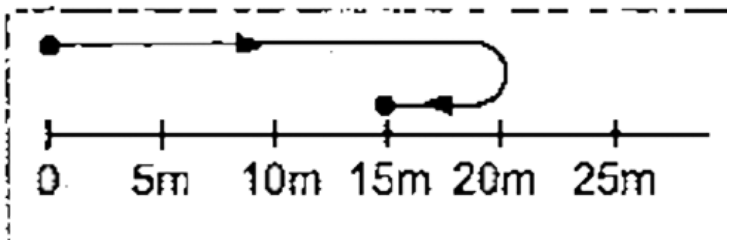
4. 

A student starts from his physics classroom considered to bel !origin, walks 20 m down the corridor, then stops, turns ,around and walks 5.0 m back towards the classroom. He stops 15.0 mfrom the door. Tota1time of motion is 25.0 sec. What is his average speed and average velociry?

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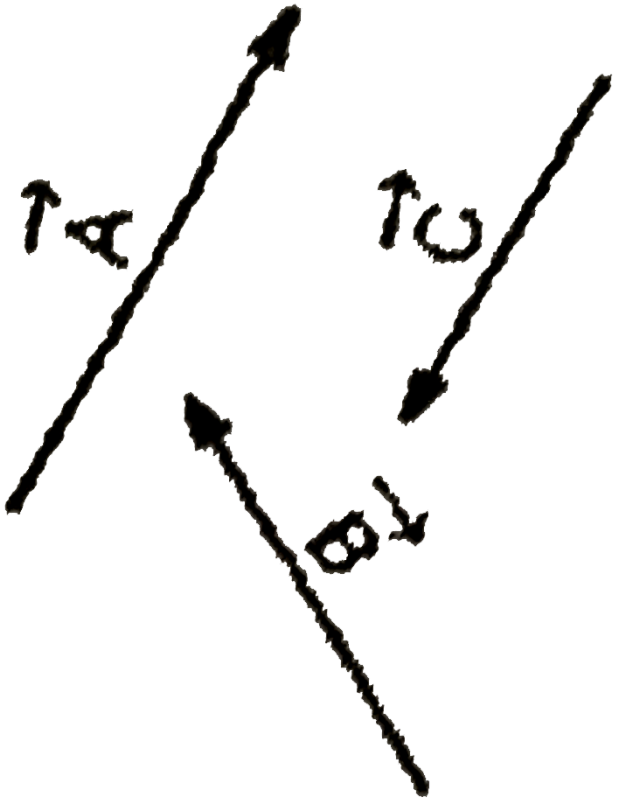
5. Consider three vectors $\vec{A}, \vec{B}$ and $\vec{C}$ as shown in fig. perform graphically the following vector additions and subtractions (a) $\vec{A} + \vec{B}$

(b). $\vec{A} + \vec{B} + \vec{C}$

(c). $\vec{A} - \vec{B}$

(d). $\vec{A} + \vec{B} - \vec{C}$



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6. Vector $\vec{A} = 3\hat{i} + 5\hat{j} - 2\hat{k}$ and vector $\vec{B} = -3\hat{j} + 6\hat{k}$ find a, vector $\vec{C}$ such that $2\vec{A} + 7\vec{B} + 4\vec{C} = 0$

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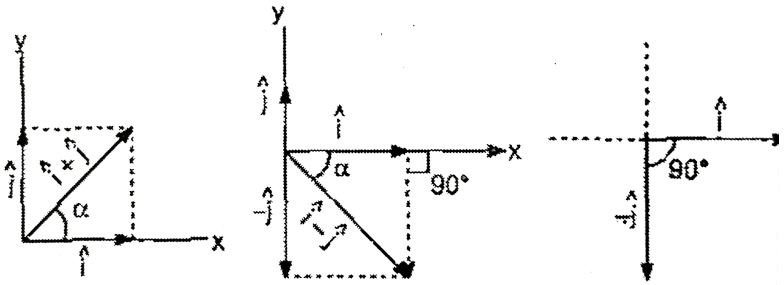
7. Two unit vectors $\hat{i}$ and $\hat{j}$ are directed along x-axis and y-axis respectively. What is the magnitude and direction of the vectors $\hat{i}+\hat{j}$ and $\hat{i}-\hat{j}$?



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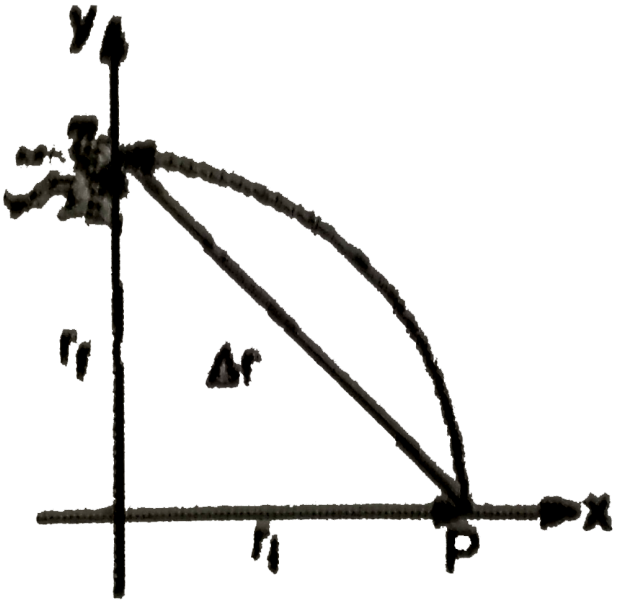
8. A girl is jogging along a circular path of radius. 25. 0 m. In 1 110.0 second she jogs a. quarter ofa circle starting from point1 P. (a) Compute her displacement and average velocity, and (b) Compute the magnirude

of the runner's average velocity and her average speed.



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9. Find he component of $\vec{a} = 2\hat{i} + 3\hat{j}$ along the direction of vectors $\left(\hat{i} + \hat{j}\right)$

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10. If $\vec{A} = 3\hat{i} + 4\hat{j}$ and $\vec{B} = 7\hat{i} + 24\hat{j}$, find a vector having the same magnitude as $\vec{B}$ and parallel and same direction as $\vec{A}$.

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11. Under a fore $\left(10\hat{i} - 3\hat{j} + 6\hat{k}\right)$ newton a bod of mass 5 kg moves from position $\left(6\hat{i} + 5\hat{j} - 3\hat{k}\right)$ m to position $\left(10\hat{i} - 2\hat{j} + 7\hat{k}\right)$m. deduce the work done.

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12. A particle moves in the x-y plane under the action of a force $\vec{F}$ such that the value of its linear momentum $\vec{P}$ at any time t is $P_x = 2\cos t$ and $p_y = 2\sin t$. What is the angle θ between $\vec{F}$ and P at a given time t?

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13. The velocity of a particle is $3\hat{i} + 2\hat{j} + 3\hat{k}$. Find the vector component of the velocity along the line $\hat{i} - \hat{j} + \hat{k}$ and its magnitude.

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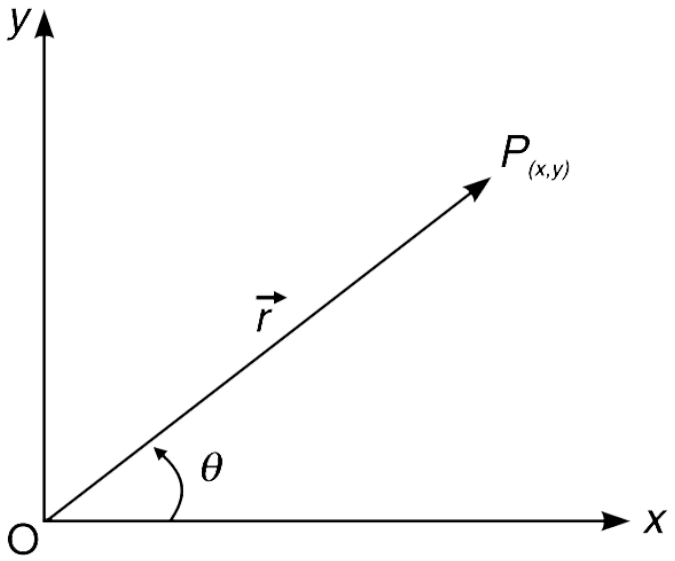
14. A particle has co-ordinates (x, y). Its position vector makes on angle θ with positive x direction. In an infinitesimally small interval of time the particle moves such that length of its position vector does not change but angle θ increases by $d\theta$. Express the change in position vector of the particle in terms of x, y, $d\theta$ and unit vectors $\hat{i}$ and $\hat{j}$.



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15. If two non-zero vectors $\vec{A}$ and $\vec{B}$ obey the relation $\vec{A} + \vec{B} = \vec{A} - \vec{B}$, the angle between them is

(a). 120°

(b). 90°

(c). 60°

(d). 0°

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16. $\hat{i}$ and $\hat{j}$ are unit vectors along x-axis and y-axis respectively what is the magnitude and direction of the vector $\hat{i} + \hat{j}$ and $\hat{i} - \hat{j}$? What are the magnitudes of components of a vector $\vec{a} = 2\hat{i} + 3\hat{j}$ along the directions of $\hat{i} + \hat{j}$ and $\hat{i} - \hat{j}$?

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17. Given $\vec{a} = \hat{i} + 2\hat{j} + 3\hat{k}$, $\vec{b} = -\hat{i} + +2\hat{j} + \hat{k}$ and $\vec{c} = 3\hat{i} + \hat{j}$ find the angle of resultant with x-axis. Also finid a unit vector in the direction of the resultant of these vectors. Also find a unit vecotr $\vec{r}$ which is normal to both $\vec{a}$ and $\vec{b}$ what is the inclination of $\vec{r}$ and $\vec{c}$?

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18. If $\vec{a} = 2\hat{i} + 3\hat{j} + 6\hat{k}$ and $\vec{b} = 6\hat{i} + 3\hat{j} - 2\hat{k}$, find the angle, between vectors $\vec{a}$ and $\vec{b}$. Also find unit vector perpendicular to both $\vec{a}$ and $\vec{b}$

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19. A cyclist starting from a point A travels 200m due north to a point B at constant speed of 5 ms^{-1}. He rests at B for 30 seconds and then travels 300 m due south to a point G at a constant speed of $10ms^{-1}$ find average velcity.

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20. A particle is travelling in a straight line, it has a initial velocity of $10ms^{-1}$. When it is subjected to an acceleration of $-2ms^{-2}$ for 8 sec. find displacement and distance traversed in 8 sec.

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21. A particle moves in a straight line with constant velocity of 5 ms^{-1} for 2 sec. it then moves with a constant acceleration of $-2ms^{-2}$ for 8 sec. draw velocity-time graph for 10 sec of motion and find

(a). Final velocity

(b). Displacement

(c). Total distance.

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22. Differentiate

(a). $f(x) = \dfrac{1}{x^2}$

(b). $y = \sqrt[2]{x^2}$

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23. Find the points on the curve $y = x^4 - 6x^2 + 4$ where the tangent line is horizontal.

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24. if $f(x) = xe^x$ find $f'(x)$

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25. Differentiate the function $f(t) = \sqrt{t}(1 - t)$

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26. if $f(x) = \sqrt{x}g(x)$ where $g(4) = 2$ and $g(4) = 3$, $f \in df(4)$

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27. Find an equation of the tangent line to the curve $y = e^x / \left(1 + x^2\right)$ at the point $(1, e/2)$

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28. differentiate $y = x^2 \sin x$.

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29. Differentiate $y = \tan x$

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30. Find $F'(x)$ if $\left(F(x) = \sqrt{x^2 + 1}\right)$

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31. Differentiate $y = \left(x^3 - 1\right)^{100}$

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32. Find $f(x)$ if $f(x) = \dfrac{1}{\sqrt[3]{x^2 + x + 1}}$

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33. find the derivative of the function

$g(t) = \left(\dfrac{t - 2}{2t + 1}\right)^9$

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34. Defferentiate $y = e^{\sin x}$

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35. Let $s(t) = t^3 - 6t^2$ be the position function of a particle moving along an s-axis, where s is in meters and t is in sec. find the instantaneous acceleration a(t) and show the graph of acceleration versus time.

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36. The po9sition of aparticle is given by the equation.

$s = f(t) = t^3 - 6t^2 - 9t$

where r is is measure in seconds and s in meters.

(a). Find the velocity at the t

(b). What is thhe velocity after 2s ? After 4 s ?

(c). When is the particle at rest ?

(d). When is the particle moving formward that is, ini the positive direction)?

(e). Find the total distance traveled by the particle during the first five sec.?

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37. sketh the region whose area is represented by the definite integral and evaluat the integral using an appropriate formula form geometry.

(a). $\int_1^4 2dx$

(b). $\int_{-1}^2 (x+2)dx$

(c) $\int_0^1 \sqrt{1-x^2}dx$

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38. Evaluate

(a). $\int_0^2 (x-1)dx$

(b). $x \underset{0}{\overset{2}{-}} 1dx$

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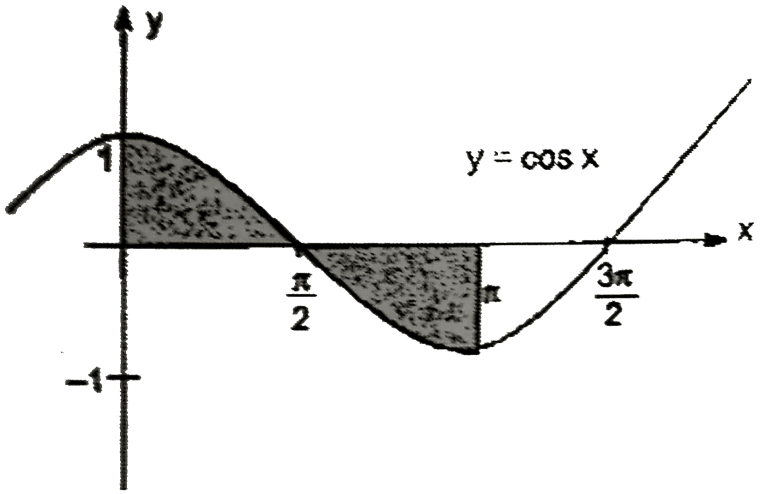

39.

(a). Find the area under the curve $y = \cos x$ over the interval $[0, \pi/2]$ and $[0, \pi]$

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40. Evaluate

$$\int_0^3 (x^3 - 6x)\,dx$$

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41. Find $\int_0^2 \left(2x^3 - 6x + \frac{3}{x^2+1}\right)dx$

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42. Evaluate $\int_1^9 \frac{2t^2 + t^{\frac{1}{2}}\sqrt{t} - 1}{t^2} dt$

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43. A particle moves along a line so that its velocity at time t is $v(t) = t^2 - t - 6$ (measured in meters per second) ltbr. (a). Find the displacement of the particle during the time period $1 \leq t \leq 4$

(b). Find the distance traveled dring this time period.

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44. Find the position function of a particle that moves with velocity $v(t) = \cos \pi t$ along a coordinate line, assuming that the particle has coordinate $s = 4$ or time t=0.

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45. Suppose that a particle mvoes on a straight line so that is velocity at time t is $v(t) = \left(t^2 - 2t\right) m/s$.

(a). Find the displacement of the particle during the time interval $0 \leq t \leq 3$

(b). Find the distance traveled by the particle during the time interval $0 \leq t \leq 3$.

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46.

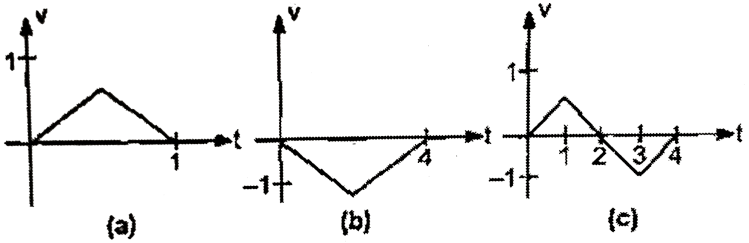

Fig. shows thre velocity versus time curves for a particle in rectilinear motionalong a horizontal line. In each case, find the displacement of the particle over the time interval $0 \leq t \leq 4$, and explain what it tells you about the motion of the particle.

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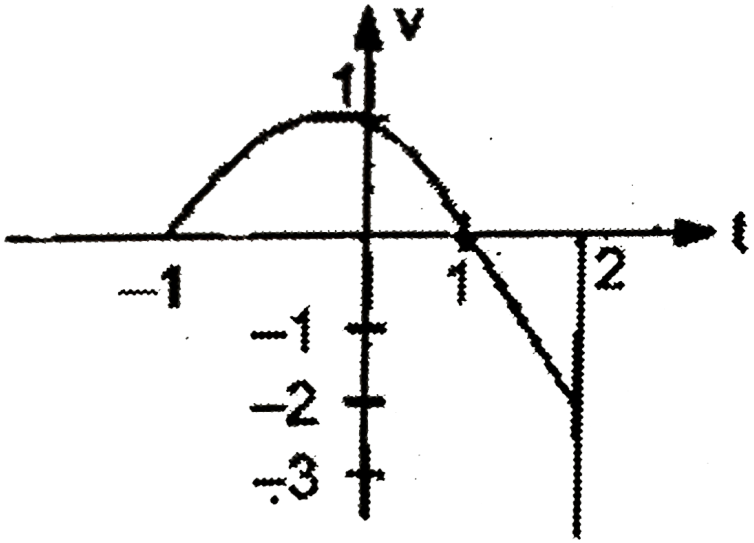

47.

find the total area between the cuve $y = 1 - x^2$ and the x-axis over the interval [0,2] (fig).

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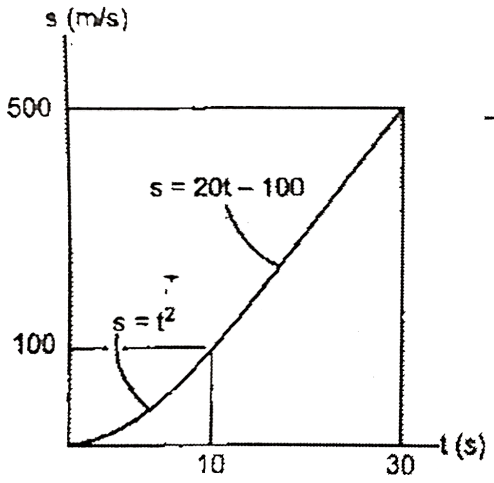

48.

A bicycle moves along a stragith road such that its construct the v-t and a-t graphs for $0 \leq t \leq 30$.

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49. An experimental car in fig (a) starts from rest and travels along a straight track such that it accelerates at a constant rate for 10 s and then decelerates at a constant rate draw the v-t and s-t graphs and determine the time t' needed to stop the car. how far has the car travelled.?

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50. Given $a = 4 - 2t$, initial velocity at $t = 0, u = 5$, find distance travelled till 12 sec.

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51. If a particle with $a = kv^2$ and initial velocity is u then velocity after S displacement. Here k is a constant

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52. Given $a = -\cos t$, at $t = 0, u = 0, x = 1$

Position at $t = \pi$

Find distance from 0 to 2π.

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53. A particle moves along x-axis with acceleration $a = 6(t-1)$ where t is in second. If the particle is initially at the origin and it moves along positive x-axis with $v_0 = 2m/s$, find the nature of motion of the particle.

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54. A particle moves alo g a straight line and its velocity depends on time as $v = 6t - 3t^2$ where 'v' is in m/sec and 't' is in sec. find average velocity and average speed forr first four seconds.

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55. Velocity vector of a particle is given as

$\vec{v} = 4t\hat{i} + 3\hat{j}$

At t=0 position of the particle is given as $\vec{r}_0 = 2\hat{j}$

Find the position vector of the particle at t=2 sec and te average acceleration of the particle for t=0 to t=2sec.

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56. Given that $x = 120 - 15t - 6t^2 + t^3 (t > 0)$, find the time when the velocity is zero. Find the displacement at this instant.

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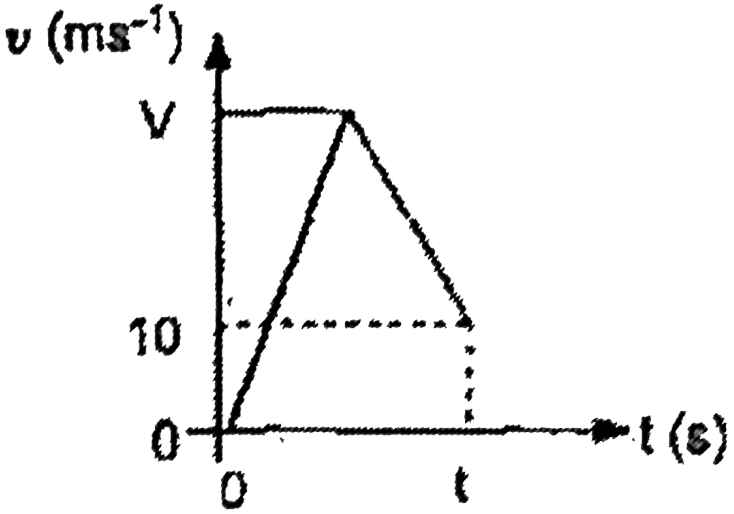
57. (The figure shows the (V,t) graph for the train .accelerating' ifrom resi up to a maximum speed of $Vms - 1.$ and then decelerating to a speed of $10ms^{-1}$The acceleration and deceleration. have , the same magnitude which is equal to $0.5m / s$



show that the distance travelled is $\left(2V^2 - 100\right)$ metre

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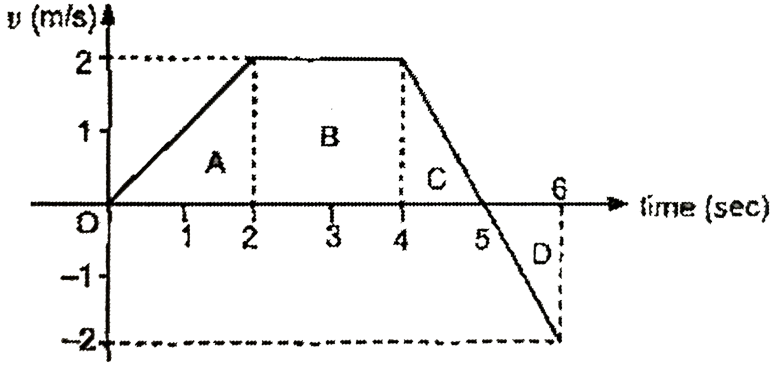
58. The velocily-time graph for a particle travelling along a straight line is.shown in the Fig. 1E:61. Find



(a). distance travelled from zero to 6 sec.

displacement in the above time interval

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59. A bird flies for 4s with a velocity $V = (t-2)m/s$ in a straight line where t= time in second Calculate the displacement and distance covered by the bird

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60. A particle moves in such a way that its position vector at any time $t$ist "is" hati+$\frac{1}{2}t^2\hat{j} + t\widehat{K}$ Find a function of time (a) the velocity, (b) the speed, (c) the acceleration, (d) the magnitude of the acceleration, (e) the magnitude of the component of acceleration along velocity (called tangential' acceleration), (f) the magnitude of the component ofacceleration perpendicular to velocity (called normal acceleration).

