PHYSICS

BOOKS - DC PANDEY PHYSICS (HINGLISH)

KINEMATICS

Example

1. Velocity of a particle at some instant is $v = \left(3\hat{i} + 4\hat{j} + 5\hat{k}\right)m/s$. Find speed of the particle at this instant.

A. 12

B. 7

C. -12

D. $5\sqrt{2}$

Answer: D

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2. "A lift is ascending with decreasing speed". What are the directions of velocity and acceleration of the lift at the given instant.

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3. Give two examples of two dimensional motion.

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4. Velocity of a particle is $v = \left(2\hat{i} + 3\hat{j} - 4\hat{k}\right)m/s$ and its acceleration is zero. State whether it is 1-D, 2-D or 3-D motion?

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5. Projectile motion is a two dimensional motion with constant acceleration. Is this statement true or false?

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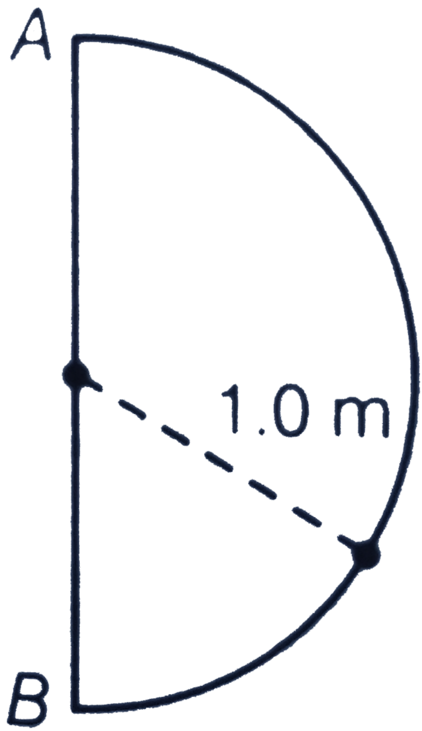
6. In one second, a particle goes from point A to point B moving in a semicircle (Fig). Find the magnitude of the average velocity.



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7. A particle is moving along x-axis. Its X-coordinate varies with time as, $X = 2t^2 + 4t - 6$ Here, X is in meters and t in seconds. Find average velocity between the time interval $t = 0 \rightarrow t = 2s$.

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8. A particle is moving along x-y plane. Its x and y co-ordinates vary with time as $x = 2t^2$ and $y = t^3$ respectively. Here, x and y are in metre and t is in seconds. Find average acceleration between the time interval from $t = 0$ to $t = 2s$.

A. $= \left(6\hat{i} + 6\hat{j}\right)m/s^2$

B. $= \left(4\hat{i} + 8\hat{j}\right)m/s^2$

C. $= \left(4\hat{i} + 6\hat{j}\right)m/s^2$

D. $= \left(1\hat{i} + 6\hat{j}\right)m/s^2$

Answer: C

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9. A particle travels first half of the total distance with constant speed v_1 and second half with constant speed v_2. Find the average speed during the complete journey.

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10. A particle travels first half of the total time with speed v_1 and second half time with speed v_2. Find the average speed during the complete journey.

A. $(v_1 + v_2)$

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

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

D. $\frac{v_1 \cdot v_2}{2}$

Answer: C

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11. A particle travels first half of the total distance with speed v_1. In second half distace with speed in1/3 rd timeis v_2. and in remaining 2/3 rd time constant speed is v_3. Find the average speed during the complete journey.

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12. A ball is thrown upwards from the top of a tower $40m$ high with a velocity of $10m/s$. Find the time when it strikes the ground. Take $g = 10m/s^2$.

A. $4s$

B. $-28s$

C. $12s$

D. $-2s$

Answer: A

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13. A ball is thrown upwards from the ground with an initial speed of u. The ball is at height of $80m$ at two times, the time interval being 6 s. Find u. Take $g = 10m/s^2$.

A. $30ms^{-1}$

B. $40ms^{-1}$

C. $50ms^{-1}$

D. $60ms^{-1}$

Answer: C

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14. A particle is projected vertically upwards with velocity $40m/s$. Find the displacement and distance travelled by the particle in

(a) $2s$ (b) $4s$ (c) $6s$ Take $g = 10m/s^2$

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15. Displacement-time equation of a particle moving along x-axis is $x = 20 + t^3 - 12t$ (SI units)

(a) Find, position and velocity of particle at time t=0.

(b) State whether the motion is uniformly accelerated or not.

(c) Find position of particle when velocity of particle is zero.

A. $12m / s$

B. $22m / s$

C. $-22m / s$

D. $-12m / s$

Answer: D

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16. Velocity-time equation of a particle moving in a straight line is, $v=\left(10+2t+3t^2\right)$ (SI units) Find

(a) displacement of particle from the mean position at time $t=1s$, if it is given that displacement is 20m at time $t=0$.

(b) acceleration-time equation.

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17. 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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18. Velocity and acceleration of a particle at time $t = 0$ are $u = \left(2\hat{i} + 3\hat{j}\right)m/s$ and $a = \left(4\hat{i} + 3\hat{j}\right)m/s^2$ respectively. Find the velocity and displacement if particle at $t = 2s$.

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19. Velocity of a particle in x-y plane at any time t is $v = \left(2t\hat{i} + 3t^2\hat{j}\right)m/s$ At $t = 0$, particle starts from the co-ordinates $(2m, 4m)$. Find

(a) acceleration of the particle at $t = 1s$.

(b) position vector and co-ordinates of the particle at $t = 2s$.

20. s-t graph of a particle in motion is as shown below.

(a) State, whether the given graph represents a uniform motion or not.

(b) Find velocity of the particle.

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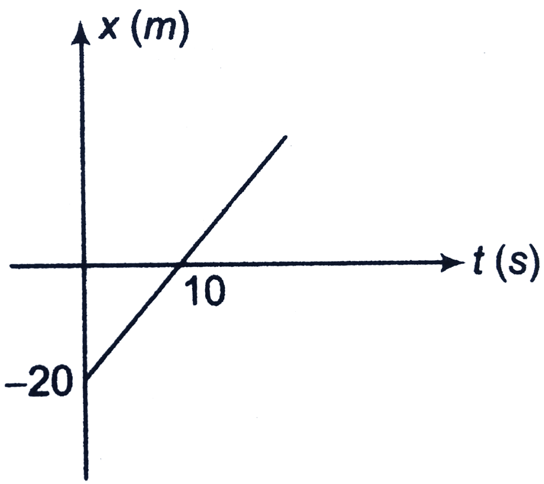
21. A particle is moving along x-axis. Its x-coordinate versus time graph is as shown below.



Draw some conclusion from the given graph.

A. $+2\frac{m}{s}$

B. $+1\frac{m}{s}$

C. $+12\frac{m}{s}$

D. $+20\frac{m}{s}$

Answer: A

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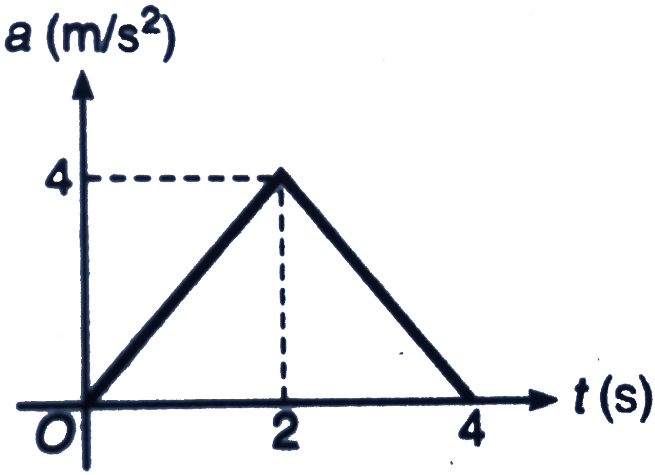
22. Accleration-time graph of a particle moving in a straight line is as shown in Fig. Velocity of particle at time $t = 0$ is $2m / s$. Find the velocity at the end of fourth second.



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23. A particle is projected upwards with velocity $40m/s$. Taking the value of $g = 10m/s^2$ and upward direction as positive, plot a-t,v-t and s-t graphs of the particle from the starting point till it further strikes the ground.

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24. A car accelerates from rest at a constant rate α for some time, after which it decelerates at a constant rate β, to come to rest. If the total time elapsed is t seconds. Then evalute (a) the maximum velocity reached and (b) the total distance travelled.

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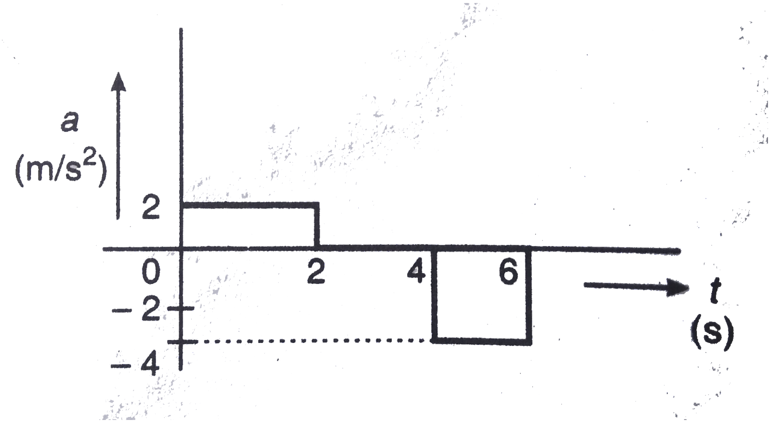
25. The acceleration versus time graph of a particle moving along a straight line is shown in the figure. Draw the respective velocity-time graph Given $v = 0$

at $t = 0$.



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26. Anoop is moving due east with a velocity of $1m/s$ and Dhyani is moving due west with a velocity of $2m/s$. what is the velocity of Anoop with respect to Dhyani?

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27. Car A has an acceleration of $2m/s^2$ due east and car B,$4m/s^2$. due north. What is the acceleration of car B with respect to car A?

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28. Car A and car B start moving simultaneously in the same direction along the line joining them. Car A moves with a constant acceleration $a = 4m/s^2$, while car B moves with a constant velocity $v = 1m/s$. At time $t = 0$, car A is $10m$ behind car B. Find the time when car A overtake car B.

A. $2.5s$

B. $3.5s$

C. $-2s$

D. none

Answer: A

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29. Two ships A and B are $10km$ apart on a line running south to north. Ship A farther north is streaming west at $20km/h$ and ship B is streaming north at $20km/h$. What is their distance of closest approach and how long do they take to reach it?

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30. Width of a river is $30m$, velocity is $2m/s$ and rowing velocity is $5m/s$ at 37° from the direction of river current find the time taken to cross the river.

A. 10sec

B.

C.

D.

Answer: A::B::C

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31. Width of a river is $30m$, velocity is $4m/s$ and rowing velocity is $5m/s$

(a) Make the velocity diagram for crossing the river in shortest time. Then, find this shortest time, net velocity of boatman and drigt along the river.

(b) Can the boatman reach a point just oppsite on the other shore? If yes then make the velocity diagram, the direction in which the should row his boat and the time taken to cross the river in this case.

(c) How long will it iake hom to row $10m$ up the stream and then back to his starting point?

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32. An aircraft flies at $400 km/h$ in still air. A wind of $200\sqrt{2} km/h$ is blowing from the south towards north. The pilot wishes to travel from A to a point B north east of A. Find the time of his journey if $AB = 1000 km$.

A. $t = 0.83h$

B. $t = 1.83h$

C. $t = 2.83h$

D. 1

Answer: B

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33. A man is walking with $3m/s$, due east. Rain is falling vetically downwards with speed $4m/s$. Find the direction in which man should hold his umbrella, so that rain does not wet him.

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34. To a man walking at the rate of $3km/h$ the rain appear to fall vertically downwards. When he increases his speed $6km/h$ it appears to meet him at an angle of 45° with vertical. Find the speed of rain.

A. $\sqrt{2}km/h$

B. $2\sqrt{2}km/h$

C. $3\sqrt{2}km/h$

D. $5\sqrt{2}km/h$

Answer: C

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Example Type 1

1. Two particles are moving along x-axis. Particle-1 starts from $x = -10m$ with velocity $4m/s$ along negative x-direction and acceleration $2m/s^2$ along positive x-direction. Particle-2 starts from $x = +2m$

with velocity $6m/s$ along positive x-direction and acceleration $2m/s^2$ along negative x-direction.

(a) Find the time when they collide.

(b) Find the x-coordinates where they collide. Both start simultaneously.

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Example Type 2

1. Two particles are moving along x-axis. Particle-1 is $40m$ behind Particle-2. Particle-1 starts with velocity $12m/s$ and acceleration $4m/s^2$ both in positive x-direction. Particle-2 starts with velocity $4m/s$ and acceleration $12m/s^2$ also in positive x-direction. Find

(a) the time when distance between them is minimum.

(b) the minimum distacne between them.

A. $1s$ $36m$

B. $12s$ $36m$

C. $1s$ $360m$

D. $1s$ $136m$

Answer: A

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Example Type 3

1. A particle is moving in x-y plane with its x and y co-ordinates varying with time as, $x = 2t$ and $y = 10t - 16t^2$. Find trajectory of the particle.

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Example Type 4

1. A particle is moving in x-y plane. Its initial velocity and acceleration are $u = (4\hat{i} + 8\hat{j})m/s$ and $a = (2\hat{i} - 4\hat{j})m/s^2$. Find

(a) the time when the particle will cross the x-axis.

(b) x-coordinate of particle at this instant.

(c) velocity of the particle at this instant.

Initial coordinates of particle are $(4m, 10m)$.

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Example Type 5

1. Find the time t_0 when x-coordinate of the particle is zero.

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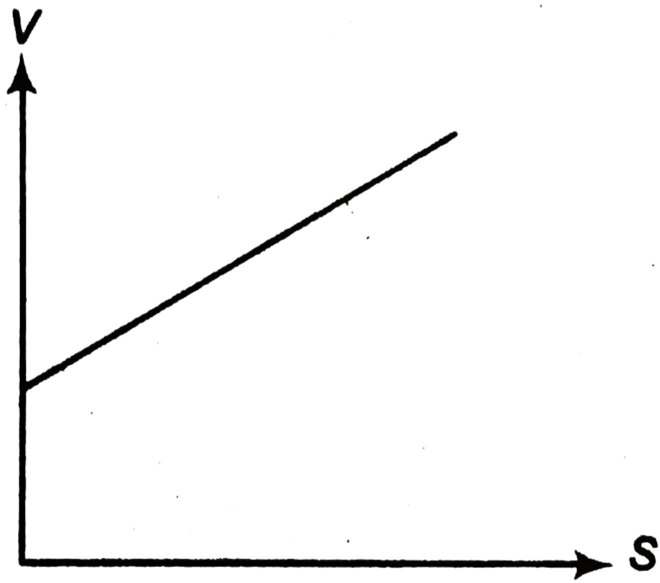
Example Type 6

1. Corresponding to given v-s graph of a particle moving in a straight line, plot a-s graph.



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Example Type 7

1. A particle is moving along x-axis. At time $t = 0$, Its x-coordinate is $x = -4m$. Its velocity-time equation is $v = 8 - 2t$ where, v is in m//s and t in seconds.

(a) At how many times, particle is at a distance of $8m$ from the origin?

(b) Find those times.

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Miscellaneous Example

1. A rocket is fired vertically upwards with a net acceleration of $4m/s^2$ and initial velocity zero. After

$5s$ its fuel is finished and it decelerates with g. At the highest point its velocity becomes zero. Then, it accelerates downwards with acceleration g and return back to ground. Plot velocity-time and displacement - time graphs for the complete journey. Take $g = 10m/s^2$.

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2. An open lift is moving upward with velocity $10m/s$. It has an upward acceleration of $2m/s^2$. A ball is projected upwards with velocity $20m/s$ relative to ground. Find

(a) time when ball again meets the lift

(b) displacement of lift and ball at that instant.

(c) distance travelled by the ball upto that instant.

Take $g = 10m/s^2$

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3. A particle starts with an initial velocity and passes successively over the two halves of a given distance with constant accelerations a_1 and a_2 respectively. Show that the final velocity is the same as if the whole distance is covered with a uniform acceleration $\dfrac{a_1 + a_2}{2}$.

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4. 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 $v = \sqrt{a_1 a_2} t$.

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5. An open elevator is ascending with constant speed $v = 10 m/s$. A ball is thrown vertically up by a boy on the lift when he is at a height $h = 10 m$ from the ground. The velocity of projection is $v = 30 m/s$ with respect to elevator. Find

(a) the maximum height attained by the ball.

(b) the time taken by the ball to meet the elevator again.

(c) time taken by the ball to reach the ground after crossing the elevator.

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6. From an elevated point A, a stone is projected vertically upwards. When the stone reaches a distance h below A, its velocity is doubleof what it was at a height h above A. Show that the greatest height attained by the stone is $\frac{5}{3}h$.

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7. Velocity of a particle moving in a straight line varies with its displacement as $v = (\sqrt{4+4s})m/s.$ Displacement of particle at time $t = 0$ is $s = 0$. Find displacement of particle at time $t = 2s$.

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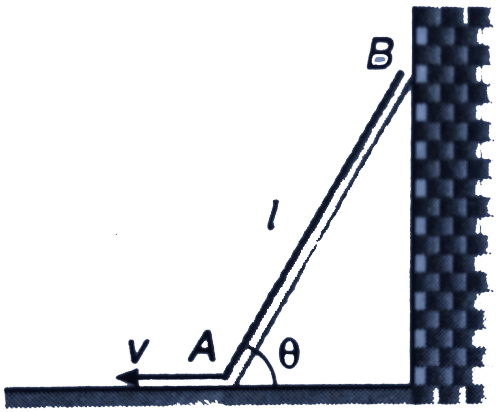
8. Figure shows a rod of length l resting on a wall and the floor. Its lower end A is pulled towards left with a constant velocity v. Find the velocity of the other end B downward when the rod makes an angle θ with the horizontal.



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9. A particle is moving in a straight line with constant acceleration. If x,y and z be the distances described by a particle during the pth, qth and rth second respectively, prove that (q-r)x+(r-p)y+(p-q)z=0

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

A. $t = \dfrac{d}{v}$

B. $t = \dfrac{3d}{2v}$

C. $t = \dfrac{2d}{3v}$

D. $t = 0$

Answer: C

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11. An elevator car whose floor to ceiling distance is equal to $2.7m$ starts ascending with constant acceleration $1.2m/s^2$. 2 s after the start, a bolt begins falling from the ceiling of the car. Find

(a)the time after which bolt hits the floor of the elevator.

(b)the net displacement and distance travelled by the bolt, with respect to earth. (Take $g = 9.8m/s^2$)

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12. A man wants to reach point B on the opposite bank of a river flowing at a speed as shown in figure. What minimum speed relative to water should the man have so that he can reach point B? In which direction should he swim?

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Exercise 6.1

1. "A lift is ascending with decreasing speed". What are the directions of velocity and acceleration of the lift at the given instant.

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2. velocity and acceleration of a particle at some instant are

$v = \left(3\hat{i} - 4\hat{j} + 2\hat{k}\right)m/s$ and $a = \left(2\hat{i} + \hat{j} - 2\hat{k}\right)m/s^2$

(a) What is the value of dot product of v and a at the given instant?

(b) What is the angle between v and a, acute, obtuse or 90°?

(c) At the given instant, whether speed of the particle is increasing, decreasing or constant?

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Exercise 6.2

1. Velocity and acceleration of a particle are $v = \left(2\hat{i} - 4\hat{j}\right)\frac{m}{s}$ and $a = \left(-2\hat{i} + 4\hat{j}\right)\frac{m}{s^2}$ Which type of motion is this?

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2. Velocity and acceleration of a particle are $v = \left(2\hat{i}\right)\frac{m}{s}$ and $a = \left(4t\hat{i} + t^2\hat{j}\right)\frac{m}{s^2}$ where, t is the time. Which type of motion is this ?

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3. In the above question, can we use $v - u + at$ equation directly?

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Exercise 6.3

1. Average speed is always equal to magnitude of average velocity. Is this statement true or false ?

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2. When a particle moves with constant velocity its average velocity, its instantaneous velocity and its speed all are equal. Is this statement true or false ?

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3. A stone is released from an elevator going up with an acceleration of $\frac{g}{2}$. What is the acceleration of the stone just after release ?

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4. A clock has its second hand $2.0cm$ long. Find the average speed and modulus of average velocity of the tip of the second hand in $15s$.

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5. (a) Is it possible to be accelerating if you are travelling at constant speed?

(b) Is it possible to move on a curved path with zero acceleration, constant acceleration, variable acceleration

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6. A particle is moving in a circle of radius $4cm$ with constant speed of $1cm/s$. Find

(a) time period of the particle.

(b) average speed, average velocity and average acceleration in a time interval from $t = 0$ to $t = \frac{T}{4}$. Here, T is the time period of the particle. Give only their magnitudes.

A. $T = 2s$, $1.9cm/s$ $0.23cm/s^2$

B. $T = 25.13s$, $0.9cm/s$ $2.23cm/s^2$

C. $T = 15.13s$, $1.9cm/s$ $1.23cm/s^2$

D. $T = 25.13s$, $0.9cm/s$ $0.23cm/s^2$

Answer: D

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Exercise 6.4

1. A particle moves in a straight line with constant speed of $4m/s$ for $2s$, then with $6m/s$ for $3s$. Find the average speed of the particle in the given time interval.

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2. A particle travels half of the time with constant speed $2m/s$, In remaining half of the time it travels,

$\frac{1}{4}th$ distance with constant speed of $4m/s$ and $\frac{3}{4}th$ distance with $6m/s$. Find average speed during the complete journey.

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Exercise 6.5

1. Prove the relation, $s_t = u + at - \frac{1}{2}a$.

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2. Equation $s_t = u + at - \frac{1}{2}a$ does not seem dimensionally correct, why?

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3. A particle is projected vertically upwards. What is the value of acceleration

(i) during upward journey,

(ii) during downward journey and

(iii) at highest point?

A. $10\frac{m}{s^2}$

B. $-10\frac{m}{s^2}$

C. $10\frac{m}{s^2} - 10\frac{m}{s^2} 0\frac{m}{s^2}$

D. Variable

Answer: B

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4. A ball is thrown vertically upwards. Which quantity remains constant among, speed, kinetic energy, velocity and acceleration?

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5. A particle is projected vertically upwards with an initial velocity of $40m/s$. Find the displacement and distance covered by the particle in $6s$. Take $g = 10m/s^2$.

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6. A particle moves rectilinearly with initial velocity u and constant acceleration a. Find the average velocity of the particle in a time interval from $t = 0$ to $t = t$ second of its motion.

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7. A particle moves in a straight line with uniform acceleration. Its velocity at time $t = 0$ is v_1 and at time

$t = t$ is v_2. The average velocity of the particle in this time interval is $\frac{v_1 + v_2}{2}$. Is this statement true or false?

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8. Find the average velocity of a particle released from rest from a height of $125m$ over a time interval till it strikes the ground. Take $g = 10m/s^2$.

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9. A particle starts with an initial velocity $2.5m/s$ along the posiive x-direction and it accelerates uniformly at the rate $0.50 m / s^2$.

(a) Find the distance travelled by it in the first two seconds

(b) How much time does it take to reach the velocity $7.5 m / s$?

(c) How much distance will it cover in reaching the velocity $7.5 m / s$?

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10. A ball is projected vertically upward with a speed of $50 m / s$. Find (a) the maximum height, (b) the time to reach the maximum height, (c) the speed at half the maximum height. Take $g = 10 m s^2$.

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Exercise 6.6

1. Velocity (in m/s) of a particle moving along x-axis varies with time as, $v = (10 + 5t - t^2)$ At time $t = 0, x = 0.$ Find

(a) acceleration of particle at $t = 2s$ and

(b) x-coordinate of particle at $t = 3s$

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2. A particle is moving with a velocity of $v = \left(3 + 6t + 9t^2\right)\frac{m}{s}$. Find out

(a) the acceleration of the particle at $t = 3s$.

(b) the displacement of the particle in the interval $t = 5s$ to $t = 8s$.

A. 60

B. 20

C. 10

D. 15

Answer: A

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3. The motion of a particle along a straight line is described by the function $x = (2t - 3)^2$, where x is in metres and t is in seconds. Find

(a) the position, velocity and acceleration at $t = 2s$.

(b) the velocity of the particle at the origin .

A. $1, 0, 4$

B. $1, 4, 0$

C. $10, 14, -\frac{3}{4}$

D. $10, -1, 0$

Answer: B

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4. x-coordinate of a particle moving along this axis is $x = (2 + t^2 + 2t^3)$. Here, x is in meres and t in seconds. Find (a) position of particle from where it started its journey, (b) initial velocity of particle and (c) acceleration of particle at $t = 2s$.

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5. The velocity of a particle moving in a straight line is directly proportional to $3/4th$ power of time elapsed. How does its displacement and acceleration depend on time?

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Exercise 6.7

1. Velocity of a particle at time $t = 0 is 2m/s$. A constant acceleration of $2\frac{m}{s^2}$ acts on the particle for $2s$ at an angle of 60° with its initial velocity. Find the magnitude of velocity and displacement of particle at the end of $t = 2s$.

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2. Velocity of a particle at any time t is $v = \left(2\hat{i} + 2t\hat{j}\right)m/s$. Find acceleration and displacement of particle at $t = 1s$. Can we apply $v = u + at$ or not?

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3. Acceleration of a particle in x-y plane varies with time as $a = \left(2t\hat{i} + 3t^2\hat{j}\right)m/s^2$ At time $t = 0$, velocity of particle is $2m/s$ along positive x direction and particle starts from origin. Find velocity and coordinates of particle at $t = 1s$.

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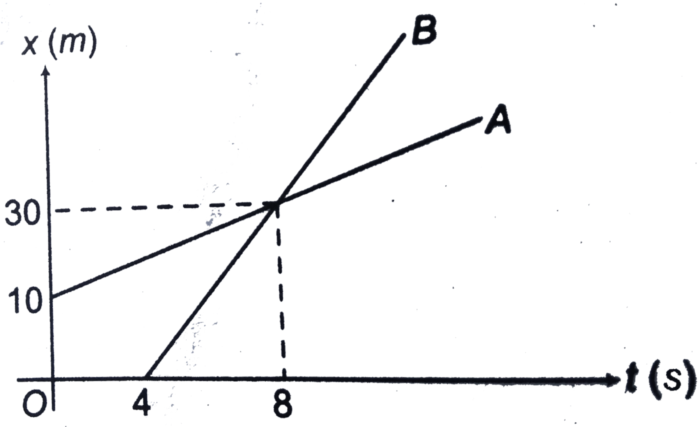
Exercise 6.8

1. Two particles A and B are moving along x-axis. Their x-coordinate versus time graphs are as shown below



(a) Find the time when the particles start their journey and the x-coordinate at that time.

(b) Find velocities of the two particles.

(c) When and where the particles strike with each other.

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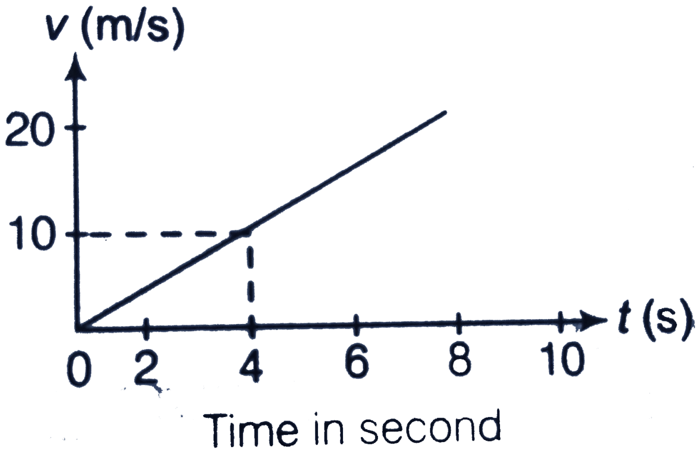
2. The velocity of a car as a function of time is shown in Fig. Find the distance travelled by the car in $8s$ and its acceleration.



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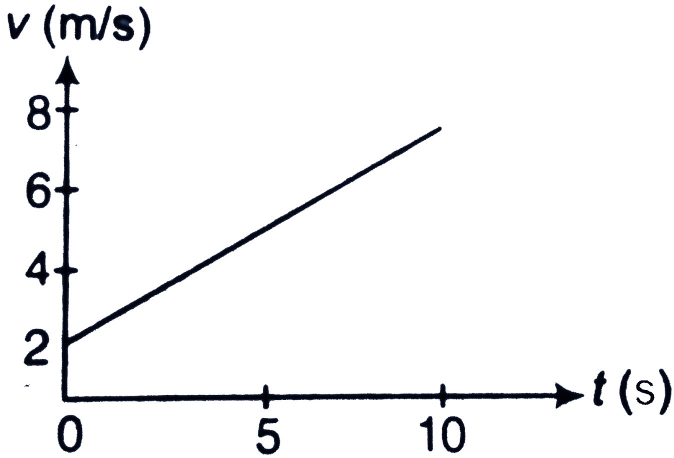
3. Fig. shows the graph of velocity versus time for a partice going along the x-axis. Find (a) acceleration, (b) the distance traveled in $0 \rightarrow 10s$ and (c) the displacement in 0 to $10s$.