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61. A particle moves in xy plane with a velocity given by $\vec{V} = (8t - 2)\hat{i} + 2\hat{j}$. . If it passes through the point $(14, 4)$ at `t=2 sec , then give eqution of the point

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62. First, an auto starts from rest and accelerates uniformly for 15 s acquiring a velocity of $30m/s$. Secondly, the auto then moves:at this constant velocity of $30m/s$ for the next 15 s, after which thirdly, the auto decelerates uniformly by braking at $1.5m/s^2$ until it stops.

(a) Sketch the velocity-time graph.

(b) Sketch the acceleration-time graph for auto

(c) Sketch displacement-time graph for auto

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63. A particle having a velocity $v = v_0$ at $t = 0$ is decelerated at the rate $|a| = \alpha\sqrt{v}$, where α is a positive constant.

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64. A particle travels so that its acceleration is given by $\vec{a} = 5\cos t\hat{i} - 3\sin t\hat{j}$. If the particle is located at $(-3, 2)$ at time $t = 0$ and is moving with a velocity given by $\left(-3\hat{i} + 2\hat{j}\right)$. Find

(i) The velocity $\left[\vec{v} = \int \vec{a}\,.\,dt\right]$ at time t and

(ii) The position vector $\left[\vec{r} = \int \vec{v}\,.\,dt\right]$ of the particle at time $t(t > 0)$.

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65. (i) A particle is moving in three dimensions.Its position vector is given by

$\vec{r} = 6\hat{i} + (3 + 4t)\hat{j} - \left(3 + 2t - t^2\right)\hat{k}$

Distance are in meters, and the time t, in seconds.

(a) What is the velocity vector at $t = +3$?

(b) What is the speed $(\text{in} m/\sec) at. t = +3$?

(c) What is the acceleration vector and what is its magnitude $\left(\text{in m}/\sec^2\right) at. t = +3$?

(ii) Now the particle is moving only along the z-axis, and its position is given by $\left(t^2 - 2t - 3\right)\hat{k}$ k at what time does the particle stand still? _

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66. A body projected vertically upward from the top of a tower reaches the ground in itme t_1. If it is projected vertically downwards from the same position with the same velocity , it reaches the ground in time t_2. If a body is released from rest and from the same position then what will be the time (t) required by body to reach the ground?

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67. A body falls from same height and return back to initial position Draw displacement $\hat{s}$-time (t), distance (s) - time (t) and velocity $\widehat{V}$-time (t),

speed (v), time (t) and acceleration $\hat{a}$-time (t) graphs for the motion of the body

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68. A boy throws a ball vertically upward with an initial speed of $15.0m/s$ .The ball was released when it was at 2.00m above ground. The boy catches it at the same point as the point of projection

(a) What is maximum height reaches by the ball ?

How long is the ball in the air?

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69. A man standing in an elevator observes a screw fall from the ceiling. The ceiling is 3 m above the floor.

(a) If the elevator is moving upward with a speed of $2.2m/s$ how long does it takes for the screw to hit the floor?

(b) How long is the screw in air if the elevator starts from rest when the

screw falls and moves upwards with a constant acceleration of $a = 4.0m/s^2$?

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70. A speeder moves at a constant $15m/s$ in a school zone A police car starts from rest just as the speeder passed it.The police car accelerates at.$2m/s^2$ until it reaches its.maximum velocity of $20m/s$. Where and when does the speeder get caught ?

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71. two cars approach each other on a straight road. Car A moves at $16m/s$ and car B moves at $8m/s$. When they are $45m$ apart both drivers apply their brakes. Car A slows down at $.2m/s^2$. While car B slows down at $4m/s^2$. Where and when do they collide?

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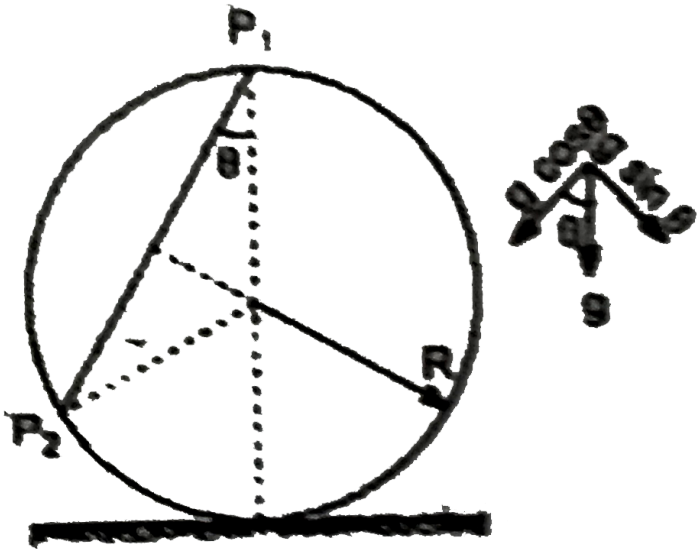
72. A circular wire frame is fixed in a vertical plane. A smooth wire is tightly stretched between point $P_1 \text{and} P_2$. A bead slides from the point P_1 the highest point of the circle Determine (a) its velocity v when it arrives at P_2 and (b) show that time to slide along any similar chord is same



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73. A car is speeding at $25m/s$ in a low speed zone .A police car starts from rest just as the speeder passes and accelerates at a constant rate of $5m/s^2$

(a) When does the police car catch the speeding car?

(b) How fast in the police car travelling when it catches up with the speeder ?

How for have the cars travelled when the police car catches the speeder?

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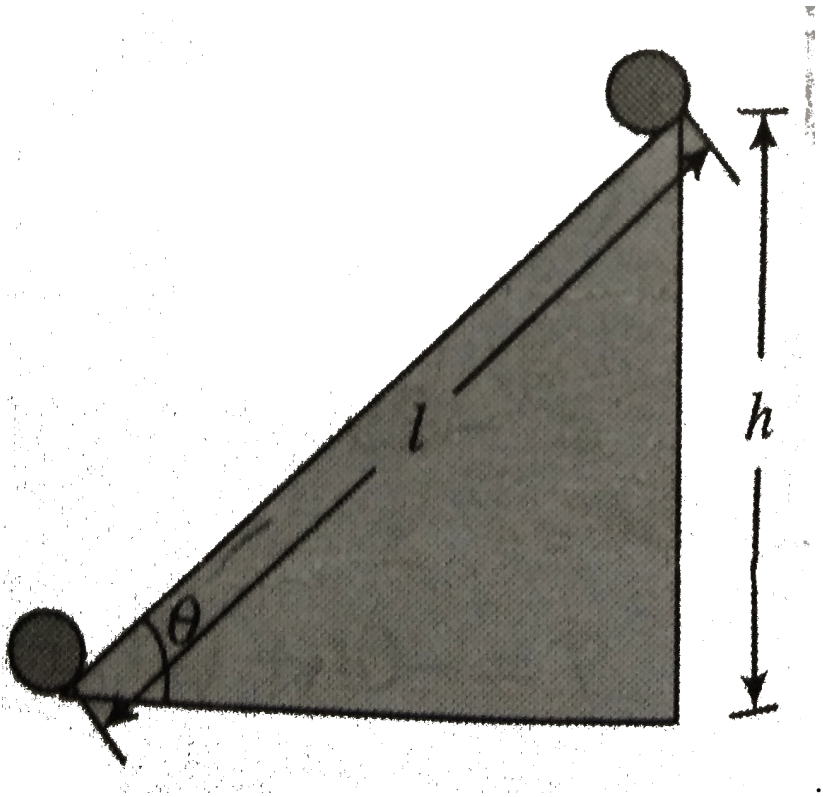
74. Ball 1 is released from the top of a smooth inclined plane, the at the same instant ball 2 is projected from the foot of the plane with such a velocity that they meet halfway up the incline. Determine:

a.the velocity with which balls are projected and

b. the velocity of each ball when they meet.



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75. The velocity of a particle at $t = 0 \text{is} \overrightarrow{U} = 4\hat{i} + 3\hat{j}\text{m}/\text{sec}$ and a constant acceleration is $\overrightarrow{a} = 6\hat{i} + 4\hat{j}\text{m}/\text{sec}^2$. Find the velocity and displacement of the particle at $t = 2\,\text{sec}$.

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76. The acceleration of a moving body at any time 't' is given by $\vec{a} = (4t)\hat{i} + \left(3t^2\right)\hat{j}$ $\mathrm{m/sec^2}$. $If \vec{U} = 0$ then find the velocity of the prticle at 4 sec.

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77. A particle of mass 1 kg has a velocity of $2m/s$. A constant force of 2N acts on the particle for 1s in a direction perpendicular to its initial velocity. Find the velocity and displacement of the particle at the end of 1 s.

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78. A particle is moving in xy-plane .At certain instant the components of its velocity and acceleration are as follows $u_x = 3m/s, u_y = 4m/s, a_x = 2m/s^2 \text{and} a_y = 1m/^2$. The rate of change of speed at this moment is

$(a) 4.\ m/s^2$

$(b) 2, m / s^2$

$(c) \sqrt{3}. m / s^2$

$(d) \sqrt{5}. m / s^2$

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79. The figure shows the velocity and the accelerationl of a point-like body at the initial moment of its motion. The direction and the absolute value of the acceleration remain constant.Find the time in seconds when the velocity reach its minimum value?

`("Data" : a=6m//^(2), v_(0)=24m//s,phi=143^(@))

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80. A footballer throws a ball from a height of 2.00m above the ground with an initial velocity of $20.0m/s$ at an angle of 30° above the horizontal (a) How long does the ball take to cross the goal line $32.0m$ from the point of release?(b) What is the ball's height above the ground as it crosses the goal line?

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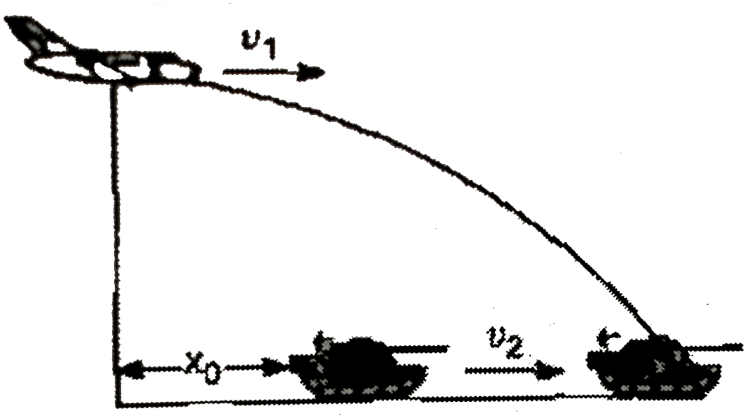
81. A bomber is moving horizontally at a speed $v_1 = 72m/s$ at a height of $h = 103m$. An enemy tank is moving horizontally $(x - a\xi s)$ with constant spedd . At the instant the bomb is released a tank is at a distance $x_0 = 125m$ from origin. Origin is directly below a bomber at the instant of release of bomb. Assurning the tank to be 3 m high find the

velocity v_2 and the time of flight of bomb.



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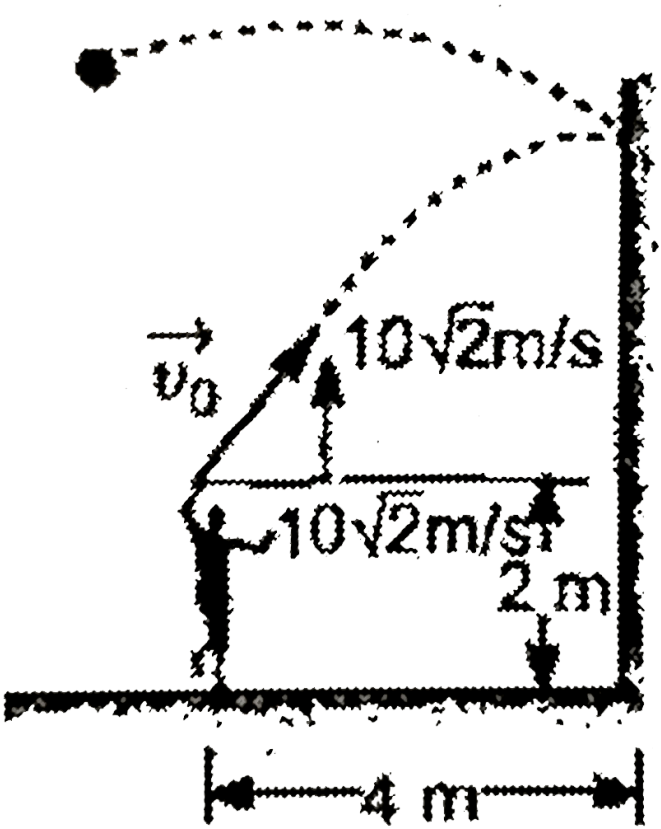
82. A boy throws a ball with velocity $v_0 = 10\sqrt{2}m/s$ at an angle of 45° as shown in the figure .After collision with the ball the vertical component of ball's velocity is unchanged and the horizontal. Component is reversed

in direction .Where does the ball hit the ground?



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83. A policeman is in pursuit of a thief Both are running at $5m/s$. Suddenly they come across a gap between building as shown in figure. The thief leaps at $5m/s$ and at 45° while the policeman leaps

horizontally.

(a) Does the policeman clear the gap ?

(b) BY how much does the thief clear the gap ?

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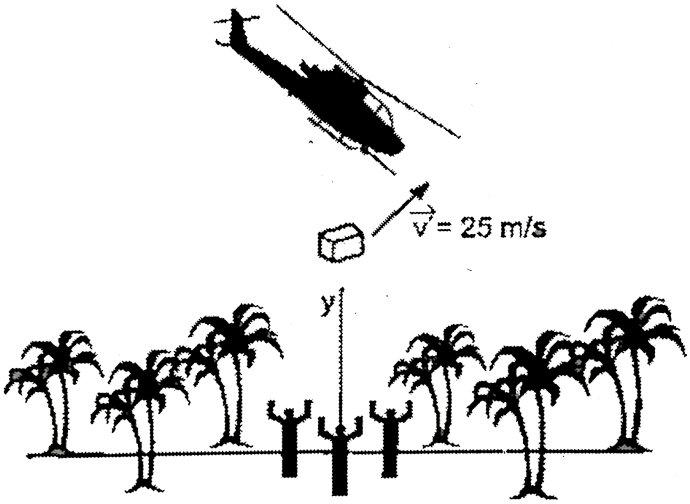
84. A helicopter is flying at 100m and flying at $25m/s$ at an angle 37° above the horizontal when a package is dropped from it ,

(a) Where does the package land ,

(b) If the helicopter flies at constant velocity where is it when the package lands?



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85. A particle is projected from the origin in such a way that it passes through a given point P (a, b} What is the minimum requrired speed to do so?

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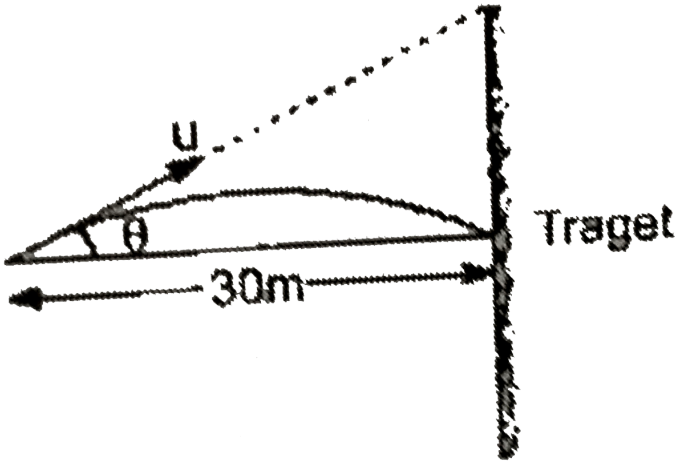
86. A bullet with muzzvelocity 100 m/s is to be shot at a target 30 m away in the horizontal line .How high above the target must the renaimed so that the bullet will hit the target?



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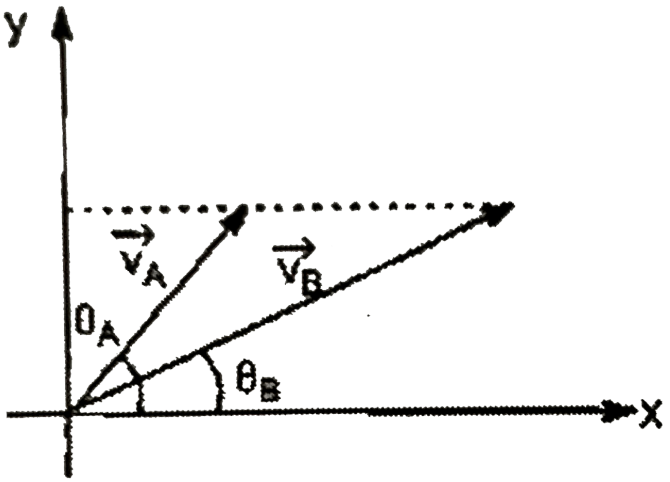
87. Iwo particles A & B are projected from the same point in, different directions in such a manner that vertical components of their initial velocities are same :

(a) Find ratio of time of flight

(b) Find ratio of range.



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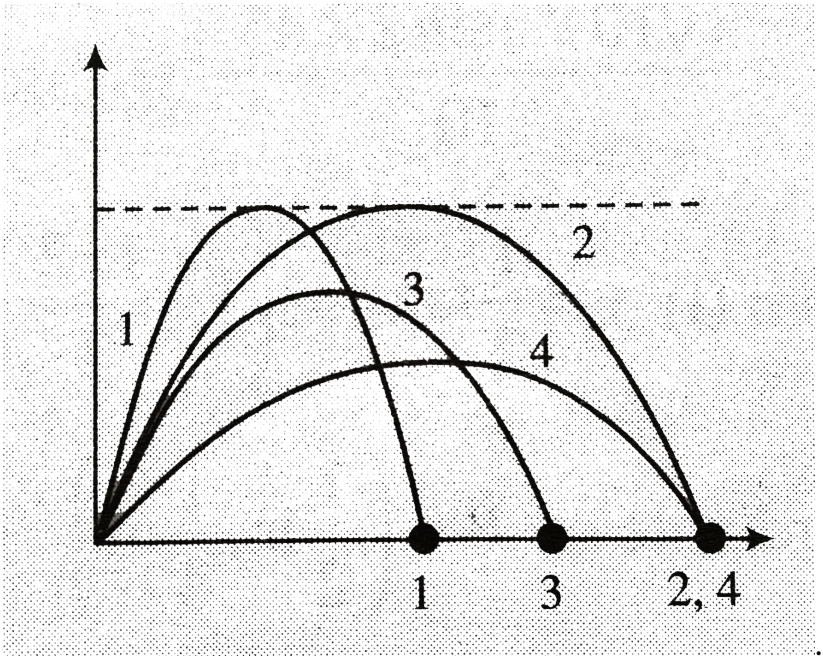
88. Four cannon balls, $(1), (2), (3),$ and (4) are fired from level ground. Cannon ball (1) is fired at an angle of 60° above the horizontal and

follows the path shown in (Fig. 5.9).



Cannon balls (2) and (3) are fired at angle of 45° and (4) is fired at an angle of 30° above the horozontal. Which cannon ball has the largest initial speed ?

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89. A particle is projected from origin in xy-plane and its equation ,of trajectory is given by $y = ax - bx^2$. The only acceleration ,in the motion is' f' which is constant and in $-ve$ direction of, y-axis.

(a) Find the velocity of projection and the angle of projection.

(b) Point of projection is considered as origin and x-axis along the horizontal ground. Find the horizontal range: and maximum height of projectile. Projectile completes its flight in horizonal plane of projection.

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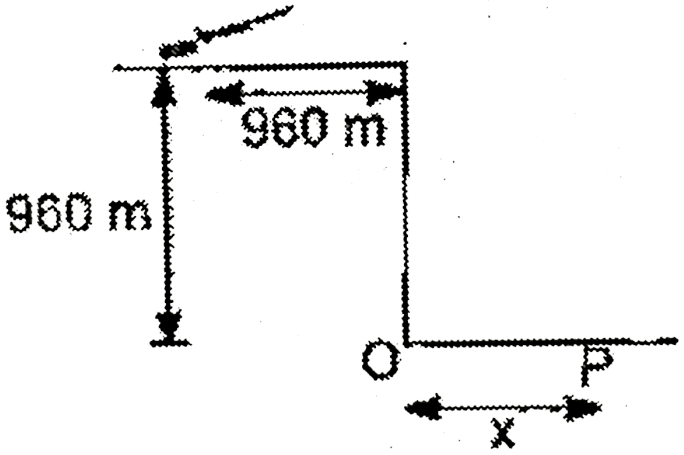
90. A gun is mounted on a plateau 960 m away from its edge as shown. Height of plateau is 960 m The gun can fire shells with a velocity of 100 m/s at any angle. Of the following choices, what is the minimum distance (OP)x from the edge of plateau where the shell of gun can reach?



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91. Two particles were projected one by one with the same initial velocity from the same point on level ground. They follow the same parabolic trajectory and are found to be in the same horizontal level, separated by a distance of $1m, 2s$ after the second partice was projected. Assume that the horizontal component of their velocities is $0.5ms^{-1}$. Find

(a) the horizontal range of the parabolic path.

(b) the maximum height for the parabolic path.

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92. A projectile is fired with velocity v_0 from a gun adjusted for a maximum range.It passes through two points P and Q whose heights above the horizontal are h each.The separation of the two points is

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93. A fighter plane is flying horizontally at a height of $250m$ from ground with constant velocity of $500m/s$. It passes exactly over a cannon which

can fire a shell at any time in any direction with a speed of $100m/s$. Find the duration of time for which the plane is in danger of being hit by a cannon shell.

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94. A shot is fired with a velocity u at a very high vertical wall whose distance from the point of projection is x.The greatest height above the level of the point of projection at which the bullet can hit the wall is.

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95. An Aeroplane flies horizontaily at a height h at a speed v. An anti-air craft gun fires a shell at the plane when it is vertically above the gun. Show that the minimum muzzle velocity required to hit the plane is $\sqrt{v^2+2gh}$ at an angle $\tan^{-1}\left(\frac{\sqrt{2gh}}{v}\right)$

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96. A particle is projected from a point on the level ground and its height is h when at horizontal distances a and $2a$ from its point of projection. Find the velocity of projection.

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97. A man is riding on a flat car travelling with a constant speed of $10m/s$ .He wishes to throw a ball through a stationary hoop $5m$ above the height of his hands in such a manner that the ball will move horizontally as it passes through the hoop. He throws the ball with a speed of $12.5m/s$ w.r.t himself.

How many seconds after he release the ball will it pass through the hoop?

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98. A heavy particles is projected from a point at the foot of a fixed plane, inclined at an angle 45° to the horizontal, in the vertical plane containing

the line of greatest slope through the point. If $\phi(>45^\circ)$ is the inclination to the horizontal of the initial direction of projection,for what value of $\tan\phi$ will the particle strike the plane horizontal.

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99. The angular elevation of an enemy's position on a hill 'h' ft height is α .What should be the minimum velocity of the projectile in order to hit the enemy?

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100. A projectile is thrown at an angle θ with an inclined plane of inclination β as shown in fig. 1E108. Find the relation between β and θ ifv :

(a)projectile strikezs the inclined plane perpendicularly,

(b) projectile strikes the inclined plane horizontal.

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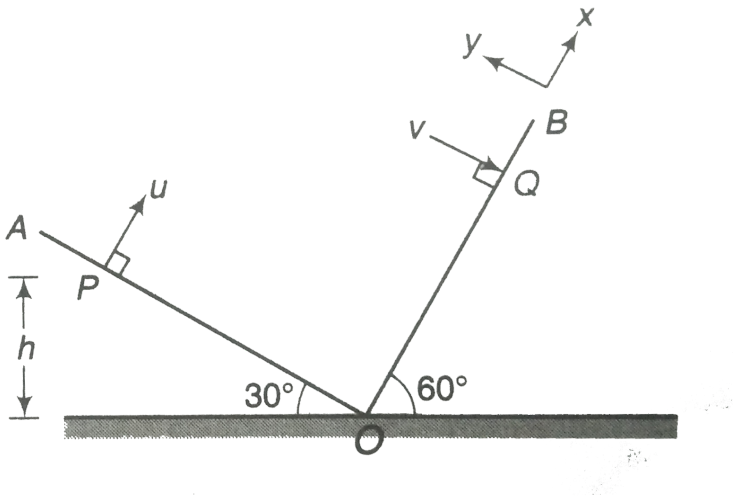
101. Two inclined planes OA and OB having inclinations 30° and 60° with the horizontal respectively intersect each other at O, as shown in figure. A particle is projected from point P with velocity $u = 10\sqrt{3}m/s$ along a direction perpendicular to plane OA. If the particle strikes plane OB perpendicular at Q. Calculate.



(a) time of flight,

(b) velocity with which the particle strikes the plane OB,

(c) height h of point P from point O,

(d) distance PQ. (Take $g = 10m/s^2$)

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102. Two guns situated at the top of a hill of height $10m$ fire one shot each with the same speed $5\sqrt{3}m/s$ at some interval of time. One gun fires horizontal and the other fores upwards at an angle of 60° with the horizontal. Two shots collide in air at a poit P. Find (i) time-interval between the firing and (ii) coordinates of the point P. Take the origin of coordinates system at the foot of the hill right below the muzzle and trajectorise in the $x-y$ plane.

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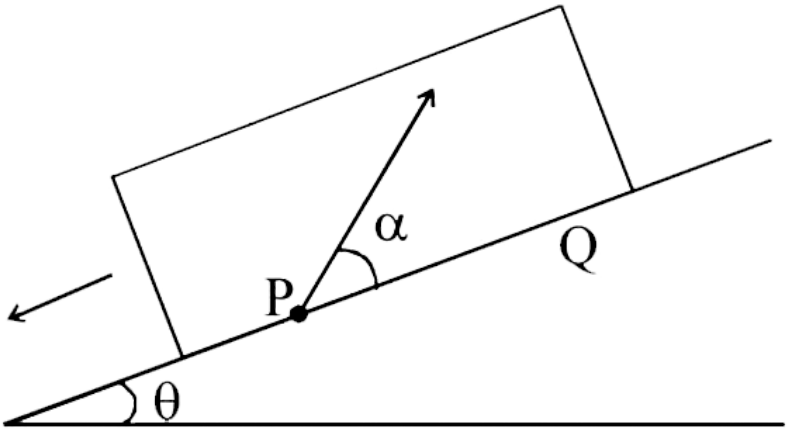
103. A large , heavy box is sliding without friction down a smooth plane of inclination θ . From a point P on the bottom of the box , a particle is projected inside the box . The initial speed of the particle with respect to the box is u , and the direction of projection makes an angle α with the bottom as shown in Figure .

(a) Find the distance along the bottom of the box between the point of projection p and the point Q where the particle lands . (Assume that the particle does not hit any other surface of the box . Neglect air resistance .)

(b) If the horizontal displacement of the particle as seen by an observer on the ground is zero , find the speed of the box with respect to the ground at the instant when particle was projected .



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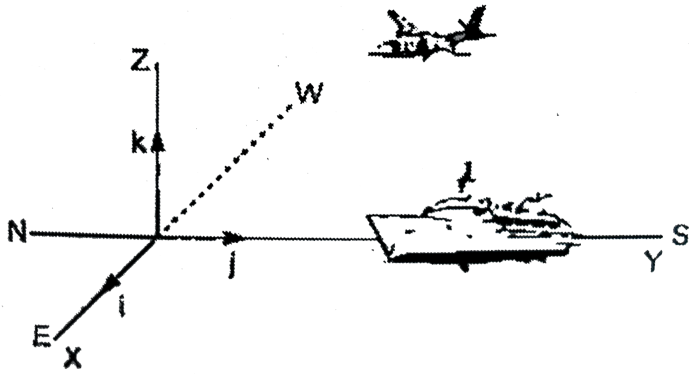
104. A helicopter is trying to land on a submarine deck which is moving south at 17m/s. A balloon is moving at 12m/s with wind into the west. If to the submarine crew the helicopter is descending vetically at 5m/s, what is

its speed? (a) relative to the water and (b) relative to the balloon. See fig.



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105. A boat moves right across a river with velocity $10Kmh^{-1}$ relative to water. The water has a uniform speed of $5.00Kmh^{-1}$ relative to the earth. Find the velocity of the boat' relative to an observer standing on either bank. If the width of river is $3.0Km$, find the time it takes the baat to cross it.

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106. If the baat of preceding example travels with same speed relaative to the river and is to be towards right across, in what direction shoul is head?

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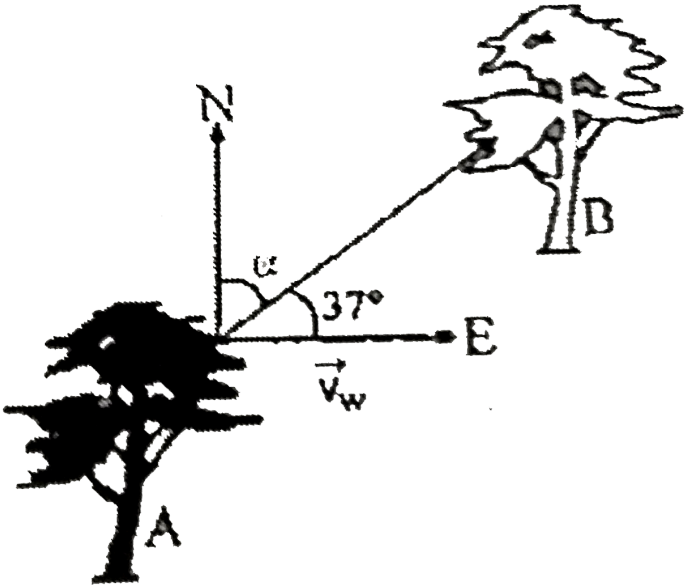
107. Wind is blowing in the east direction with a speed of 2m/s. A,. bird wishes to travel from tree A to tree B. Tree B is 100 m · away from A in a direction 37° north of east the velocity of ·bird in still air is 4 m/s.

(a) Find the direction in which bird should fly so that it can reach from A to B directly.

(b) Find the actual velocity of the bird during the flight.

(c) Find the time taken by the bird to reach B.



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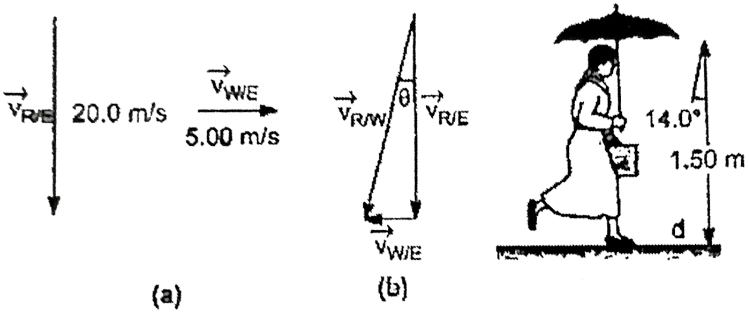
108. A woman is running through rain at a speed of 5.00 m/s. Rain is falling vertically at a speed of 20.0 m/s. (a) What is the velocity of the rain relative to the woman? (b) How far in front of her would an umbrella have to extend to keep the rain off if she holds the umbrella 1.50 m above her

feet?



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109. A boat has a velocity $4m/s$ towards east with respect to river is flowing north with velocity $2m/s$ Wind is blowing towards north with velocity $6m/s$. The direction of the flag blown over by the wind hoisted on the boat is :

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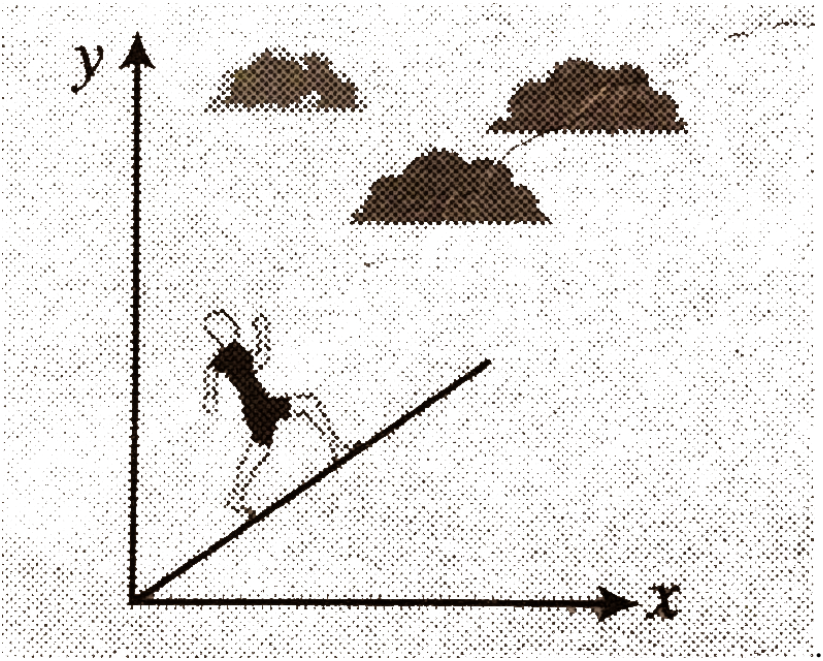
110. To a man running upwards on the hill, the rain appears to fall vertically downwards with $4ms^{-1}$. The velocity vector of the man w.r.t. earth is $\left(2\hat{i}+3\hat{j}\right)ms^{-1}$. If the man starts running down the hill with the

same speed, then determine the relative speed of the rain w.r.t. man.



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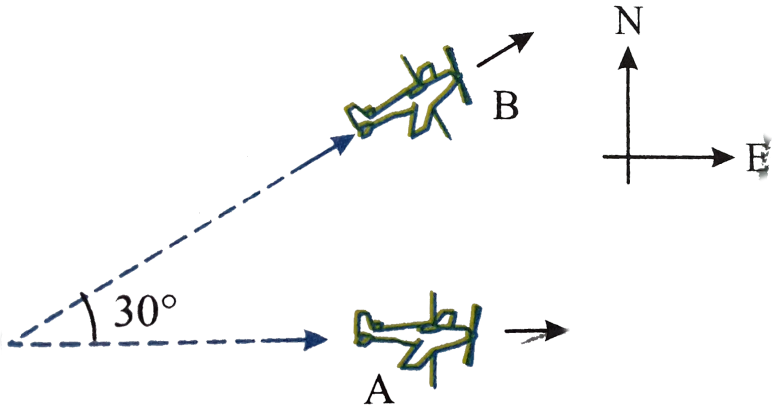
111. An aeroplane A is flying horizontally due east at a speed of $400km/hr$.Passengers in A, observe another aeroplane B moving perpendicular to direction of motion of A.Aeroplane B is actually moving in a direction 30° north of east in the same horizontal plane as shown in

the figure.Determine the velocity of B



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112. A man is coming down an incline of angle 30° . When he walks with speed $2\sqrt{3}m/s$ he has to keep his umbrella vertical to protect hismself from rain. The actual speed of rain is $5m/s$. At what angle with vertical should he keep his umbrella when he is at rest so that he does not get drenched ?

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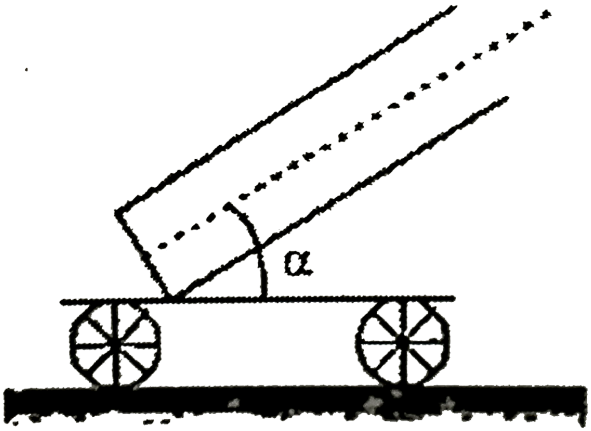
113. ·A pipe which can be swivelled in a vertical plane is mounted on a cart (see Fig. lE.122). The cart moves uniformly along a horizontal path with speed $v_1 = 2m/s$. At what angle a to the horizon should the pipe be placed so that drops of rain falling plumb with a velocity $v_2 = 6m/s$ move parallel to the walls of the pipe without touching them? Consider the velocity of the drope as constant due to the resitance of air.



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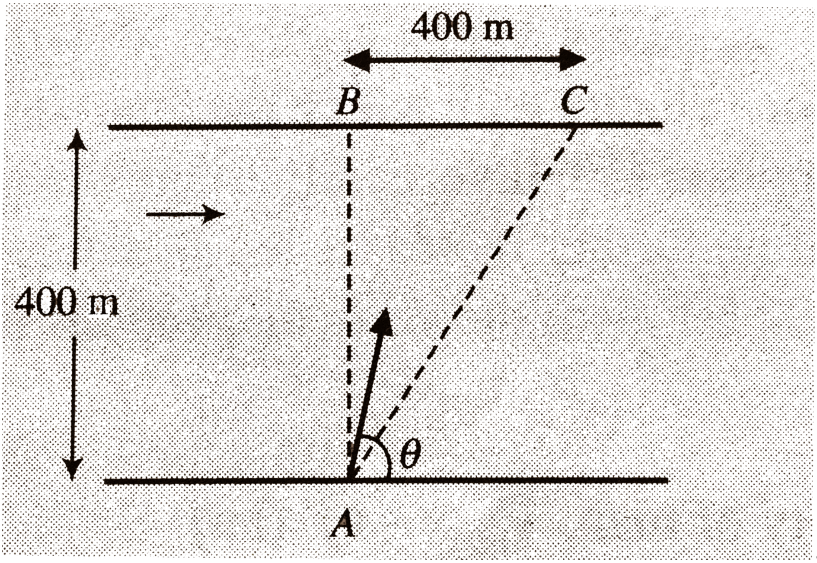
114. A river is flowing with a speed of $1kmh^{-1}$ A swimmer wants to go point C starting from A. He swims with a speed of $5kmh^{-1}$ at an angle θ w.r.t. the river flow. If $AB = BC = 400m$, at what angle with the river

bank should the swimmer swim ?



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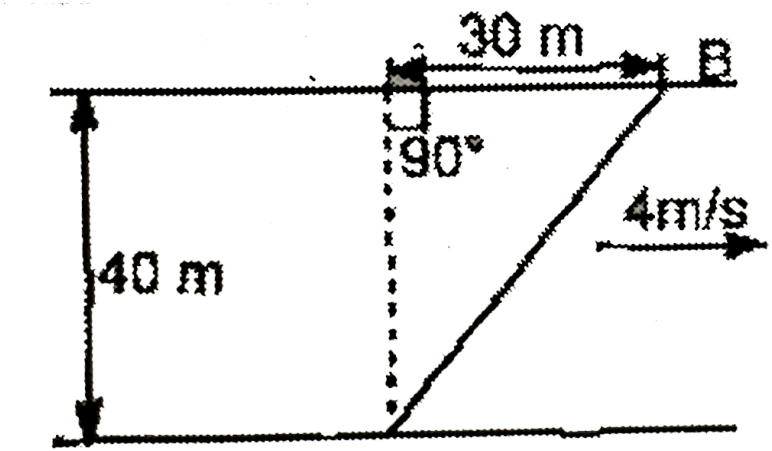
115. A man wants to reach point B on the opposite bank of a river flowing at a speed 4m/s as shown in the fig $1E.125$ (a) what minimum speed relative to water should the man have so that he can reach point B

directly by swimming? In which direction should he swin?



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116. A river has a width d. A fisherman in a boat crosses the river tiwce. During the first crossing, his goal is to minimize the cross minimize the distance that the boat is carried downstram In the first case, the crossing time is T_0 . In the second case, the crossing time is $3T_0$. What is the speed of the river flow? Find all possible answera:

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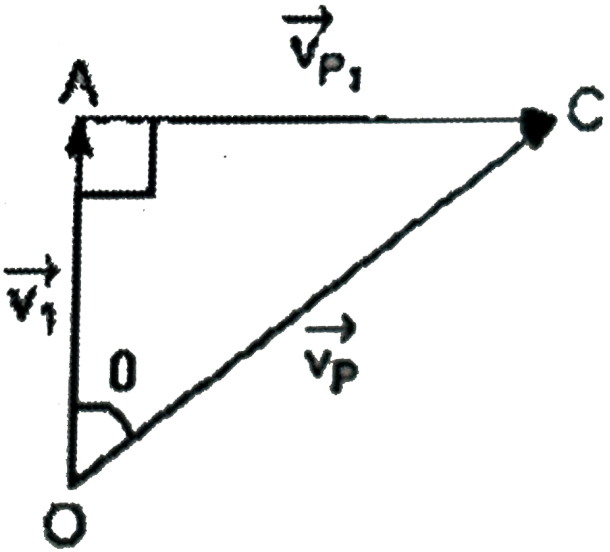
117. An airplane is observed by two persons travelling at 60 km/hour in two vehicles moving in opposite directions on a straight road. To an observer in one vehicle the plane appears to cross the road track at right angles while to the observer in the other vehicle the angle appears to be 45° . At what angle does the plane actually cross the road track and what is its speed relative to ground?



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118. The slopes of wind screen of two cars are $\alpha_1 = 30^\circ$ and $\alpha_2 = 15^\circ$ respectively. At what ratio $\frac{v_1}{v_2}$ of the velocities of the cars will their

drivers see the hail stones bounced back by the wind screen on their cars in vertical direction? Assume hail stones fall vertically downwards and collisions to be elastic.

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119. A car 2m long and 3m wide is moving at $10m/s$ when a bullet hits it in a direction making an angle of $\tan^{-1}(3/4)$ with the car as seen from the ground. The bullet enters one edge of the car at the corner and passes out at diagonally opposite corner. Neglecting gravity, the time for the bullet to cross the car is

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120. An elevator is moving with an upward acceleration a. A coin is dropped from rest from the roof of the elevator, relative to you. After what time the coin will strike the base of the elevator?

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121. A lift is moving with uniform downward acceleration of 2 m/s^2 . A ball is dropped from a height 2 metre from the floor of lift. Find the time after which ball will strike the floor.

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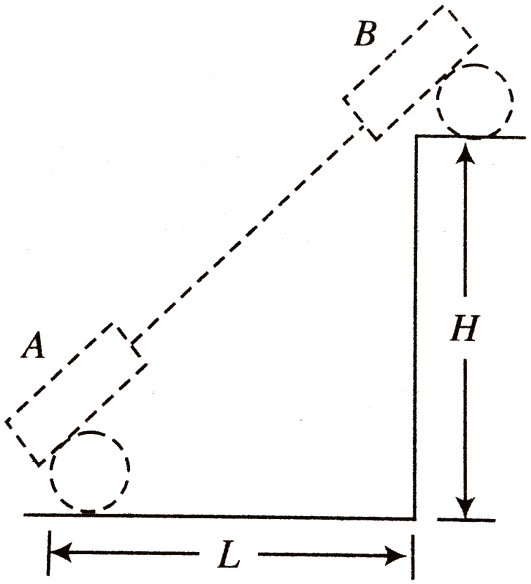
122. Cannon A is located on a plain a distance L from a wall of height H. On top of this wall is an idential cannon (cannon B). Ignore air resistance throughout this problem.

Also ignore the size of the cannons relative to L and H. The two groups of gunners aim the cannons directly at each other. They fire at each other simultaneously, with equal muzzle speed v_0

What is the velue of v_0 for which the two cannon balls collide just as they

hit the ground ?



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123. A platform is moving upwards with a constant acceleration of $2ms^{-2}$. At time $t = 0$, a boy standing on the platform throws a ball upwards with a relative speed of $8ms^{-1}$. At this instant, platform was at the height of $4m$ from the ground and was moving with a speed of $2ms^{-1}$. Take $g = 0ms^{-2}$. Find

(a) when and where the ball strikes the platform.