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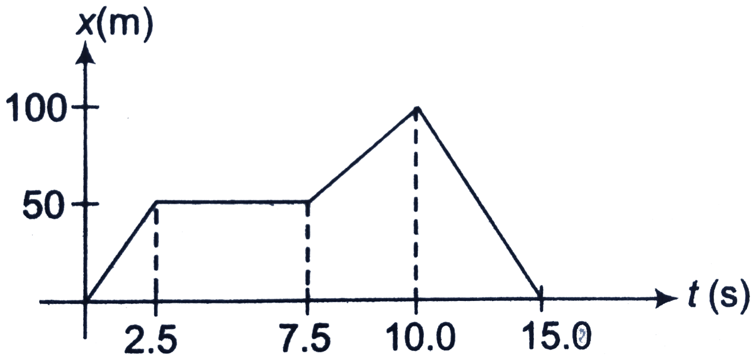
4. Fig. shows the graph of the x-coordinate of a particle going along the x-axis as a function of time. Find (a) the average velocity during 0 to $10s$, (b) instantaneous velocity at 2, 5, 8 and 12s.



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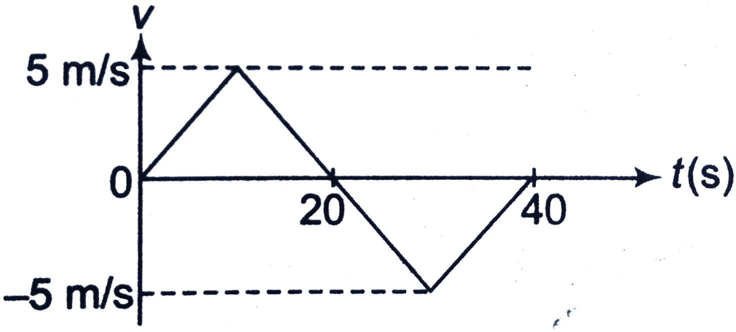
5. From the velocity-time plot shown in Fig. find the distance travelled by the particle during the first $40s$.

Also find the average velocity during this period.



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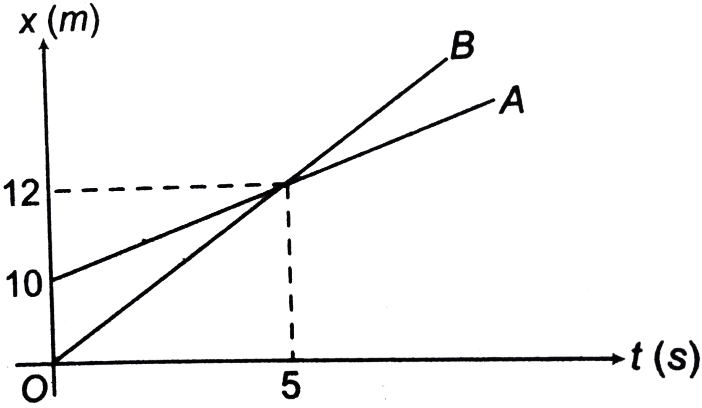
Exercise 6.9

1. Two particles are moving along x-axis. Their x-coordinate versus time graph are as shown below.



Find velocity of A w.r.t. B

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2. Two balls A and B are projected vertically upwards with different velocities. What is the relative acceleration between them?

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3. A river $400m$ wide is flowing at a rate of $2.0m/s$. A boat is sailing at a velocity of $10.0m/s$ with respect to the water In a direction perpendicular to the river.

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

(b) How far from the point directly opposite to the starting point does the boat reach the opposite bank?

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

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5. A man crosses a river in a boat. If he cross the river in minimum time he takes $10 \min$ with a drift $120 m$. If he crosses the river taking shortest path, he takes $12.5 \min$, find

(a) width of the river

(b) velocity of the boat with respect to water

(c) speed of the current

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6. A river is $20m$ wide. River speed is $3m/s$. A boat starts with velocity $2\sqrt{2}m/s$ at angle 45° from the river current (relative to river)

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

(b) How far from the point directly opposite to the starting point does the boat reach the opposite bank?

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Assertion And Reason

1. Assertion : Velocity and acceleration of a particle are given as,

$v = \hat{i} - \hat{j}$ and $a = -2\hat{i} + 2\hat{j}$ This is a two dimensional motion with constant acceleration.

Reason : Velocity and acceleration are two constant vectors.

A. If the 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 the 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: D

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2. Assertion : Displacement-time graph is a parabola corresponding to straight line velocity-time graph.

Reason : If $v = u + at$ then $s = ut + \frac{1}{2}at^2$

A. If the 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 the 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: D

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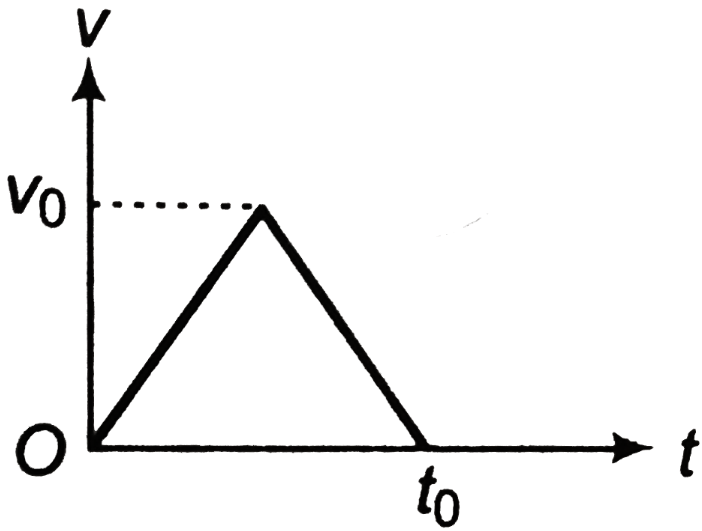
3. Assertion : In v-t graph shown in figure, average velocity in time interval from $0 \rightarrow t_0$ depends only on v_0. It is independent of t_0.

Reason : In the given time interval average velocity is $\frac{v_0}{2}$.



A. If the 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 the 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: A

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4. Assertion : We know the relation $a = v.\frac{dv}{d}s$. Therefore, if velocity of a particle is zero, then acceleration is also zero.

Reason : In the above equation, a is the instantaneous acceleration.

A. If the 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 the 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: D

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5. Assertion : Speed of a particle may decrease, even if acceleration is increasing.

Reason: This will happen if acceleration is positive.

A. If the 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 the 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: C

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6. Assertion : Starting from rest with zero acceleration if acceleration of particle increases at a constant rate of $2ms^{-3}$ then velocity should increase at constant rate of $1ms^{-2}$.

Reason : For the given condition. $\frac{da}{dt} = 2ms^{-3}$

$\therefore a = 2t$

A. If the 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 the 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: D

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7. Assertion : Average velocity can't be zero in case of uniform acceleration.

Reason : For average velocity to be zero, a non zero velocity should not remain constant.

A. If the 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 the 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: D

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8. Assertion : In displacement-time graph of a particle as shown in figure, velocity of particle changes its direction at point A.

Reason : Sign of slope of s-t graph decides the direction of velocity.

A. If the 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 the 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: D

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9. Assertion : Displacement-time equation of two particles moving in a straight line are, $s_1 = 2t - 4t^2$ and $s_2 = -2t + 4t^2$. Relative velocity between the two will go on increasing.

Reason : If velocity and acceleration are of same sign then speed will increase.

A. If the 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 the 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: D

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10. Assertion : Acceleration of a moving particle can change its direction without any change in direction of velocity.

Reason : If the direction of change in velocity vector changes, the direction of acceleration vector also changes.

A. If the 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 the 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: A::B

Watch Video Solution

11. Assertion : A body is dropped from height h and another body is thrown vertically upwards with a speed $\sqrt{gh}$. They meet at height $\frac{h}{2}$.

Reason : The time taken by both the blocks in reaching the height $\frac{h}{2}$ is same.

A. If the 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 the 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: A

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12. Assertion : Two bodies of unequal masses m_1 and m_2 are dropped from the same height. If the resistance offered by air to the motion of both bodies is the same, the bodies will reach the earth at the same time.

Reason : For equal air resistance, acceleration of fall of masses m_1 and m_2 will be different.

A. If the 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 the 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: D

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Objective

1. A stone is released from a rising balloon accelerating upward with acceleration a. The acceleration of the stone just after the release is

A. a upward

B. g downward

C. $(g - a)$ downward

D. $(g + a)$ downward

Answer: B

Watch Video Solution

2. A ball is thrown vertically upwards from the ground. If T_1 and T_2 are the respective time taken in going up and coming down, and the air resistance is not ignored, then

A. $T_1 > T_2$

B. $T_1 = T_2$

C. $T_1 < T_2$

D. nothing can be said

Answer: C

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3. The length of a seconds hand in watch is $1cm$. The change in velocity of its tip in $15s$ is

A. zero

B. $\frac{\pi}{30\sqrt{2}} cm/s$

C. $\frac{\pi}{30} cm/s$

D. $\frac{\pi\left(\sqrt{2}\right)}{30}cm/s$

Answer: D

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4. When a ball is thrown up vertically with velocity v_0, it reaches a maximum height of h. If one wishes to triple the maximum height then the ball should be thrown with velocity

A. $\sqrt{3}v_0$

B. $3v_0$

C. $9v_0$

D. $\frac{3}{2}v_0$

Answer: A

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5. During the first 18 min of a 60 min trip, a car has an average speed of $11ms^{-1}$. What should be the average speed for remaining 42 min so that car is having an average speed of $21ms^{-1}$ for the entire trip?

A. $25.3ms^{-1}$

B. $29.2ms^{-1}$

C. $31ms^{-1}$

D. $35.6ms^{-1}$

Answer: A

Watch Video Solution

6. A particle moves along a straight line. Its position at any instant is given by $x = 32t - \frac{8t^3}{3}$ where x is in metres and t in seconds. Find the acceleration of the particle at the instant when particle is at rest.

A. $-16ms^{-2}$

B. $-32ms^{-2}$

C. $32ms^{-2}$

D. $16ms^{-2}$

Answer: B

Watch Video Solution

7. The acceleration of a particle is increasing linearly with time t as bt. The particle starts from the origin with an initial velocity v_0. The distance travelled by the particle in time t will be

A. $v_0t + \frac{1}{6}bt^3$

B. $v_0t + \frac{1}{3}bt^3$

C. $v_0t + \frac{1}{3}bt^2$

D. $v_0t + \frac{1}{2}bt^2$

Answer: A

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8. Water drops fall at regular intervals from a tap 5 m above the ground. The third drop is leaving the tap, the instant the first drop touches the ground. How far above the ground is the second drop at that instant. $(g = 10ms^{-2})$

A. $1.25m$

B. $2.50m$

C. $3.75m$

D. $4.00m$

Answer: C

Watch Video Solution

9. A stone is dropped from the top of a tower and one second later, a second stone is thrown vertically downward with a velocity $20ms^{-1}$. The second stone will overtake the first after travelling a distance of $(g = 10ms^{-2})$

A. $13m$

B. $15m$

C. $11.25m$

D. $19.5m$

Answer: C

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10. A particle moves in the x-y plane with velocity $v_x = 8t - 2$ and $v_y = 2$. If it passes through the point $x = 14$ and $y = 4att = 2s$, the equation of the path is

A. $x = y^2 - y + 2$

B. $x = y^2 - 2$

C. $x = y^2 + y - 6$

D. None of these

Answer: A

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11. The horizontal and vertical displacements of a particle moving along a curved line are given by $x = 5t$ and $y = 2t^2 + t$. Time after which its velocity vector makes an angle of 45° with the horizontal is

A. $0.5s$

B. $1s$

C. $2s$

D. $1.5s$

Answer: B

Watch Video Solution

12. A ball is released from the top of a tower of height h metre. It takes T second to reach the ground. What is the position of the ball in $\frac{T}{3}$ second?

A. $\frac{h}{9}$ metre from the ground

B. $(7h/9)$ metre from the ground

C. $(8h/9)$ metre from the ground

D. $(17h/18)$ metre from the ground

Answer: C

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13. An ant is at a corner of a cubical room of side a. The ant can move with a constant speed u. The minimum time taken to reach the farthest corner of the cube is

A. $\frac{3a}{u}$

B. $\dfrac{\sqrt{3}a}{u}$

C. $\dfrac{\sqrt{5}a}{u}$

D. $\dfrac{\left(\sqrt{2}+1\right)a}{u}$

Answer: C

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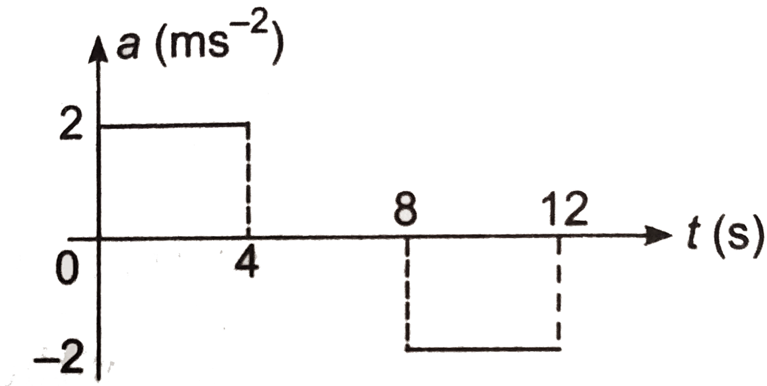
14. A lift starts from rest. Its acceleration is plotted against time. When it comes to rest its height above its starting point is



A. $20m$

B. $64m$

C. $32m$

D. $36m$

Answer: B

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15. A lift performs the first part of its ascent with uniform acceleration a and the remaining with uniform retardation $2a$. If t is the time of ascent, find the depth of the shaft.

A. $\frac{at^2}{4}$

B. $\frac{at^2}{3}$

C. $\frac{at^2}{2}$

D. $\frac{at^2}{8}$

Answer: B

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16. Two objects are moving along the same straight line. They cross a point A With an acceleration a, 2a and velocity 2u, u at time $t = 0$. The distance moved by the object when one overtakes the

A. $\frac{6u^2}{a}$

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

C. $\frac{4u^2}{a}$

D. $\frac{8u^2}{a}$

Answer: A

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17. A cart is moving horizontally along a straight line with constant speed $30ms^{-1}$. A particle is to be fired vertically upwards from the moving cart in such a way that it returns to the cart at the same point from where it was projected after the cart has moved $80m$. At what speed (relative to the cart) must the projectile be fired? (Take $g = 10ms^{-2}$)

A. $10ms^{-1}$

B. $10\sqrt{8}ms^{-1}$

C. $\frac{40}{3}ms^{-1}$

D. None of these

Answer: C

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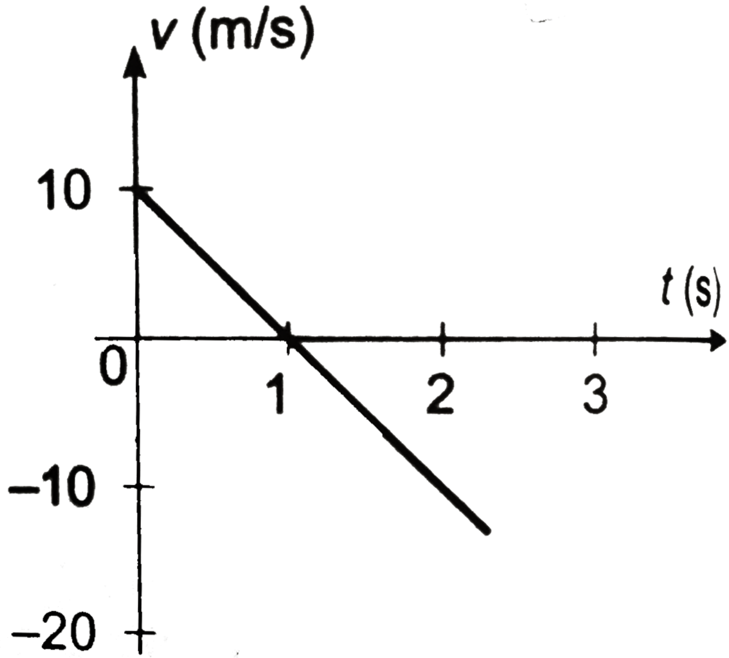
18. The figure shows velocity-time graph of a particle moving along a straight line. Identify the correct statement.



A. The particle starts from the origin

B. The particle crosses it initial position at $t = 2s$

C. The average speed of the particle in the time interval, $0 \leq t \leq 2s$ is zero

D. All of the above

Answer: B

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19. A ball is thrown vertically upwards from the ground and a student gazing out of the window sees it moving upward past him at $10ms^{-1}$. The window is at 15 m above the ground level. The velocity of ball 3 s after it was projected from the ground is [Take $g = 10ms^{-2}$]

A. $10m/s$, up

B. $20m/s$, up

C. $20ms^{-1}$, down

D. $10ms^{-1}$, down

Answer: D

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20. A body starts moving with a velocity $v_0 = 10ms^{-1}$. It experiences a retardation equal to

$0.2v^2$. Its velocity after 2s is given by

A. $+2ms^{-1}$

B. $+4ms^{-1}$

C. $-2ms^{-1}$

D. $+6ms^{-1}$

Answer: A

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21. Two trains are moving with velocities $v_1 = 10ms^{-1}$ and $v_2 = 20ms^{-1}$ on the same track in opposite directions. After the application of brakes if their retarding rates are $a_1 = 2ms^{-2}$ and $a_2 = 1ms^{-2}$ respectively, then the minimum distance of separation between the trains to avoid collision is

A. 150 m

B. 225 m

C. 450 m

D. 300 m

Answer: B

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22. Two balls of equal masses are thrown upwards, along the same vertical direction at an interval of 2 seconds, with the same initial velocity of $40m/s$. Then these collide at a height of (Take $g = 10m/s^2$).

A. 50 m

B. 75 m

C. 100 m

D. 125 m

Answer: B

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23. A particle is projected vertically upwards and reaches the maximum height H in time T. The height of the partlcle at any time $t(< T)$ will be

A. $g(t-T)^2$

B. $H-g(t-T)^2$

C. $\frac{1}{2}g(t-T)^2$

D. $H-\frac{1}{2}g(T-t)^2$

Answer: D

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24. A particle moves along the curve $y = \frac{x^2}{2}$. Here x varies with time as $x = \frac{t^2}{2}$. Where x and y are measured in metres and t in seconds. At $t = 2s$, the velocity of the particle (in ms^{-1}) is

A. $4\hat{i} + 6\hat{j}$

B. $2\hat{i} + 4\hat{j}$

C. $4\hat{i} + 2\hat{j}$

D. $4\hat{i} + 4\hat{j}$

Answer: B

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25. If the displacement of a particle varies with time as

$\sqrt{x} = t + 3$

A. velocity of the particle is inversely proportional to t

B. velocity of particle varies linearly with t

C. velocity of particle is proportional to $\sqrt{t}$

D. initial velocity of the particle is zero

Answer: B

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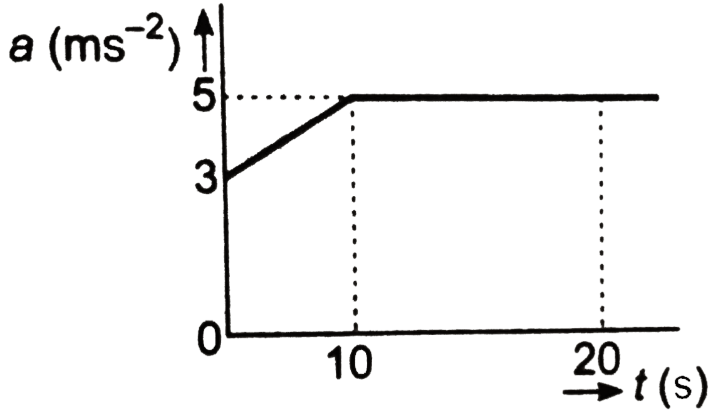
26. The graph describes an airplane's acceleration during its take-off run. The airplane's velocity when it lifts of at $t = 20s$ is



A. $40ms^{-1}$

B. $50ms^{-1}$

C. $90ms^{-1}$

D. $180ms^{-1}$

Answer: C

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27. A particle moving in a straight line has velocity-displacement equation as $v = 5\sqrt{1+s}$. Here v is in ms^{-1} and s in metres. Select the correct alternative.

A. Particle is initially at rest

B. Initially velocity of the particle is $5m/s$ and the particle has a constant acceleration of $12.5ms^{-2}$

C. Particle moves with a uniform velocity

D. None of the above

Answer: B

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28. A particle is thrown upwards from ground. It experiences a constant resistance force which can produce a retardation of $2ms^{-2}$. The ratio of time of ascent to time of descent 13 $(g = 10ms^{-2})$

A. $1:1$

B. $\sqrt{\frac{2}{3}}$

C. $\frac{2}{3}$

D. $\sqrt{\frac{3}{2}}$

Answer: B

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29. A body of mass 10 kg is being acted upon by a force $3t^2$ and an opposing constant force of 32 N. The initial speed is $10ms^{-1}$. The velocity of body after 5 s is

A. $14.5ms^{-1}$

B. $6.5ms^{-1}$

C. $3.5ms^{-1}$

D. $4.5ms^{-1}$

Answer: B

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30. A stone is thrown vertically upwards. When stone is at a height half of its maximum height, its speed is $10ms^{-1}$, then the maximum height attained by the stone is $(g = 10ms^{-2})$

A. 25 m

B. 10 m

C. 15 m

D. 20 m

Answer: B

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31. (a) What does $\left|\frac{dv}{dt}\right|$ and $\frac{d|v|}{dt}$ represent? (b) Can these be equal?

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32. The coordinates of a particle moving in x-y plane at any time t are $(2t, t^2)$. Find (a) the trajectory of the particle, (b) velocity of particle at time t and (c) acceleration of particle at any time t.

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33. A farmer has to go 500 m due north, 400 m due east and 200 m due south to reach his field. If he takes 20 min to reach the field.

(a) What distance he has to walk to reach the field ?

(b) What is the displacement from his house to the field ?

(c) What is the average speed of farmer during the walk ?

(d) What is the average velocity of farmer during the walk ?

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34. A rocket is fired vertically up from the ground with a resultant vertical acceleration of $10m/s^2$. The fuel is finished in 1 min and it continues to move up. (a) What is the maximum height reached? (b) Afte2r how much time from then will the maximum height be reached?(Take $g = 10m/s^2$)

Watch Video Solution

35. A particle is projected upwards from the roof of a tower 60 m high with velocity $20m/s$. Find

(a) the average speed and

(b) average velocity of the particle upto an instant when it strikes the ground. Take $g = 10m/s^2$

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36. A block moves in a straight line with velocity v for time t_0. Then, its velocity becomes 2v for next t_0 time. Finally, its velocity becomes 3v for time T. If average velocity during the complete journey was 2. 5 v, then find T in terms of t_0.

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37. A particle starting from rest has a constant acceleration of $4m/s^2$ for 4 s. It then retards uniformly for next 8 s and comes to rest. Find during the motion of particle (a) average acceleration (b) average speed and (c) average velocity.

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38. A particle moves in a circle of radius $R = \frac{21}{22}m$ with constant speed $1m/s$. Find,

(a) magnitude of average velocity and

(b) magnitude of average acceleration in 2 s.

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39. Two particles A and B start moving simultaneously along the line joining them in the same direction with acceleration of $1m/s^2$ and $2m/s^2$ and speeds $3m/s$ and $1m/s$ respectively. Initially, A is 10 m behind B. What is the minimum distance between them?

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40. Two diamonds begin a free fall from rest from the same height, 1.0 s apart. How long after the first diamond begins to fall will the two diamonds be 10 m apart? Take $g = 10m / s^2$.

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41. Two bodies are projected vertically upwards from one point with the same initial velocity v_0. The second body is projected $t_0 s$ after the first. How long after will the bodies meet?

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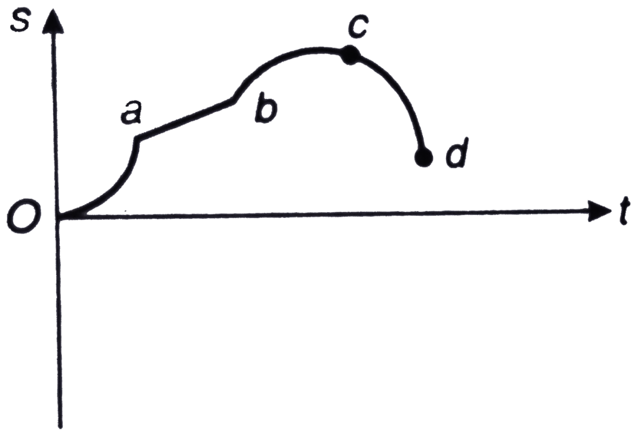
42. Displacement-time graph of a particle moving in a straight line is as shown in figure.



(a) Find the sign of velocity in regions oa,ab, bc and cd.

(b) Find the sign of acceleration in the above region.

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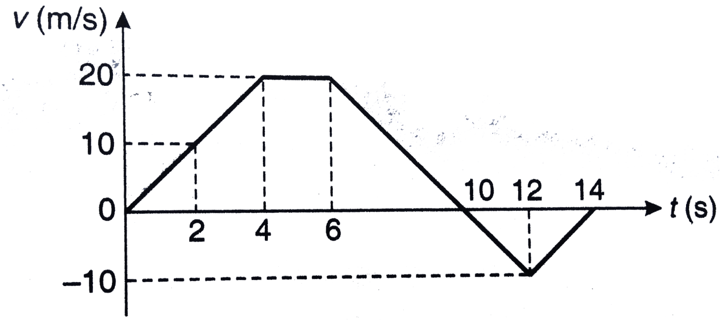
43. Velocity-time graph of a particle moving in a straight line is shown in figure. In the time interval from $t = 0$ to $t = 14s$, find



(a) average velocity and

(b) average speed of the particle.

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44. A person walks up a stalled 15 m long escalator in 90 s. When standing on the same escalator, now moving, the person is carried up in 60 s. How much time would it take that person to walk up the moving escalator? Does the answer depend on the length of the escalator?

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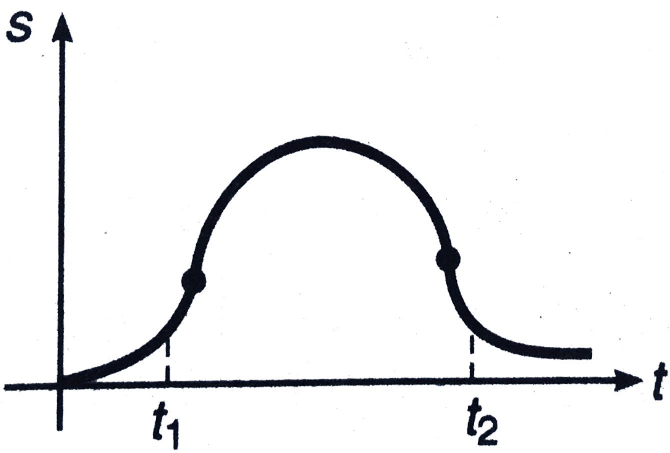
45. Figure shows the displacement-time graph of a particle moving in a straight line. Find the signs of velocity and acceleration of particle at time $t = t_1$ and $t = t_2$.



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Subjective

1. Velocity of particle moving along positive x-direction is $v = (40 - 10t)m/s$. Here,t is in seconds. At time $t = 0$, tha x coordinate of particle is zero. Find the time when the particle is at a distance of 60 m from origin.

A. $t_3 = 2(1 + \sqrt{7})s$

B. $t_3 = 2(2 + \sqrt{7})s$

C. $t_3 = 2(2 + \sqrt{9})s$

D. $t_3 = \sqrt{7}) s$

Answer: B

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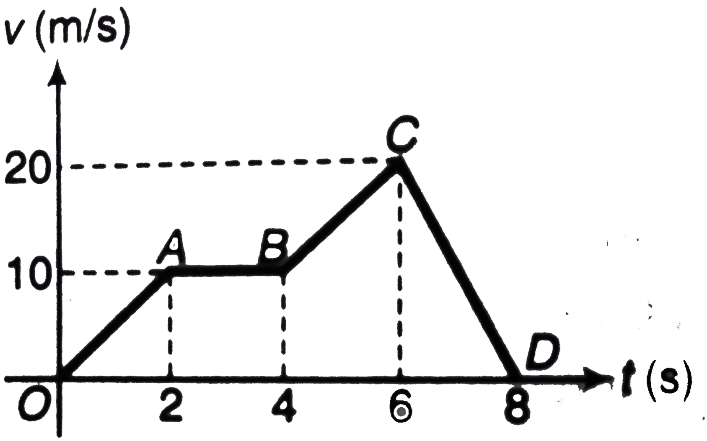
2. Velocity-time graph of a particle moving in a straight line is shown in figure. Plot the corresponding displacement-time graph of the particle if at time

$t = 0$, displacement $s = 0$.