(b) the maximum height attained by the ball from the ground.

(c) the maximum distance of the ball from the platform.

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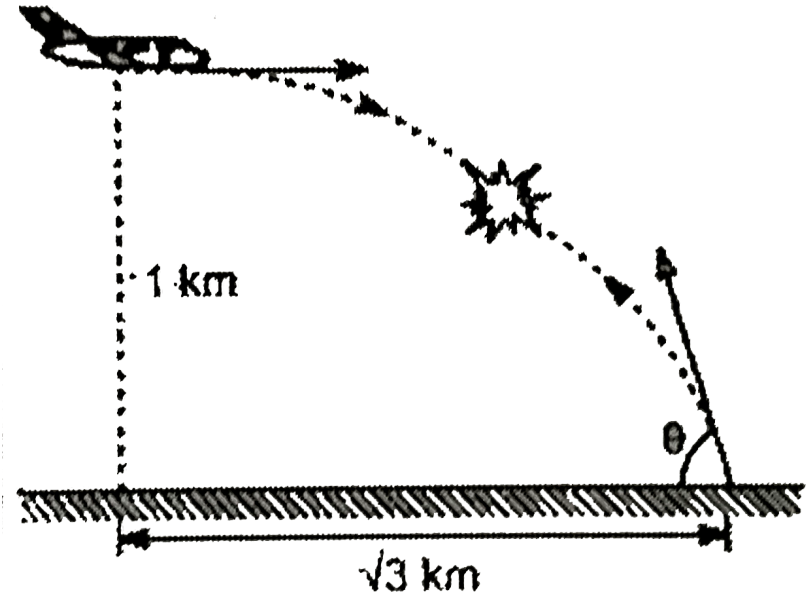
124. An aircraft is .flying. horizontally with a constant vefocity $= 200m/s$ at a height $= 1km$ above groun At the momement shown, a bomb is released from the aircraft and the cannon-gun below fires a shell with initial speed $= 200m/s$, at some angle θ For what value of θ will the projectile shell destroy the bomb in mid-air? If the value of θ is 53^3 , find the minimum distance between the bomb and the shell as they fly past

each other. Take $\sin 53^\circ = 4/5$



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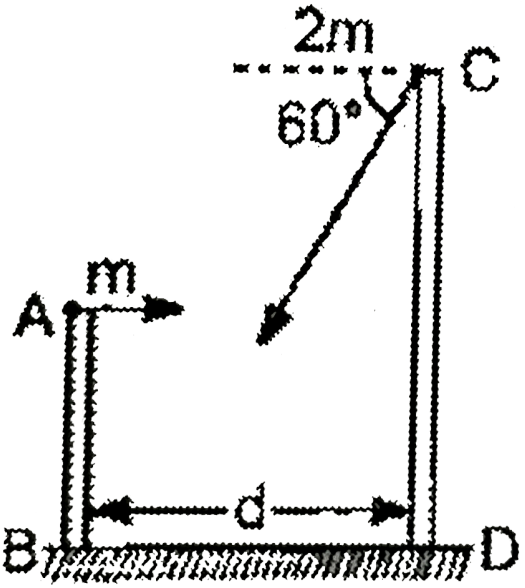
125. Two towers AB and CD are situated a distance d apart as: shown in Fig. 1E.139 (a). AB is 20 m high and CD is 30 m high from the ground. An object of mass mis thrown from the top of AB horizontally with a velocity of 10 m/s towards CD.

Simultaneously another object of mass 2m is thrown from the ·top of CD at an angle of 60° to the horizontal towards AB with the same

magnitude of initial velocity as that of the_ first' objects . The two objects move in the same vertical plane, collide in mid-air and stick to each other. Calculate the distance d between the towers.



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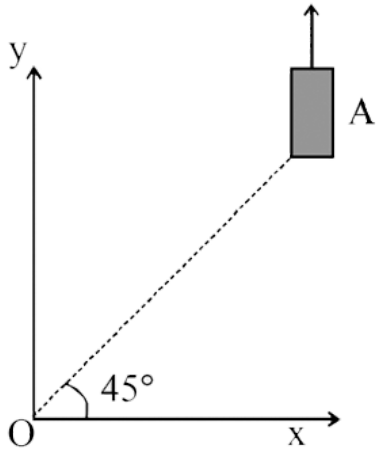
126. On a frictionless horizontal surface , assumed to be the $x-y$ plane , a small trolley A is moving along a straight line parallel to the $y-a\xi s($ see figure) with a constant velocity of $\left(\sqrt{3}-1\right)m/s$. At a particular instant , when the line OA makes an angle of $45(\circ)$ with the $x-a\xi s$, a ball is thrown along the surface from the origin O. Its velocity makes an

angle ϕ with the $x - a\xi s$ and $ithitsthetrol \leq y. (a)Themotionoftheballisobservedomthe$ thetamadebythevelocity $\longrightarrow$ $roftheballwiththe$ x-axis in this frame .

(b) Find the speed of the ball with respect to the surface , if $\phi = (4\theta)/(4)$.



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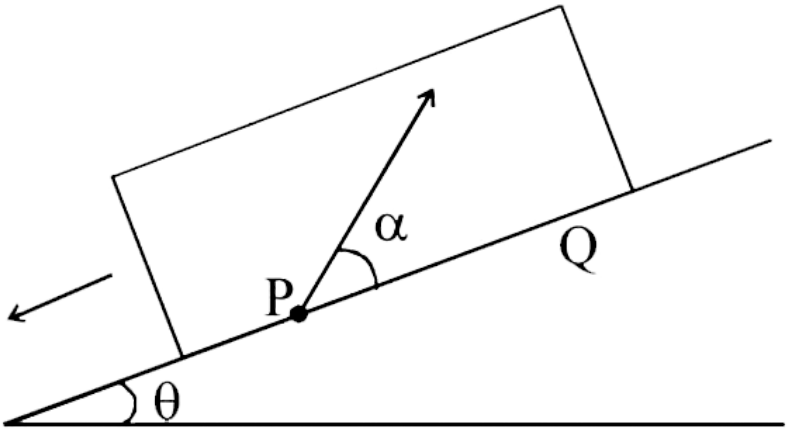
127. A large , heavy box is sliding without friction down a smooth plane of inclination θ . From a point P on the bottom of the box , a particle is projected inside the box . The initial speed of the particle with respect to the box is u , and the direction of projection makes an angle α with the

bottom as shown in Figure .

(a) Find the distance along the bottom of the box between the point of projection p and the point Q where the particle lands . (Assume that the particle does not hit any other surface of the box . Neglect air resistance .)

(b) If the horizontal displacement of the particle as seen by an observer on the ground is zero , find the speed of the box with respect to the ground at the instant when particle was projected .



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Level 1

1. It is possible to add five. unit vectors to get an unit vector, The statement is :

(a) True , (b) False

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2. If a vector is rotated by angle θ then it is necessarily changed. The statement is :

(a) True , (b) False

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3. It is possible to add n vectors of equal magnitude and get zero:

(True , (b) False

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4. It is possible to add n vectors of different magnitude and get zero.

(a) True , (b) False

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5. It is possible to have $\vec{a} \times \vec{b} = \vec{a} . \vec{b}$ for some suitable selection of $\vec{a}$ and $\vec{b}$. For example $\vec{a} = \vec{0}$. The statement is :

(a) True , (b) False

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6. If $\left|\vec{A}\right| = \left|\vec{B}\right|$ and $\vec{A} \neq \pm \vec{B}$ then angle between the vectors $\left(\vec{A} + \vec{B}\right)$ and $\left(\vec{A} - \vec{B}\right)$ is :

A. 0

B. $\pi / 6$

C. $\pi / 3$

D. $\pi/2$

Answer: D

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7. A vector of magnitude a is turned through angle θ . The magnitude of change in the vector is given by:

A. $|2a\sin\theta|$

B. $|2a\sin\theta/2|$

C. $\left|\frac{a}{2}\sin\theta\right|$

D. $\left|\frac{a}{2}\sin\theta/2\right|$

Answer: B

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8. Which of the sets given below may represent the magnitudes of three vectors adding to zero?

A. 2, 4, 8

B. 4, 8, 16

C. 4, 8, 4

D. $0.5, 1, 2$

Answer: C

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9. The resultant of $\vec{a}$ and $\vec{b}$ makes α with $\vec{a}$ and β with $\vec{b}$, then (a,b represent magnitudes of respective vectors) :

A. $\alpha < \beta$

B. $\alpha < \beta$ if $a < b$

C. $\alpha < \beta$ if $a > b$

D. $\alpha < \beta$ if $a = b$

Answer: C

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10. Let $\vec{C} = \vec{A} + \vec{B}$:

A. $\left|\vec{C}\right|$ is always greater than $\left|\vec{A}\right|$

B. It is possible to have $\left|\vec{C}\right| < \left|\vec{A}\right|$ and $\left|\vec{C}\right| < \left|\vec{B}\right|$

C. $\left|\vec{C}\right|$ is always equal to $\left|\vec{A}\right| + \left|\vec{B}\right|$

D. $\left|\vec{C}\right|$ is never equal to $\left|\vec{A}\right| + \left|\vec{B}\right|$

Answer: B

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11. Let the angle between two non-zero vectors $\vec{A}$ and $\vec{B}$ be 120° and its resultant be $\vec{C}$ then:

A. $|\vec{C}|$ must be equal $\left||\vec{A}| - |\vec{B}|\right|$

B. $|\vec{C}|$ must be less than $\left||\vec{A}| - |\vec{B}|\right|$

C. $|\vec{C}|$ must be greater than $\left||\vec{A}| - |\vec{B}|\right|$

D. $|\vec{C}|$ may be equal to $\left||\vec{A}| - |\vec{B}|\right|$

Answer: C

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12. Which of the following two statements is more appropriate?

(a) Two velocities are added using triangle rule because velocity is vector quantity.

(b) Velocity is a vector quantity because two velocities are added using triangle rule.

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13. Vector $\vec{a}$ is increased by $\Delta\vec{a}$. If increment in magnitude of $\vec{a}$ is greater than magnitude of increment vector then angle between $\vec{a}$ and $\Delta\vec{a}$ is :

A. greater than $\pi/6$

B. exactly $\pi/6$

C. exactly $\pi/2$

D. ϕ

Answer: D

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14. A moter 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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15. A person moving on earth's surface starts from north pole & moves 500 km towards south and then moves 1000 km towards east and then again moves 500 km towards north and stops. The displacement of the person is:

A. 1000 km eastward

B. $\sqrt{1000^2 + 500^2}$ km towords south- east

C. $\sqrt{1000^2 + 500^2}$ km towards

D. Zero.

Answer: D

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16. A person moves 20 m towards north-east then moves 20 m towards west and then again moves 20 m towards north-east and stops. The magnitude of displacement of the person is:

A. $20\sqrt{5-2\sqrt{2m}}$

B. 20 m

C. $20\sqrt{5+2\sqrt{2m}}$

D. None of these

Answer: A

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17. If $\vec{A}, \vec{B}, \vec{C}$ are mutually perpendicular vectors then which of the following statements is wrong?

A. $\vec{C} \times \left(\vec{A} \times \vec{B}\right) = 0$

B. $\frac{\vec{A} \times \vec{B}}{\left|\vec{A} \times \vec{B}\right|} = \frac{\vec{C}}{\left|\vec{C}\right|}$

C. $\vec{A} . \vec{B} = \vec{B} . \vec{C} = \vec{C} . \vec{A} = 0$

D. $\left(\vec{B} + \vec{C}\right)$ is perpendicular to $\vec{A}$

Answer: B

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18. The velocity of a particle varies with time as per the law $\vec{v} = \vec{a} + \vec{b}$ t where $\vec{a}$ and $\vec{b}$ are two constant vectors. The time at which velocity of the particle at t=0 is :

A. $-\frac{\left|\vec{a}\right|}{\vec{a} . \vec{b}}$

B. $-\frac{\left|\vec{a}\right|^2}{\vec{a}\,.\,\vec{b}}$

C. $-\frac{\vec{a}\,.\,\vec{b}}{\left|\vec{a}\right|^2}$

D. None of these

Answer: B

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19. A plane is inclined at an angle 30° with horizontal. The component of a vector $\vec{A} = -10k$ perpendicular to this plane is: (here z-direction is vertically upwards)

A. $5\sqrt{2}$

B. $5\sqrt{3}$

C. 5

D. 2.5

Answer: B

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20. If $\vec{a_1}$ and $\vec{a_2}$ are two non-collinear unit vectors and if $\left|\vec{a_1}+\vec{a_2}\right|=\sqrt{3}$, then the value of $\left(\vec{a_1}-\vec{a_2}\right).\left(2\vec{a_1}+\vec{a_2}\right)$ is :

A. 2

B. $3/2$

C. $1/2$

D. 1

Answer: C

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21. If $\vec{A}=\vec{B}+\vec{C}$ and the magnitude of $\vec{A}$, $\vec{B}$ and $\vec{C}$ are 5, 4, and 3 units respectively the angle between $\vec{A}$ and $\vec{B}$ is :

A. $\cos^{-1}\left(\frac{3}{5}\right)$

B. $\cos^{-1}\left(\frac{4}{5}\right)$

C. $\left(\frac{\pi}{2}\right)$

D. $\sin^{-1}\left(\frac{4}{5}\right)$

Answer: B

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22. The sum of two forces at a point is 16N. if their resultant is normal to the smaller force and has a magnitude of 8N, then two forces are

A. 6N and 10 N

B. 8N and 8 N

C. 4N and 12N

D. 2 N and 14 N

Answer: A

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23. What is the component of $3\hat{i}+4\hat{j}$ along $\hat{i}+\hat{j}$:

A. $\frac{1}{2}\left(\hat{i}+\hat{j}\right)$

B. $\frac{3}{2}\left(\hat{i}+\hat{j}\right)$

C. $\frac{5}{2}\left(\hat{i}+\hat{j}\right)$

D. $\frac{7}{2}\left(\hat{i}+\hat{j}\right)$

Answer: D

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24. At what angle the vector $\left(\vec{A}+\vec{B}\right)$ and $\left(\vec{A}-\vec{B}\right)$ must act, so that the resultant is $\sqrt{A^2\_B^2}$

A. $\cos^{-1}\left(\frac{A^2-B^2}{A^2+B^2}\right)$

B. $\cos^{-1}\left(\frac{A^2+B^2}{A^2-B^2}\right)$

C. $\cos^{-1}\left(\frac{A^2 - B^2}{2(A^2 + B^2)}\right)$

D. $\cos^{-1}\left(\frac{A^2 + B^2}{2(B^2 - A^2)}\right)$

Answer: D

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25. The resultant of $\overrightarrow{A}$ and $\overrightarrow{B}$ is perpendicular to $\overrightarrow{A}$. What is angle between $\overrightarrow{A}$ and $\overrightarrow{B}$?

A. $\cos^{-1}\left(\frac{A}{B}\right)$

B. $\cos^{-1}\left(-\frac{A}{B}\right)$

C. $\sin^{-1}\left(\frac{A}{B}\right)$

D. $\sin^{-1}\left(-\frac{A}{B}\right)$

Answer: B

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26. A particle moves through angular displacement θ on a circular path of radius' r'. The linear displacement will be:

A. $2r \sin\left(\frac{\theta}{2}\right)$

B. $2r \cos\left(\frac{\theta}{2}\right)$

C. $2r \tan\left(\frac{\theta}{2}\right)$

D. $2r \cot\left(\frac{\theta}{2}\right)$

Answer: A

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27. If a vector $\vec{A}$ makes an angle α, β and γ with X,Y and Z axis respectively then $\sin^2\alpha + \sin^2\beta + \sin^2\gamma = ...$

A. 0

B. 1

C. 2

D. 3

Answer: C

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28. The X and Y - component of $\overrightarrow{p}$ are $7\hat{i}$ and $6\hat{j}$. Also , the X and Y-components of $\overrightarrow{p}+\overrightarrow{Q}$ are $11\hat{i}$ and $9\hat{j}$ respectively. Then magnitude of $\overrightarrow{Q}$ is :

A. 7

B. 6

C. 5

D. 13

Answer: C

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29. Two vector $\vec{A} = 2\hat{i} + 3\hat{j} - 4\hat{k}$ and $\vec{B} = 4\hat{i} + 8\hat{j} + x\hat{k}$ are such that the component of $\vec{B}$ along $\vec{A}$ is zero . Then the value of x will be :

A. 8

B. -4

C. 4

D. -8

Answer: A

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30. Two vector $\vec{A} = 3\hat{i} + 8\hat{j} - 2\hat{k}$ and $\vec{B} = 6\hat{i} + 16\hat{j} + x\hat{k}$ are such that the component of $\vec{B}$ perpendicular to $\vec{A}$ is zero . Then the value of x will be :

A. 8

B. -4

C. 4

D. -8

Answer: B

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31. A blind person after Walking 10 steps in one direction, each of length 80cm, turns randomly to left or right, After walking 'n' steps, the maximum displacement of person is $16\sqrt{2}$ .Then value of'n' is :

A. 20

B. 30

C. 40

D. 60

Answer: C

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32. Two vectors $\vec{A}$ and $\vec{B}$ have magnitudes 2 and $2\sqrt{2}$ respectively. It is found that $\vec{A} \cdot \vec{B} = \left|\vec{A} \times \vec{B}\right|$, then the value of $\left|\frac{\vec{A}+\vec{B}}{\vec{A}-\vec{B}}\right|$ will be :

A. 5

B. $\sqrt{5}$

C. $\frac{\sqrt{2}+1}{\sqrt{2}-1}$

D. $\frac{\sqrt{2}-1}{\sqrt{2}+1}$

Answer: B

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33. If the resultant of two vectors having magnitudes of 7 and 4 is 3, then the magnitude of the cross product of the two vectors will be:

A. 28

B. $\sqrt{65}$

C. $\sqrt{33}$

D. zero

Answer: D

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34. The adjacent sides of a parallelogram is represented by vectors $2\hat{i}+3\hat{j}$ and $\hat{i}+4\hat{j}$. The area of the parallelogram is :

A. 5 units

B. 3 units

C. 8 units

D. 11 units

Answer: A

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35. The maximum magnitude of cross product of two vectors is 12 units and the maximum magnitude of their resultant is 7 units, then their minimum resultant vector will be a:

A. unit vector

B. null vector

C. vector of magnitude between $\left|\overrightarrow{A}\right|$ and $\left|\overrightarrow{B}\right|$

D. nothing can be said

Answer: A

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36. Six forces are acting on a particle. Angle between two adjacent force is 60°. Five of the forces have magnitude F_1 and the sixth has magnitude F_2. The resultant of all the forces will have magnitude of:

A. zero

B. $F_1 + F_2$

C. $F_1 - F_2$

D. F_2

Answer: C

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37. The quantity $\int_{t_1}^{t_2} \overrightarrow{V}\, dt$ represents:

A. Distance travelled during $t_1 \to t_2$

B. Displacement during $t_1 \to t_2$

C. Average acceleration during $t_1 \to t_2$

D. None of these

Answer: B

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38. Let $\overrightarrow{V} = v_x\hat{i} + v_y\hat{j} + v_z\hat{k}$, then $\int_{t_1}^{t_2} V_y$ represents: (for the duration $t_1 \to t_2$)

A. Distance travelled along y-axis

B. Displacement along y-axis

C. Total displacement - displacement along y-axis

D. Total distance travelled - distance travels along y-axis

Answer: B

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39. 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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40. 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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41. 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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42. A body travelling along a straight line , one thired of the total distance with a velocity $4ms^{-1}$. The remaining part of the distance was covered with a velocity $2ms^{-1}$ for half the time and with velocity $6ms^{-1}$

for the other half of time . What is the mean velocity averaged over te whle time of motin ?

A. 5m/s

B. 4m/s

C. $4.5m/s$

D. $3.5m/s$

Answer: B

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

A. The faster one

B. The slower one

C. Both will reach sirnultanetmsly

D. Depends on the masses

Answer: C

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44. Two projectiles A and B are projected with an angle of projection 15° for the projectile A and 45° for the projectile B. If R_A and R_B be the horizontal range for the two projectiles, 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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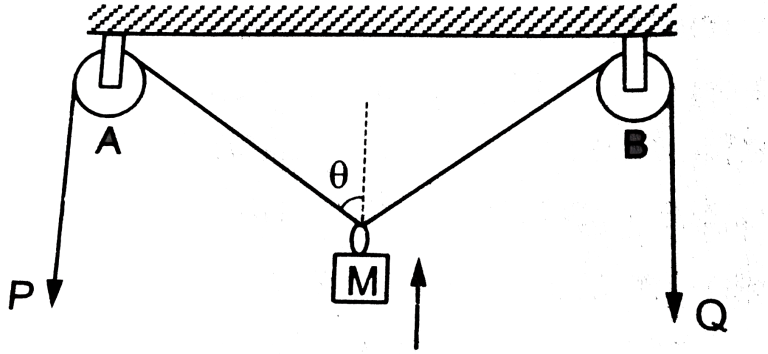
45. In the arrangement shown in figure the ends P and Q of an inextensible string move downwards with uniform speed u. Pulleys A and B are fixed. The mass M moves upwards with a speed



A. $2u\cos\theta$

B. $u/\cos\theta$

C. $2u/\cos\theta$

D. $u\cos\theta$

Answer: B

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46. The Acelerations of a paerticle as seen from two frames S_1 and S_2 have equal magnitude $4\frac{m}{s^2}$.

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

B. The frames may be moving with respect to each other but neither should be accelerated with respect to the other

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

D. The acceleration of S_2 with respect to S_1 may be anything between zero and $8m/s^2$

Answer: D

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47. A train passes an observer standing on a platform. The first carriage of the train passes the observer in time $t_1 = 1s$ and the second carriage in

$t_2 = 1.5s$. Find its acceleration assuming it to be constant. The length of each carriage is: l = 12 m.

A. $3.3m/s^2$

B. $-3.2m/s^2$

C. $24m/s^2$

D. $-24m/s^2$

Answer: B

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48. The position vector of a particle varies with time as $\bar{r} = \overline{r_0}t(1 - \alpha t)$ where $\bar{r}_0$ is a constant vector and α is a positive constant. The distance travelled by particle in a time interval in which particle returns to its initial position is $Kr_0/16\alpha$. Determine the value of K?