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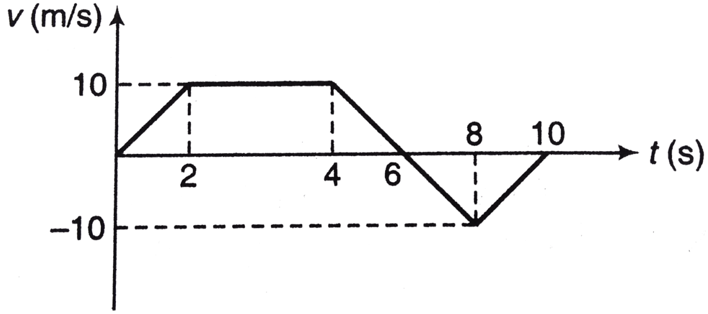
3. Acceleration-time graph of a particle moving in a straight line is as shown in figure. At time $t = 0$, velocity of the particle is zero. Find



(a) average acceleration in a time interval from $t = 6s$ to $t = 12s$,

(b) velocity of the particle at $t = 14s$.

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4. A particle is moving in x-y p1ane.At time t $= 0$, particle is at $(1m, 2m)$ and has velocity $\left(4\hat{i} + 6\hat{j}\right)m/s$. At $t = 4s$, particle reaches at $(6m, 4m)$ and has velocity $\left(2\hat{i} + 10\hat{j}\right)m/s$. In the given time interval, find

(a) average velocity,

(b) average acceleration and

(c) from the given data, can you find average speed?

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5. A stone is dropped from the top of a tower. When it crosses a point 5 m below the top, another stone is let fall from a point 25 m below the top. Both stones reach the bottom of the tower simultaneously. Find the height of the tower. Take $g = 10m/s^2$.

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6. A point mass starts moving in a straight line with constant acceleration. After time t_0 the acceleration changes its sign, remaining the same in magnitude. Determine the time T from the beginning of motion in which the point mass returns to the initial position.

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7. A football is kicked vertically upward from the ground and a student gazing out of the window sees it moving upwards past her at $5.00m/s$. The window is $15.0m$ above the ground. Air resistance may be ignored. Take $g = 10m/s^2$.

(a) How high does the football go above ground?

(b) How much time does it take to go from the ground to its highest point?

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8. A car moving with constant acceleration covered the distance between two points $60.0m$ apart in $6.00s$. Its speed as it passes the second point was $15.0m/s$.

(a) What is the speed at the first point?

(b) What is the acceleration?

(c) At what prior distance from the first was the car at rest?

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9. A particle moves along the x-direction with constant acceleration. The displacement, measured from a convenient position, is 2 m at time $t = 0$ and is zero when $t = 10s$. If the velocity of the particle is momentary zero when $t = 6s$, determine the acceleration a and the velocity v when $t = 10s$.

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10. At time $t = 0$, a particle is at $(2m, 4m)$. It starts moving towards positive x-axis with constant acceleration $2m/s^2$ (initial velocity=0). After 2 s, an additional acceleration of $4m/s^2$ starts acting on the particle in negative y-direction also. Find after next 2 s.

(a) velocity and

(b) coordinates of particle.

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11. A particle starts from the origin at $t=0$ with a velocity of $8.0\hat{j}m/s$ and moves in the x-y plane with a constant acceleration of $\left(4.0\hat{i}+2.0\hat{j}\right)m/s^2$. At the instant the particle's x-coordinate is 29 m, what are

(a) its y-coordinate and

(b) its speed ?

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12. The velocity of a particle moving in a straight line is decreasing at the rate of $3m/s$ per metre of displacement at an instant when the velocity is $10m/s$. Determine the acceleration of the particle at this instant.

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13. A particle moves along a horizontal path, such that its velocity is given by $v = (3t^2 - 6t)m/s$, where t is the time in seconds. If it is initially located at the origin O, determine the distance travelled by the particle in time interval from $t = 0$ to $t = 3.5s$ and the particle's average velocity and average speed during the same time interval.

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14. A particle travels m a straight line, such that for a short time $2s \leq t \leq 6s$, its motion is described by $v = \left(\frac{4}{a}\right)m/s$, where a is in m/s^2. If $v = 6m/s$. when $t = 2s$, determine the particle's acceleration when $t = 3s$.

Watch Video Solution

15. If the velocity v of a particle moving along a straight line decreases linearly with its displacement from $20m/s$ to a value approaching zero at $s = 30m$, determine the acceleration of the particle when $s = 15m$.

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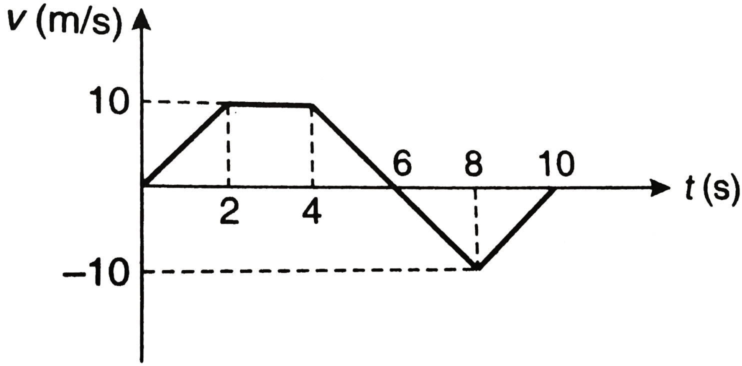
16. Velocity-time graph of a particle moving in a straight line is shown in figure. At time $t = 0, s = -10m$. Plot corresponding a-t and s-t graphs.



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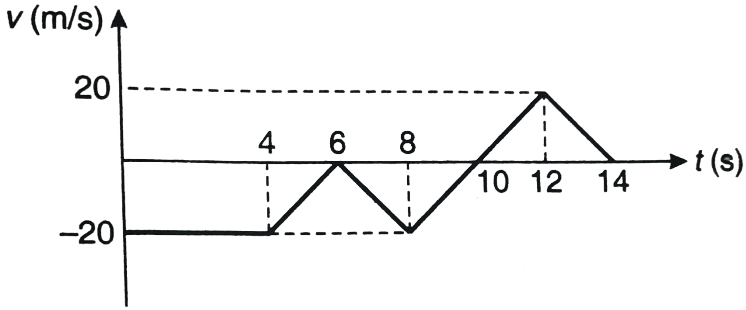
17. Velocity-time graph of a particle moving in a straight line is shown in figure. At time $t = 0.\ s = 20m.$ Plot a-t and s-t graphs of the particle.



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18. A particle of mass m is released from a certain height h with zero initial velocity. It strikes the ground elastlcally (direction of its velocity is reversed but magnitude remains the same). Plot the graph between its kinetic energy and time till it returns to its initial position.

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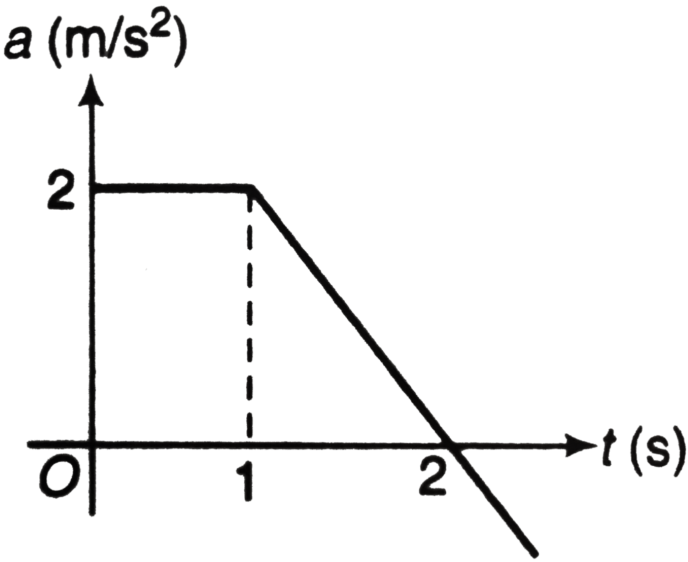
19. A ball is dropped from a height of 80 m on a floor. At each collision, the ball loses half of its speed. Plot the speed-time graph and velocity-time graph of its motion till two collisions With the floor. [Take $g = 10m/s^2$]

20. Figure shows the acceleration-time graph of a particle moving along a straight line. After what time the particle acquires its initial velocity?



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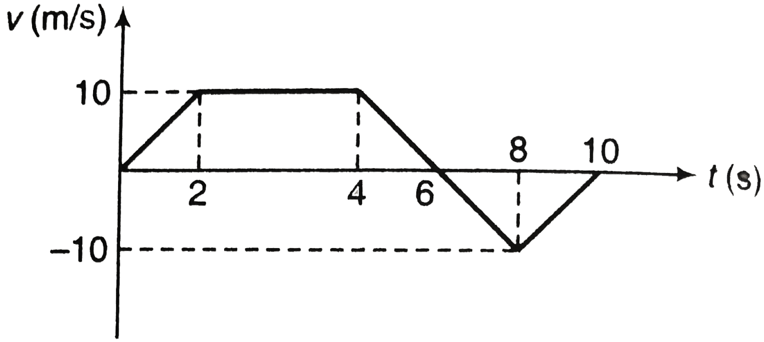
21. Velocity-time graph of a particle moving in a straight line is shown in figure. At time $t = 0$, displacement of the particle from mean position is 10 m. Find



(a) acceleration of particle at $t = 1s, 3s$ and $9s$.

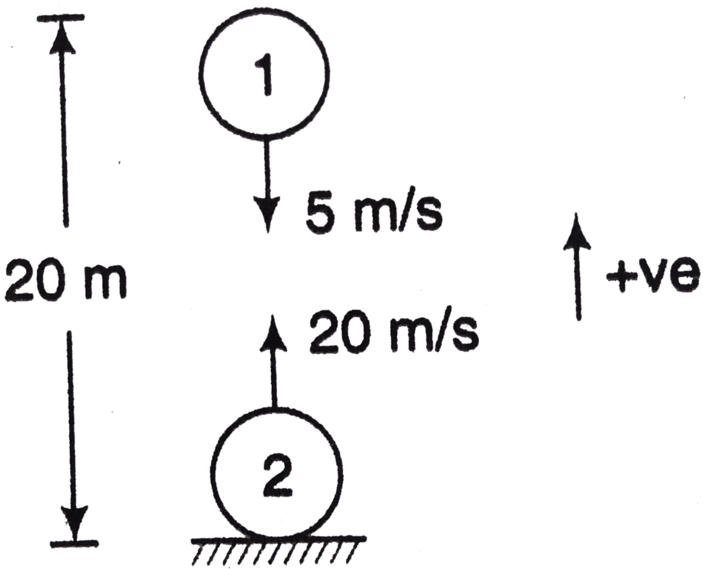
(b) position of particle from mean position at $t = 10s$.

(c) write down s-t equation for time interval (i) $0 \le t \le 2s$, (ii) $4s \le t \le 8s$

Watch Video Solution

22. Two particles 1 and 2 are thrown in the directions shown in figure simultaneously with velocities

$5m/s$ and $20m/s$. Initially, particle 1 is at height 20 m from the ground. Taking upwards as the positive direction, find



(a) acceleration of 1 with respect to 2

(b) initial velocity of with respect to 1

(c) velocity of 1 with respect to 2 after time $t = \frac{1}{2}s$

(d) time when the particles will collide.

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23. A ball is thrown vertically upward from the 12 m level with an initial velocity of $18m/s$. At the same instant an open platform elevator passes the 5 m level, moving upward with a constant velocity of $2m/s$. Determine ($g = 9.8m/s^2$)

(a) when and where the ball will meet the elevator,

(b) the relative velocity of the ball with respect to the elevator when the ball hits the elevator.

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24. An automobile and a truck start from rest at the same instant, with the automobile initially at some distance behind the truck. The truck has a constant acceleration of $2.2m/s^2$ and the automobile has an acceleration of $3.5m/s^2$. The automobile overtakes the truck when it (truck) has moved 60 m.

(a) How much time does it take the automobile to overtake the truck ?

(b) How far was the automobile behind the truck initially ?

(c) What is the speed of each during overtaking ?

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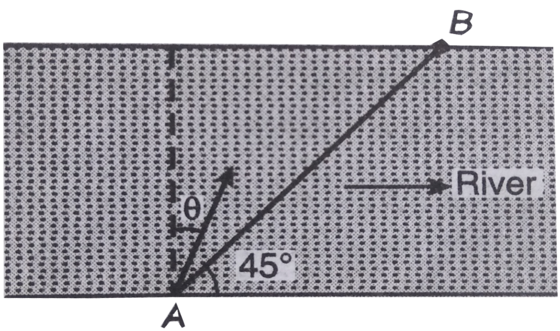
25. Given $|V_br| = 4m/s =$ magnitude of velocity of boatman with respect to river, $v_r = 2m/s$ in the directior shown. Boatman wants to reach from point A to point B. At what angle θ should he row his boat ?



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26. An aeroplane has to go from a point P to another point Q, 1000 km away due north. Wind is blowing due east at a speed of $200 km/h$. The air speed of plane is $500 km/h$.

(a) Find the direction in which the pilot should head the plane to reach the point Q.

(b) Find the time taken by the plane to go from P to Q.

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27. A train stopping at two stations 4 km apart takes 4 min on the journey from one of the station to the other. Assuming that it first accelerates with a uniform acceleration x and then that of uniform retardation y, prove that $\frac{1}{x} + \frac{1}{y} = 2$.

Watch Video Solution

28. When a man moves down the inclined plane with a constant speed $5ms^{-1}$ which makes an angle of 37° with the horizontal, he finds that the rain is falling vertically downward. When he moves up the same inclined plane with the same speed, he finds that the rain makes an angle $\theta = \tan^{-1}\left(\frac{7}{8}\right)$ with the horizontal. The speed of the rain is

A. $\sqrt{116}ms^{-1}$

B. $\sqrt{32}ms^{-1}$

C. $5ms^{-1}$

D. $\sqrt{73}ms^{-1}$

Answer: A::B

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29. Equation of motion of a body is $\frac{dv}{dt} = -4v + 8$, where v is the velocity in ms^{-1} and t is the time in second. Initial velocity of the particle was zero. Then,

A. the initial rate of change of acceleration of the particle is $8ms^{-2}$

B. the terminal speed is $2ms^{-1}$

C. Both (a) and (b) are correct

D. Both (a) and (b) are wrong

Answer: B

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30. Two particles A and B are placed in gravity free space at $(0, 0, 0)m$ and $(30, 0, 0)m$ respectively. Particle A is projected with a velocity $\left(5\hat{i} + 10\hat{j} + 5\hat{k}\right)ms^{-1}$, while particle B is projected with a velocity $\left(10\hat{i} + 5\hat{j} + 5\hat{k}\right)ms^{-1}$ simultaneously. Then,

A. they will collide at $(10, 20, 10)m$

B. they will collide at $(10, 10, 10)m$

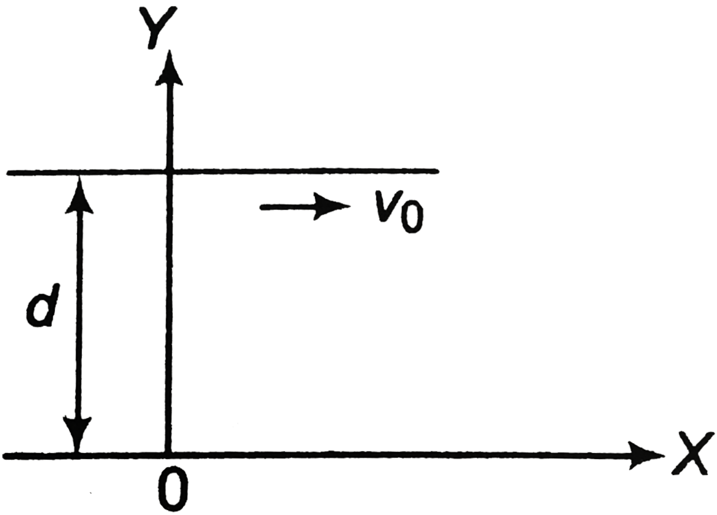
C. they will never collide

D. they will collide at 2 s

Answer: C

Watch Video Solution

31. Velocity of the river with respect to ground is given by v_0. Width of the river is d. A swimmer swims (with respect to water) perpendicular to the current with acceleration $a = 2t$ (where t is time) starting from rest from the origin O at $t = 0$. The equation of trajectory of the path followed by the swimmer is



A. $y = \frac{x^3}{3v_0^3}$

B. $y = \frac{x^2}{2v_0^2}$

C. $y = \frac{x}{v_0}$

D. $y = \sqrt{\frac{x}{v_0}}$

Answer: A

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32. The relation between time t and displacement x is $t = \alpha x^2 + \beta x$, where α and β are constants. The retardation is

A. $2\alpha v^3$

B. $2\beta v^3$

C. $2\alpha\beta v^3$

D. $2\beta^2 v^3$

Answer: A

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33. A street car moves rectilinearly from station A to the next station B (from rest to rest) with an acceleration varying according to the law $f = a - bx$, where a and b are constants and x is the distance from station A. The distance between the two stations and the maximum velocity are

A. $x = 2\frac{a}{b}, v_{\max} = \frac{a}{\sqrt{b}}$

B. $x = \frac{a}{2}b, v_{\max} = \frac{a}{b}$

C. $x = \frac{a}{2}b, v_{\max} = \frac{b}{\sqrt{a}}$

D. $x = \frac{a}{b}, v_{\max} = \frac{\sqrt{a}}{b}$

Answer: A

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34. A particle of mass m moves on positive x-axis under the influence of force acting towards the origin given by $-kx^2\hat{i}$. If the particle starts from rest at $x = a$, the speed it will attain when it crosses the origin is

A. $\left(\frac{\sqrt{k}}{ma}\right)$

B. $\left(\sqrt{2}\frac{k}{ma}\right)$

C. $\left(\frac{\sqrt{ma}}{2}k\right)$

D. None of these

Answer: D

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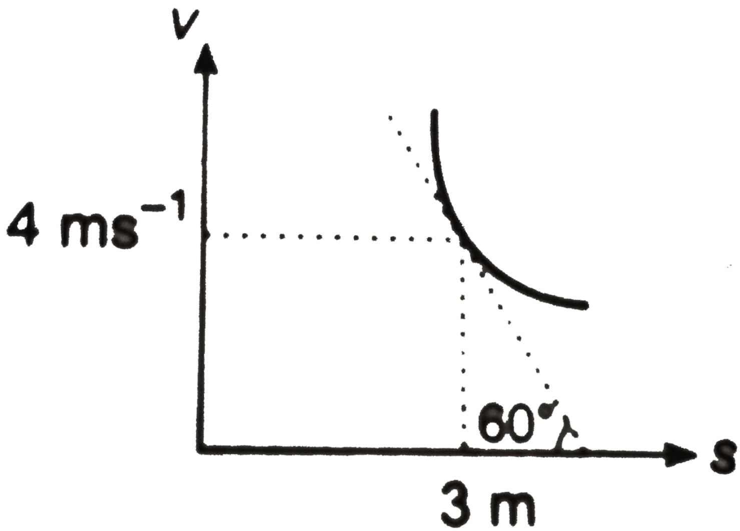
35. A partial along a straight line whose velocity-displacement graph is as shown in the figure. What is the magnitude of acceleration when displacement is 3 m ?



A. $-4\sqrt{3}ms^{-2}$

B. $3\sqrt{3}ms^{-2}$

C. $\sqrt{3}ms^{-2}$

D. $\frac{4}{\sqrt{3}}ms^{-2}$

Answer: A

Watch Video Solution

36. A particle is falling freely under gravity. In first t second it covers distance x_1 and in the next t second, it covers distance x_2, then t is given by

A. $\sqrt{\frac{x_2 - x_1}{g}}$

B. $\sqrt{\frac{x_2 + x_1}{g}}$

C. `sqrt((2(x_2-x_1))/g)

D. $\sqrt{\frac{2(x_2+x_1)}{g}}$

Answer: A

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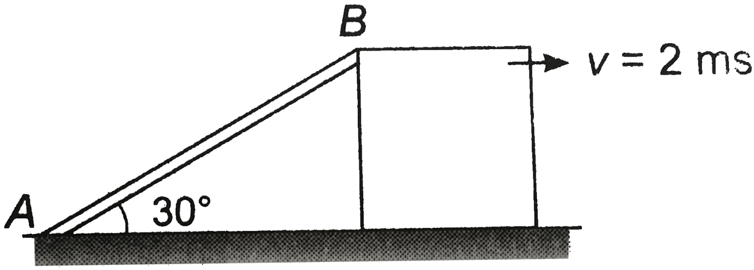
37. A rod AB is shown in figure. End A of the rod is fixed on the ground. Block is moving with velocity $2ms^{-1}$ towards right. The velocity of end B of rod at the instant shown in figure is



A. $\sqrt{3}ms^{-1}$

B. $2ms^{-1}$

C. $2\sqrt{3}ms^{-1}$

D. $4ms^{-1}$

Answer: D

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38. A thief in a stolen car passes through a police check post at his top speed of $90kmh^{-1}$. A motorcycle cop, reacting after 2 s, accelerates from rest at $5ms^{-2}$. His top speed being $108kmh^{-1}$. Find the maximum separation between policemen and thief.

A. $112.5m$

B. $115m$

C. $116.5m$

D. None of these

Answer: A

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39. Anoop (A) hits a ball along the ground with a speed u in a direction which makes an angle 30° with the line joining him and the fielder Babul (B). Babul runs to intercept the ball With a speed $\frac{2u}{3}$. At What angle theta should he run to intercept the ball ?

A. $\sin^{-1}\left[\frac{\sqrt{3}}{2}\right]$

B. $\sin^{-1}\left[\frac{2}{3}\right]$

C. $\sin^{-1}\left[\frac{3}{4}\right]$

D. $\sin^{-1}\left[\frac{4}{5}\right]$

Answer: C

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40. A car is travelling on a straight road. The maximum velocity the car Can attain is $24ms^{-1}$. The maximum acceleration and deceleration it can attain are $1ms^{-2}$ and $4ms^{-2}$ respectively. The shortest time the car takes from rest to rest in a distance of 200 m is,

A. $22.4s$ (b) 30 s (c) 11.2 s (d) 5.6 s

B. $30s$

C. $11.2s$

D. $5.6s$

Answer: A

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41. A car is travelling on a road. The maximum velocity the car can attain is $24ms^{-1}$ and the maximum deceleration is $4ms^{-2}$. If car starts from rest and comes to rest after travelling 1032m in the shortest time of 56 s, the maximum acceleration that the car can attain is

A. $6ms^{-2}$

B. $1.2ms^{-2}$

C. $12ms^{-2}$

D. $3.6ms^{-2}$

Answer: B

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42. Two particles are moving along two long straight lines, in the same plane with same speed equal to $20cm/s$. The angle between the two linse is 60° and their intersection point isO. At a certain moment, the two particles are located at distances 3m and 4m from O and are moving twowards O. Subsequently, the shortest distance between them will be

A. $50cm$

B. $40\sqrt{2}cm$

C. $50\sqrt{2}cm$

D. $50\sqrt{3}cm$

Answer: D

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43. 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.

A. The particle comes to rest at $t = \frac{2\sqrt{v_0}}{\alpha}$

B. The particle will come to rest at infinity

C. The distance travelled by the particle before coming to rest is $\frac{2v_0^{3/2}}{\alpha}$

D. The distance travelled by the particle before coming to rest is $\frac{2v_0^{3/2}}{3\alpha}$

Answer: A::D

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44. At time $t = 0,$ a car moving along a straight line has a velocity of $16ms^{-1}$. It slows down with an acceleration of $-0.5tms^{-2}$, where t is in second. Mark the correct statement (s).

A. The direction of velocity changes at $t = 8s$

B. The distance travelled in 4 s is approximately 58.67 m

C. The distance travelled by the particle in 10 s is 94 m

D. The speed of particle at $t = 10$ s is $9ms^{-1}$

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

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45. An object moves with constant acceleration a. Which of the following expressions are also constant?

A. $\frac{d|v|}{dt}$

B. $\left|\frac{dv}{dt}\right|$

C. $\frac{d(v^2)}{dt}$

D. $\frac{d\left(\frac{v}{|v|}\right)}{dt}$

Answer: B

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46. Ship A is located 4 km north and 3 km east of ship B. Ship A has a velocity of $20kmh^{-1}$ towards the south and ship B is moving at $40kmh^{-1}$ in a direction 37° north of east. X and Y-axes are along east and north directions, respectively

A. Velocity of A relative to B is $\left(-32\hat{i}-44\hat{j}\right)km/h$

B. Position of A relative to B as a function of time is given by $r_{AB}=\left[(3-32t)\hat{i}+(4-44t)\hat{j}\right]km$

C. Velocity of A relative to B is $\left(32\hat{i}-44\hat{j}\right)k\frac{m}{h}$

D. Position of A relative to B as a function of time is given by $\left(32t\hat{i} - 44t\hat{j}\right)km$

Answer: A::B

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47. Starting from rest a particle is first accelerated for time t_1 with constant acceleration a_1 and then stops in time t_2 with constant retardation a_2. Let v_1 be the average velocity in this case and s_1 the total displacement. In the second case it is accelerating for the same time t_1 with constant acceleration $2a_1$ and come to rest with constant retardation a_2 in time t_3.

If v_2 is the average velocity in this case and s_2 the total displacement, then

A. $v_2 = 2v_1$

B. $2v_1 < v_2 < 4v_1$

C. $s_2 = 2s_1$

D. $2s_1 < s_2 < 4s_1$

Answer: A::D

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48. A particle is moving along a straight line. The displacement of the particle becomes zero in a certain time $(t > 0)$. The perticle does not undergo any collision.

A. The acceleration of the particle may be zero always

B. The acceleration of the particle may be zero uniform

C. The velocity of the particle must be zero at some instant

D. The acceleration of the particle must change its direction

Answer: B::C

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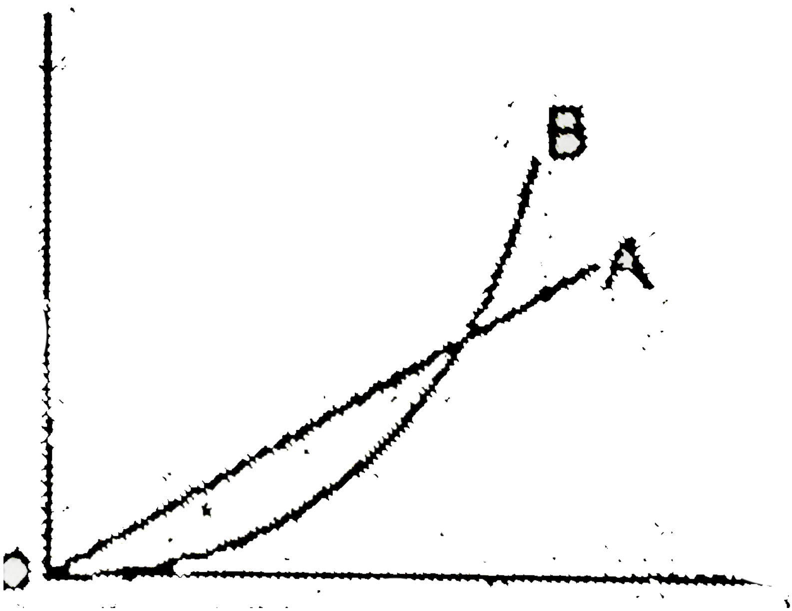
49. A particle is resting over a smooth horizontal floor. At $t = 0$, a horizontal force starts acting on it. Magnitude of the force increases with the time according to law $F = at$, where 'a' is a constant. For figure which of the following statement is/are correct ?



A. Curve 1 can be the plot of acceleration against time

B. Curve 2 can be the plot of velocity against time

C. Curve 2 can be the plot of velocity against acceleration

D. Curve 1 can be the plot of displacement against time

Answer: A::B

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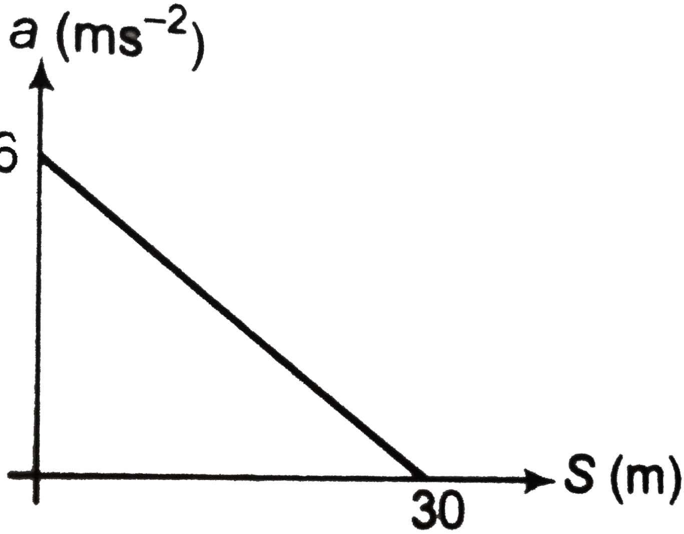
50. A train starts from rest at $S = 0$ and is subjected to an acceleration as shown in figure. Then,



A. velocity at the end of 10 m displacement is $20 ms^{-1}$

B. velocity of the train at $S = 10m$ is $10 ms^{-1}$

C. The maximum velocity attained by train is

$\sqrt{180}ms^{-1}$

D. The maximum velocity attained by the train is 15

ms^-1

Answer: B::C

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51. For a moving particle, which of the following options may be correct? Here, V_{av} is average velocity and v_{av} the average speed.

A. $|V_{av}| < v_{av}$

B. $|V_{av}| > v_{av}$

C. $V_{av} = 0$ but $v_{av} \neq 0$

D. $V_{av} \neq 0 but v_{av} = 0$

Answer: A::C

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More Than One Correct

1. Identify the correct graph represeriting the motion of a particle along a straight line With constant acceleration with zero initial velocity.

A.

B.

C.

D.

Answer: A::D

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2. A man who can swim at a velocity v relative to water wants to cross a river of width b, flowing with a speed u.

A. The minimum time in which he can cross the river is $\frac{b}{v}$

B. He can reach a point exactly opposite on the bank in time $t = \frac{b}{\sqrt{v^2 - u^2}}$ if $v > u$

C. He cannot reach a point exactly opposite on the bank if $u > v$

D. He cannot reach a point exactly opposite on the bank if $v > u$

Answer: A::B::C

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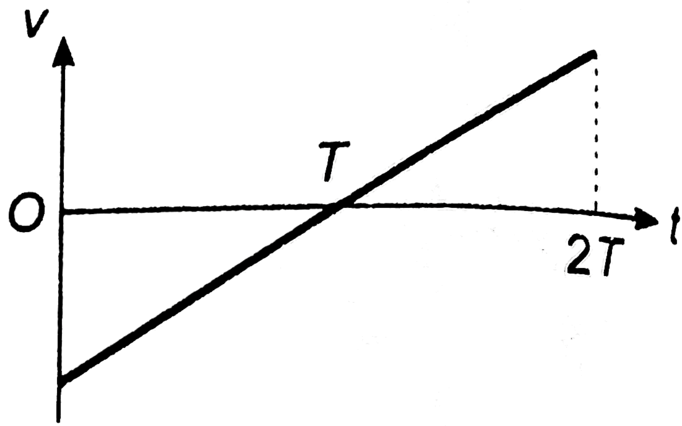
3. The figure shows the velocity (v) of a particle plotted against time (t).



A. The particle changes its direction of motion at some point.

B. The acceleration of the particle remains constant

C. The displacement of the particle is zero

D. The initial and final speeds of the particle are the same

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

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4. The speed of a train increases at a constant rate α from zero to v and then remains constant for an interval and finally decreases to zero at a constant rate β. The total distance travelled by the train is l. The time taken to complete the journey is t. Then,

A. $t = \dfrac{l(\alpha + \beta)}{\alpha\beta}$

B. $t = \frac{l}{v} + \frac{v}{2}\left(\frac{1}{\alpha} + \frac{1}{\beta}\right)$

C. t is minimum when $v = \sqrt{\frac{2l\alpha\beta}{\alpha - \beta}}$

D. t is minimum when $v = \sqrt{\frac{2l\alpha\beta}{\alpha + \beta}}$

Answer: B::D

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5. A particle moves in x-y plane and at time t is at the point $(t^2, t^3 - 2t)$, then which of the following is/are correct?

A. At $t = 0$, particle is moving parallel to y-axis

B. At $t=0,$ direction of velocity and acceleration are perpendicular

C. At $t=\sqrt{\frac{2}{3}}$, particle is moving parallel to x-axis

D. At $t=0,$ particle is at rest

Answer: A::B::C

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6. 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 speed at mid-point of XY is $10ms^{-1}$

B. its speed at a point A such that $XA : AY = 1 : 3$ is $5ms^{-1}$

C. the time to go from X to the mid-point of XY is double of that to go from mid-point to Y

D. the distance travelled in first half of the total time is half of the distance travelled in the second half of the time

Answer: A::C

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Comprehension

1. An elevator without a ceiling is ascending up with an acceleration of $5ms^{-2}$. A boy on the elevator shoots a ball in vertical upward direction from a height of 2 m above the floor of elevator. At this instant the elevator is moving up with a velocity of $10ms^{-1}$ and floor of the elevator is at a height of 50 m from the ground. The initial speed of the ball is $15ms^{-1}$ with respect to the elevator. Consider the duration for which the ball strikes the floor of elevator in answering following questions. ($g = 10ms^{-2}$)

1. The time in which the ball strikes the floor of elevator is given by

A. 2.13 s

B. 2.0 s

C. 1.0 s

D. 3.12 s

Answer: A

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2. An elevator without a ceiling is ascending up with an acceleration of $5ms^{-2}$. A boy on the elevator shoots a ball in vertical upward direction from a height of 2 m above the floor of elevator. At this instant the elevator is moving up with a velocity of $10ms^{-1}$ and floor of the elevator is at a height of 50 m from the ground. The initial speed of the ball is $15ms^{-1}$ with respect to the elevator. Consider the duration for which the ball strikes the floor of elevator in answering following questions. ($g = 10ms^{-2}$)

2. The maximum height reached by ball, as measured from the ground would be

A. 73.65 m

B. 116.25 m

C. 82.56m

D. 63.25 m

Answer: C

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3. An elevator without a ceiling is ascending up with an acceleration of $5ms^{-2}$. A boy on the elevator shoots a ball in vertical upward direction from a height of 2 m above the floor of elevator. At this instant the elevator is moving up with a velocity of $10ms^{-1}$ and floor of the elevator is at a height of 50 m from the ground. The initial speed of the ball is $15ms^{-1}$ with respect to the elevator. Consider the duration for which the ball strikes the floor of elevator in answering following questions. ($g = 10ms^{-2}$)

3. Displacement of ball with respect to ground during its night would be

A. 16.25 m

B. 8.76 m

C. 20.24 m

D. 30.56 m

Answer: D

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4. An elevator without a ceiling is ascending up with an acceleration of $5ms^{-2}$. A boy on the elevator shoots a ball in vertical upward direction from a height of 2 m above the floor of elevator. At this instant the elevator is moving up with a velocity of $10ms^{-1}$ and floor of the elevator is at a height of 50 m from the ground. The initial speed of the ball is $15ms^{-1}$ with respect to the elevator. Consider the duration for which the ball strikes the floor of elevator in answering following questions. ($g = 10ms^{-2}$)

4. The maximum separation between the floor of elevator and the ball during its flight would be

A. 12 m

B. 15 m

C. 9.5 m

D. 7.5 m

Answer: C

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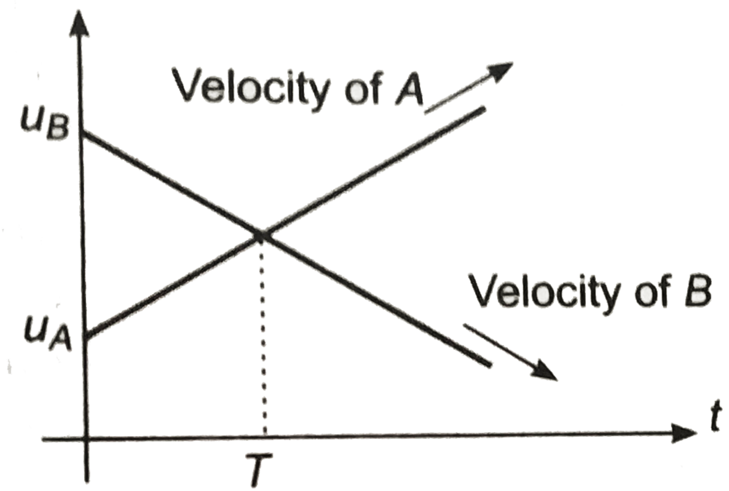
5. A situation is shown in which two objects A and B start their motion from same point in same direction. The graph of their velocities against time is drawn. u_A and u_B are the initial velocities of A and B respectively. T is the time at which their velocities become equal after start of motion. If the value of T is 4 s, then the time after which A will meet B is



A. 12 s

B. 6 s

C. 8 s

D. data insufficient

Answer: C

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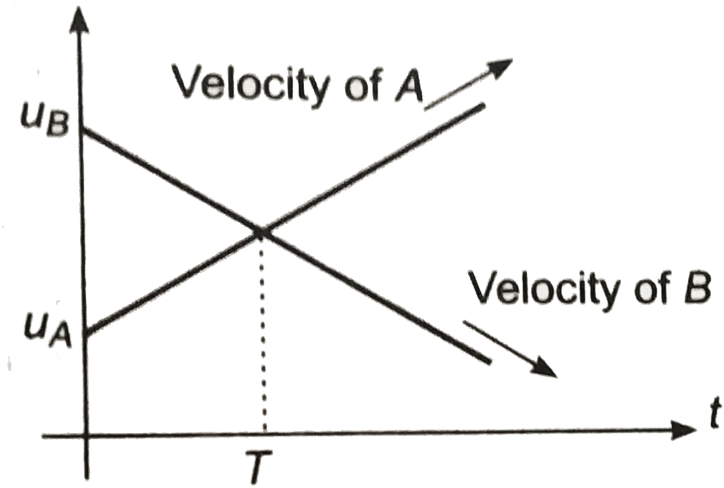
6. A situation is shown in which two objects A and B start their motion from same point in same direction. The graph of their velocities against time is drawn. u_A and u_B are the initial velocities of A and B respectively. T is the time at which their velocities become equal after start of motion. You cannot use the data of one question while solving another question of the same set. So all the questions are independent of each other.

6. Let v_A and v_B be the velocities of the particles A and B respectively at the moment A and B meet after start of the motion. If $u_A = 5ms^{-1}$ and $u_B = 15ms^{-1}$, then the

magnitude of the difference of velocities v_A and v_B is



A. $5ms^{-1}$

B. $10ms^{-1}$

C. $15ms^{-1}$

D. data insufficient

Answer: B

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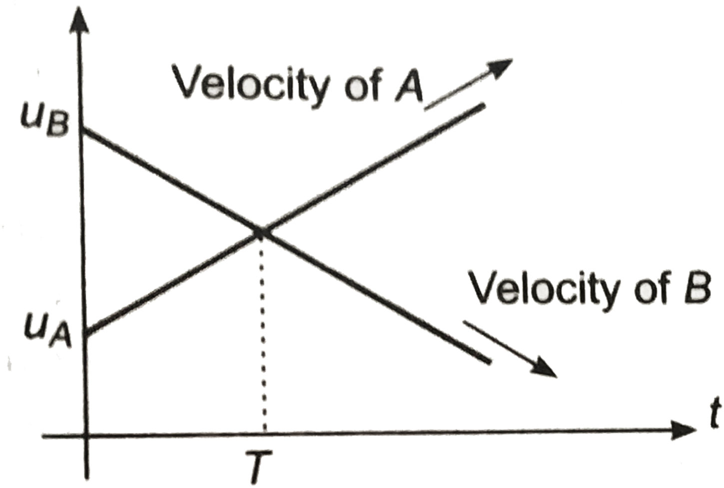
7. A situation is shown in which two objects A and B start their motion from same point in same direction. The graph of their velocities against time is drawn. u_A and u_B are the initial velocities of A and B respectively. T is the time at which their velocities become equal after start of motion. You cannot use the data of one question while solving another question of the same set. So all the questions are independent of each other.

7. After 10 s of the start of motion of both objects A and B, find the value of velocity of A if $u_A = 6ms^{-1}, u_B = 12ms^{-1}$ and at T velocity of A is

$8 ms^{-1}$ and $T = 4s$



A. $12 ms^{-1}$

B. $10 ms^{-1}$

C. $15 ms^{-1}$

D. None of these

Answer: D

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Subjective Questions

1. To test the quality of a tennis ball, you drop it onto the floor from a height of 4.00 m. It rebounds to a height of 2.00 m. If the ball is in contact with the floor for 12.0 ms, what is its average acceleration during that contact? Take $g = 98m/s^2$.

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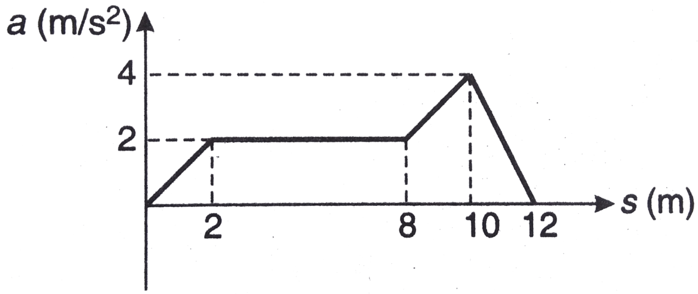
2. The acceleration-displacement graph of a particle moving in a straight line is as shown in figure, initial velocity of particle is zero. Find the velocity of the particle when displacement of the particle is $s = 12m$.



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3. At the initial moment three points A, B and C are on a horizontal straight line at equal distances from one another. Point A begins to move vertically upward with a constant velocity v and point C vertically downward without any initial velocity but with a constant acceleration a. How should point B move vertically for all the three points to be constantly on one straight line. The points begin to move simultaneously.

Watch Video Solution

4. A particle moves in a straight line with constant acceleration a. The displacements of particle from origin in times t_1, t_2 and $t_3 are s_1, s_2$ and s_3 respectively. If times are in AP with common difference d and displacements are in GP, then prove that $a = \frac{\left(\sqrt{s_1} - \sqrt{s_3}\right)^2}{d^2}$

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5. A car is to be hoisted by elevator to the fourth floor of a parking garage, which is 14 m above the ground. If the elevator can have maximum acceleration of $0.2m/s^2$ and maximum deceleration of $0.1m/s^2$ and can reach a maximum speed of 2.5 m//s, determine the shortest time to make the lift, starting from rest and ending at rest.

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6. To stop a car, first you require a certain reaction time to begin braking, then the car slows under the constant braking deceleration. Suppose that the total distance moved by your car during these two phases is 56.7 m when its initial Speed is 80.5 km//h and 24.4 m when its initial speed in 48.3 km//h. What are

(a) your reaction time and

(b) the magnitude or the deceleration?

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7. An elevator without a ceiling is ascending with a constant speed of 10 m//s. A boy on the elevator shoots a ball directly upward, from a height of 2.0 m above the elevator floor. At this time the elevator floor is 28 m above the ground. The initial speed of the ball with respect to the elevator is 20 m//s. (Take

$g = 9.8 m / s^2$)

(a) What maximum height above the ground does the ball reach?

(b) How long does the ball take to return to the elevator floor?

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8. A particle moves along a straight line and its velocity depends on time as $v = 3t - t^2$. Here, v is in m / s and t in second. Find

(a) average velocity and

(b) average speed for first five seconds.

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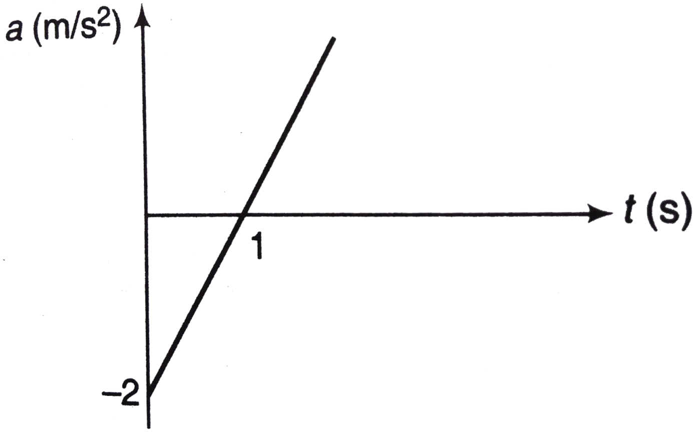
9. The acceleration of particle varies with time as



shown.

(a) Find an expression for velocity in terms of t.

(b) Calculate the displacement of the particle in the interval from $t = 2s$ to $t = 4s$. Assume that $v = 0$ at $t = 0$.

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10. A man wishes to cross a river of width 120 m by a motorboat. His rowing speed in still water is $3m/s$ and his maximum walking speed is $1m/s$. The river flows with velocity of $4m/s$.

(a) Find the path which he should take to get to the point directly opposite to his starting point in the shortest time.

(b) Also, find the time which he takes to reach his destination.

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11. The current velocity of river grows in proportion to the distance from its bank and reaches the maximum value v_0 in the middle. Near the banks the velocity is zero. A boat is moving along the river in such a manner that the boatman rows his boat always perpendicular to the current. The speed of the boat in still water is u. Find the distance through which the boat crossing the river will be carried away by the current, if the width of the river is c. Also determine the trajectory of the boat.

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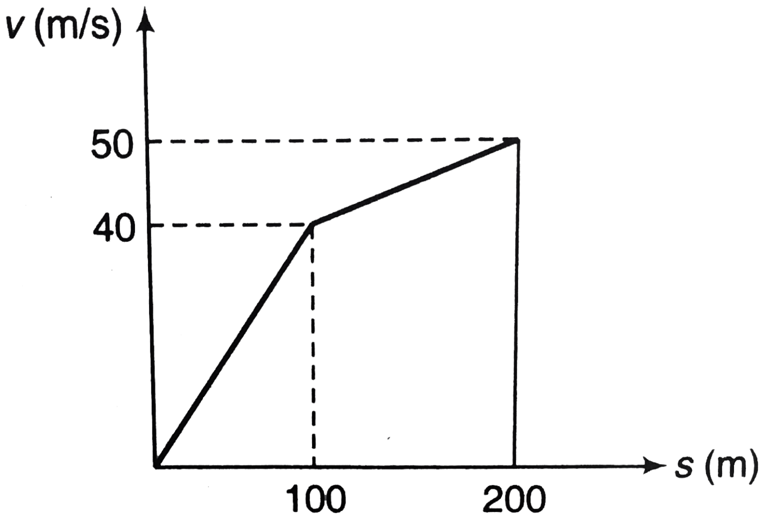
12. The v-s graph for an airplane travelling on a straight runway is shown. Determine the acceleration of the plane at $s = 50m$ and $s = 150m$. Draw the a-s graph.



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13. A river of width a with straight parallel banks flows due north with speed u. The points O and A are on opposite banks and A is due east of O. Coordinate axes O_x and O_y are taken in the east and north directions respectively. A boat, whose speed is v relative to water, starts from O and crosses the river. If the boat is steered due east and u varies with $xas: u = x(a-x)\frac{v}{a^2}$. Find

(a) equation of trajectory of the boat,

(b) time taken to cross the river,

(c) absolute velocity of boatman when he reaches the opposite bank,

(d) the displacement of boatman when he reaches the opposite bank from the initial position.

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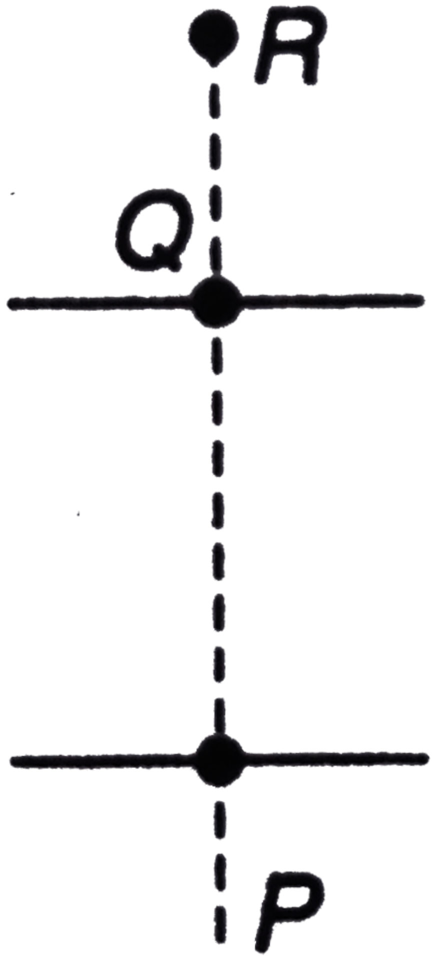
14. A river of width ω is flowing with a uniform velocity v. A boat starts moving from point P also With velocity v relative to the river. The direction of resultant velocity is always perpendicular to the line joining boat and the fixed point R. Point Q is on the opposite side of the river. P, Q and R are in a straight line. If $PQ = QR = \omega,$ find (a) the trajectory of the boat, (b) the drifting of the boat and (c) the time taken by the boat to cross the river.



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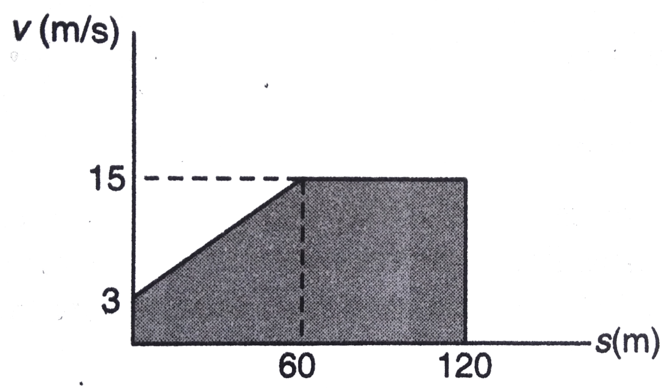
15. The v-s graph describing the motion of a motorcycle is shown in figure. Construct the a-s graph of the motion and determine the time needed for the motorcycle to reach the position $s = 120m$. Given In $5 = 1.6$.



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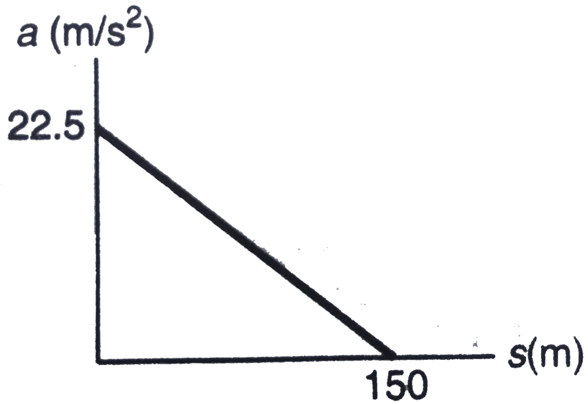
16. The jet plane starts from rest at $s = 0$ and is subjected to the acceleration shown. Determine the speed of the plane when it has travelled 60 m.



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17. A particle leaves the origin with an initial velodty $v = \left(3.00\hat{i}\right)m/s$ and a constant acceleration $a = \left(-1.00\hat{i} - 0.500\hat{j}\right)m/s^2$. When the particle reaches its maximum x coordinate, what are

(a) its velocity and (b) its position vector?

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18. The Speed Of a particle moving in a plane is equal to the magnitude of its instantaneous velocity, $v = \mid vl = \sqrt{v_x^2 + v_y^2}$.

(a) Show that the rate of change of the speed is $\dfrac{dv}{dt} = \dfrac{v_x a_x + v_y a_y}{\sqrt{v_x^2 + v_y^2}}$.

(b) Show that the rate of change of speed can be expressed as $\dfrac{dv}{dt}$ is equal toa_t the component of a that is parallelto v.

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19. A man with some passengers in his boat, starts perpendicular to flow of river 200 m wide and flowing with $2m/s$. Speed of boat in still water is $4m/s$. When he reaches half the width of river the passengers asked him that they want to reach the just opposite end from where they have started.

(a) Find the direction due which he must row to reach the required end.

(b) How many times more time, it would take to that if he would have denied the passengers?

20. A child in danger of drowning in a river is being carried downstream by a current that flows uniformly at a speed of $2.5 km / h$. The child is 0.6 km from shore and 0.8 km upstream of a boat landing when a rescue boat sets out. If the boat proceeds at its maximum speed of $20 km / h$ with respect to the water, what angle does the boat velocity v make with the shore? How long will it take boat to reach the child?

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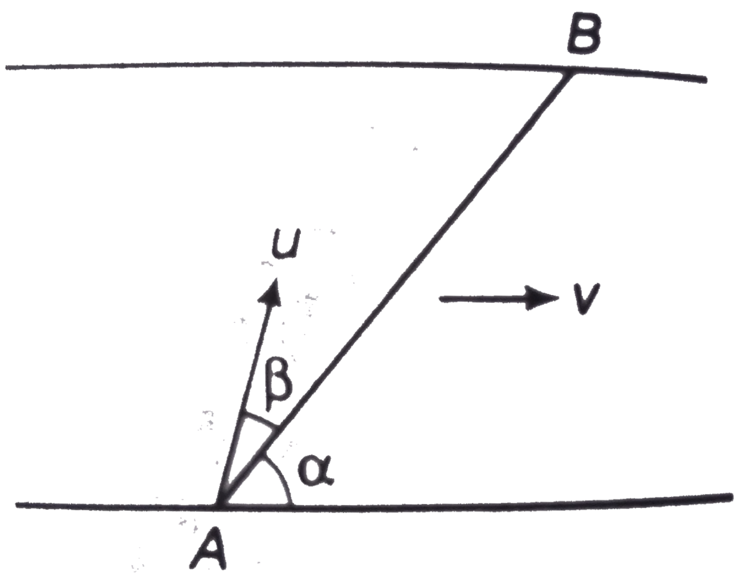
21. A launch plies between two points A and B on the opposite banks of a river always following the line AB. The distance S between points and B is 1200 m. The velocity of the river current $v = 1.9m/s$ is constant over the entire width of the river. The line AB makes an angle $\alpha = 60^\circ$ with the direction of the current. With what velocity u and at what angle beta to the line AB should the launch move to cover the distance AB and back in a time $t = 5 \text{ min}$? The angle beta remains the same during the passage from A to B and from B to A.



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22. 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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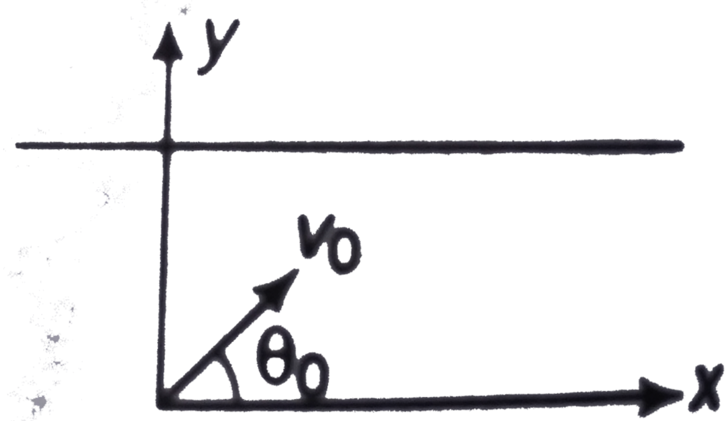
23. A projectile of mass m is fired into a liquid at an angle θ_0 with an initial velocity v_0 as shown. If the liquid develops a frictional or drag resistance on the projectile which is proportional to its velocity, i. e. $F = -kv$ where k is a positive constant, determine the x and y components of its velocity at any instant. Also find the maximum distance $x_{\max}$ that it travels?



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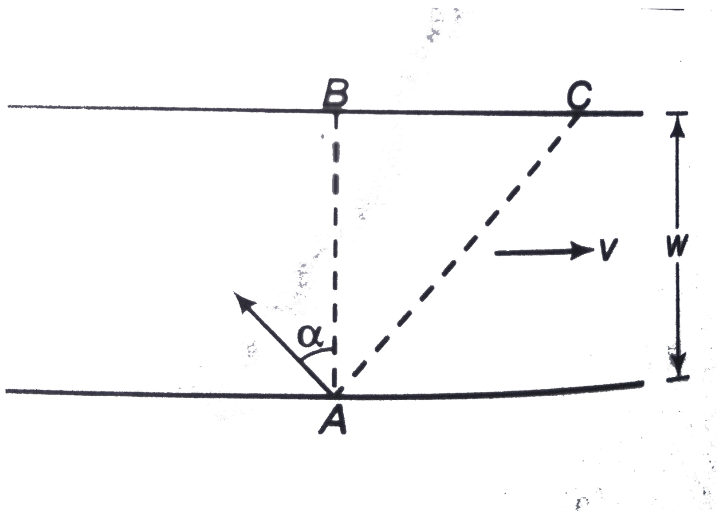
24. A man in a boat crosses a river from point A. If he rows perpendicular to the banks he reaches point C $(BC = 120m)$ in 10 min. If the man heads at a certain angle α to the straight line AB (AB is perpendicular to the banks) against the current he reaches point B in 12.5 min. Find the width of the river w, the rowing velocity u, the speed of the river current v and the angle α. Assume the velocity of the boat relative to water to be constant and the same magnitude in both cases.