A. r_0/α

B. $r_0/2\alpha$

C. $\sqrt{r_0^2 \frac{r_0}{\alpha}}$

D. $\sqrt{r_0^2 + \frac{2r_0}{\alpha}}$

Answer: B

Watch Video Solution

49. A particle traversed on third of the distance with a velocity v_0, the remaining part of the distance was covered with velocity v_1 for half the time and with a velocity v_2 for the remaining half of time. Assuming motion to be rectilinear, find the the mean velocity of the particle averaged over the whole time of motion.

A. $\frac{v_0 + v_1 + v_2}{v_1 + v_2 + v_0}$

B. $\frac{v_0^2 + (v_1 + v_2)}{v_1 v_2 + v_0^2}$

C. $\frac{3(v_1 + v_2)}{v_1 + v_2 + v_0}$

D. $\frac{3v_0(v_1 + v_2)}{v_1 + v_2 + 4v_0}$

Answer: D

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50. A point moves in xy-plane according to equation x = at, y = at (l - bt) where a and b are positive constants and t is time. The instant at which velocity vector is at $\pi/4$ with acceleration vector is given by:

A. $\left(\frac{1}{a}\right)$

B. $\left(\frac{1}{b}\right)$

C. $\left(\frac{1}{a}+\frac{1}{b}\right)$

D. $\frac{a+b}{a^2+b^2}$

Answer: B

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51. A body starts from rest at A and moves with uniform accelerationa in a straight line. T seconds after,a second body starts from A and moves with uniform velocity Kinthe same line. Prove that the second body will be ahead of the first for a time $\frac{2}{a}\sqrt{V(V-2aT)}$

A. $2\frac{\sqrt{u(u-2)}}{a}$

B. $\frac{a}{2}\sqrt{u(u-2)}$

C. $\frac{2}{a}\sqrt{u(u-2)}$

D. None of these

Answer: C

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52. A particle is moving in the x-y plane. At certain instant of time, the components of its velocity and acceleration are as follows: $v_x = 3ms^{-1}$, $v_y = 4ms^{-1}$, $a_x = 2ms^{-2}$ and $a_y = 1ms^{-2}$. The rate of change of speed at this moment is

A. $\sqrt{10}m/s^2$

B. $4m/s^2$

C. $10m/s^2$

D. $2m/s^2$

Answer: D

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53. Two cars start off to race with velocities $4\frac{m}{s}$ and $2\frac{m}{s}$ and travel in straight line with uniform accelerations $1m\sec^{-2}$and 2 msec – 2` respectively. If they reach the final point at the same instant, then the length of the path is.

A. 30 m

B. 32 m

C. 20 m

D. 24m

Answer: D

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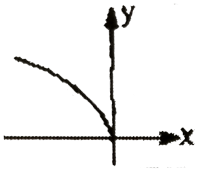
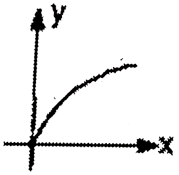
54. The instantaneous velocity of a particle moving in xy-plane is $\vec{V} = (ay)\hat{i} + (V_0)\hat{j}$ where y is the instantaneous y co-ordinat of the particle and V_0 is the particle starts from origin then its trajectory is

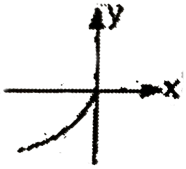
A. (a)



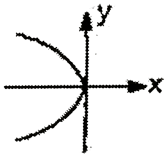
B. (b)



C. (c)



D. (d)



Answer: A

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55. An open lift is coming down from the top of building at a constant speed $v = 10m/s$. A boy standing on the lift throws a stone vertically upwards at a speed of 30 m/s w.r.t. himself. The time after which he will catch the stone is:

A. 4 sec

B. 6 sec

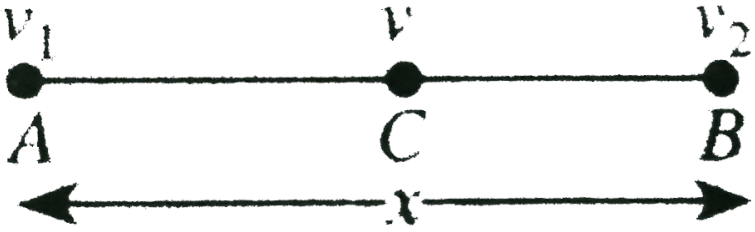
C. 8 sec

D. 10 sec

Answer: B

Watch Video Solution

56. A particle moving with uniform acceleration from A to B along a straight line has velocities v_1 and v_2 at A and B respectively. If C is the mid-point between A and B then determine the velocity of the particle at C.



A. $aV_1 = bV_2$

B. $aV_1V^2 = bV_2^2$

C. $a^2V_1 = b^2V_2$

D. $aV_2 = bV_1$

Answer: D

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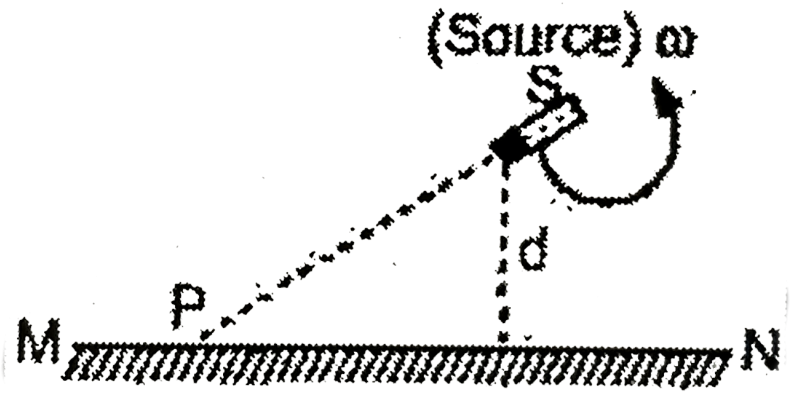
57. a point source of light is rotating in a horizontal plane at a speed of ω radians/second. There is a wall at a distance d from the source. At some instant the focus of the light is at P and $\angle SPN = \theta$ (see figure). Speed of the focus at this instant in terms of θ is



A. $\omega d / \cos\theta$

B. $\omega d / \sin\theta$

C. $\omega d / \tan\theta$

D. $\omega d / \sin^2\theta$

Answer: D

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58. When a body is thrown up in a lift with a velocity u relative to the lift, the time of flight is found to be t. The acceleration with which the lift is moving up is

A. $\frac{(u-gt)}{t}$ upwards

B. $\frac{(u-gt)}{t}$ downwards

C. $\frac{(2u-gt)}{t}$ upwards

D. $\frac{(2u-gt)}{t}$ downwards

Answer: C

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59. A block is kept on the floor of an elevator. The elevator starts descending with an acceleration of $12m/s^2$ the displacement of the block during 1^{st} one second wth respect to elevator is-

A. 1m downwards

B. 1 m upwards

C. 5m downwards

D. zero meter.

Answer: B

Watch Video Solution

60. A point moves in a straight line so its displacement x meter at time t second is given by $x^2 = 1 + t^2$. Its acceleration in ms^{-2} at time t second is .

A. $\frac{1}{x^3}$

B. $\frac{1}{x} - \frac{1}{x^2}$

C. $-\frac{t}{x^2}$

D. $-\frac{t}{x^3}$

Answer: A

Watch Video Solution

61. Two particles start moving from the same point along the same straight line. The first moves with constant velocity v and the second with constant acceleration a. During the time that elapses before the sound catches the first, the greatest distance between the particle is.

A. $\frac{v^2}{a}$

B. $\frac{v^2}{2a}$

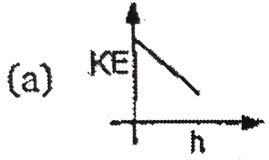
C. $\frac{2v^2}{a}$

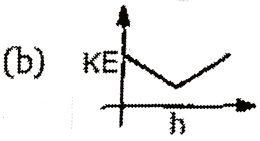
D. $\frac{v^2}{4a}$

Answer: B

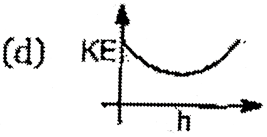
Watch Video Solution

62. A ball is thrown up with a certain velocity at angle θ to the horizontal. The kinetic energy varies with height h of the particle as:

A. 

B. 

C. 

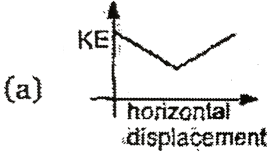
D. 

Answer: A

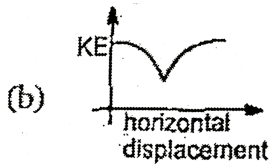
Watch Video Solution

63. A ball is thrown up with a certain velocity at an angle θ to the horizontal. The graph between kinetic energy and horizontal displacement is given by:

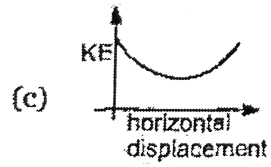
A.



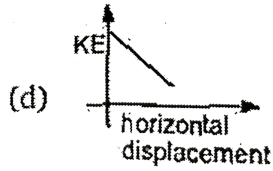
B.



C.



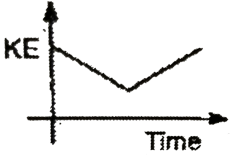
D.

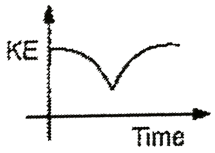


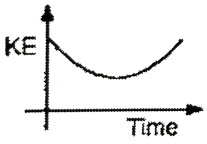
Answer: C

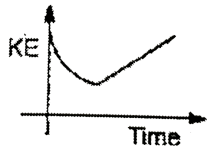
Watch Video Solution

64. A particle is thrown up with a ccrtain velocity and at an angle 0 with the horizontal. The variation of kinetic energy with time is given by :

A. 

B. 

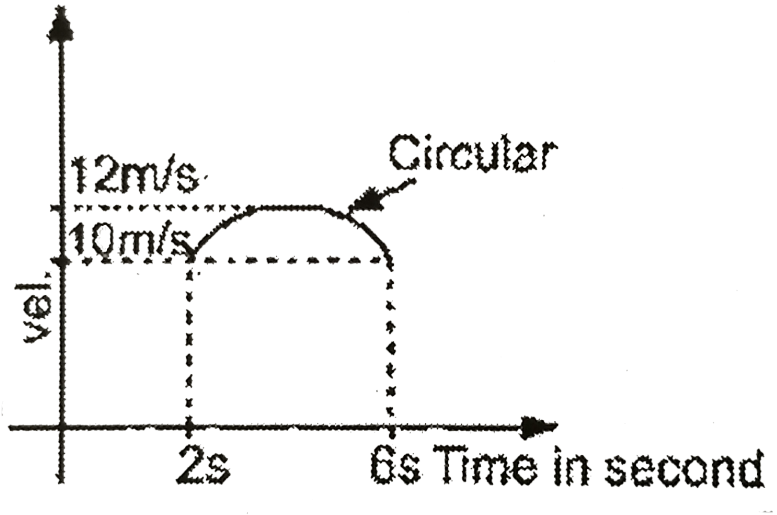
C. 

D. 

Answer: C

Watch Video Solution

65. the velocity of a particle varies with time as shown below the distance travelled by the travelled by the particle during `t=2s"and" t= 6s. Is



A. $2\pi m$

B. $(2\pi + 40)m$

C. $4\pi m$

D. $40m$

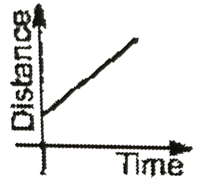
Answer: B

Watch Video Solution

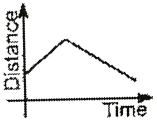
66. From a high tower at time $t = 0,$ one stone is dropped from rest and simultaneously another stone is projected vertically up with an initial

velocity the graph between distance betweeen the particles and time before either hits the ground is :

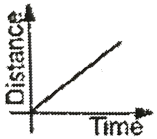
A. (a)



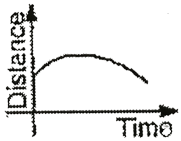
B. (b)



C. (c)



D. (d)



Answer: C

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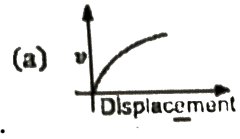
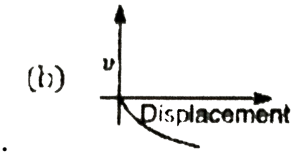
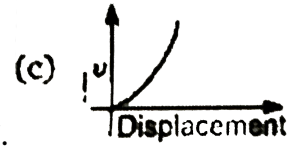
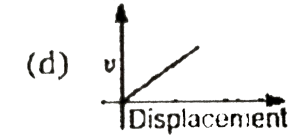
67. A particle moves with constnat acceleration in the positive x-axis. At $t = 0$, the particle is at and is at rest, then correct grahp between velocity and displacement is:

A. 

B. 

C. 

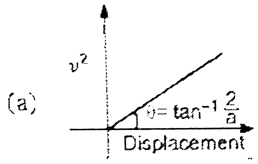
D. 

Answer: A

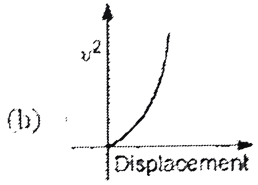
View Text Solution

68. A particle moves with constant acceleration a in the positive x-axis. At $t = 0$ the particle is at origin is at rest , then correct graph between $(\text{velocity})^2$ and displacement is :

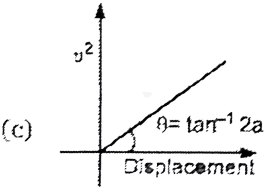
A.



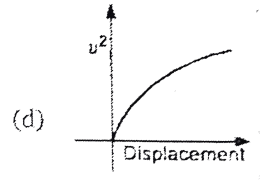
B.



C.



D.



Answer: C

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69. A particle is projected from gound At a height of 0.4 m from the ground, the velocity of a projective in vector form is $\overrightarrow{v} = \left(6\hat{i} + 2\hat{j}\right) m/s$ (the x-axis is horizontal and y-axis is vertically upwards). The angle of projection is $\left(g = 10 m/s^2\right)$

A. 45°

B. 60°

C. 30°

D. $\tan^{-1} 3/4$

Answer: C

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70. A particle moves in $x - y$ plane according to the law $x = 4\sin 6t$ and $y = 4(1 - \cos 6t)$. The distance traversed by the particle in 4 second is ($x \& y$ are in meters)

A. 96 m

B. 48 m

C. 24 m

D. 108 m

Answer: A

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71. A swimmer crosses a flowing stream of width ω to and fro in time t_1. The time taken to cover the same distance up and down the stream is t_2. If t_3 is the time the swimmer would take to swim a distance 2ω in still water, then

A. $t_1^2 = t_2 t_3$

B. $t_2^2 = t_1 t_3$

C. $t_3^2 = t_1 t_3$

D. $t_3 = t_1 + t_2$

Answer: A

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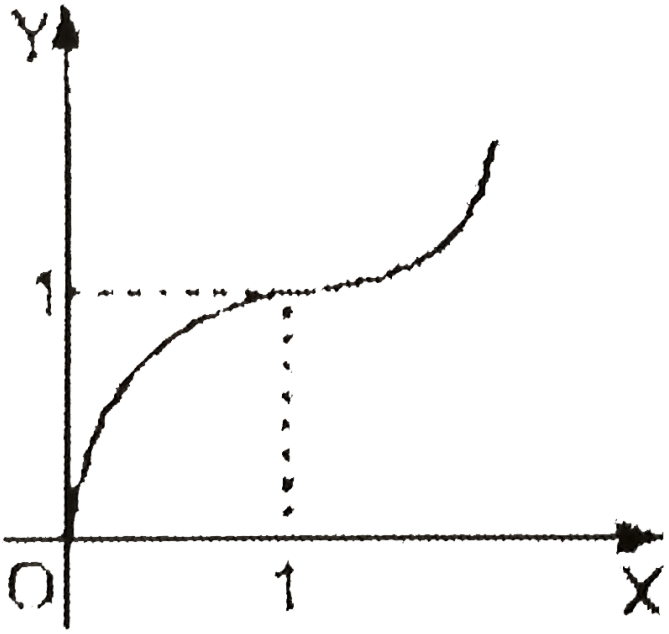
72. The trajectory of a particle is as shown here and its trajectory follows the eqution $y = (x-1)^3 + 1$. Find co-ording of the point A on the curve such that direction of instantaneous velocity at A is same as direction of average velocity for the motion O ti A:



A. $(3/2, 9/8)$

B. $(2, 2)$

C. $(3, 9)$

D. $(5/2, 35/8)$

Answer: A

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73. A bird flies for 4 seconds with a velocity of $|t-2| m/\sec$. In a straight line, where $t =$ time in seconds. It covers a distance of

A. $2m$

B. $4m$

C. $6m$

D. $8m$

Answer: B

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74. A particle has an initial velocity of $9m/s$ due east and a constant acceleration of $2m/s^2$ due west. The displacement coverd by the particle in the fifth second of its motion is :

A. zero

B. 0.5m

C. 2m

D. None

Answer: B

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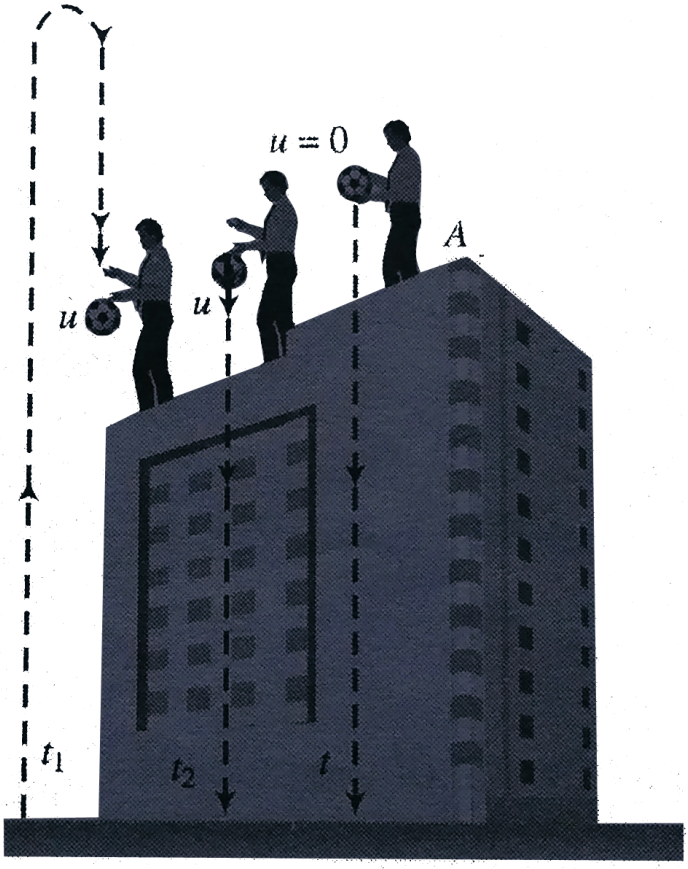
75. A body is thrown vertically upwards from A. The top of a tower . It reaches the ground in time t_1. It it is thrown vertically downwards from A with the same speed it reaches the ground in time t_2, If it is allowed to

fall freely from A. then the time it takes to reach the ground.



A. $t_3 = \frac{1}{2}(t_1 + t_2)$

B. $t_3 = \sqrt{t_1 t_2}$

C. $\frac{1}{t_3} = \frac{1}{t_2} - \frac{1}{t_1}$

D. $t_3^2 = t_1^2 - t_2^2$

Answer: B

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76. A hollow vertical cylinder of radius R and height h has smooth internal suface. A small particle is placed in contact with the inner side of the upper rim at a point P. It is given a horizontal speed v_0 tangential to rim. It leaves the lower rim point Q vertically below P. The number of revolutions made by the particle will:

A. $\frac{h}{2\pi R}$

B. $\frac{v_0}{\sqrt{2gh}}$

C. $\frac{2\pi R}{h}$

D. $\frac{v_0}{2\pi R}\left(\sqrt{\frac{2h}{g}}\right)$

Answer: D

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77. Two particles move in a uniform gravitational field with an acceleration g. At the initial moment the particles were located over a tower at one point and moved with velocities $v_1 = 3m/s$ and $v_2 = 4m/s$ horizontally in opposite directions. Find the distance between the particles at the moment when their velocity vectors become mutually perpendicular.