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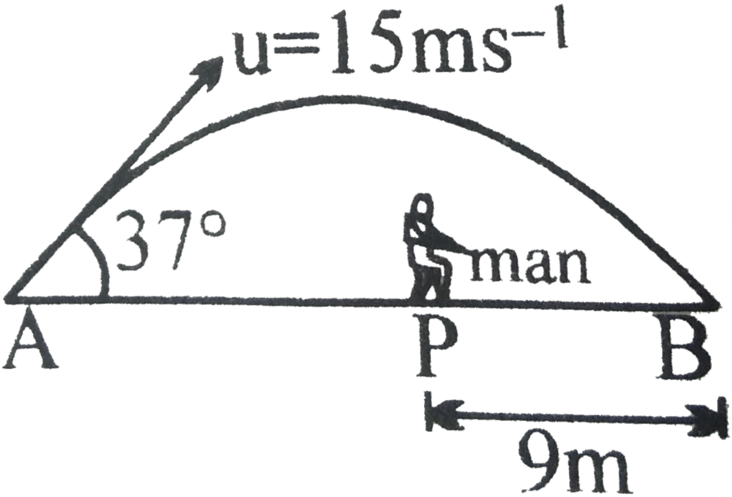
SCQ_TYPE

1. A ball is hit by a batsman at an angle of 37° as shown in figure. The man standing at P should run at

what minimum velocity so that he catches the ball before it strikes the ground. Assume that height of man is negligible in comparison to maximum height of projectile.



A. $3ms^{-1}$

B. $5ms^{-1}$

C. $9ms^{-1}$

D. $12ms^{-1}$

Answer: B

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2. A particle is projected from the ground with an initial velocity of $20m/s$ at an angle of 30° with horizontal. The magnitude of change in velocity in a time interval from $t=0$ to $t=0.5s$ is ($g=10m/s^2$)

A. $5m/s$

B. $2.5m/s$

C. $2m/s$

D. $4m/s$

Answer: A

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3. A particle is pojected from the ground at an angle of θ with the horizontal with an initial speed of u. Time after which velocity vector of the projectile is perpendicular to the initial velocity is

A. $u/(g\sin\theta)$

B. $u/(g\cos\theta)$

C. $2\frac{u}{g\sin\theta}$

D. $2u\tan\theta$

Answer: A

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4. In projectile motion, the modulus of rate of change of speed

A. is constant

B. first increases then decreases

C. first decreases then increases

D. none of the above

Answer: C

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5. A particle of mass m is projected from the ground with initial linear momentum p (magnitude) such that to have maximum possible range, its minimum kinetic energy will be

A. $\frac{p^2}{2m}$

B. $\frac{p^2}{4m}$

C. $\frac{p^2}{m}$

D. None of the these

Answer: B

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6. A particle is projected with initial velocity of $\hat{i} + 2\hat{j}$.

The eqaution of trajectory is $\left(take g = 10ms^{-2}\right)$

A. $y = 2x - 5x^2$

B. $y = x - 5x^2$

C. $4y = 2x - 5x^2$

D. $y = 2x - 25x^2$

Answer: A

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7. A particle is projected from the ground with an initial speed of v at an angle θ with horizontal. The average velocity of the particle between its point of projection and highest point of trajectroy is :

A. $\frac{v}{2}\sqrt{1+2\cos^2\theta}$

B. $\frac{v}{2}\sqrt{1+\cos^2\theta}$

C. $\frac{v}{2}\sqrt{1+3\cos^2\theta}$

D. $v\cos\theta$

Answer: C

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8. A particle A is projected verically upwards. Another indentical particle B is projected at an angle of 45°. Both reach the same height. The ratio of the initial kinetic energy of A to that of B is $-$

A. $1:2$

B. $2:1$

C. $1:\sqrt{2}$

D. $\sqrt{2}:1$

Answer: A

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9. Ratio of minimum kinetic energies of two projectiles of same mass is $4:1$. The ratio of the maximum height attained by them is also $4:1$. The ratio of their ranges would be

A. $16:1$

B. $4:1$

C. $8:1$

D. $2:1$

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10. 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 $\vec{v} = \left(6\hat{i} + 2\hat{j}\right)m/s$ (the x-axis is horizontal and y-axis is vertically upwards). The angle of projection is $(g = 10m/s^2)$

A. 45°

B. 60°

C. 30°

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

Answer: C

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11. The horizontal range and miximum height attained by a projectile are R and H, respectively. If a constant horizontal acceleration $a = g/4$ is imparted to the projectile due to wind, then its horizontal range and maximum height will be

A. $(R+H), \frac{H}{2}$

B. $\left(R+\frac{H}{2}\right), 2H$

C. $(R+2H), H$

D. $(R+H), H$

Answer: D

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12. A particle is projected at an angle of 60° above the horizontal with a speed of $10m/s$. After some time the direction of its velocity makes an angle of 30° above the horizontal. The speed of the particle at this instant is s

A. $\frac{5}{\sqrt{3}}m/s$

B. $5\sqrt{3}m/s$

C. $5m/s$

D. $\frac{10}{\sqrt{3}}m/s$

Answer: D

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13. The trajectory of a projectile in a vertical plane is $y = ax - bx^2$, where a and b are constant and x and y are, respectively, horizontal and vertical distances of the projectile from the point of projection. The maximum height attained by the particle and the angle of projectile from the horizontal are.

A. $\frac{b^2}{2a}, \tan^{-1}(b)$

B. $\frac{a^2}{b}, \tan^{-1}(2a)$

C. $\frac{a^2}{4b}, \tan^{-1}(a)$

D. $\frac{2a^2}{b}, \tan^{-1}(a)$

Answer: C

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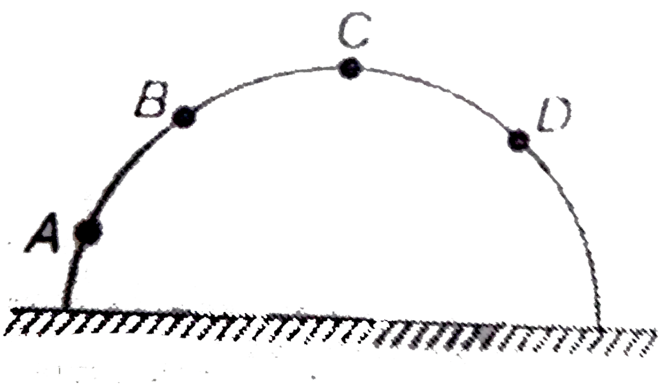
14. A stone is projected from ground. Its path is a shown in figure. At which point its speed is decreasing at fastest rate?



A. A

B. B

C. C

D. D

Answer: A

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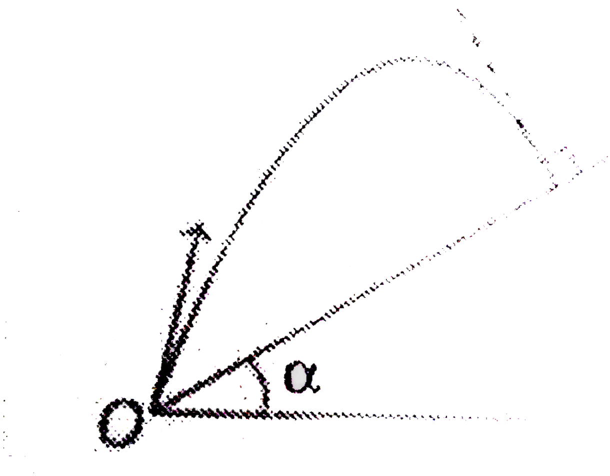
15. A projectile strikes the inclined plane perpendicularly as shown in the figure. Which of the following statements is correct?



A. Just before striking the inclined plane, component of final velocity of particle parallel to the inclined plane is non-zero

B. Initial and final velocities are perpendicular to each other.

C. Component of acceleration of particle parallel to the inclined plane before striking the plane is zero.

D. None of the above

Answer: D

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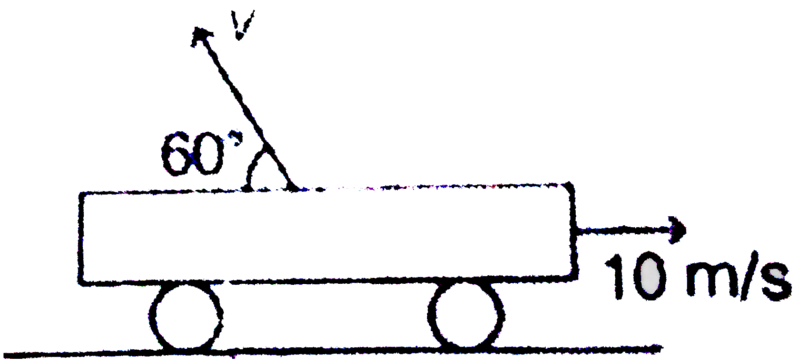
16. The direction of projection of particle is shown in the figure for an observer on trolley. An observer on the ground sees the ball rising vertically. The maximum height reached by the ball as seen from the trolley is



A. $10m$

B. $15m$

C. $20m$

D. $5m$

Answer: B

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17. A body is projected at an angle of 45° with horizontal from a point on ground at distance $6m$ from the foot of a vertical pole. It just crosses the top of the pole and falls on ground on the other side at a distance of $3m$ from the foot of the pole. The height of the pole is:

A. $1m$

B. $2m$

C. $3m$

D. $4m$

Answer: B

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18. A projectile is thrown with velocity u making an angle θ with the horizontal. Its time of flight on the horizontal ground is 4 second. The projectile is moving at angle of 45° with the horizontal just one second after the projection. Hence the angle θ is (take $g = 10m/s^2$)

A. $\tan^{-1}(4)$

B. 60°

C. 53°

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

Answer: D

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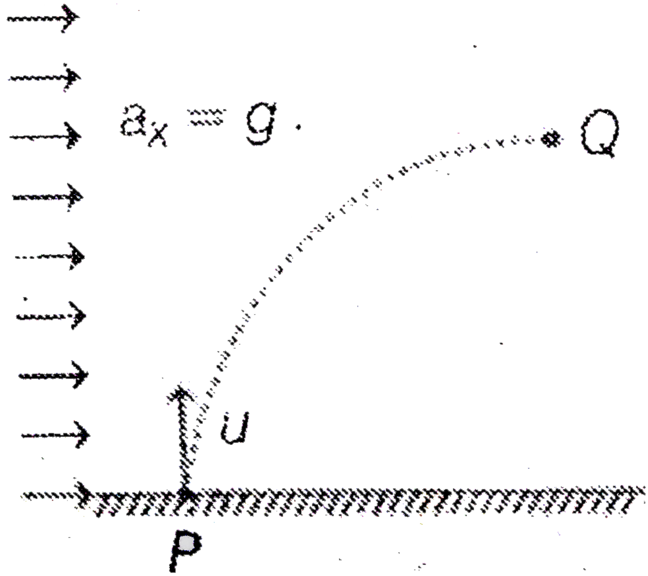
19. Air is blowing and is providing a constant horizontal acceleration $a_x = g$ to the particle as shown in the figure. Particle is projected from point P with a velocity u in upward direction. Let Q be the highest point of the particle. Speed of the particle at highest point Q is



A. $\sqrt{2}u$

B. u

C. $u / \sqrt{2}$

D. None of these

Answer: B

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20. A very broad elevator is going up vertically with a constant acceleration of $2m/s^2$. At the instant when its velocity is $4m/s$, a ball is projected from the floor of the lift wht as of $4m/s$ relative to the floor at an elevation of 30°. The time taken by the ball to return the floor is $(g = 10m/s^2)$

A. $\frac{1}{2}s$

B. $\frac{1}{3}s$

C. $\frac{1}{4}s$

D. $1s$

Answer: B

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21. A particle is projected up an inclined plane with initial speed $v = 20m/s$ at an angle $\theta = 30^\circ$ with plane. The component of its velocity perpendicular to plane when it strikes the plane is

A. $10\sqrt{3}m/s$

B. $10m/s$

C. $5\sqrt{3}m/s$

D. Data is insufficient

Answer: B

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

A. $23.1m$

B. $16.4m$

C. $30.2m$

D. $10.4m$

Answer: A

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23. Two particles A and B projected simultaneously from a point situated on a horizontal place. The particle A is projected vertically up with a velcity v_A while the particle B is projected up at an angle 30° with horizontal with velocity v_B. After 5s the particles were observed moving mutually perpendicular to each other. The velocity of projection of the particle v_A and v_B respectively are:

A. $50ms^{-1}, 100ms^{-1}$

B. $100ms^{-1}, 50ms^{-1}$

C. any value greater than $25ms^{-1}, 100ms^{-1}$

D. none of the above

Answer: C

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24. A projectile is fired at an angle of 30° to the horizontal such that the vertical component of its initial velocity is $80 m / s$. Its time of fight is T. Its velocity at $t = T / 4$ has a magnitude of nearly.

A. $200 m / s$

B. $300 m / s$

C. $140 m / s$

D. $100 m / s$

Answer: C

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25. A particle starts from the origin of co-ordinates at time $t = 0$ and moves in the xy plane with a constant acceleration α in the y-direction. Its equation of motion is $y = \beta x^2$. Its velocity component in the x-direction

A. α / β

B. $\sqrt{2\alpha / \beta}$

C. $\alpha / 2\beta$

D. $\sqrt{\alpha / 2\beta}$

Answer: D

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26. The speed of a projectile when it is at its greatest height is $\sqrt{2/5}$ times its speed at half the maximum height. The angle of projection is

A. 30°

B. 60°

C. 45°

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

Answer: B

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27. After one second the velocity of a projectile makes an angle of 45° with the horizontal. After another one more second its is travelling horizontally. The magnitude of its initial velocity and angle of projectile are

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

A. $14.62m/s, 60^{\circ}$

B. $14.62m/s, \tan^{-1}(2)$

C. $22.36m/s, \tan^{-1}(2)$

D. $22.36m/s, 60^{\circ}$

Answer: C

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28. A particle is projected with a certain velocity at an angle α above the horizontal from the foot of an inclined plane of inclination 30°. If the particle strikes the plane normally then α is equal to

A. $30^\circ + \tan^{-1}\left(\frac{\sqrt{3}}{2}\right)$

B. 45°

C. 60°

D. $30^\circ + \tan^{-1}(2\sqrt{3})$

Answer: A

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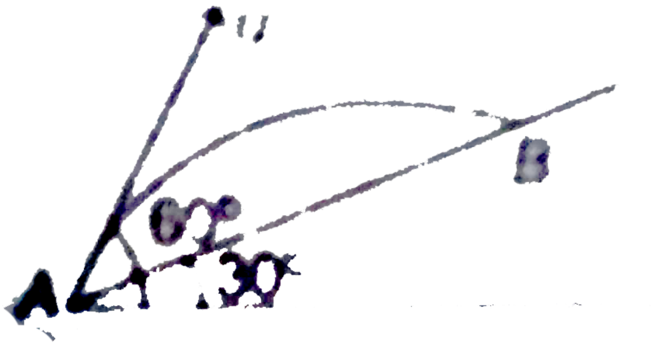
29. Time taken by the particle to reach from A to B is t. Then the distance AB is equal to



A. $\dfrac{ut}{\sqrt{3}}$

B. $\dfrac{\sqrt{3}ut}{2}$

C. $\sqrt{3}ut$

D. $2ut$

Answer: A

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30. A projectile of mass $2kg$ has velocities $3m/s$ and $4\frac{m}{s}$ at two points during its flight in the uniform gravitational field of the earth. If these two velocities are perpendicular to each other, then the minimum kinetic enerty of the particle during its flight is

A. $6.32J$

B. $8.40J$

C. $16.32J$

D. $5.76J$

Answer: D

Watch Video Solution

31. With what minimum speed must a particle be projected from origin so that it is able to pass through a given point $(30m, 40m)$? Take $g = 10m/s^2$

A. $60m/s$

B. $30m/s$

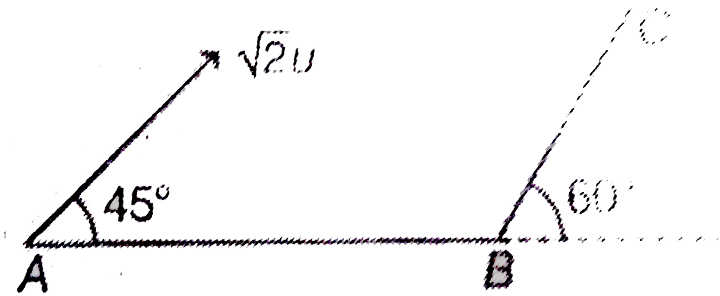
C. $50m/s$

D. $40m/s$

Answer: B

Watch Video Solution

32. A particle is projected from a point A with velocity $\sqrt{2}u$ an angle of 45° with horizontal as shown in figure. It strikes the plane BC at right angles. The velocity of the particle at the time of collision is



A. $\frac{\sqrt{3}u}{2}$

B. $\frac{u}{2}$

C. $\frac{2u}{\sqrt{3}}$

D. u

Answer: C

Watch Video Solution

33. A projectile is thrown with a velocity of $10\sqrt{2}m/s$ at an angle of 45° with horizontal. The interval between the moments when speed is $\sqrt{125}m/s$ is $(g = 10m/s^2)$

A. $1.0s$

B. $1.5s$

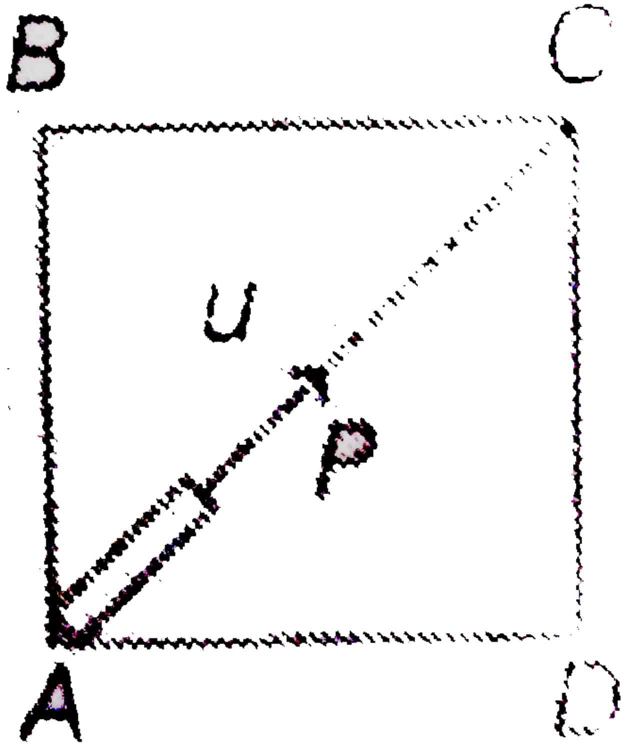
C. $2.0s$

D. $0.5s$

Answer: A

Watch Video Solution

34. A large rectangular box moves vertically downward with an acceleration a. A toy gun fixed at A and aimed towards C fires a particle P.



A. P will hit C if $a = g$

B. P will hit the roof BC, if $a > g$

C. P will hit the CD if $a < g$

D. May be either (a), (b) or (c) depending on the speed of projection of P.

Answer: D

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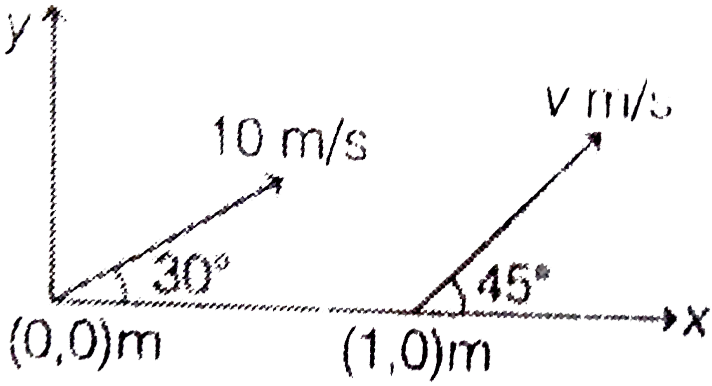
35. Two particles projected vertically upward from points $(0, 0)$ and $(1, 0)m$ with uniform velocity $10m/s$ and vm/s respectively, as shown in the figure. It is found that they collide after time t in space. Time

t is $\dfrac{1}{5(\sqrt{x}-1)}$. Calculate x



A. 2

B. 3

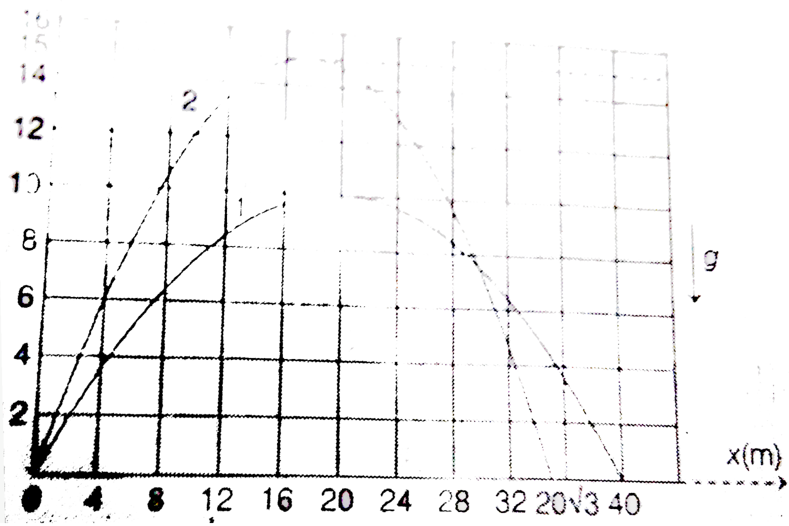
C. 5

D. 8

Answer: B

Watch Video Solution

36. Trajectory of two particles projected from origin with speeds v_1 and v_2 at angles θ_1 and θ_2 with positive x- axis respectively are as shown in the figure. Given that $\left(g = -10m/s^2\left(\hat{j}\right)\right)$. Choose the correct option related to diagram.



A. $v_1 - v_2 = 2v_1$

B. $\theta_2 - \theta_1 = 2\theta_1$

C. $3(v_1 - v_2) = v_1$

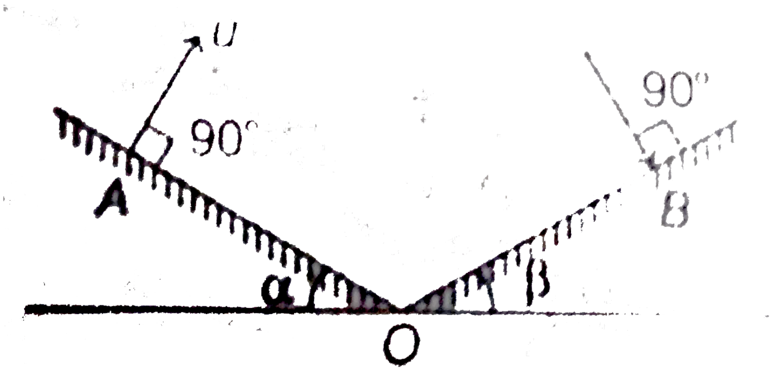
D. $3(\theta_2 - \theta_1) = \theta_1$

Answer: D

View Text Solution

37. Two inclined planes OA and OB of inclinations α and β equal to 30° are as shown in the figure. A particle is projected at an angle of 90° with plane OA from point A and it strikes the plane OB at point B normally. Then find the speed of projection u in m/s.

(Given that $OA = OB = 20cm$ and $g = 10m/s^2$)



A. 2

B. 5

C. 4

D. 6

Answer: A

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38. An elavator is going up vertically with a constant accelerartion of $2m/s^2$. At the instant when its velocity is $4m/s$ a ball is projected from the floor of the elavator with a speed of $4m/s$ relative to the floor with an angular eleavation of 60°. The time taken by the ball to return the floor is $(g = 10m/s^2)$

A. $\frac{1}{3}s$

B. $\frac{1}{\sqrt{3}}s$

C. $\frac{2}{\sqrt{3}}s$

D. $\sqrt{3}s$

Answer: B

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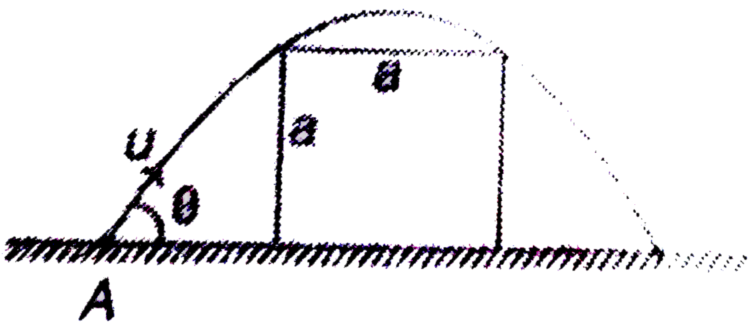
39. Figure shows a cube of side length $'a'$ placed on a horizontal surface. A particle projected from A with speed u, at an angle $\theta = \tan^{-1}\sqrt{5}$ with horizontal, just touches the cube at two vertices as shown. Find projection speed u.



A. $\sqrt{\frac{27}{8}ag}$

B. $\sqrt{2ag}$

C. $\sqrt{3ag}$

D. $\sqrt{\frac{8}{3}ag}$

Answer: C

View Text Solution

40. Two particles are projected simultaneously from two different points in a uniform gravitational field and collide with each other at a point $Q(2b, 3b)$. In the absence of the field they would have collided at $P(2b, 8b)$ in a time t_0. The acceleration due to gravity at this place g must be equal to

A. $\frac{10b}{t_0^2}$

B. $\frac{11b}{t_2^2}$

C. $\frac{15b}{t_0^2}$

D. $\frac{7b}{t_0^2}$

Answer: A

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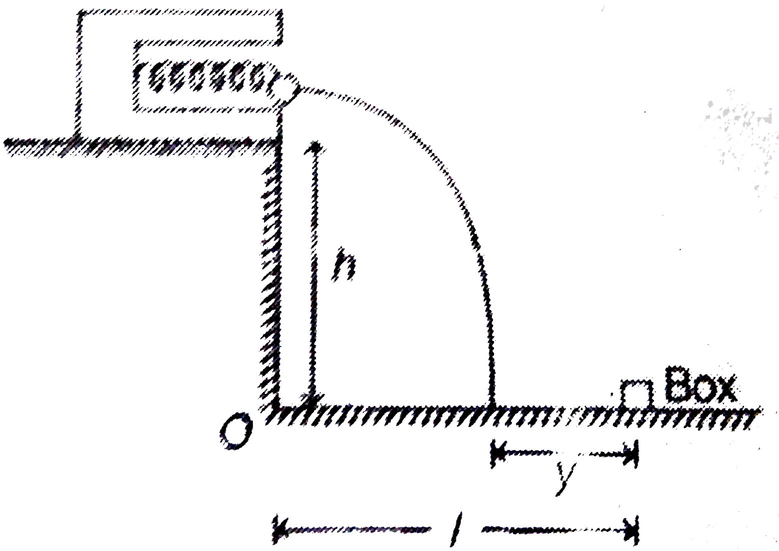
41. Two children are playing a game in which they try to hit a small box using a spring loaded machine gun, which is fixed rigidly to a table at a height h above the top of the box. The spring has spring constant k and the box is at a horizontal distance l from O. The first child compresses the spring a distanc x_0 and find that the marble falls short of box by a horizontal distance y. The second child compreses the spring by an extra amount Δx so that marble lands in the box. The value of Δx is



A. $l\sqrt{\frac{mg}{hk}}$

B. $l\sqrt{\frac{2mg}{hk}}$

C. $2y\sqrt{\frac{mg}{hk}}$

D. $y\sqrt{\frac{mg}{2hk}}$

Answer: D

View Text Solution

42. 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 displacement 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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43. A body starts from rest and is uniformly accelerated for 30 s. The distance travelled in the first 10 s is x_1, next 10 s is x_2 and the last 10 s is x_3. Then $x_1 : x_2 : x_3$ is the same as :-

A. $1 : 2 : 4$

B. $1 : 2 : 5$

C. $1:3:5$

D. $1:3:9$

Answer: C

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44. A ball is dropped from the top of a building. The ball takes $0.5s$ to fall the $3m$ length of a window some distance from the to of the building. If the speed of the ball at the top and at the bottom of the window are v_T and v_T respectively, then $\left(g = 9.8m / s^2\right)$

A. $v_T + v_B = 12ms^{-1}$

B. $v_T - v_B = 4.9ms^{-1}$

C. $v_B + v(T) = 1ms^{-1}$

D. $\frac{v_B}{v_T} = 2$

Answer: A

Watch Video Solution

45. A ball is dropped into a well in which the water level is at a depth h below the top. If the speed of sound is C, then the time after which the splash is heard will be give by.