A. $5m$

B. $7\sqrt{3}m$

C. $\frac{7\sqrt{3}}{5}m$

D. $7/2m$

Answer: C

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78. A particle is projected vertically upwards from the ground with a speed V and a speed v and a second particle is projected at the same

instant from a height h directly above the first particle with the same speed v at an angle of projection θ with the horizontal in upwards direction. The time when the distance between them is minimum is

A. $\frac{h}{2v\sin 0}$

B. $\frac{h}{2v\cos 0}$

C. h/v

D. $h/2v$

Answer: D

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79. Three particles start from origin at the same time: one with velocity v^1 along positive x-axis, the second along the positive y-axis with a velocity v^2 and the third along the line y = x with such a speed that all the three always stay in a straight line, then velocity of the third particles is:

A. $\sqrt{v_1 v_2}$

B. $\frac{v_1 + v_2}{2}$

C. $\frac{v_1 v_2}{\sqrt{v_1^2 + v_2^2}}$

D. $\frac{v_1 v_2 \sqrt{2}}{v_1 + v_2}$

Answer: D

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80. A particle is projected from the ground at an angle of 60° with horizontal at speed $u = 20m/s$. The radius of curvature of the path of the particle, when its velocity. makes an angle of 30° with horizontal is : $(g = 10m/s^2$

A. $10.6m$

B. $12.8m$

C. $15.4m$

D. $24.2m$

Answer: C

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81. Two particles are projected from the same point on ground simultaneously with speeds and $20m/s$ and $20/\sqrt{3}$ at angles 30° and 60° with the horizontal in the same direction.The maximum distance between them till both of them strike the ground is approximately $(g = 10m/s^2)$

A. 23.1 m

B. 16.4 m

C. 30.2 m

D. 10.4 m

Answer: A

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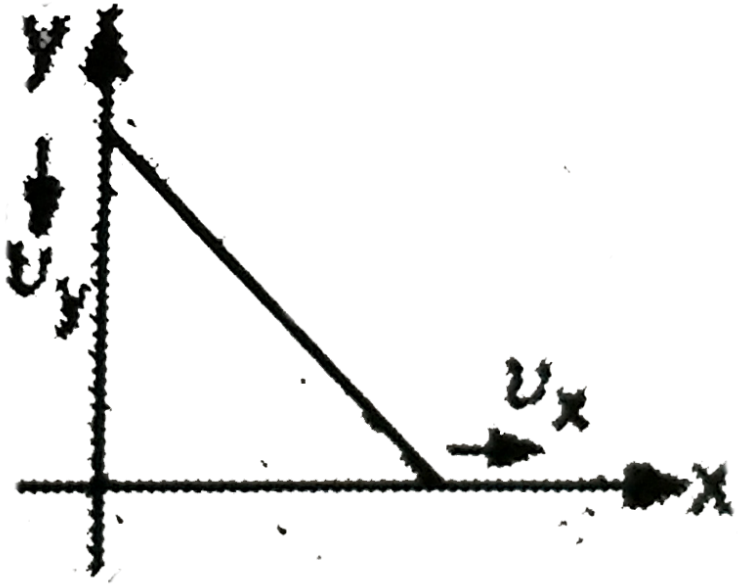
82. A rod of length I leans by its upper end against a smooth vertical wall, while its other end leans against the floor. The end that leans against the wall moves uniformly downward. Then:



A. The other end also moves uniformly

B. The speed of other end goes on decreasing

C. The speed of other end goes on increasing

D. The speed of other end first decreases and then increases

Answer: B

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83. A boy throws a ball upward with velocity $v_0 = 20m/s$. The wind imparts a horizontal acceleration of $4m/s^2$ to the left. The angle θ at which the ball must be thrown so that the ball returns to the boy's hand is : $(g = 10ms^{-2})$

A. $\tan^{-1}(1.2)$

B. $\tan^{-1}(0.2)$

C. $\tan^{-1}(2)$

D. $\tan^{-1}(0.4)$

Answer: D

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84. Position vectors of a particle moving in xy plane at time t is $\overrightarrow{r} = a(1 - \cos omnt)\hat{i} + a\sin\omega t\hat{j}$. The path of the particle is

A. a circle of radius a and centre at (a, 0)

B. a circle of radius a and centre at (0, 0)

C. an ellipse

D. neither a circle nor an ellipse.

Answer: A

Watch Video Solution

85. A particle moves in xy-plane. The position vector of particle at any time is $\vec{r} = \left\{(2t)\hat{i} + \left(2t^2\right)\hat{j}\right\}m$. The rate of change of θ at time $t = 2$ second. (where 0 is the angle which its velocity vector makes with positive x-axis) is :

A. $\frac{2}{17}\text{rad}/s$

B. $\frac{1}{14}\text{rad}/s$

C. $\frac{4}{7}\text{rad}/s$

D. $\frac{6}{5}\text{rad}/s$

Answer: A

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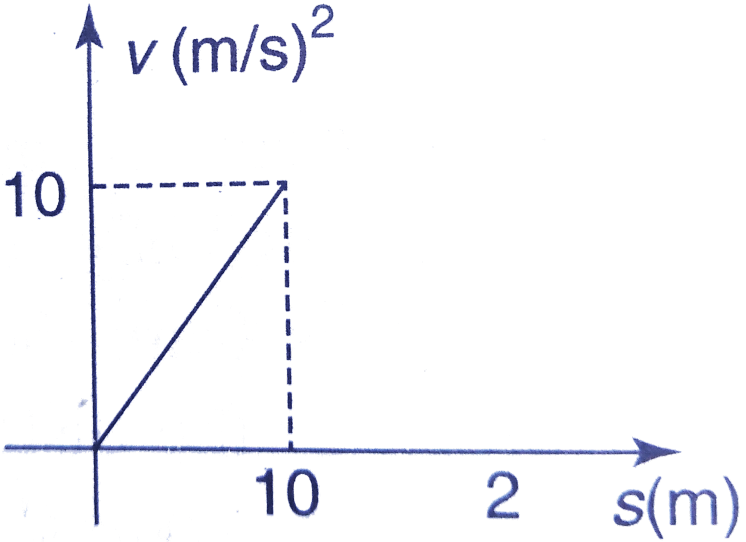
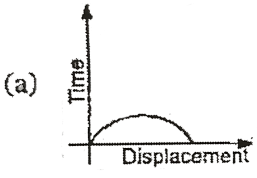
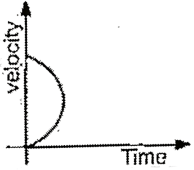
86. Velocity versus displacement graph of a particle moving in a straight line is shown in figure. Corresponding acceleration versus velocity graph will be.



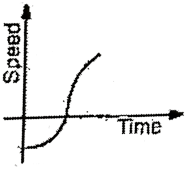
A.



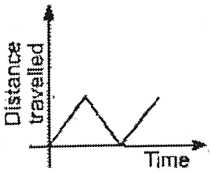
B. (b)



C. (c)



D. (d)



Answer: A

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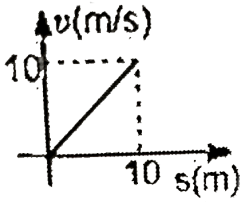
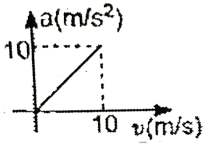
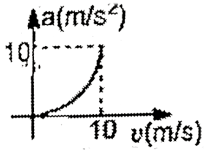
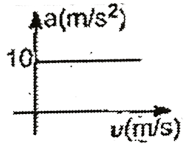
Level 2

1. Which of the following graphs cannot represent one dimensional motion of a particle?

A. 

B. (a) 

C. (b) 

D. (c) 

Answer: A::B::C::D

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2. A lift of very broad - floor is moving vertically upward with a constant retardation equal to 'g'. At an instant a stone is projected from a point on the floor of the lift at angle of elevation 0. Then the trajectory of the stone is:

A. A parabola in the lift-frame

B. A straight line in the lift-frame

C. A parabola in the ground frame

D. A straight line in the ground frame

Answer: B::C

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3. An aeroplane flies along straight line from A to B and backs again to the same point. There is a steady wind speed v. The distance between A and B is l still air speed of the aeroplane is V, then:

A. Total time for the round trip, if the wind blows along the line AB, is

$$\frac{2Vl}{v^2 - v^2}$$

B. Total time for the round trip, if the wind blows perpendicular to the line AB, is $\frac{2l}{\sqrt{V^2 - v^2}}$

C. Total time for the round trip depends on the direction of wind.

D. Total time for the round trip is independent of direction of wind.

Answer: A::B::C

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4. For a constant initial speed and for constant angle of projection of a projectile the change dR in its horizontal range R due to a change dg in value of gravitational acceleration g is governed by the relation:

A. $\frac{dR}{R} = \frac{dg}{g}$

B. $\frac{dR}{R} = \frac{-dg}{g}$

C. $\frac{dR}{g} = \frac{dg}{R}$

D. $\frac{dR}{g} = \frac{-dg}{R}$

Answer: B

View Text Solution

5. Two particles, 1 and 2, move with constant velocities v_1 and v_2. At the initial moment their radius vectors are equal to r_1 and r_2. How must these four vectors be interrelated for the particles to collide?

A. $\frac{\vec{r}_1 - \vec{r}_2}{\left|\vec{r}_1 - \vec{r}_2\right|} = \frac{\vec{v}_1 - \vec{v}_2}{\left|\vec{r}_1 - \vec{v}_2\right|}$

B. $\frac{\vec{r}_1 - \vec{r}_2}{\left|\vec{r}_1 - \vec{r}_2\right|} = \frac{\vec{v}_2 - \vec{v}_1}{\left|\vec{r}_2 - \vec{v}_1\right|}$

C. $\frac{\vec{r}_1 - \vec{r}_2}{\left|\vec{r}_2 - \vec{r}_1\right|} = \frac{\vec{v}_2 - \vec{v}_1}{\left|\vec{r}_1 - \vec{v}_2\right|}$

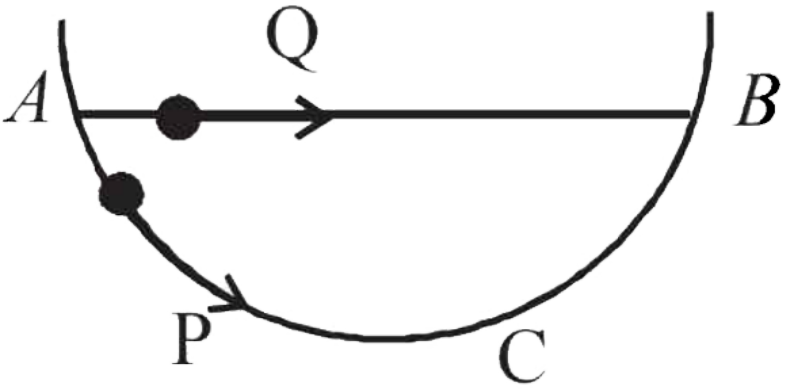
D. None of these

Answer: B

Watch Video Solution

6. A particle P is sliding down a frictionless hemispherical bowl. It passes the point A at $t = 0$. At this instant of time, the horizontal component of its velocity is v. A bead Q of the same mass as P is ejected from A at $t = 0$ along the horizontal string AB, with the speed v. Friction between the bead and the string may be neglected. Let t_P and t_Q be the respective

times taken by P and Q to reach the point B. Then:



A. $t_P < t_Q$

B. $t_P = t_Q$

C. $t_P > t_Q$

D. $\frac{t_P}{t_Q} \frac{\text{length of arc ACB}}{\text{length of cord AB}}$

Answer: A

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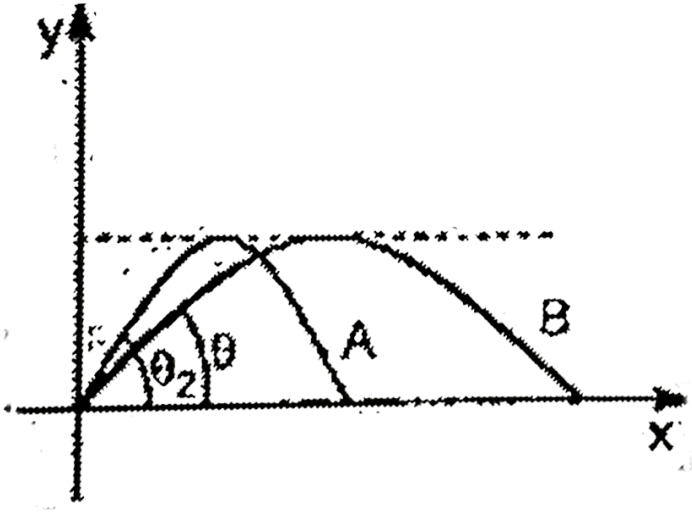
7. Two partides. are thrown from the same point in the same vertical plane, as shown in figure simultaneously. Then indicate the correct statements :



A. Time of flight for B is less than that of A

B. Projection speed of B is greater than that of A

C. Horizontal component of velocities of B is greater than that of A

D. The vertical component of velocities of both A and B are always equal throughout the duration for which both the particles in air

Answer: B::C::D

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8. A particle of mass m moves on the $x - a\xi s$ as follows : it starts from rest at $t = 0$, from the point $x = 0$, and comes to rest at $t = l$ at the point $x = 1$. No other information is available about its motion at intermediate times $(0 < t < l)$. If α denotes the instantaneous accelartion of the particle , then :

A. α cannot remain positive for all t in the interval $0 > t > 1$

B. $|apha|$ cannot exceed 2 at any point in its path

C. $|\alpha|\text{must be} > 4$ at some point or points in its path

D. α must change sign during the motion but no other assertion can be made with the information given.

Answer: A::C

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9. The magnitude of acceleration of a particle as seen by observer A is a $m/s^2$and that observed by Bis b m/s^2. If magnitude of acceleration of A with respect to B is x m/s^2 then indicate the correct statements is :

A. $\left|a^2 - b^2\right| \leq x \leq \left|a^2 + b^2\right|$

B. $|a - b| \leq x \leq |a + b|$

C. $|a - b| < x < |a + b|$

D. $0 \leq x \leq |a - b| \text{ or } x \geq |a + b|$

Answer: B

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10. An aeroplane moving horizontally from west to east with some velocity and with an acceleration $5m/s^2$ drops a food packet at some instant. Then:

A. The path of the packet is parabolic with respect to ground

B. A person sitting on the aeroplane shall see the packet is always vertically below the plane.

C. With respect to plane the packet travels in a straight line making an angle $\tan^1(1/2)$ east of vertical.

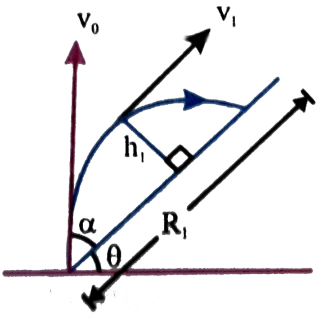
D. With respect to plane the packet travels in a straight line making an angle $\tan^{-1}(1/2)$ east of vertical.

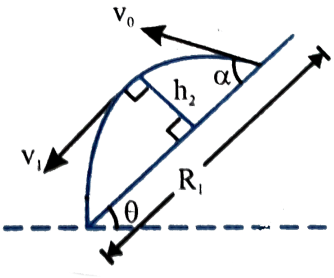
Answer: A::C

View Text Solution

11. Two balls are thrown from an inclined plane at angle of projection α with the plane, one up the incline and other down the incline as shown in

figure (T stands for total time of flight):





A. $h_1 = h_2 \dfrac{v_0^2 \sin^2 \alpha}{2g \cos 0}$

B. $T_1 = T_2 = \dfrac{2v_0 \sin \alpha}{g \cos 0}$

C. $R_2 - R_1 = g(\sin 0)T_1^2$

D. $v_{t_2} = v_{t_1}$

Answer: A::B::C

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12. A particle moves in the xy-plane according to the law $x = a \sin(\omega t) \text{and} y = a(1 - \cos \omega t)$ where 'a' and 'omega' are constants. Then the particle. follows :

A. a parabolic path

B. a straight line path, equally inclined to x- and y-axis

C. circular path

D. a path such that distance moved by it is proportional to time

Answer: C::D

View Text Solution

13. Mark correct statements.

A. Two particles thrown with same speed from the same point at the same instant but at different angles cannot collide in mid air.

B. A body projected in uniform gravitational field follows a parabolic path

C. In projectile motion, velocity never perpendicular to the acceleration.

D. A particle dropped from rest and blown over by a horizontal wind with constant velocity traces a parabolic path.

Answer: A::D

View Text Solution

14. An aeroplane at a constant speed releases a bomb.As the bomb drops away from the aeroplane,

A. It will always be vertically below the aeroplane

B. It will always be vertically below the aeroplane only if the aeroplane was flying horizontally

C. It will always be·vertically- below the aeroplane only if the aeroplane was flying at 11n angle of

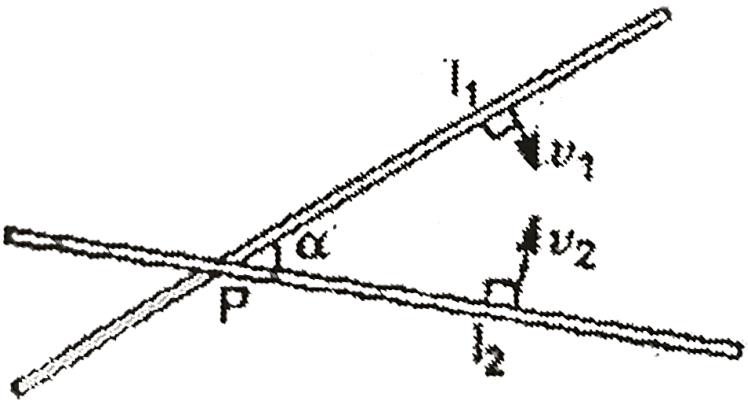
45° to the horizontal

D. It will gradually fall behind the aeroplane if the aeroplane was flying horizontally

Answer: A

Watch Video Solution

15. Two straight lines l_1 and l_2 cross each other ar point P The line l_1 is moving at a speed v_1 perpendicular to itself & line l_2 is moving at a speed v_2 in the similar fashion. The speed of point P is :



A. $\sqrt{\frac{v_1 v_2}{\sin \alpha}}$

B. $\frac{\sqrt{v_1^2 + v_2^2 + 2(v_1 + v_2)^2 \cos\alpha}}{\cos\alpha}$

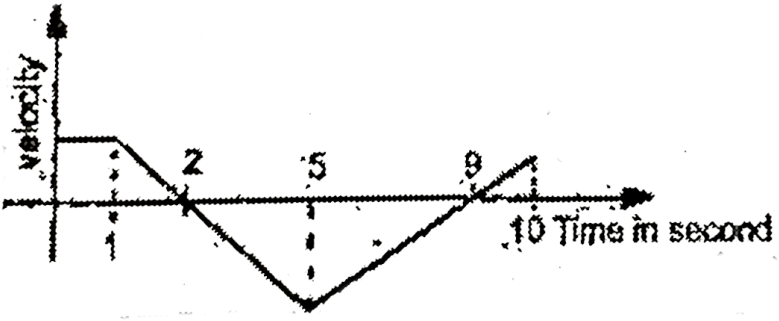
C. $\frac{\sqrt{v_1^2 + v_2^2 + 2(v_1 + v_2)^2 \cos\alpha}}{\sin\alpha}$

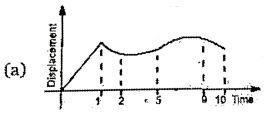
D. $\frac{(v_1 + v_2) + \sqrt{v_1 v_2}\cos\alpha}{\cos\alpha}$

Answer: C

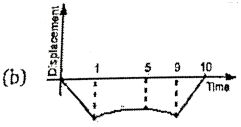
View Text Solution

16. The velocity-time graph of a particle moving along a straight line is given as below. The displacement time curve for the particle is given by :

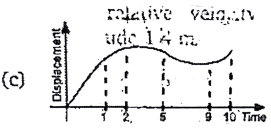


A. 

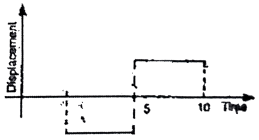
B.



C.



D.



Answer: C

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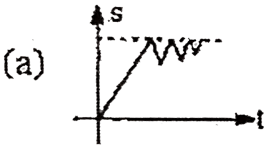
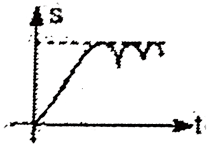
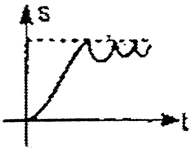
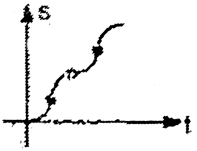
17. A ball is dropped from a certain height on a horizontal floor. The coefficient of restitution between the ball and the floor is $\frac{1}{2}$. The displacement time graph of the ball will be.

A.



B. (b) 

C. (c) 

D. (d) 

Answer: C

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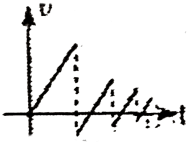
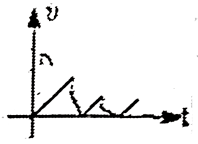
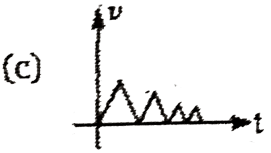
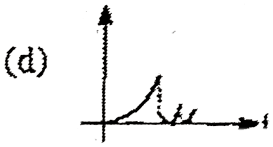
18. The speed -time graph of the ball in the above situation is.

A. (a) 

B. (b) 

C. 

D. 

Answer: B

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19. In a car race, car A takes a time t less than car B at the finish and passes the finishing point with speed v more than that of the car B. Assuming that both the cars start from rest and travel with constant acceleration a_1 and a_2 respectively. Show that $v = \sqrt{a_1 a_2} t$.

A. $a_1 > a_2$

B. $a_1 < a_2$

C. $v = \sqrt{q_1 a_2 t_0}$

D. $v = (a_1 + a_2) t_0$

Answer: A

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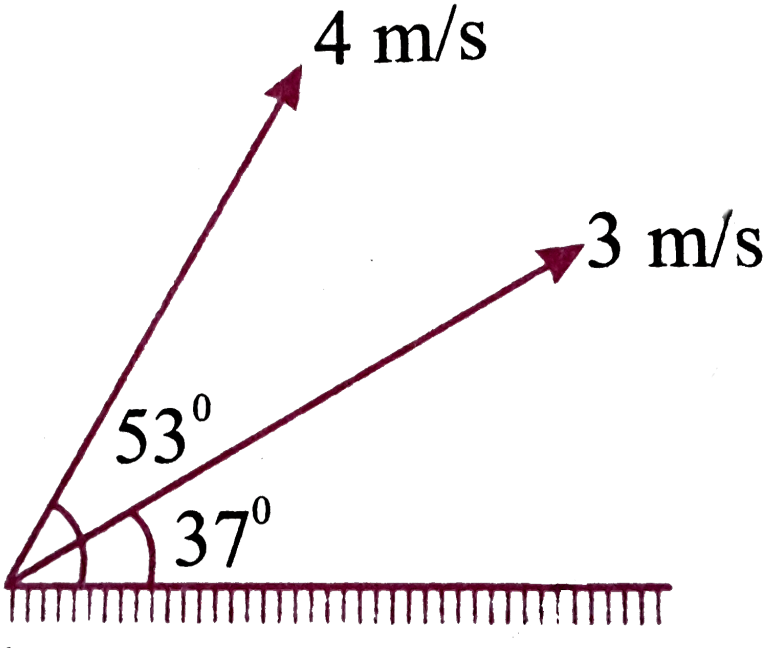
20. Two particles are projected with speed $4m/s$ and $3m/s$ simultaneously from same point as shown in the figure. Then:



A. Their relative velocity is along vertical direction

B. Their relative acceleration. is non-zero and it is along vertical direction·

C. They will hit the surface simultaneouslu

D. Their relative velocity is constanand has magnitude $1.4m/s$

Answer: A::D

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21. The motion of a body falling from rest in a resisting medium is described by the equation $(dv)/(dt) = a - bv$ where a and b are constant . The velocity at any time t is given by

A. maxiriuun possible veiocity is $A/Bm/s$

B. initial acceleration is Am/s^2

C. velocity at any time t is $v = \frac{A}{B}(1 - e^{-Bt}$

D. Velocity at any time t is $v = \frac{A}{B}\left(1 - e^{-At}\right)$

Answer: A::B::C

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22. Which of the following statement is / are correct ?