A. $T = \frac{2h}{v}$

B. $T = \sqrt{\frac{2h}{g}} + \frac{h}{v}$

C. $T = \sqrt{\frac{2h}{g}} + \frac{h}{2v}$

D. $T = \sqrt{\frac{h}{2g}} + \frac{2h}{v}$

Answer: B

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46. Two balls of equal masses are thrown upwards, along the same vertical direction at an interval of 2 seconds, with the same initial velocity of $40m/s$. Then these collide at a height of (Take $g = 10m/s^2$).

A. $120m$

B. $75m$

C. $200m$

D. $45m$

Answer: B

Watch Video Solution

47. A stone is thrown vertically upwards with an initial speed u from the top of a tower, reaches the ground with a speed $3u$. The height of the tower is :

A. $3u^2 / g$

B. $4u^2 / g$

C. $6u^2/g$

D. $9u^2/g$

Answer: B

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48. A particle starts from rest with uniform acceleration and its velocity after n seconds is v. The displacement of the body in last two seconds is

A. $\dfrac{2v(n-1)}{n}$

B. $\dfrac{v(n-1)}{a}$

C. $\dfrac{v(n+1)}{n}$

D. $\dfrac{2v(2n+1)}{a}$

Answer: A

Watch Video Solution

49. A balloon is moving upwards with velocity $10m/s$. It releases a stone which comes down to the ground in $11s$. The height of the balloon from the ground at the moment when the stone was dropped is $(g = 10m/s^2)$

A. $495m$

B. $592m$

C. $362m$

D. $500m$

Answer: A

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50. A particle is thrown upwards from ground. It experiences a constant resistance force which can produce a retardation of $2ms^{-2}$. The ratio of time of ascent to time of descent 13 ($g = 10ms^{-2}$)

A. $1:1$

B. $\sqrt{\frac{2}{3}}$

C. $\frac{2}{3}$

D. $\sqrt{\frac{3}{2}}$

Answer: B

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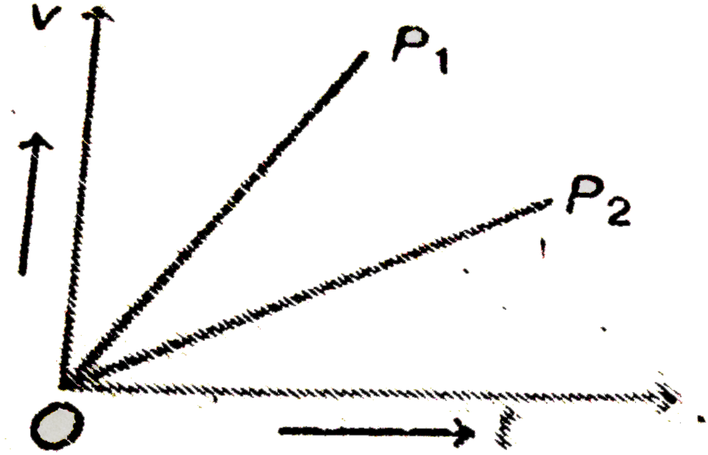
51. Shown in the figure are the velocity time graphs of the two particle P_1 and P_2 moving in same straight line in same direction. Which of the following statements about their relative motion is true?



Their relative velocity

A. is zero

B. is non-zero but constant

C. continuously decreases

D. continuously increases

Answer: D

Watch Video Solution

52. Two trains A and B , $100 km$ apart are travelling towards each other on different tracks with same starting speed of $50 km / h$. The train A accelerates at $20 km / h^2$ and the train B retards at the rate $20 km / h^2$. The distance covered by the train A when they cross each other is

A. $70 km$

B. $55 km$

C. $65 km$

D. $60 km$

Answer: D

Watch Video Solution

53. To cross the river in shortest distance, a swimmer should swimming an angle `theta with the upsteram. What is the ratio of the time taken to swim across in the shortest time to that in swimming across over shortest distance. [Asume that the speed of swimmer in still water is greater than the speed of river flow]

A. $\cos\theta$

B. $\sin\theta$

C. $\tan\theta$

D. $\cot\theta$

Answer: B

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54. Rain drops are falling vertically with a velocity $10m/s$. To a cyclist moving on a straight road, the rain drops appear to be coming with a velocity of $20m/s$. The velocity of cyclist is :-

A. $10m/s$

B. $10\sqrt{3}m/s$

C. $20m/s$

D. $20\sqrt{3}m/s$

Answer: B

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55. A person walks up a stationary escalator in time t_1. If he remains stationary on the escalator, then it can take him up in time t_2. How much time would it take for him to walk up the moving escalator?

A. $\dfrac{t_1 + t_2}{2}$

B. $\sqrt{t_1 t_2}$

C. $\dfrac{t_1 t_2}{t_1 + t_2}$

D. $t_1 + t_2$

Answer: C

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56. Two card are moving in the same direction with the same speed of $30kmh^{-10}$ at a distance of $5km$ from each other . A third car moving in the opposite direction meets these two card at an interval of 4 minutes. Find the speed of third car.

A. $30kmh^{-1}$

B. $35kmh^{-1}$

C. $40kmh^{-1}$

D. $45 km h^{-1}$

Answer: D

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57. A bus is moving with a velocity $10 m s^{-1}$ on a straight road. A scooterist wishes to overtake the bus in $100 s$. If the bus is at a distance of $1 km$ from the scooterist, with what velocity should the scooterist chase the bus ?

A. $50 m s^{-1}$

B. $40 m s^{-1}$

C. $30ms^{-1}$

D. $20ms^{-1}$

Answer: D

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58. Two trains take $3s$ to pass another when going in the opposite directions but only $2.5s$ if the speed of one is increased by 50%. The time one would take to pass the other when going in the same direction at their original speed is

A. $10s$

B. $12s$

C. $15s$

D. $18s$

Answer: C

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59. For four particle A,B,C,D, the velocities of one with respect to other are given as $\vec{V}_{DC}$ is $20\frac{m}{s}$ towards north, $\vec{V}_{BC}$ is $20\frac{m}{s}$ towards east and $\vec{V}_{BA}$ is $20\frac{m}{s}$ towards south. Then $\vec{V}_{DA}$ is

A. $20m/s$ towards north

B. $20m/s$ towards south

C. $20m/s$ towards east

D. $20m/s$ towards west

Answer: D

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60. A ball is thrown vertically down with velocity of $5m/s$. With what velocity should another ball be thrown down after 2 seconds so that it can hit the 1^{st} ball in next 2 second.

A. $40m/s$

B. $10m/s$

C. $15m/s$

D. $20m/s$

Answer: A

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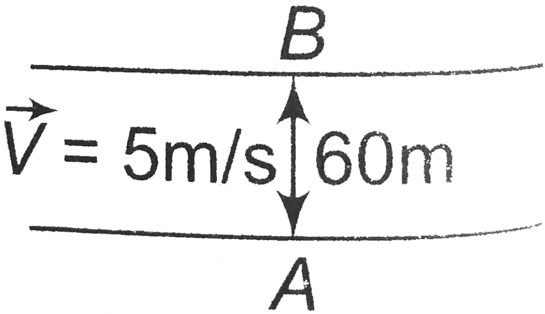
61. A man is crossing a river flowing with velocity of $5m/s$. He reaches a point directly across at a distance of 60m in 5 sec. His velocity in still water should be



A. $12m/s$

B. $13m/s$

C. $5m/s$

D. $10m/s$

Answer: B

Watch Video Solution

62. The velocity of an object moving rectillinearly is given as a functiion of time by $v = 4t - 3t^2$ where v is in m/s and t is in seconds. The average velociy if particle between $t = 0$ to $t = 2$ seconds is

A. 0

B. $-2m/s$

C. $-4m/s$

D. $+2m/s$

Answer: A

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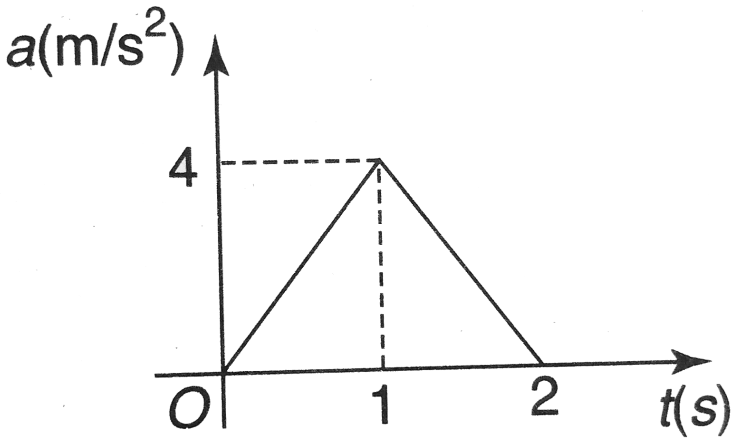
63. The acceleration-time graph of a particle moving in a straight line is as shown in figure. The velocity of the particle at time $t = 0$ is $2m/s$. The velocity after 2 seconds will be



A. $6m/s$

B. $4m/s$

C. $2m/s$

D. $8m/s$

Answer: A

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64. Two cars A and B cross a point P with velocities $10m/s$ and $15m/s$. After that they move with different uniform accelerations and the car A overtakes B with a speed of $25ms^{-1}$. What is velocity of B at that instant?

A. $20ms^{-1}$

B. $25ms^{-1}$

C. $30ms^{-1}$

D. $40ms^{-1}$

Answer: A

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65. The last soldier of an $80m$ long marching troops runs from the end to its front, and then it runs back to the end with the same speed. During this, the marching troop covers a distance of $150m$. The distance covered by the soldier is

A. $310m$

B. $250m$

C. $230m$

D. $160m$

Answer: B

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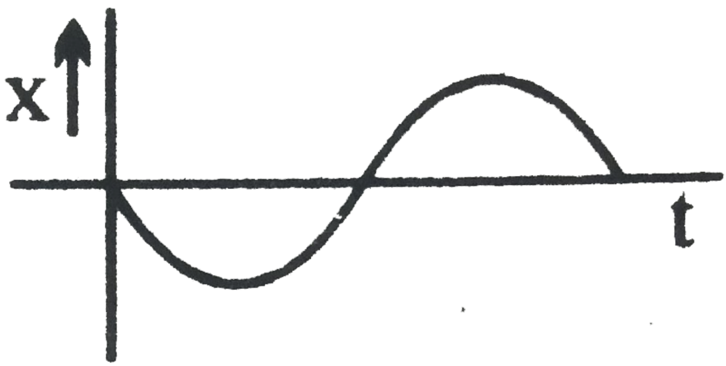
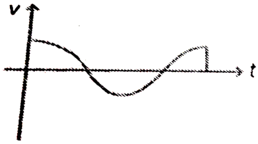
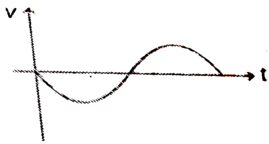
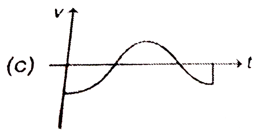
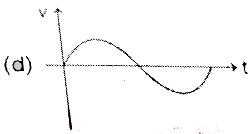
66. If position-time graph of a particle is sin curve as shown, what will be its velocity-time graph?



A. 

B. 

C. 

D. 

Answer: C

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67. The greatest acceleration or deceleration that a train may have is a. The minimum time in which the train may reach form one station to the other seprated by a distance is-

A. $4\sqrt{\frac{d}{a}}$

B. $\sqrt{\frac{2d}{a}}$

C. $\frac{1}{2}\sqrt{\frac{d}{a}}$

D. $2\sqrt{\frac{d}{a}}$

Answer: D

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68. Average velocity of a particle moving in a straight line, with constant acceleration a and initial velocity u

in first t seconds is.

A. $u+\frac{1}{2}at$

B. $u+at$

C. $\frac{u+at}{2}$

D. $\frac{u}{2}$

Answer: A

Watch Video Solution

69. During a accelerated motion of a particle

A. average velocity of the particle is always less than its final velocity

B. average velociyt of the particle is always greater than its final velocity

C. average velocity of the particle may be zero also

D. average velocity of the particle is half its final velocity

Answer: C

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70. Two particles are released from the same height at an interval of $1s$. How long after the first particle begins to fall will the two particles be $10m$ apart? ($g = 10m / s^2$)

A. $1.5s$

B. $2s$

C. $1.25s$

D. $2.5s$

Answer: A

Watch Video Solution

71. 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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72. 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. $30m$

B. $32m$

C. $20m$

D. $24m$

Answer: D

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73. A juggler maintains four balls in motion, making each to them to rise a height of $20m$ from his hand. What time interval should he maintain, for the alphaer distance between them.

A. $3s$

B. $\frac{3}{2}s$

C. $1s$

D. $2s$

Answer: C

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74. The displacement of a particle moving in a straight line is described by the relation $s = 6 + 12t - 2t^2$. Here s is in metre and t in second. The distance covered by the particle in first $5s$ is

A. $20m$

B. $32m$

C. $24m$

D. $26m$

Answer: D

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75. A ball projected upwards from the foot of a tower. The ball crosses the top of the tower twice after an interval of $6s$ and the ball reaches the ground after $12s$. The height of the tower is $\left(g = 10m/s^2\right)$:

A. $120m$

B. $135m$

C. $175m$

D. $80m$

Answer: B

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76. A particle is projected vertically upwards from a point A on the ground. It takes t_1 time to reach a point B but it still continues to move up. If it takes further t_2 time to reach the ground from point B then height of point B from the ground is :-

A. $\frac{1}{2}g(t_1 + t_2)^2$

B. gt_1t_2

C. $\frac{1}{8}g(t_1 + t_2)^2$

D. $\frac{1}{2}gt_1t_2$

Answer: D

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77. A particle is released from rest from a tower of height 3h. The ratio of time intervals for fall of equal height h i.e. $t_1 : t_2 : t_3$ is :

A. $5 : 3 : 1$

B. $3 : 2 : 1$

C. $9 : 4 : 1$

D. $1 : (\sqrt{2} - 1) : (\sqrt{3} : \sqrt{2})$

Answer: D

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78. A ball is dropped from the roof of a tower height h. The total distance covered by it in the last second of its motion is equal to the distance covered by it in first three seconds. The value of h in metre is $(g = 10m/s^2)$

A. 125

B. 200

C. 100

D. 80

Answer: A

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79. Ball A is dropped from the top of a building. At the same instant ball B is thrown vertically upwards from the ground. When the balls collide, they are moving in opposite direction and the speed of A is twice the speed of B. At what fraction of the height of the building did the collision occurs ?

A. $1/3$

B. $2/3$

C. $1/4$

D. $2/5$

Answer: B

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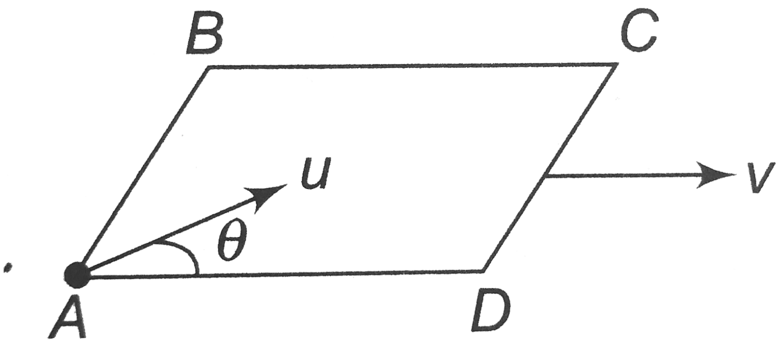
80. A smooth square plateform ABCD is moving towards right with a uniform speed v. At what angle θ must a particle be projected from A with speed u so that it strikes the point B



A. $\sin^{-1}\left(\frac{u}{v}\right)$

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

C. $\cos^{-1}\left(\frac{u}{v}\right)$

D. $\sin^{-1}\left(\frac{v}{u}\right)$

Answer: B

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81. Two stones are thrown up simultaneously from the edge of a cliff with initial speed v and $2v$. The relative position of the second stone with respect to first varies with time till both the stones strike the ground as.

A. linearly

B. first linearly then parabolically

C. parabolically

D. first parabolically then linearly

Answer: B

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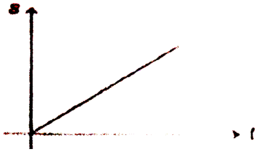
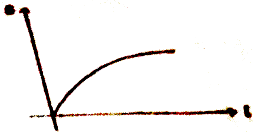
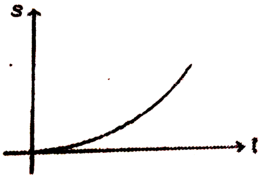
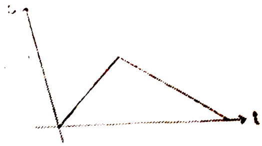
82. One stone is dropped from a tower from rest and simultaneously another stone is projected vertically upwards from the tower with some initial velocity. The graph of distance (s) between the two stones varies with time (t) as (before either stone hits the ground).

A. 

B. 

C. 

D. 

Answer: A

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83. A particle is dropped from point A at a certain height from ground. It falls freely and passes through thre points B, C and D with $BC = CD$. The time taken by the particle to move from B to CD is $2s$ and from C to D is $1s$. The time taken to move from A to B is s

A. $0.5s$

B. $1.5s$

C. $0.75s$

D. $0.25s$

Answer: A

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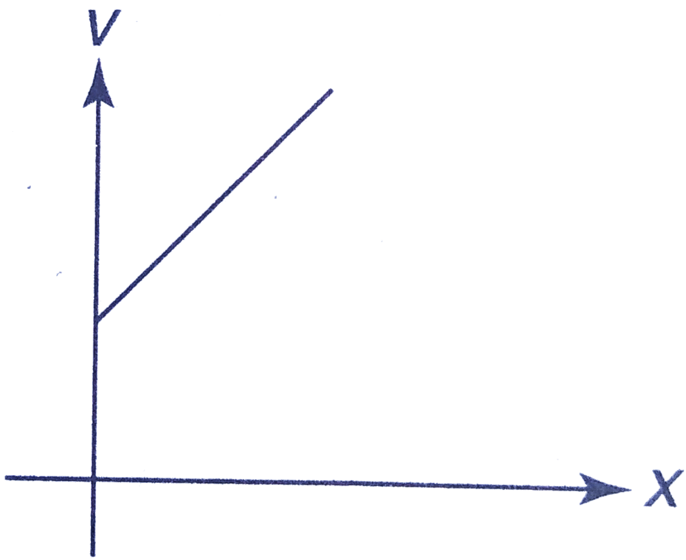
84. Graph of velocity versus displacement of a particle moving in a straight line is as shown in figure. The acceleration of the particle is.



A. constant

B. increases linearly with x

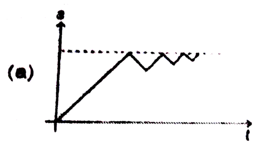
C. increases parabolically with x

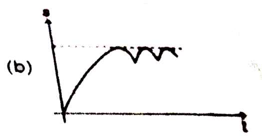
D. zero

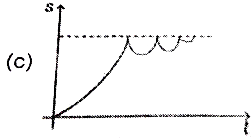
Answer: B

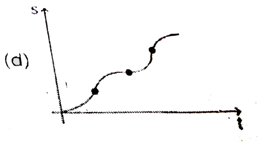
Watch Video Solution

85. 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. 

C. 

D. 

Answer: C

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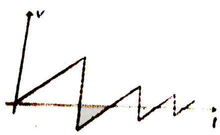
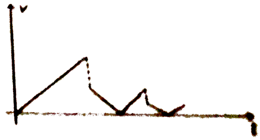
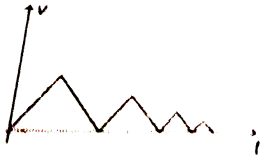
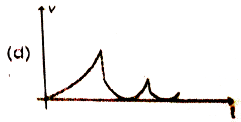
86. The speed -time graph of the ball in the above situation is.

A. 

B. 

C. 

D. 

Answer: B

Watch Video Solution

87. Velocity time equation of a particle moving in a straight line is $v = 2t - 4$ for $t \le 2s$ and $v = 4 - 2t$ for $t > 2$.The distance travelled by the particle in the time interval from $t = 0$ to $t = 4s$ is (Here t is in second and v in m/s)

A. $12m$

B. $16m$

C. $4m$

D. $8m$

Answer: B

Watch Video Solution

88. A body starts from the origin and moves along the X-axis such that the velocity at any instant is given by

$(4t^3 - 2t)$, where t is in sec and velocity in m/s. what is the acceleration of the particle when it is 2 m from the origin?

A. $28m/s^2$

B. $22m/s^2$

C. $12m/s^2$

D. $10m/s^2$

Answer: A

Watch Video Solution

89. Two objects are moving along the same straight line. They cross a point A With an acceleration a, 2a and velocity 2u, u at time $t = 0$. The distance moved by the object when one overtakes the

A. $\frac{6u^2}{a}$

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

C. $\frac{4u^2}{a}$

D. $\frac{8u^2}{a}$

Answer: D

Watch Video Solution

90. Two balloons are moving in air with velocities $v_1 = \left\{2t\hat{i} + (t-2)\hat{j}\right)m/s$ and $v_2 = \left\{(t-4)\hat{i} + t\hat{j}\right\}m/s$ then at what t balloons are moving parallel to each other:

A. $5/4s$

B. $4/5s$

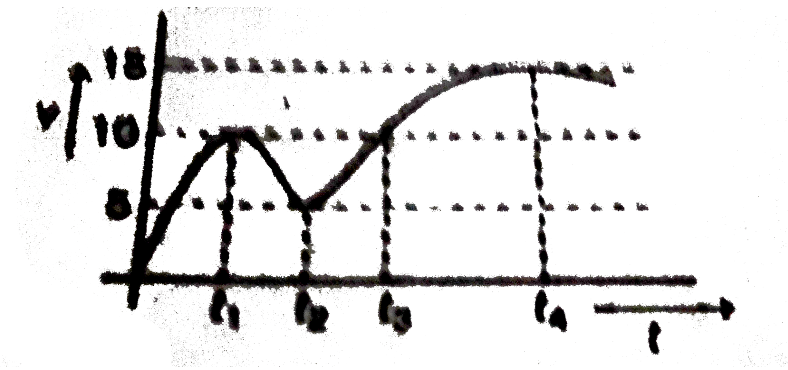
C. $10/3s$

D. $-3 \pm \sqrt{17}s$

Answer: C

Watch Video Solution

91. Veolocity-time graph of a particle undergoing rectilinear motioin is plotted upto $t = t_4$ as shown in the figure. Average acceleration of the particle is zero in the time internal between



A. 0 and t_1

B. t_1 and t_2

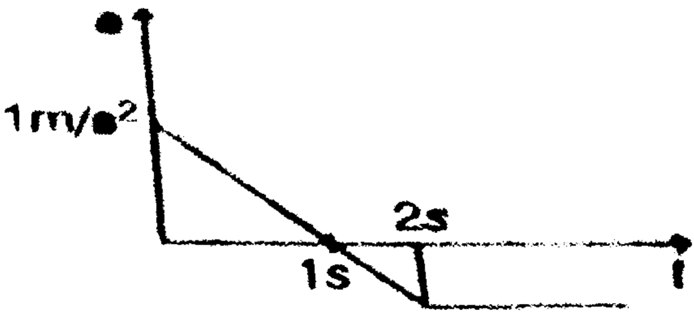
C. t_1 and t_3

D. t_3 and t_4

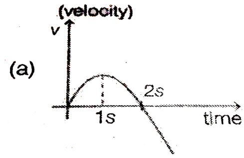
Answer: A

Watch Video Solution

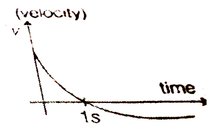
92. Acceleration versus time curve for a particle moving in a straight line is shown in the figure. If particle starts from rest at $t = 0$, then which of the following curve is correct for the same particle.



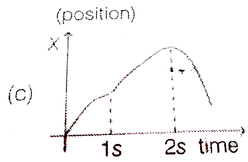
A.



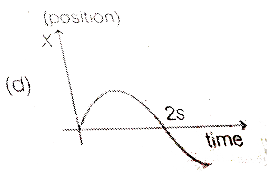
B.



C.



D.



Answer: B

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93. An airplane flies northward from town A and B and then back again. There is a steady wind blowing towards the north so that for the first state of the trip, the airplane is flying in the same direction as the wind and for the return trip of the journey, the airplane is flying opposite of the wind. The total trip time T_ω as compared to the total trip time in the absence of any winds T_0 is:

A. $T_w = T_0$

B. $T_w > T_0$

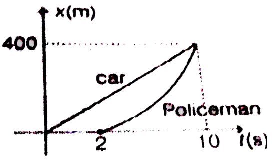
C. $T_w < T_0$

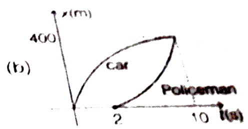
D. Data is insufficient

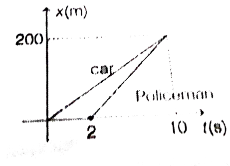
Answer: A

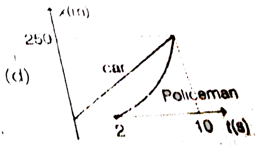
Watch Video Solution

94. A car breaks a traffic signal with a speed of $40 m / s$. After $2s$, a policeman starts following him with a constant acceleration of $12.5 m / s^2$. Taking the position of signal to be origin, correct position time graph would be

A. 

B. 

C. 

D. 

Answer: A

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95. A plane is flying at a speed of $720kmh^{-1}$ with respect to air. The wind is blowing at a speed of $54kmh^{-1}$ from west to east. With respect to ground the plane is found to be movig northwards. In which direction is the plane heading?

A. North-West at angle $\sin^{-1}\left(\frac{3}{40}\right)$ to north

B. North-West at angle $\tan^{-1}\left(\frac{3}{40}\right)$ to west.

C. North-East at angle $\sin^{-1}\left(\frac{3}{40}\right)$ to north.

D. North -East at angle $\tan^{-1}\left(\frac{3}{40}\right)$ to east

Answer: D

View Text Solution

96. A particle is moving on a straight line. Its velocity at time t is $(8-2t)m/s$. What is the total distance covered from $t=0$ to $t=6s$?

A. $12m$

B. $16m$

C. $18m$

D. $20m$

Answer: A

Watch Video Solution

97. A ball is dropped from a tower of height h under gravity. If it takes $4s$ to reach the ground from height $\frac{h}{2}$, then time taken by it to reach from h to $\frac{h}{2}$ is nearly:

A. $9.65s$

B. $6.35s$

C. $8.35s$

D. $5.65s$

Answer: B

Watch Video Solution

98. Velocity of a particle varies with time as $v = at\hat{i} + 2ht^2\hat{j}$. If the particle starts from point $(0, c)$, the trajectory of the particle is

A. $y = \frac{bx^{3/2}}{a} + c$

B. $y = \frac{4\sqrt{2}b}{3}\left(\frac{x}{a}\right)^{3/2} + c$

C. $y = \frac{4\sqrt{2}b}{3}\left(\frac{x}{a}\right)^{3/2} - c$

D. $y = \frac{bx^{3/2}}{a} - c$

Answer: A

Watch Video Solution

99. 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

100. A glass wind screen whose inclination with the vertical can be changed is mounted on a car. The car moves horizontally with a speed of $2m/s$. At what angle α with the vertical should the wind screen be placed so that the rain drops falling vertically downwards with velocity $6m/s$ strike the wind screen perpendicularly?

A. $\tan^{-1}(1/3)$

B. $\tan^{-1}(3)$

C. $\cos^{-1}(3)$

D. $\sin^{-1}(1/3)$

Answer: B

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101. 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. $t_3^2 = t_1 t_2$

D. $t_3 = t_1 + t_2$

Answer: A

Watch Video Solution

102. A point mass starts moving in straight line with constant acceleration a from rest at $t = 0$. At time $t = 2s$, the acceleration changes the sign remaining the same in magnitude. The mass returns to the initial position at time $t = t_0$ after start of motion. Here t_0 is

A. $4s$

B. $(4 + 2\sqrt{2})s$

C. $(2 + 2\sqrt{2})s$

D. $(4 + 4\sqrt{2})s$

Answer: B

Watch Video Solution

103. In a car race car A takes t_0 time less to finish than car B and pases the finishing point with a velocity v_0 more than car B. The cars start from rest and travel with constant accelerations a_1 and a_2 . Then the ratio $\frac{v_0}{t_0}$ is equal to

A. $\frac{a_1^2}{a_2}$

B. $\frac{a_1 + a_2}{2}$

C. $\sqrt{a_1 a_2}$

D. $\frac{a_2^2}{a_1}$

Answer: C

Watch Video Solution

104. A particle moves in space along the path $z = ax^3 + by^2$ in such a way that $\frac{dx}{dt} = c = \frac{dy}{dt}$ where a, b and c are constants. The acceleration of the particle is

A. $\left(6ac^2x + 2bc^2\right)\hat{k}$

B. $\left(2ax^2 + 6by^2\right)\hat{k}$

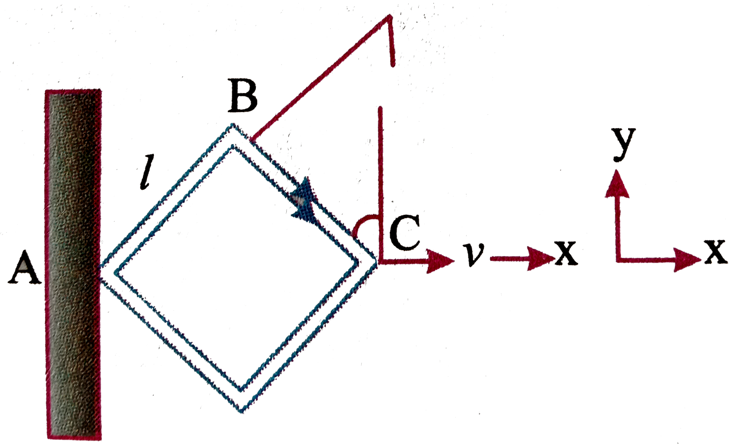
C. $\left(4bc^2 + 3ac^2\right)\hat{k}$

D. $\left(bc^2x + 2by\right)\hat{k}$

Answer: A

Watch Video Solution

105. Four rods of side length l have been hinged to form a rhombus. Vertex A is fixed to a rigid support, vertex C is being moved along the x-axis with constant velocity V as shown in figure. The rate at which vertex B is nearing the x-axis at the moment the rhombus is in the form of a squarem is



A. $\frac{v}{4}$

B. $\frac{v}{3}$

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

D. $\frac{v}{\sqrt{2}}$

Answer: C

Watch Video Solution

106. A car leaves station X for station Y every 10 min. The distance between X and Y is $60km$. The car travels at speed $60km/h$. A man drives a car from Y towards X at speed $60km/h$. If he starts at the moment when first car leaves station X, how many cars would he meet om route?

A. 20

B. 7

C. 10

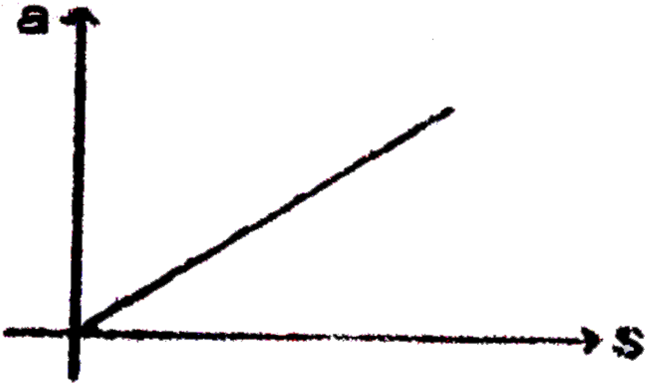
D. 5

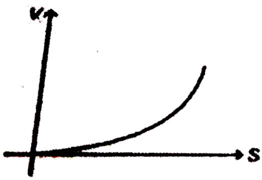
Answer: B

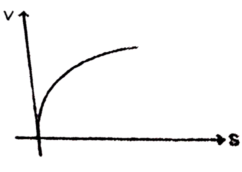
Watch Video Solution

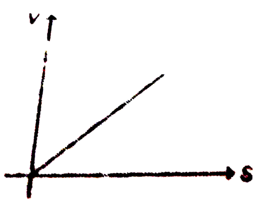
107. Acceleration (a) -displacement (s) graph of a particle moving in a straight line is as shown in the figure. The initial velocity of the particle is zero. The

$v - s$ graph of the particle would be



A. 

B. 

C. 

D. 

Answer: C

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108. A horizontal wid is blowing with a velocity v towards north-east. A man starts running towards north with acceleration a. The after which man will feel the wind blowing towards east is

A. $\dfrac{v}{a}$

B. $\dfrac{\sqrt{2}V}{a}$

C. $\dfrac{v}{\sqrt{2}a}$

D. $\dfrac{2v}{a}$

Answer: C

Watch Video Solution

109. The distance between two moving particles P and Q at any time is a.If v_r be their relative velocity and if u and v be the components of v_r, along and perpendicular to PQ.The closest distance between P and Q and time that elapses before they arrive at their nearest distance is

A. $\frac{av_1}{v^2}$

B. $\frac{av_2}{v^2}$

C. $\frac{av}{v_1^2}$

D. $\frac{av}{v_2^2}$

Answer: A

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110. Consider a collection of a large number of particles each with speed v. The direction of velocity is randomly distributed in the collection. Show that the magnitude of the relative velocity between a pair of particles averaged over all the pairs in the collection is greater than v.

A. zero

B. greater than$v$

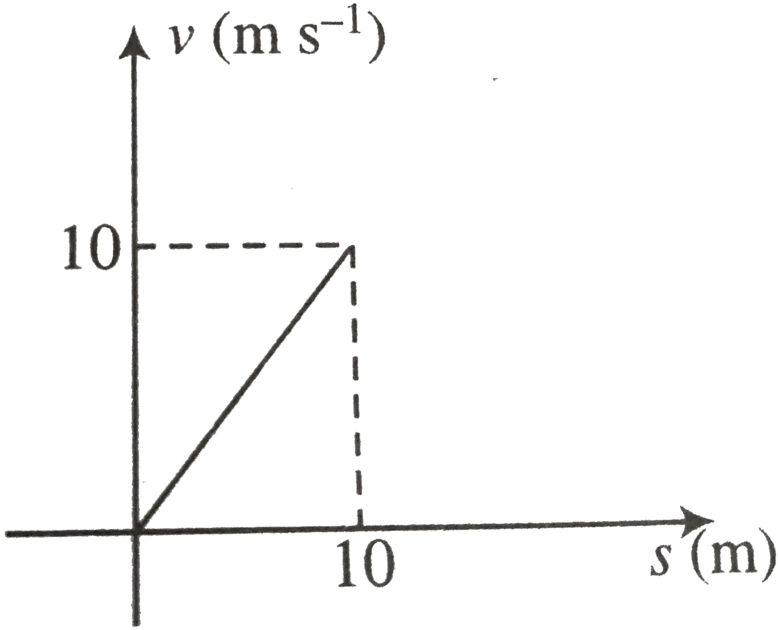
C. less than v

D. v

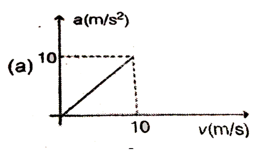
Answer: B

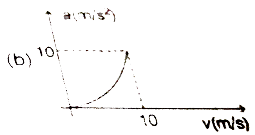
Watch Video Solution

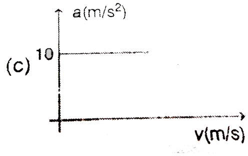
111. Velocity versus displacement graph of a particle moving in a straight line as shown in figure.

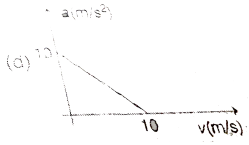


The corresponding acceleration versus velocity graph will be .

A. 

B. 

C. 

D. 

Answer: A

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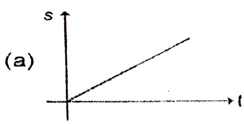
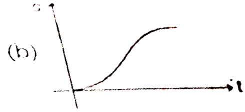
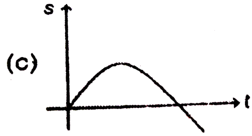
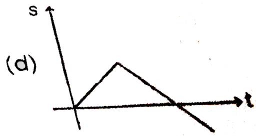
112. A particle is moving in $x-y$ plane with $y=\dfrac{x}{2}$ and $V_x=4-2t$. The displacement versus time graph of the particle would be

A. 

B. 

C. 

D. 

Answer: C

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113. 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

A. $1.0s$

B. $0.4s$

C. $0.2s$

D. $0.6s$

Answer: C

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114. A particle starts from rest and moves with an acceleration of $a = \{2 + |t - 2|\}m/s^2$ The velocity of the particle at $t = 4$ sec is

A. $16m/s$

B. $20m/s$

C. $8m/s$

D. $12m/s$

Answer: D

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115. A $2-m$ wide truck is moving with a uniform speed $v_0 = 8ms^{-1}$ along a straight horizontal road. A pedestrian starts to cross the road with a uniform speed v when the truck is $4m$ away from him, The minimum value of v so that he can cross the road safely is .

A. $2.62m/s$

B. $4.6m/s$

C. $3.57m/s$

D. $1.414m/s$

Answer: C

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116. In the one-dimensional motion of a particle, the relation between position x and time t is given by $x^2 + 2x = t$ (here $x > 0$). Choose the correct statement.

A. The retardation of the particle is $\dfrac{1}{4(x+1)^3}$

B. The uniform velocity of the particle is $\dfrac{1}{(x+1)^3}$

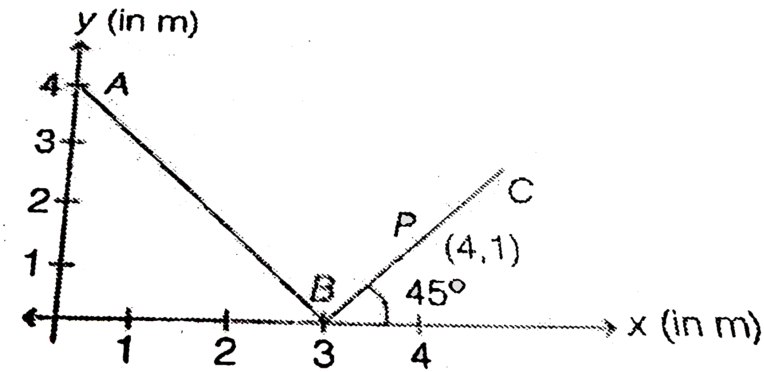
C. Both are correct

D. Both are wrong

Answer: A

Watch Video Solution

117. A particle moves in $x-y$ plane, starting from A along straight line path AB and BC as shown in the graph. When it is at point P, the angle between directions of its average velocity and instantaneous velocity is $\left[\tan 37^{\circ}=3/4\right]$



A. 90°

B. 82°

C. 98°

D. 74°

Answer: B

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118. A particle is moving along x-axis with constant acceleration. At $t=0$, the particle is at $x=3m$ and $\frac{dx}{dt}=+4m/s$. The maximum value of x co-ordiante of the particle is observed 2 seconds later. Starting from $t=0$ sec, after what time, particle reaches its initial position again?

A. $4s$

B. $6s$

C. $8s$

D. $12s$

Answer: A

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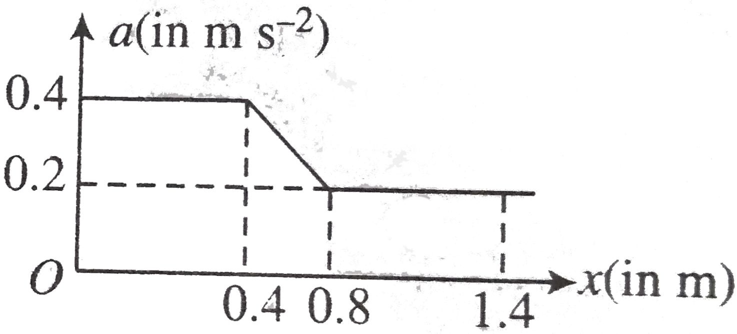
119. The acceleration of a particle which moves along the positive x-axis varies with its position as shown in figure. If the velocity of the particle is $0.8ms^{-1}$ at x = 0, then velocity of the particle at $x = 1.4m$ is

$\left(\in ms^{-1} \right)$.



A. 1.6

B. 1.2

C. 1.4

D. None of these

Answer: B

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120. A stone is dropped from the top of a tall cliff and n seconds later another stone is thrown vertically downwards with a velocity u. Then the second stone overtakes the first, below the top of the cliff at a distance given by

A. $\frac{g}{2}\left[\frac{n(gn/2-u)}{(gn-u)}\right]^2$

B. $\frac{g}{2}\left[\frac{n(gn-u/2)}{(gn-u)}\right]^2$

C. $\frac{g}{2}\left[\frac{n(gn-u/2)}{(gn-u/2)}\right]^2$

D. $\frac{g}{2}\left[\frac{gn-u}{gn-(u-2)}\right]^2$

Answer: A

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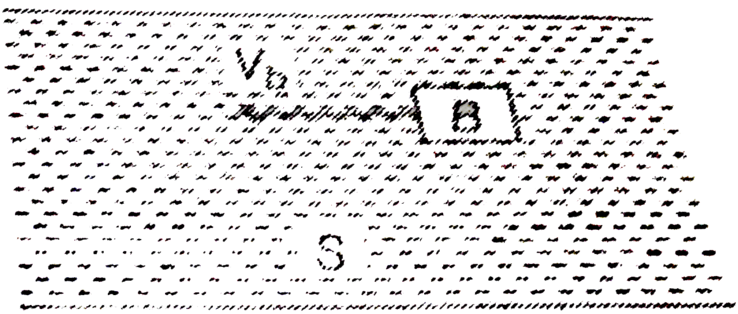
121. A boat $'B'$ is moving upstream with velocity $3m/s$ with respect to ground. An observer standing on the boat observes that a swimmer $'S'$ is crossing the river perpendicular to the direction of motion of the boat. If river flow velocity is $4m/s$ and swimmer crosses the river of width $100, m$ is $50s$. Then



A. velocity of swimmer w.r.t ground is $\sqrt{13}m/s$

B. drift of swimmer along river is zero

C. drift of swimmer along river will be $50m$

D. velocity of swimmer w.r.t grond is $2m / s$

Answer: A

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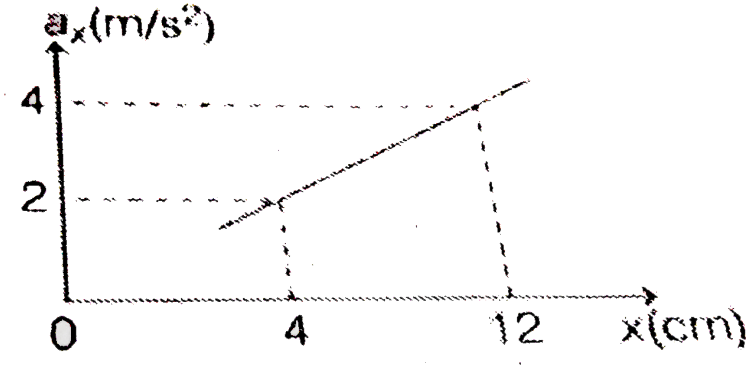
122. A particle moves along the positive x-axis with an accelerationa_x which increases linearly with x, as shown in the graph. If the velocity of the particle at $x = 4cm$ is $0.40m / s$ determine the velocity at

$x = 12cm$



A. $0.2m/s$

B. $0.4m/s$

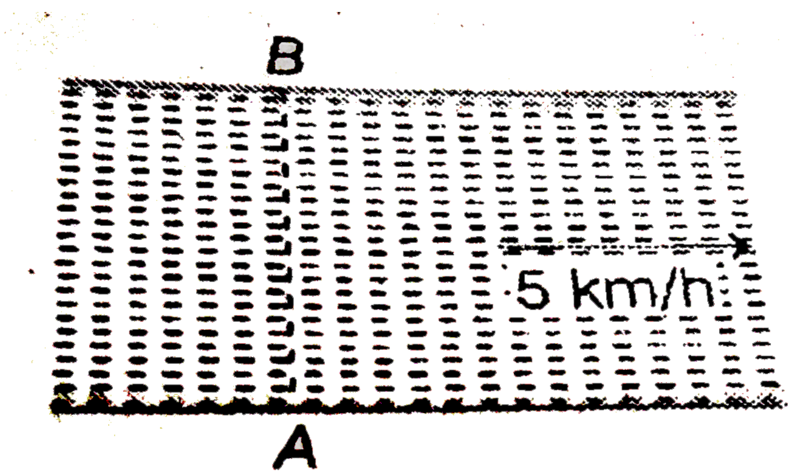
C. $0.8m/s$

D. $1.6m/s$

Answer: C

Watch Video Solution

123. In the figure shown a river of width $4km$ is flowing with speed of $5kim/h$. A swimmer whose swimming speed relative to the wter is $4km/h$, starts swimming from a point A on a bank. On the other bank B is a point which is directly opposite to A. What minimum distance (inkm) the swimmer will have to walk on the other bank to reach the point B.



A. 2

B. 3

C. 4

D. 5

Answer: B

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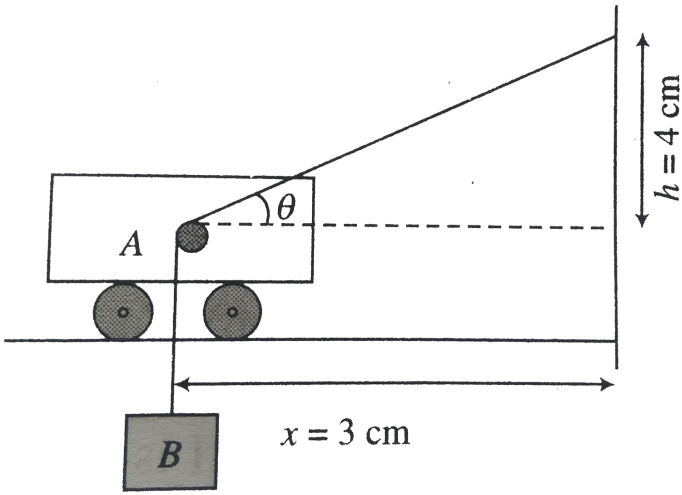
124. The string in fig. is passing over small smooth pulley rigidly attached to trolley A. If the speed of trolley is constant and qual to v_A towards right, speed and magnitude of acceleration of block B at the instant shown in figure are



A. v_A

B. $\frac{4}{5}v_A$

C. $\frac{3}{4}v_A$

D. $\frac{3}{5}v_A$

Answer: D

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125. A man who swims at a speed of $5km/h$ wants to cross a $500m$ wide stream flowing at $4km/h$ and reach the point which is directly opposite to his starting point. If he reaches a point somewhere else he has to walk back to desitination, his walking speed being $2km/h$. Find the minimum time in which he can reah his destination.

A. 5 min

B. 10 min

C. 15 min

D. 20 min

Answer: B

Watch Video Solution

126. Two particles having position verctors $\vec{r}_1 = \left(3\hat{i} + 5\hat{j}\right)$ metres and $\vec{r}_2 = \left(-5\hat{i} - 3\hat{j}\right)$ metres are moving with velocities $\vec{v}_1 = \left(4\hat{i} + 3\hat{j}\right) m/s$ and $\vec{v}_2 = \left(\alpha\hat{i} + 7\hat{j}\right) m/s$. If they collide after 2 seconds, the value of α is

A. 2

B. 4

C. 6

D. 8

Answer: D

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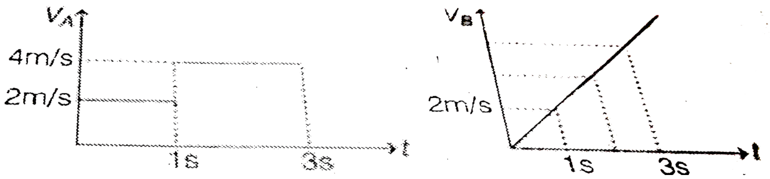
127. Two particles A and B start from the origin along x-axis. Velocity time graph of both particles are shown in the figure. During the given time interval, the maximum separation between the particles is



A. $4m$

B. $1m$

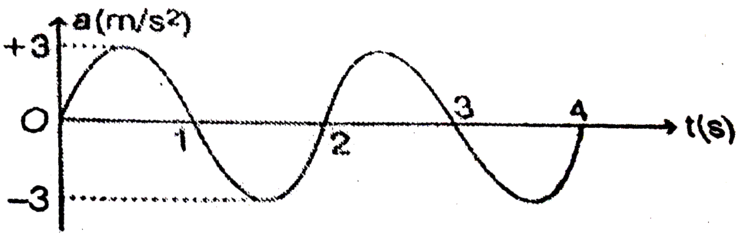
C. $2m$

D. $3m$

Answer: C

Watch Video Solution

128. A particle is moving in a straight line. Particle was initially at rest. Acceleration versus time graph is shown in figure. Acceleration of particle is given by $a = 3\sin \pi t$ in m/s^2. The time (in s) when the particle comes to rest is



A. $t = 0, 1, 2, 3, 4$

B. $t = 1, 3$

C. $t = 0, 2, 4$

D. at $t = 0.5, 1.5, 2.5$

Answer: C

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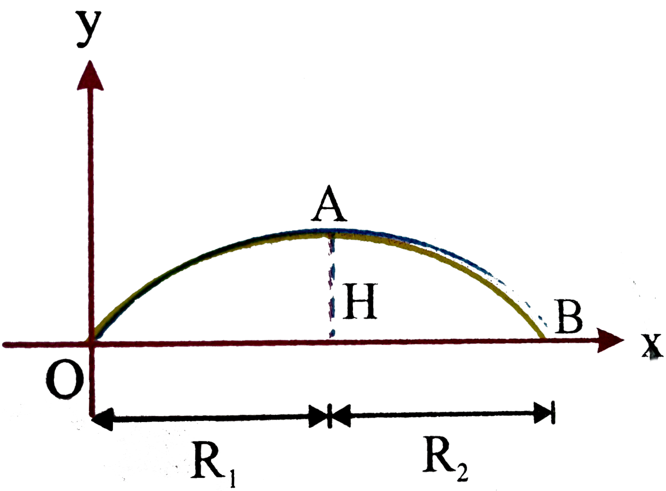
MCQ_TYPE

1. In a projectile motion let $t_{OA} = t_1$ and $t_{AB} = t_2$.The horizontal displacement from O to A is R_1 and from A to B is R_2.Maximum height is H and time of flight is T.If air drag is to be considered, then choose the correct alternative(s).



A. t_1 will decrease while t_2 will increase

B. H will increase

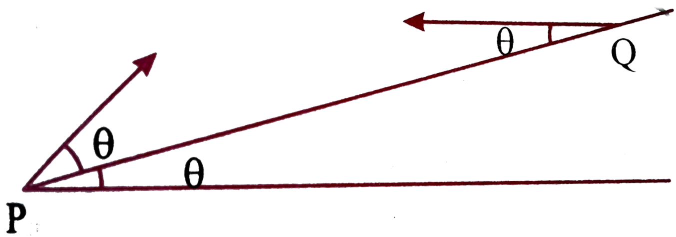
C. R_1 will decrease while R_2 will increase

D. T may increased or decrease

Answer: A::D

Watch Video Solution

2. From an inclined palne two particles P, Q are projected with same speed at same angle θ,one up and other down the plane as shown in figure.Which of the following statement(s) is/are correct ?



A. The particles will collide the plane with same speed

B. The times of flight of each particle are same

C. Both particles strike the plane perpendicularly

D. The particles will collide in mid air if projected simultaneously and time of flight of each particle is less than the time of collision

Answer: B::D

Watch Video Solution

3. A particle is projected from a point P with a velocity v at an angle θ with horizontal. At a certain point Q it moves at right angles to its initial direction. Then

A. velocity of particle at Q is $v \sin \theta$

B. velocity of particle at Q is $v \cot \theta$

C. time of flight from P to Q is $(v/g)\cos ec\theta$

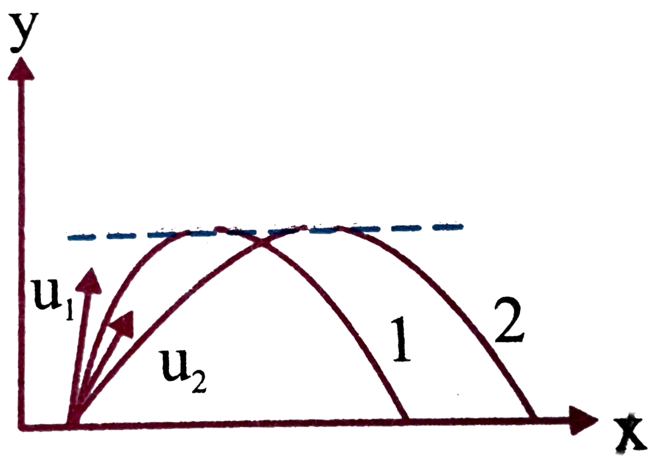
D. time of flight from P to Q is $(v/g)\sec\theta$

Answer: B::C

Watch Video Solution

4. Trajectories of two projectiles are shown in figure.Let T_1 and T_2 be the time periods and u_1 and

u_2 their speeds of projection.Then



A. $T_2 > T_1$

B. $T_1 = T_2$

C. $u_1 > u_2$

D. $u_1 < u_2$

Answer: B::D

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5. In a projectile motion let v_x and v_y are the horizontal and vertical components of velocity at any time t and x and y are displacements along horizontal and vertical from the point of projection at any time t .Then

A. $v_y -$ graph is a straight line with negative slope and positive intercept.

B. $x - t$ graph is a straight line passing through origin

C. $y - t$ graph is a straight line passing through origin

D. $v_x - t$ graph is a straight line

Answer: A::B::D

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6. Choose the correct alternative (s)

A. If the greatest height to which a man can throw a stone is h then the greatest horizontal distance upto which he can throw the stone is $2h$

B. The angle of projection for a projectile motioin whose range R is n times the maximum height H is $\tan^{-1}(4/n)$

C. The time of flight T and the horizontal range R of a projectile are connected by the equation $gT^2 = 2R\tan\theta$ where θ is the angle of projection.

D. A ball is thrown vertically up. Another ball is thrown at an angle θ with he vertical. Both of them remain in air for the same period of time. Then the ratio of heights attained by the two balls is $1:1$

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

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7. A projectile has the same range R for two angles of projections but same speed. If T_1 and T_2 be the times of flight in the two cases, then

Here θ is the angle of projection corresponding to T_1.

A. $T_1 T_2 \propto R$

B. $T_1 T_2 \propto R^2$

C. $\dfrac{T_1}{T_2} = \tan\theta$

D. $\dfrac{T_1}{T_2} = \cot\theta$

Answer: A::C

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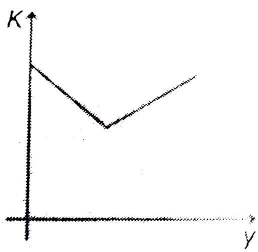
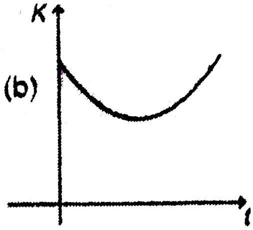
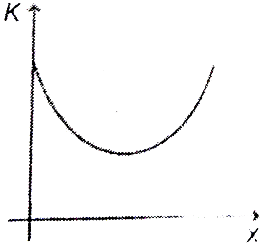
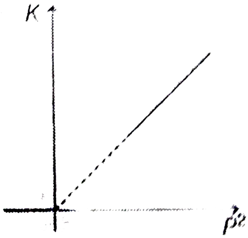
8. A particle is projected up from a point at an angle of 30° with the horizontal. At any time $t$if $p =$ linear momentum $y =$ vertical displacement $x =$ horizontal displacement then the kinetic energy (K) of the particle plotted against these parametes can be

A. 

B. 

C. 

D. 

Answer: B::C::D

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9. A particles falls through a vertical height h and makes perfectly elastic impact with a smooth inclined plane of angle α. The time interval between its first and second impact on the incline

A. is proportional to $h^{-1/2}$

B. is proportional to $h^{1/2}$

C. is proportional to $\frac{1}{\cos\alpha}$

D. is proportional to α

Answer: B

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10. A projectile is projected from the ground making an angle of 30° with the horizontal.Air exerts a drag which is proportional to the velocity of the projectile

A. at highest point velocity will be horizontal

B. the time of ascent will be equal to the time of descent

C. the time of ascent will be greater than the time of descent

D. the time of descent will be greater than the time of ascent

Answer: A::D

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11. A particle is fired from a point on the ground with speed u making an angle θ with the horizontal.Then

A. the radius of curvature of the projectile at the highest point is $\dfrac{u^2\cos^2\theta}{g}$

B. the radius of curvature of the projectile at the highest point is $\dfrac{u^2\sin^2\theta}{g}$

C. at the point of projection magnitude of tangential acceleration is $g\sin\theta$

D. at the point of projection magnitude of tangential acceleration is $g\cos\theta$

Answer: A::C

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12. A particle is projected from ground with velocity $40\sqrt{2}m/s$ at 45°. At time $t=2s$

A. displacement of particle is $100m$

B. vertical component of velocity is $20m/s$

C. velocity makes an angle $\tan^{-1}(2)$ with vertical

D. particle is at height of $60m$ from ground

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

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13. Two particles are projected from ground with same intial velocities at angles 60° and 30° (with horizontal). Let R_1 and R_2 be their horizontal ranges, H_1 and H_2 their maximum heights and T_1 and T_2 are the time of flights.Then

A. $\dfrac{H_1}{R_1} > \dfrac{H_2}{R_2}$

B. $\dfrac{H_1}{R_1} < \dfrac{H_2}{R_2}$

C. $\dfrac{H_1}{T_1} > \dfrac{H_2}{T_2}$

D. $\dfrac{H_1}{T_1} > \dfrac{H_2}{T_2}$

Answer: A::C

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14. If T is the total time of flight, h is the maximum height and R is the range for horizontal motion, the x and y coordinates of projectile motion and time t are related as

A. $y=4h\left(\frac{t}{T}\right)\left(1-\frac{t}{T}\right)$

B. $y=4h\left(\frac{x}{R}\right)\left(1-\frac{x}{R}\right)$

C. $y=4h\left(\frac{T}{t}\right)\left(1-\frac{T}{t}\right)$

D. $y=4h\left(\frac{R}{x}\right)\left(1-\frac{R}{x}\right)$

Answer: A::B::D

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15. A ball is rolled off along the edge of a horizontal table with velocity $4m/s$. It hits the ground after time $0.4s$. Which of the following are correct?