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

B. it is possible to have situations in which $\left|\frac{d\vec{v}}{dt}\right| \not= 0$, but $\left|\frac{d\vec{v}}{dt}\right| = 0$

C. It is possible to have situations in which $\frac{d\left|\vec{v}\right|}{dt} cencel = 0 \text{but} \left|\frac{d\vec{v}}{dt}\right| = 0$

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

Answer: A::B::D

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23. A car is moving with uniform acceleration along a straight line between two stops X and Y. Its speed at X and Y are $2ms^{-1}$ and $14ms^{-1}$, Then

A. its spied at the mid-point of AB is $10m/s$

B. its speed at a point P such that $AP:PB=1:5\text{is}6m/s$

C. the time to go from A to the mid-point of AB is double of that to go from mid-point to B

D. hone of these

Answer: A::B::C

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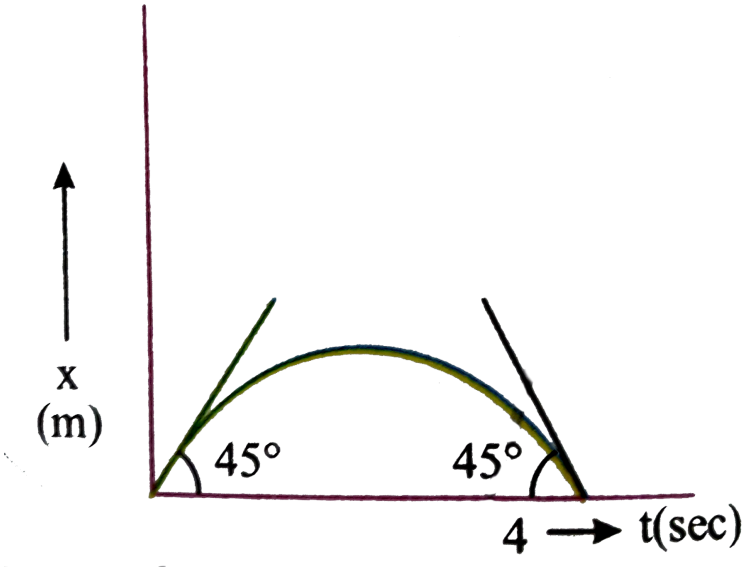
24. A particle moves along x-axis with constant acceleration and its x-position depend on time t as shown in the following graph

(parabola),then in interval 0 to $4\,\text{sec}$.



A. relation between x-coordinate & time is $x = t - t^2/4$

B. maximum x-coordinate is 1m

C. total distance traveled is 2m

D. average speed is $0.5m/s$

Answer: A::B::C::D

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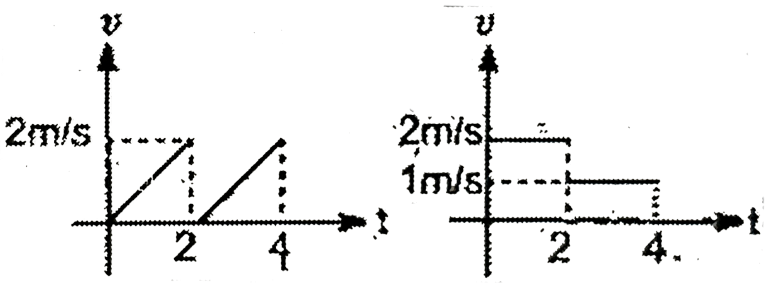
25. The velocity versus time of two particles moving along x-axis varies as shown in the following two plots. Then



A. maximum separation between the two particles is 2m

B. maximum separation between the two particles is 2.5 m

C. maximum separation between occurs after time $\cdot t = 2\,\text{sec}$

D. maximum separation between occurs after time $t = 3\,\text{sec}$

Answer: B::D

View Text Solution

Level 3

1. A particle 'A' starts moving frorri point A with constant velocity 4 m/s along x-axis. Another particle 'B' initially at rest starts moving along x-axis after (8/3), sec after the start of A, with acceleration varying $a = 4 = (3 - t)m/s^2$

Particle B will stop again at the position x equal to :

A. 72m

B. 36m

C. 3m

D. 6m

Answer: A

View Text Solution

2. A particle 'A' starts moving frorri point A with constant velocity 4 m/s along x-axis. Another particle 'B' initially at rest starts moving along x-axis after (8/3), sec after the start of A, with acceleration varying

$a = 4 = (3 - t)m/s^2$

The two particles will meet twice in the due course of their motion. The time interval between these two successive meets will be :

A. 6sec

B. 4 sec

C. 2 sec

D. 8 sec

Answer: A

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3. A particle 'A' starts moving frorri point A with constant velocity 4 m/s along x-axis. Another particle 'B' initially at rest starts moving along x-axis after (8/3), sec after the start of A, with acceleration varying $a = 4 = (3 - t)m/s^2$

Position where the two particles will meet for the second time is given by :

A. $x = 72m$

B. $x = \frac{128}{3}m$

C. $x = 36m$

D. $x = \frac{56}{3}m$

Answer: B

View Text Solution

4. A particle 'A' starts moving frorri point A with constant velocity 4 m/s along x-axis. Another particle 'B' initially at rest starts moving along x-axis after (8/3), sec after the start of A, with acceleration varying $a = 4 = (3 - t)m/s^2$

Total distance traveled by the particle B when it meets the particle A for the second time is :

A. $\frac{304}{3}m$

B. $\frac{96}{3}m$

C. $\frac{56}{3}m$

D. $36m$

Answer: A

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5. A particle 'A' starts moving frorri point A with constant velocity 4 m/s along x-axis. Another particle 'B' initially at rest starts moving along x-axis after (8/3), sec after the start of A, with acceleration varying $a = 4 = (3 - t)m/s^2$

Magnitude of the relative velocity of the two particles when they meet for the first time is :

A. $16m/s$

B. $12m/s$

C. $20m/s$

D. $18m/s$

Answer: B

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6. A particle 'A' starts moving frorri point A with constant velocity 4 m/s along x-axis. Another particle 'B' initially at rest starts moving along x-axis after (8/3), sec after the start of A, with acceleration varying $a = 4 = (3 - t)m / s^2$

Magnitude of the relative velocity of the two particles when they meet for the second time is :

A. 16m/s

B. 32m/s

C. 36m/s

D. 28m/s

Answer: C

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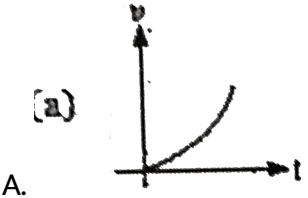
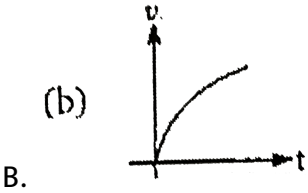
7. A particle 'A' starts moving frorri point A with constant velocity 4 m/s along x-axis. Another particle 'B' initially at rest starts moving along x-axis after (8/3), sec after the start of A, with acceleration varying $a = 4 = (3 - t)m/s^2$

Variation of velocity uf the particle B with time is best represented by :

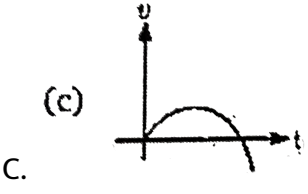
A.



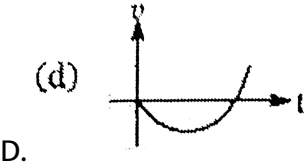
B.



C.



D.



Answer: C

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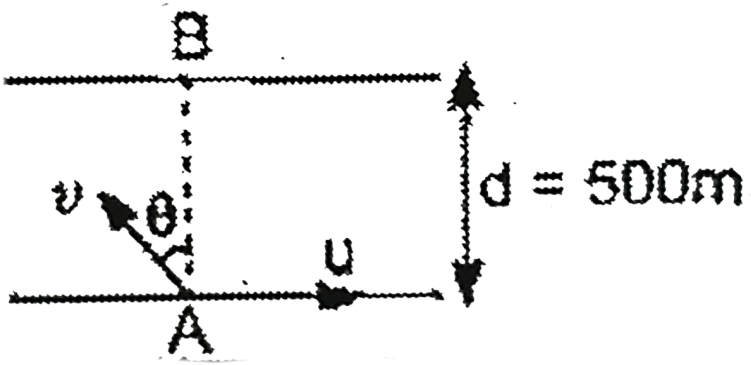
8. A swimmer wishes to .cross a river 500 m wide flowing at a rate 'u'. His speed with respect to still water is 'v'. For this, he makes an angleθ with the perpendicular as shown ip. the. figure.



To cross the river in minimum time, the value of θ should be:

A. 0°

B. 90°

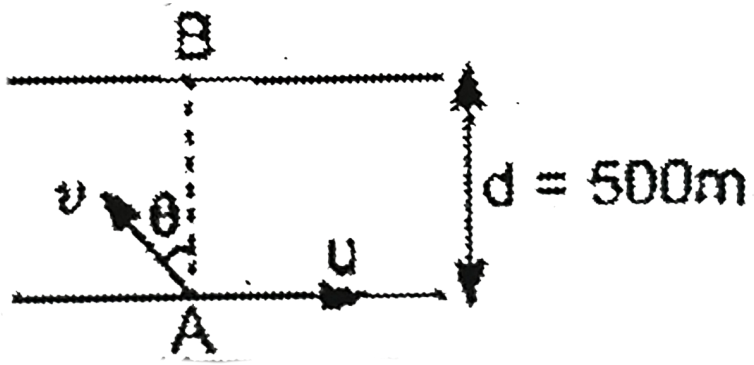
C. 30°

D. 60°

Answer: A

Watch Video Solution

9. A swimmer wishes to cross a river 500 m wide flowing at a rate 'u'. His speed with respect to still water is 'v'. For this, he makes an angleθ with the perpendicular as shown in the figure.



To cross the river in minimum time, the value of θ should be.

A. 3 min

B. 6hr

C. 6min

D. 3hr

Answer: C

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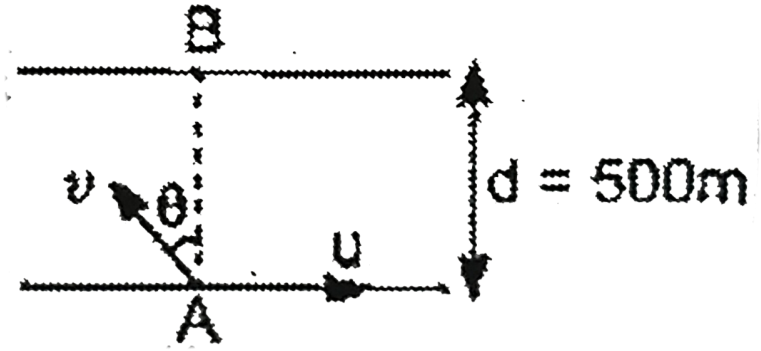
10. A swimmer wishes to cross a river 500 m wide flowing at a rate 'u'. His speed with respect to still water is 'v'. For this, he makes an angle θ with the perpendicular as shown in the figure.



For u = 3 km/hr and v = 5 km/hr, the time taken to cross the river in minimum time will be :

A. can reach to B in 7.5 min

B. can reach to B in 6 min

C. can reach to B in less than 6 min

D. can never reach to B

Answer: A

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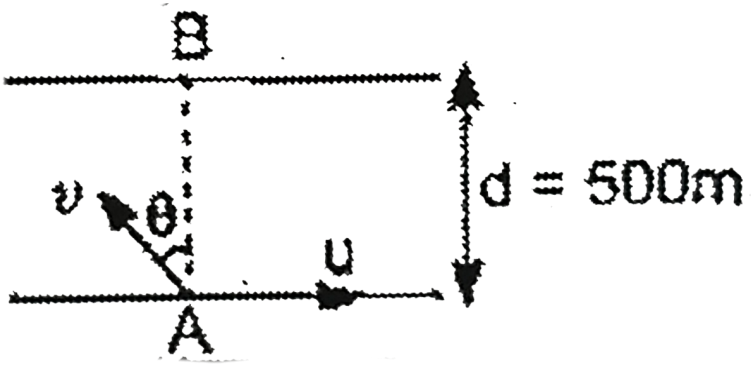
11. A swimmer wishes to cross a river 500 m wide flowing at a rate 'u'. His speed with respect to still water is 'v'. For this, he makes an angle θ with the perpendicular as shown in the figure.



To cross the river in minimum time, the value of θ should be.

A. can reach to B in 7.5 min

B. can reach to B in 6 min

C. can reach to B in less than 6 min

D. can never reach to B

Answer: D

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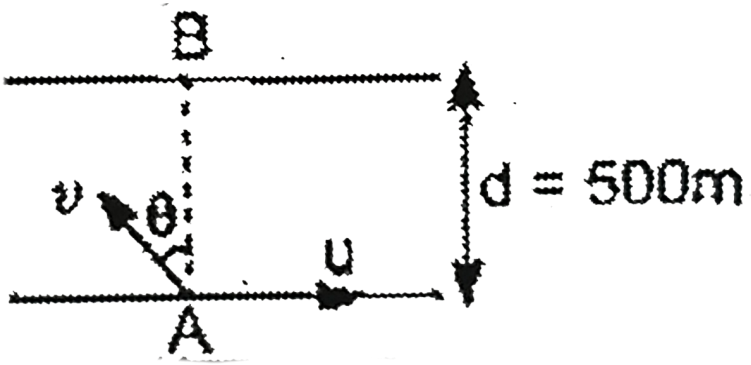
12. A swimmer wishes to cross a river 500 m wide flowing at a rate 'u'. His speed with respect to still water is 'v'. For this, he makes an angle θ with the perpendicular as shown in the figure.



To cross the river in minimum time, the value of θ should be.

A. 37°

B. 53°

C. 60°

D. can never reach to B

Answer: A

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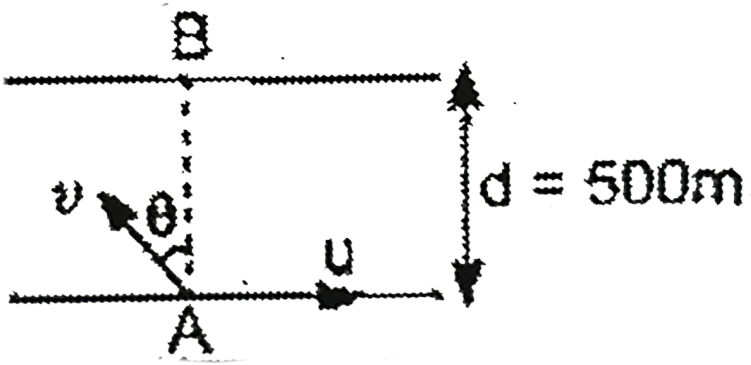
13. A swimmer wishes to cross a river 500 m wide flowing at a rate 'u'. His speed with respect to still water is 'v'. For this, he makes an angle θ with the perpendicular as shown in the figure.



To cross the river in minimum time, the value of θ should be.

A. 30°

B. 60°

C. 0°

D. 45°

Answer: A

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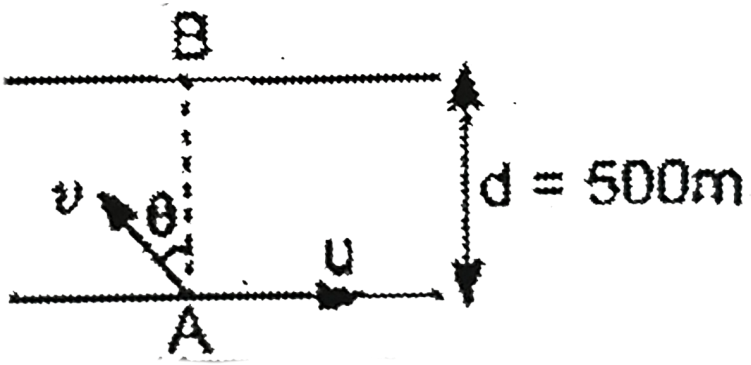
14. A swimmer wishes to cross a river 500 m wide flowing at a rate 'u'. His speed with respect to still water is 'v'. For this, he makes an angleθ with the perpendicular as shown in the figure.



To cross the river in minimum time, the value of θ should be.

A. 30°

B. 60°

C. 0°

D. 45°

Answer: A

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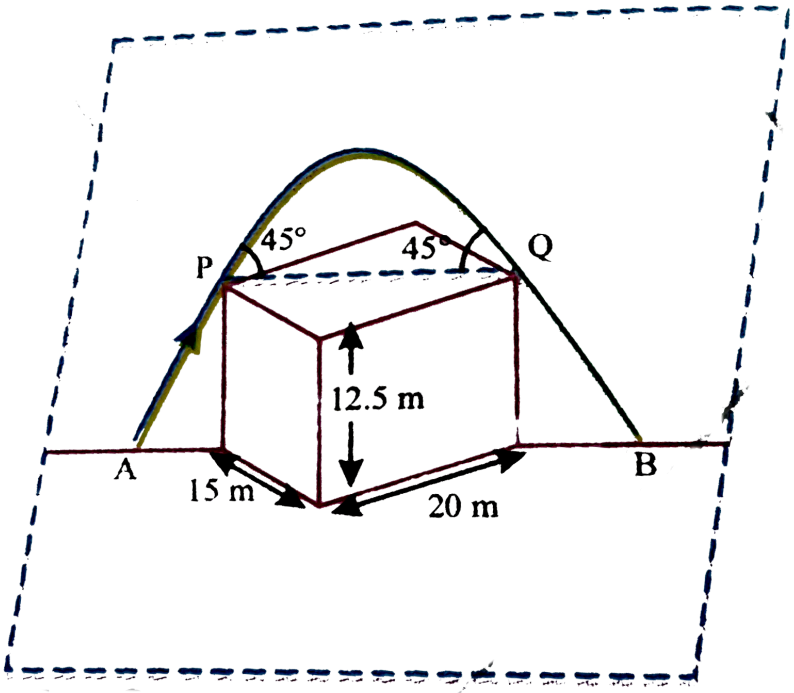
15. A particle is fired from A in the diagonal plane of a building of dimension $20m$(length) $\times$ $15m$ (breadth) $\times$ $12.5m$(height), just clears the roof diagonally & falls on the other side of the building at B.It is observed that the particle is travelling at an angle 45° with the horizontal when it clears the edges P and Q of the diagonal. Take $g = 10m/s^2$.

The speed of the particle at point P will be:



A. $5\sqrt{10}m/s$

B. $10\sqrt{5}m/s$

C. $5\sqrt{15}m/s$

D. $5\sqrt{5}m/s$

Answer: A

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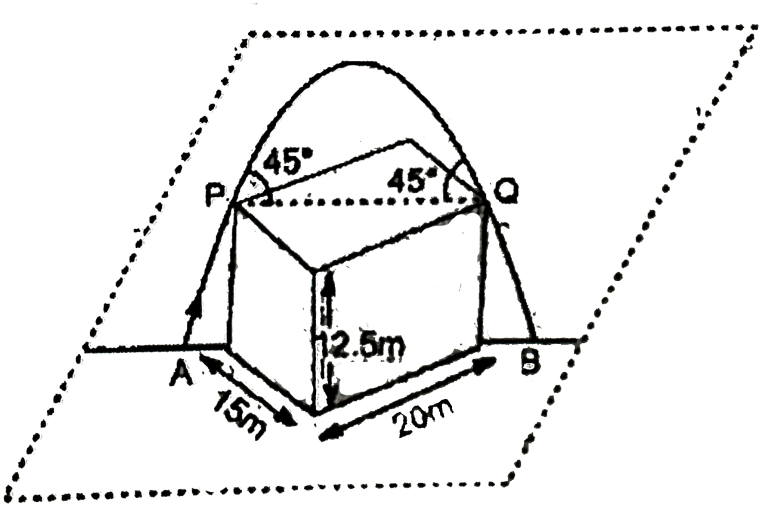
16. A particle is fired from 'A' in the diagonal plane of building of dimension 20 m (length)x 1.5 m (breadth) x 12.5 m (height) , just clears the roof diagonally & falls on the other side of the building at B. it is observed that the particle is travelling at an angle 45° with the horizontal whtn it clears tha edges P and Q of the diagonal Take g= $10m/s^2$



The angle pf projection at A will be :

A. 30°

B. 45°

C. 60°

D. 75°

Answer: C

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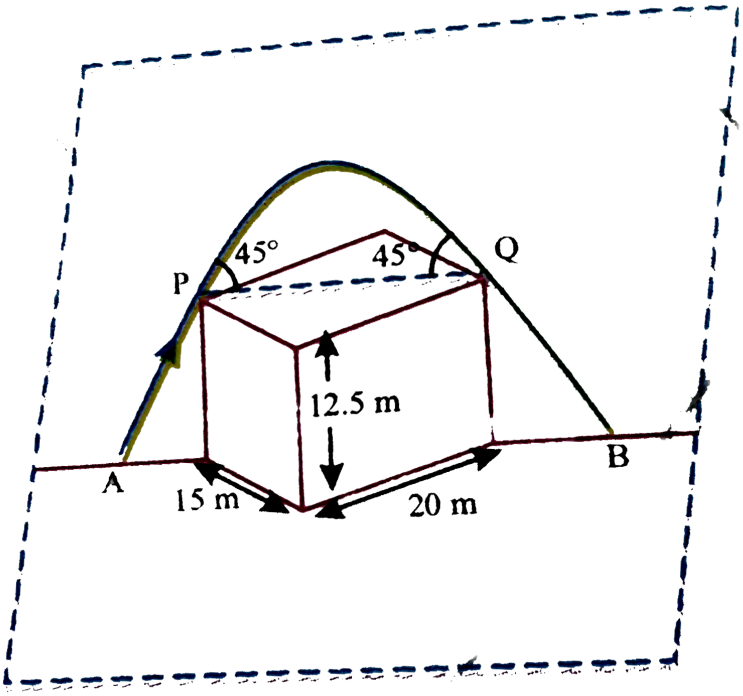
17. A particle is fired from A in the diagonal plane of a building of dimension $20m$(length) $\times$ $15m$ (breadth) $\times$ $12.5m$(height), just clears the roof diagonally & falls on the other side of the building at B.It is observed that the particle is travelling at an angle 45° with the horizontal when it clears the edges P and Q of the diagonal. Take $g = 10m/s^2$.

The speed of projection of the particle at A will be:



A. $5\sqrt{10}m/s$

B. $10\sqrt{5}m/s$

C. $5\sqrt{15}m/s$

D. $5\sqrt{5}m/s$

Answer: B

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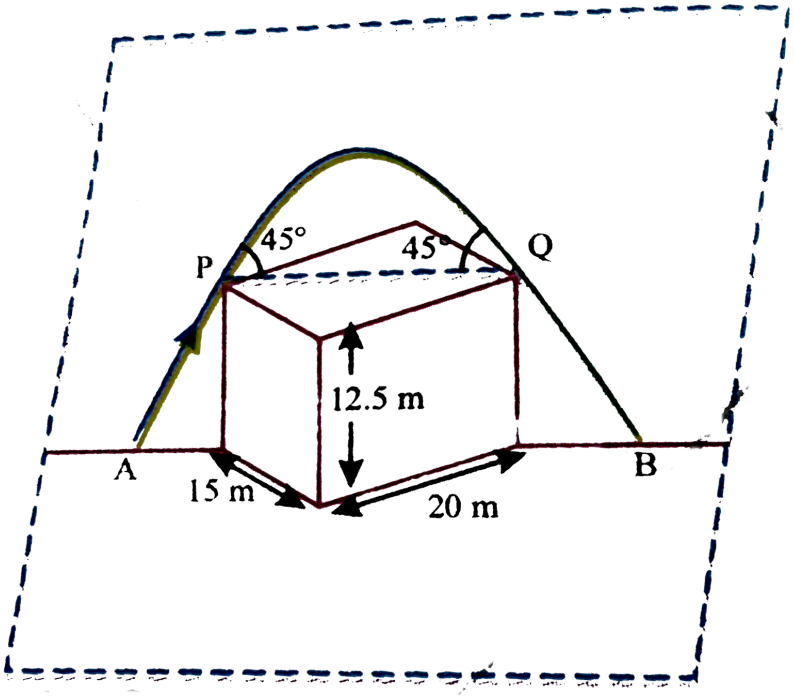
18. A particle is fired from A in the diagonal plane of a building of dimension $20m$(length) $\times$ $15m$ (breadth) $\times$ $12.5m$(height), just clears the roof diagonally & falls on the other side of the building at B.It is observed that the particle is travelling at an angle 45° with the horizontal when it clears the edges P and Q of the diagonal. Take $g = 10m/s^2$.

The speed of the particle at point P will be:



A. $5\sqrt{10}m/s$

B. $10\sqrt{5}m/s$

C. $5\sqrt{15}m/s$

D. \

Answer: D

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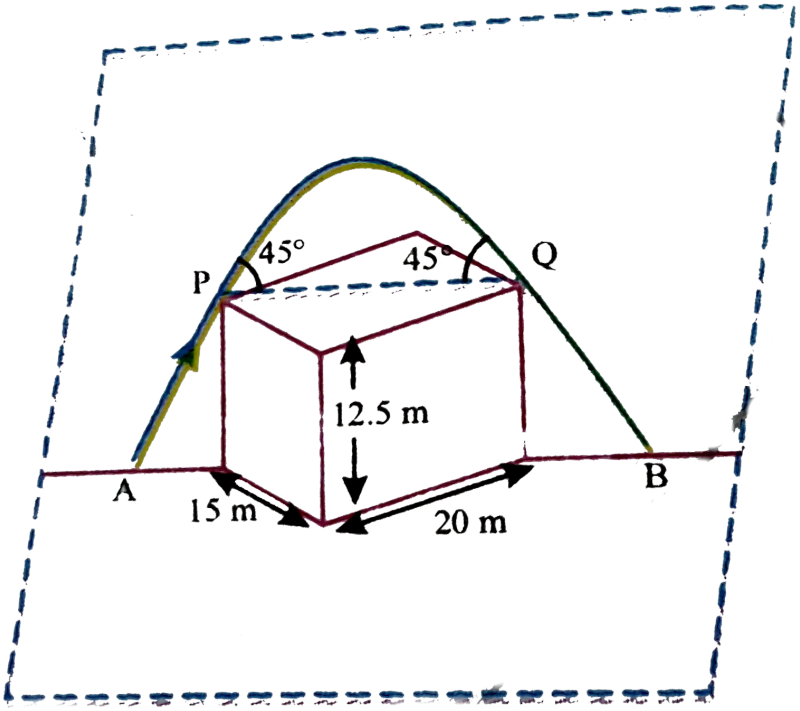
19. A particle is fired from A in the diagonal plane of a building of dimension $20m$(length) $\times$ $15m$ (breadth) $\times$ $12.5m$(height), just clears the roof diagonally & falls on the other side of the building at B.It is observed that the particle is travelling at an angle 45° with the horizontal when it clears the edges P and Q of the diagonal. Take $g = 10m/s^2$.

The range that is AB will be:



A. $5\sqrt{10}m/s$

B. $25\sqrt{3}m$

C. $5\sqrt{15}m/s$

D. $25\sqrt{5}m$

Answer: B

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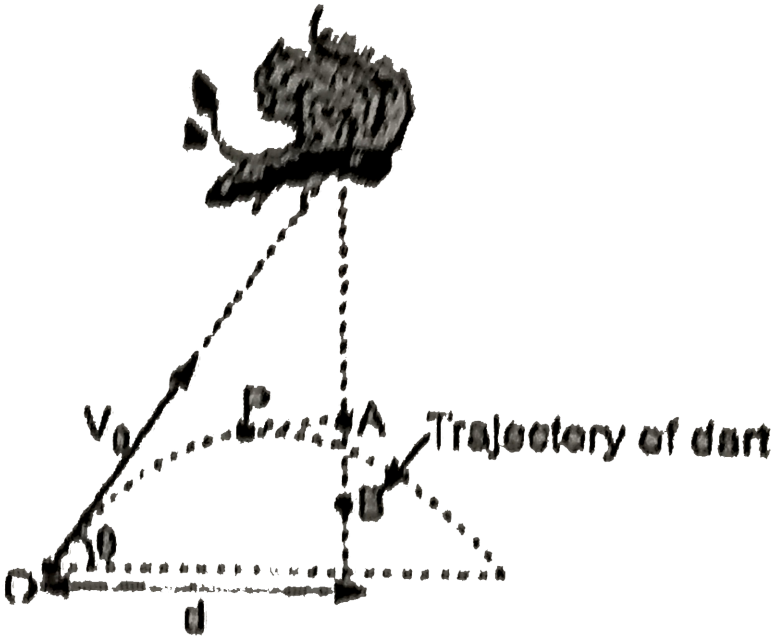
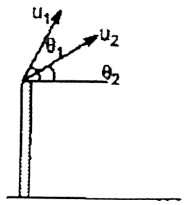
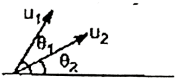
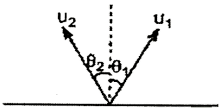
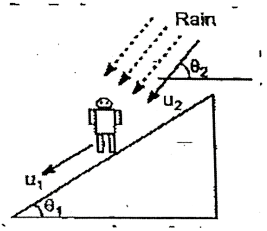
20. A dart gun is fired towards a Squirrel hanging from a tree. Dart gun was initially directed towards Squirrel. P is maximum height attained by dart in its flight. Three different events can occur. (Assume Squirrel to be a particle and there is no air resistance) .


V_0
P
A
Trajectory of dart
B
θ
O
d

Column-1	Column-2
(A) $u_1 = u_2; \theta_1 = \theta_2$ (P)	 Two projectiles are projected from a height such that they strike ground at the same time.
(B) $u_1 > u_2; \theta_1 > \theta_2$ (Q)	 Two projectiles under standard ground to ground projection such that horizontal range is same.
(C) $u_1 < u_2; \theta_2 > \theta_1$ (R)	 Two swimmer starting from same point on a river bank such that time of crossing is same. u_1 and u_2 are velocities relative to river.
(S)	 Person moving downward along slope in rain such that he observes rain vertically.

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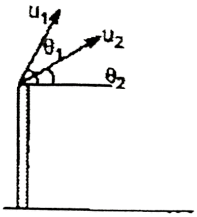
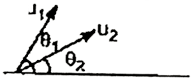
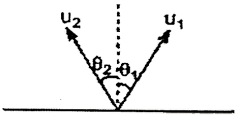
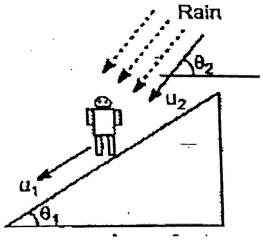
21. Column-1 shows certain situations with certain conditions and column-2 shows the parameters in which situations of column-1 match. Which can

be possible combination.

Column-1	Column-2
(A) $u_1 = u_2; \theta_1 = \theta_2$ (P)	 Two projectiles are projected from a height such that they strike ground at the same time.
(B) $u_1 > u_2; \theta_1 > \theta_2$ (Q)	 Two projectiles under standard ground to ground projection such that horizontal range is same.
(C) $u_1 < u_2; \theta_2 > \theta_1$ (R)	 Two swimmer starting from same point on a river bank such that time of crossing is same. u_1 and u_2 are velocities relative to river.
(S)	 Person moving downward along slope in rain such that he observes rain vertically.

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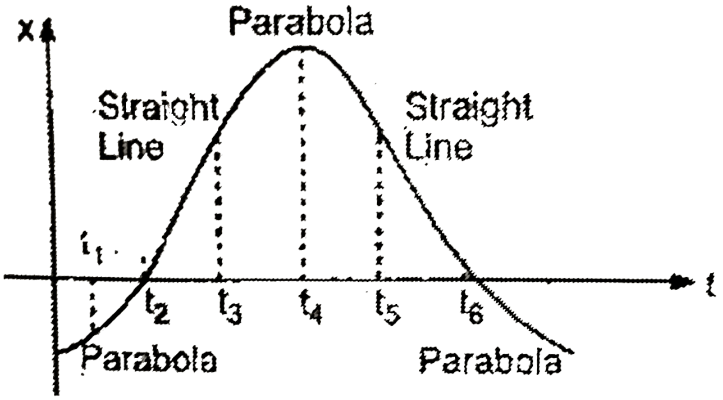
22. Column-1 shows certain situations with certain conditions and column-2 shows the parameters in which situations of column-1 match. Which can be possible combination.



Column-1		Column-2	
(A)	Slowing down	(P)	$t_1 \to t_2$
(B)	Returning towards origin	(Q)	$t_2 \to t_3$
(C)	Moving away from origin	(R)	$t_3 \to t_4$
(D)	Speeding up	(S)	$t_4 \to t_5$
		(t)	$t_5 \to t_6$

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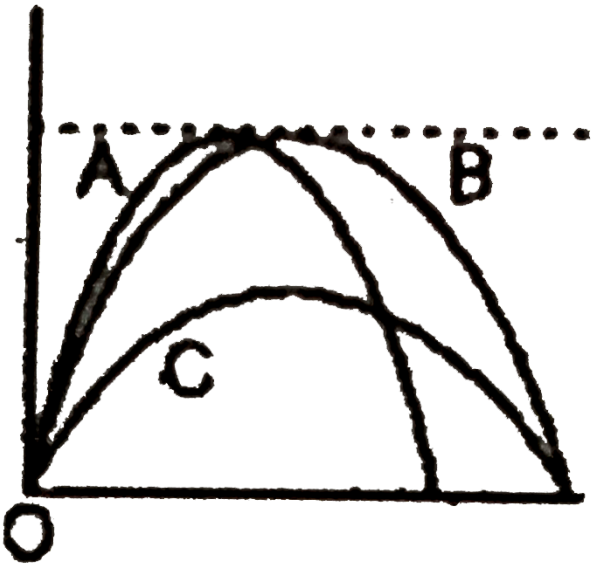
23. Trajectories are shown in figure for three kicked footballs. Initial vertical and horizontal velocity components are u_y and u_x respectively. Ignoring air resistance, choose the correct statement from column-2 for the value of variable in column-1.



Column-1	Column-2
(A) Time of flight	(P) greatest for A only
(B) u_y/u_x	(Q) greatest for C only
(C) u_x	(R) equal for A and B
(D) $u_x u_y$	(S) equal for B and C

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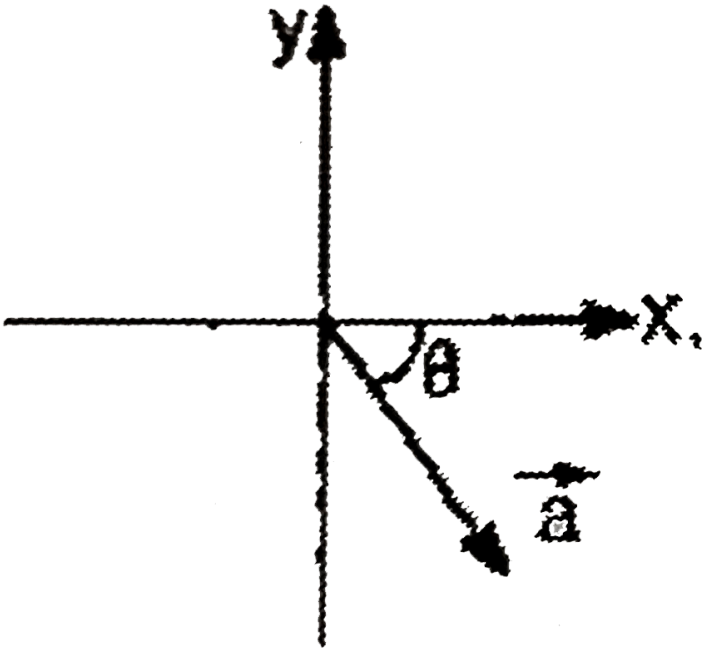
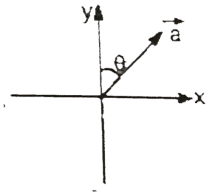
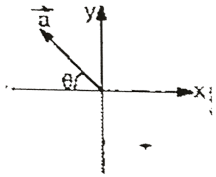
24. Shown a vector $\overrightarrow{a}$ angle θ as shown in the figure column-2. Show its unit vector representation .

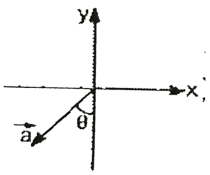


(B) 

(Q) $\vec{a} = -a\cos\theta\,\hat{i} + a\sin\theta\,\hat{j}$

(C) 

(R) $\vec{a} = -a\sin\theta\,\hat{i} - a\cos\theta\,\hat{j}$

(D) 

(S) $\vec{a} = a\cos\theta\,\hat{i} - a\sin\theta\,\hat{j}$

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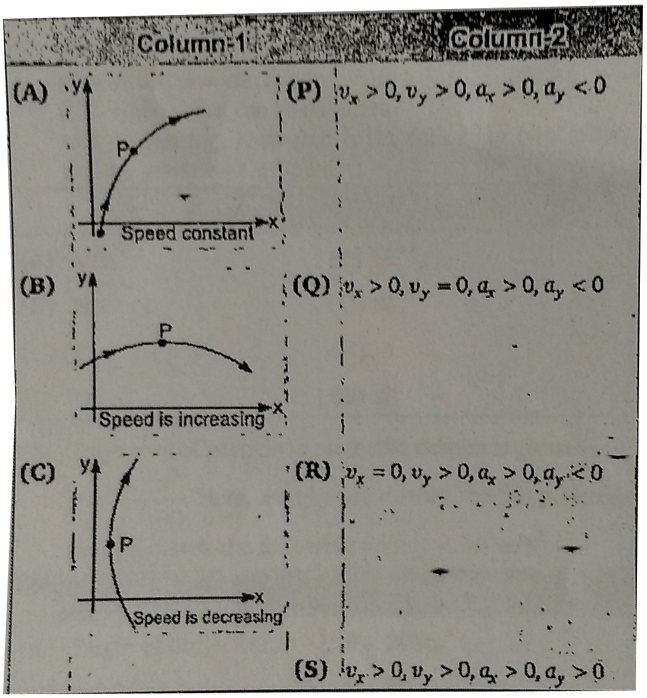
25. Consider an object at point P along each trajectory shown in column-1 in the direction of arrow shown. Column-2 gives algebraic sign of v_x, v_y, a_x and a_y .



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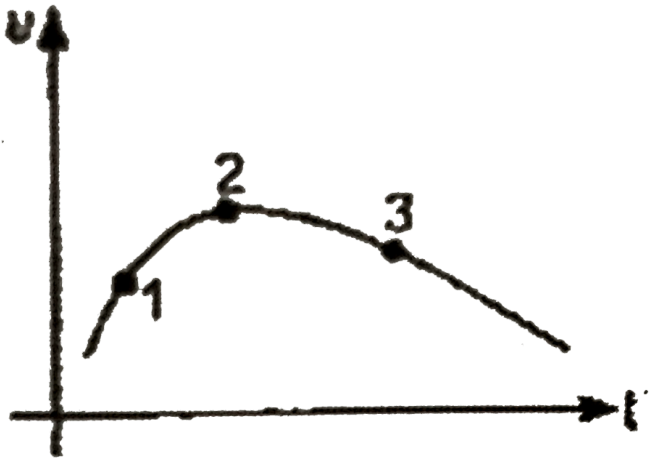
26. A particle is moving along a straight line. Its v-t graph is as shown in figure. Point l, 2 and 3 marked on graph are three different instants. Column-1 has fill in the blanks, which are to be filled by the entries in column-2.



Column-1	Column-2
(A) a_1 is ..... a_2	(P) Parallel to
(B) v_1 is ..... v_2	(Q) Anti-parallel to
(C) v_3 is ..... v_1	(R) Greater than (in magnitude)
(D) a_1 is ..... v_1	(S) Less than (in magnitude)

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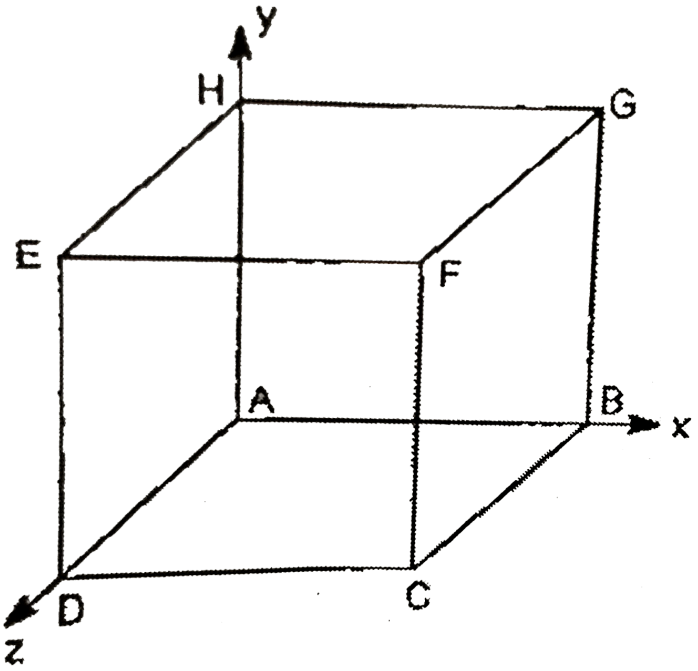
27. Figure shows a cube of edge lenth a



Column-1		Column-2	
(A)	The angle between AF and x -axis	(P)	$60°$
(B)	Angle between AF and DG	(Q)	$\cos^{-1}\frac{1}{3}$
(C)	Angle between AE and AG	(R)	$\cos^{-1}\frac{1}{\sqrt{3}}$
		(S)	$\cos^{-1}\sqrt{\frac{2}{3}}$

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28. Match the following :

Column-2	Column-2
(A) $\frac{d\vec{v}}{dt}$	(P) Acceleration
(B) $\frac{d\lvert\vec{v}\rvert}{dt}$	(Q) Magnitude of acceleration
(C) $\frac{d\vec{r}}{dt}$	(R) Velocity
(D) $\frac{d\lvert\vec{r}\rvert}{dt}$	(S) Magnitude of velocity
	(T) None

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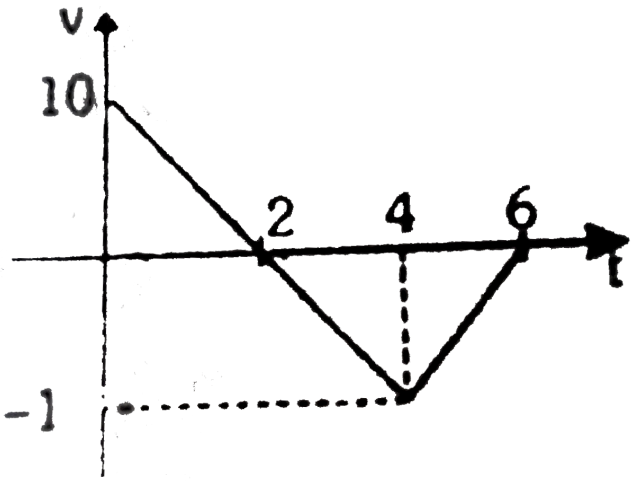
29. For the velocity -time graph shown in figure, in a time interval from $t = 0$ to $t = 6s$, match the following:



	Column I		Column II
(A)	Change in velocity	(p)	$-5/3SI$unit
(B)	Average acceleration	(q)	$-20SI$unit
(C)	Total displacement	(r)	$-10SI$unit
(D)	Acceleration ay t=3s	(s)	$-5SI$unit

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30. Assertion : A body can have acceleration even if its velocity is zero at a given instant of time.

Reason : A body is momentarily at rest when it reverses its direction of motion.

A. If both assertion and reason are true and the reason is correct explanation of the assertion.

B. If both assertion and reason are true, but reason is not correct explanation of assertion.

C. If assertion is true, but the reason is false,

D. If assertion is false, but the reason is true.

Answer:

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31. Assertion : A body having uniform speed is circular path has a constant acceleration .

Reason : Direction of acceleration is always away from the centre.

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32. Assertion: Two bodies of masses M and $m(M > m)$ are allowed to fall from the same height if the air resistance for each be the same then both the bodies will reach the earth simultaneously.

Reason: For same air resistance, acceleration of both the bodies will be same.

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33. Statement I: A body can have acceleration even if its velocity is zero at a given instant .

Statement II: A body is momentarily at rest when it reverses its direction of velocity.

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34. STATEMENT-1: A particle in motion may not have variable speed but constant velocity.

STATEMENT-2: A particle having non-zero acceleration may move with constant speed.

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