A. The height of the table is $0.8m$

B. It hits the ground at an angle of 60° with the vertical

C. It covers a horizontal distance of $1.6m$ from the table

D. It hits the ground with vertical velocity $4m/s$

Answer: A::C::D

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16. Consider a shell that has a muzzle velocity of $45ms^{-1}$ fired from the tail gun of an airplane moving horizontally with a velocity of $215ms^{-1}$. The tail gun can be directed at any angle with the vertical in the plane of motion of the airplane. The shell is fired when the plane is above point A on ground, and the plane is above point B on ground when the shell hits the ground. (Assume for simplicity that the Earth is flat)

A. Shell may hit the grond at point A

B. Shell may hit the ground at point B

C. Shell may hit a point on earth which is behind point A

D. Shell may hit a point on earth is ahead of point B

Answer: B::D

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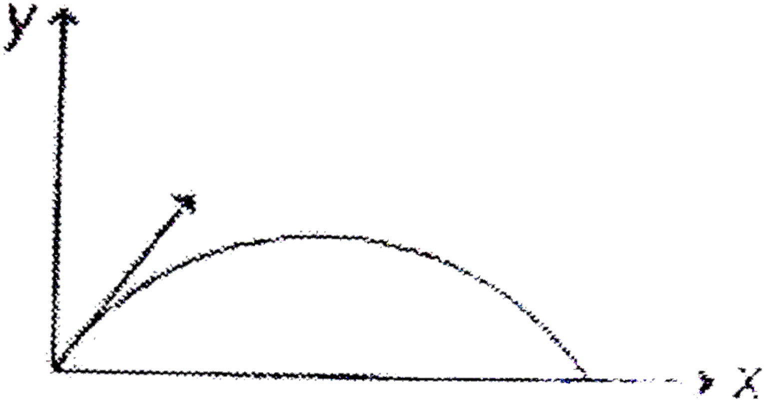
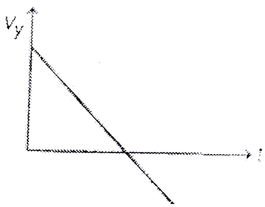
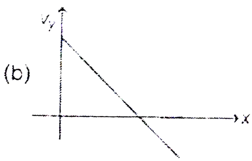
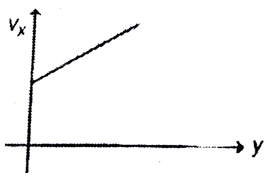
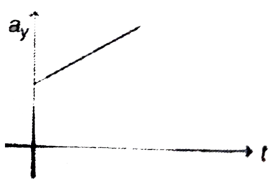
17. For projectile motion, which of the following graphs is/are corrects.



A. 

B. 

C. 

D. 

Answer: A::B::D

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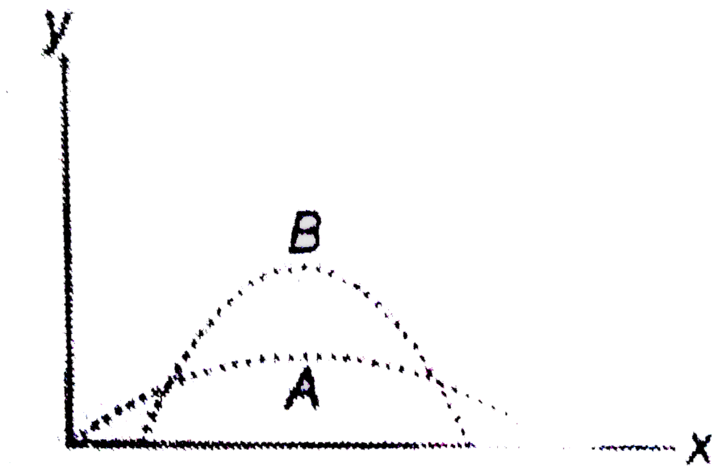
18. Two balls projected at different times have trajectories A and B as shown below. The balls do no collie. Which statement(s) is/are correct?



A. velocity of ball B must be greater than velocity of ball A

B. Ball A is in the air for a longer time than ball B

C. Ball B is in the air for a longer time than ball A

D. Ball B has same acceleration as that of ball A

Answer: C::D

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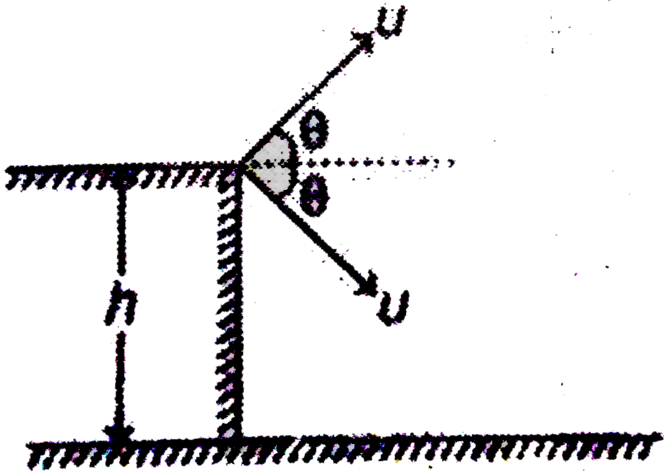
19. Two projectiles are launched from a building of height $'h'$ as shown in the figure. One is launched at angle θ above horizontal and the other at angle θ

below horizontal. Both the projectiles have same initial speed u. Which of the following is /are correct?



A. The difference in the times of flight for these two projectiles is $\frac{2u \sin \theta}{g}$

B. The horizontal distance between these two projectiles when they reach the ground is $\frac{2u^2 \sin \theta \cos \theta}{g}$

C. They have same speed when they reach the ground

D. They have different speeds when they reach the ground

Answer: A::B::C

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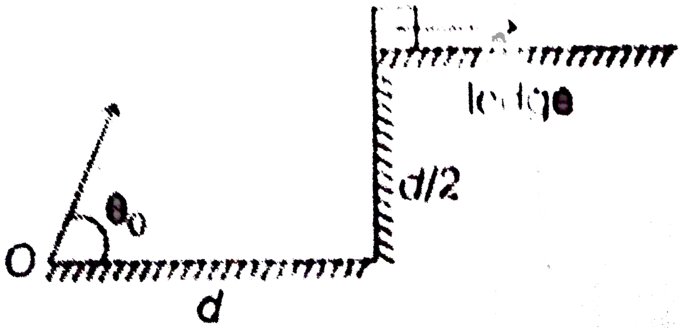
20. A person is a playing a game that requires throwing an object onto a ledge. The ledge is at a distance d and a height $d/2$ above the point O. You may neglect air resistance. Once the object reaches the ledge it slows down with constant deceleration and comes to stop after sliding a distance $'s'$. Object velocity becomes horizontal when it reaches the ledge. Which of the following statements is/are correct?



A. Initial vertical component of velocity is $\sqrt{gd}$

B. Time of motion on the ledge is $\dfrac{2s}{\sqrt{gd}}$

C. Initial vertical component of velocity is $2\sqrt{gd}$

D. Total time of motion is $\sqrt{\dfrac{d}{g}} + \dfrac{2s}{\sqrt{gd}}$

Answer: A::B::D

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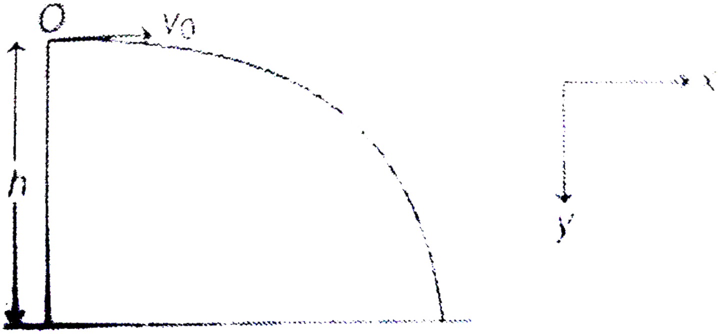
21. A projectile is thrown horizontally forma height $'h'$ a shown in the figure.

v_x : horizontal component of velocity

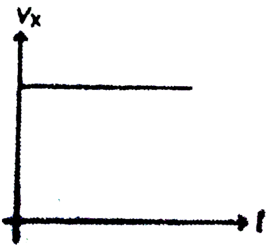
v_y: vertical component of velocity

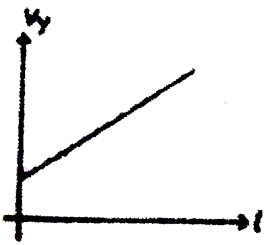
x: horizontal position

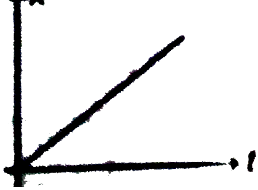
y: vertical position

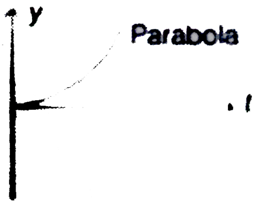


Which of the following graph is/are correct?

A. 

B. 

C. 

D. 

Answer: A::C::D

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22. A particle is projected at an angle of θ with the horizontal, with initial speed u.If the magnitude of velocity of projectile motion and time are related as $v^2 - 100t^2 + 400t - 800 = 0$. Then which of the following is/are correct. (Take $g = 10m/s^2$)

A. Angle of projection is 45°

B. Maximum height attained by the particle is 20 meter

C. Range of the particle is 80 meter

D. Projection velocity is 40 m/sec

Answer: A::B::C

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23. Two projectile are thrown at the same time from two different points. One projectile thrown from the origin has initial velocity $3\hat{i} + 3\hat{j}$ with respect to earth. The other projectile has initial velocity $a\hat{i} + b\hat{j}$

with respect to earth thrown from the point $(10, 5)$.

($\hat{i}$ is a unit vector along horizontal $\hat{j}$ along vertical).If the projectile collides after two seconds, then choose from following the correct options(s). All values are in SI units.

A. value of a is -2

B. valueof a is $\frac{1}{2}$

C. value of b is $\frac{1}{2}$

D. value of b is -2

Answer: A::C

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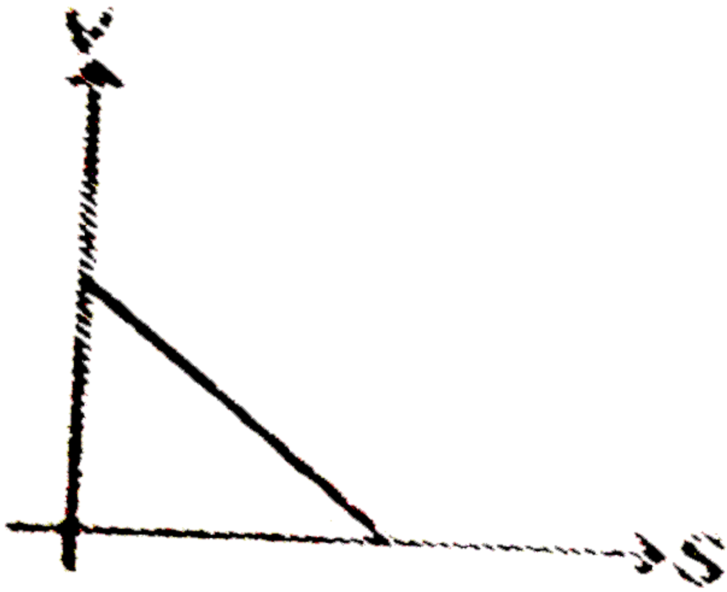
24. Velocity displacement graph of a particle moving in a straight line is as shown in figure.



A. magnitude of acceleration of particle is decreasing

B. magnitude of acceleration of particlre is increasing

C. acceleration versus displacement graph straight line

D. acceleration versus displacement graph is parabola

Answer: A::C

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25. Let v and a be the instantaneous velocity and acceleration of a particle moving in a plane. Then rate of change of speed $\frac{dv}{dt}$ of the particle is equal to

A. $|a|$

B. $\frac{v.\,a}{v}$

C. the component of a parallel to v

D. the component of a perpendicular to v

Answer: B::C

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26. Starting from rest a particle is first accelerated for time t_1 with constant acceleration a_1 and then stops in time t_2 with constant retardation a_2. Let v_1 be the average velocity in this case and s_1 the total displacement. In the second case it is accelerating for the same time t_1 with constant acceleration $2a_1$ and come to rest with constant retardation a_2 in time t_3.

If v_2 is the average velocity in this case and s_2 the total displacement, then

A. $v_2 = 2v_1$

B. $2v_1 < v_2 < 4v_1$

C. $s_2 = 2s_1$

D. $2s_1 < s_2 < 4s_1$

Answer: A::D

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27. A particle leaves the origin with an initial velodty $v = \left(3.00\hat{i}\right)m/s$ and a constant acceleration $a = \left(-1.00\hat{i} - 0.500\hat{j}\right)m/s^2$. When the particle reaches its maximum x coordinate, what are

(a) its velocity and (b) its position vector?

A. $v = -2\hat{i}$

B. $v = \left(-1.5\hat{j}\right)m/s$

C. $r = \left(4.5\hat{i} - 2.25\hat{j}\right)m$

D. $r = \left(3\hat{i} - 2\hat{j}\right)m$

Answer: B::C

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28. Acceleration of a particle which is at rest at $x = 0$ is $\overrightarrow{a} = (4 - 2x)\hat{i}$. Select the correct alternative (s).

A. Particle further comes to rest at $x = 4$

B. Particle oscillates about $x = 2$

C. Maximum speed of particle is 4 units

D. Maximum speed of particle is 2 units

Answer: A::B

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29. A car is moving rectilinearly on a horizontal path with acceleration a_0.A person sitting inside the car observes that an insect S is crawling up the screen with an acceleration a.If θ is the inclination of the wind screen with the horizontal, then the acceleration of the insect.

A. parallel to screen is $a + a_0 \cos\theta$

B. along the horizontal is $a_0 - a\cos\theta$

C. perpendicular to screen is $a_0 \sin\theta$

D. perpendicular to screen is $a_0 \tan\theta$

Answer: B::C

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30. The coordinate of a particle moving in a plane are given by $x(t) = a\cos(pt)$ and $y(t) = b\sin(pt)$ where $a, b(< a)$ and P are positive constants of appropriate dimensions . Then

A. the path of the particle is an ellipse

B. The velocity and acceleration of the particle are normal to each other at $t = \pi/2p$

C. the acceleration of the particle is always directed towards a fixed point

D. the distance travelled by the particle in time interval $t = 0$ to $t = \pi / 2p$ is a

Answer: A::B::C

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31. a particle moving along a straight line with uniform acceleration has velocities $7m / s$ at A and $17m / s$ at C. B is the mid point of AC. Then :-

A. the average velocity betwene R and O is $15m / s$

B. the ratio of time to go from P to R and that from R to Q is $3 : 2$

C. the velocity at R is $10m/s$

D. the average velocity between P and R is $10m/s$

Answer: A::B::D

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32. Let r be the radius vector of a particle in motion about some reference point and r its modulus. Similarly, v be the velocity vector and v its modulus. Then

A. $v \neq \frac{dr}{dt}$

B. $v = \frac{dr}{dt}$

C. $v = \left|\frac{dr}{dt}\right|$

D. $|dr| \neq dr$

Answer: A::C::D

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33. Two particles A and B are located in $x - y$ plane at points $(0, 0)$ and $(0, 4m)$. They simultaneoulsy start moving with velocities $v_A = 2\hat{j}m/s$ and $v_B = 2\hat{i}m/s$. Select the correct alternative(s)

A. the distance between them is constant

B. The distance between them first decreases and then increases

C. the shortest distance between them is $2\sqrt{2}m$

D. Time after which they are at minimum distances is $1s$

Answer: B::C::D

Watch Video Solution

34. The co-ordinate of the particle in x-y plane are given as $x = 2 + 2t + 4t^2$ and $y = 4t + 8t^2$:-

The motion of the particle is :-

A. along a straight line

B. uniformly accelerated

C. along a parabolic path

D. non-uniformly accelerated

Answer: A::B

Watch Video Solution

35. River is flowing with a velocity $v_{BR} = 4\hat{i}m/s$. A boat is moving with a velocity of $v_{BR} = \left(-2\hat{i} + 4\hat{j}\right)m/s$ relative to river. The width of the river is $100m$ along y-direction. Choose the correct alternative(s)

A. The boatman will cross the river in $25s$

B. Absolute velocity of boatman is $2\sqrt{5}m/s$

C. Drift of the boatman along the river current is $50m$

D. The boatman can never cross the river

Answer: A::B::C

Watch Video Solution

36. A particle is moving along x-axis. Its velocity v with x co-ordinate is varying as $v = \sqrt{x}$. Then

A. initial velocity of particle is zero

B. motion is non-uniformly accelerated

C. acceleration of particle at $x = 2m$ is $\frac{1}{2} m / s^2$

D. acceleration of particle at $x = 4m$ is $1 m / s^2$

Answer: A::C

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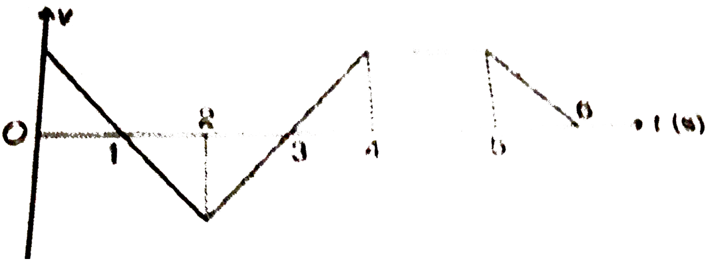
37. From $v-t$ graph shown in figure. We can draw the following conclusions



A. between $t=1s$ to $t=2s$ speed of particle is decreasing

B. between $t=2s$ to $t=3s$ speed of particle is increasing

C. between $t=5s$ to $t=6$ acceleration of particle is negative

D. between $t = 0$ to $t = 4s$ particle changes its directioin of motion twice

Answer: C::D

Watch Video Solution

38. A particle P is projected upwards with $80 m/s$. One second later another particle Q is projected with initial velocity $70 m/s$. Before either of the particle srikes the ground $(g = 10 m/s^2)$

A. both particle are at rest with respect to each other

B. after $2s$ distance between the particles is $75m$

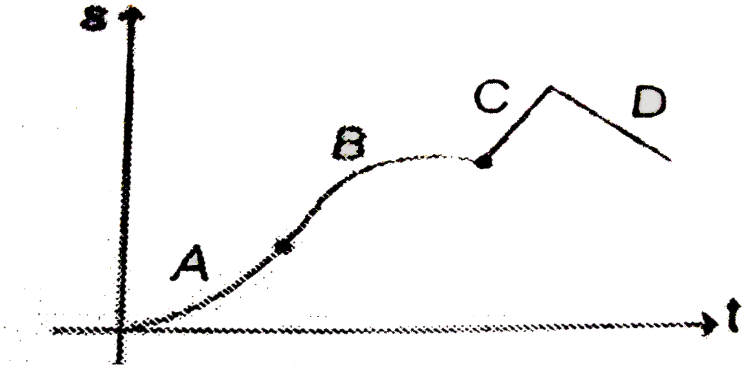
C. when particle P is at highest point, particle Q is moving downwards

D. when particle P is at highest point, particle Q is moving upwards

Answer: A::B

Watch Video Solution

39. Displacement time graph of a particle moving in a straight line is a shown in figure.



A. in region A acceleration is positive

B. in region B acceleration is negative

C. in region C acceleration is positive

D. in region D acceleration is negative

Answer: A::B

Watch Video Solution

40. At time $t=0$, a particle is at $(-1m, 2m)$ and at $t=2s$ it is at $(-4m, 6m)$. From this we can conclude that in the given time interval.

A. particle may be accelerate

B. particle may be accelerated

C. average speed of the particle is $2.5m/s$

D. average velocity of the particle is $2.5m/s$

Answer: B::D

Watch Video Solution

41. A particle P lying on a smooth horizontal $x-y$ plane starts from $\left(3\hat{i}+4\hat{j}\right)m$ with velocity $\left(2\hat{i}\right)m/s$. Another particle Q is projected (horizontally from origin with velocity $\left(x\hat{i}+y\hat{j}\right)$ so that is strikes P after $2s$. Then

A. $x=2.0$

B. $x=3.5$

C. $y=2.0$

D. $y=3.5$

Answer: B::C

Watch Video Solution

42. Path of a particle moving in $x - y$ plane is $y = 3x + 4$. At some instant suppose x- component of velocity is $1m / s$ and it is increasing at a constant rate of $1m / s^2$. Then at this instant.

A. speed of particle is $\sqrt{10}m / s$

B. acceleration of particle is $\sqrt{10}m / s$

C. velocity time graph is parabola

D. acceleration time graph is parabola

Answer: A::B

Watch Video Solution

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

A. the initial velocity of the particle is u

B. the acceleration of the parabola is u

C. the acceleration of the particle is $2a$

D. at $t = 2s$ particle is at the origin

Answer: C::D

Watch Video Solution

44. A man standing on the edge of the terrace of a high rise building throws a stone, vertically up with at speed of $20m/s$. Two seconds later, an identical stone is thrown vertically downwards with the same speed of $20m$,. Then

A. the relative velocity between the two stones remains constant till one hits the ground

B. both will have the ame kinetic energy when they hit the ground

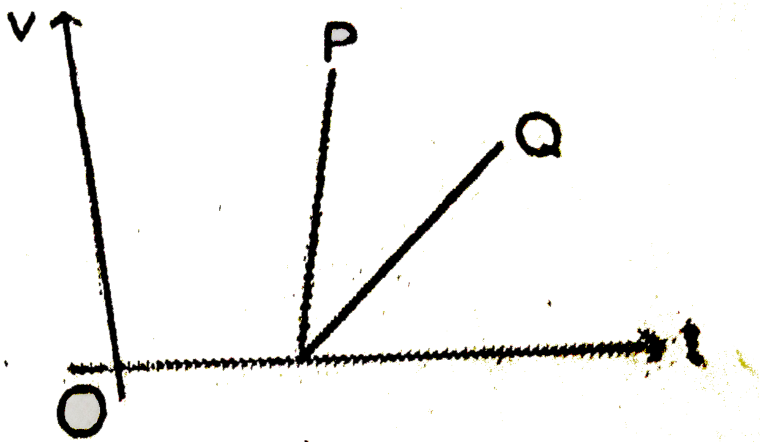
C. the time interval between their hitting the ground is 2 seconds

D. if the collisions on the ground are perfectlyl elastic bothh will rise to the same height above the ground

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

Watch Video Solution

45. The $v-t$ graph for two particles P and Q are given in the figure. Consider the following statements(s). Then, which of the following statement(s) is/are True:



A. Their relative velocity is non-zero but constant

B. Their relative velocity is continuously increasing

C. Their relative acceleration is non-zero but constant

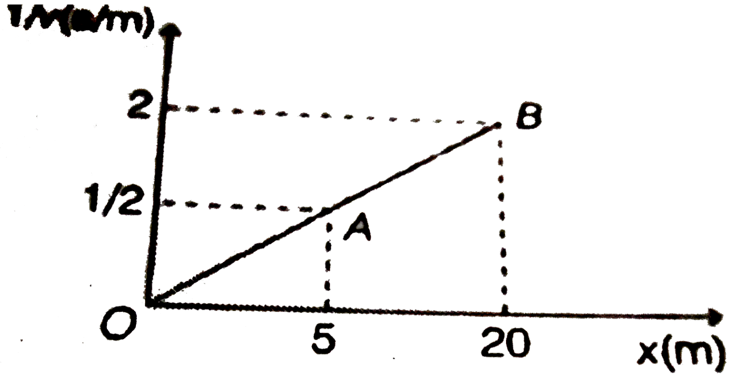
D. Their relative acceleration continuously increse

Answer: B::C

Watch Video Solution

46. A particle is moving in a straight line along the positive x-axis such that its speed is inversely proportional to the distance from origin $\left[v \propto \frac{1}{\xi} mplies v = \frac{k}{x}\right.$ where k is the proportionally constant].

The graph of motion of the particle for $1/v$ versus x (distance from origin) is shown in the figure.



A. The time interval of motion from point A to point B is 12.50

B. The time interval of motion from point A to point B is $18.75s$.

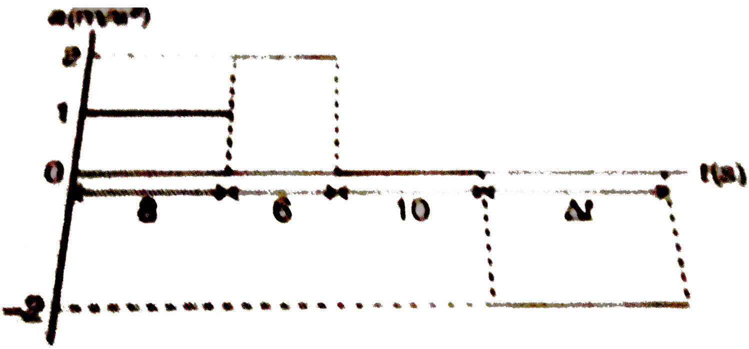
C. The proportionality constant k is $10m^2/s$

D. The proportionality constant k is $20m^2/s$

Answer: B::C

Watch Video Solution

47. A subway train travels between two of its stations at then stops with the acceleration shcedule shown in the acceleration versus time graph. Then



A. The time interval Δ is $8s$.

B. The distance between station is $350m$

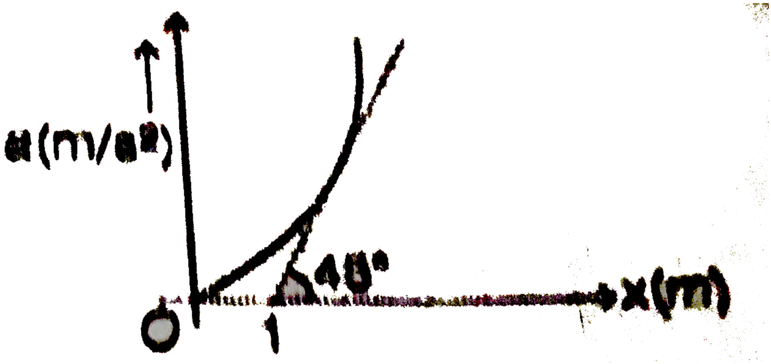
C. The time interval Δt is $10s$

D. The distance between stations is $416m$

Answer: C::D

Watch Video Solution

48. A particle starts moving with initial velocity $3m/s$ along x- axis from origin. Its acceleration is varying with x co-ordinate in parobalic nature as shown in the figure. At $x = 1m$, tangent to the graph makes an angle 45° with positive x- aixs. Then at $x = 3m$,



A. velocity of the particle is $3\sqrt{2}m/s$

B. velocity of the particle is $3\sqrt{2}m/s$

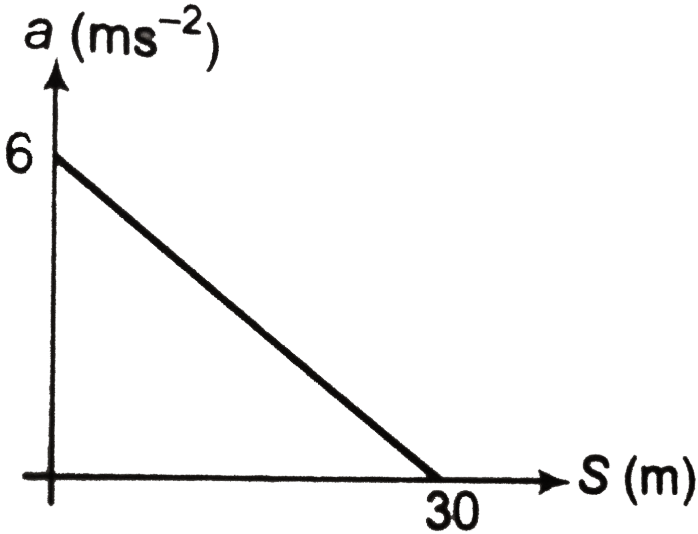
C. acceleration of the particle is $4.5m/s^2$

D. acceleration of the particle is $9m/s^2$

Answer: A::C

Watch Video Solution

49. A train starts from rest at $S = 0$ and is subjected to an acceleration as shown in figure. Then,



A. Change in velocity at he end of $10m$ displacement is $50m / s$

B. Velocity of the train for $s = 10m$ is $10m / s$

C. The maximum velocity attained by train is equal to $6\sqrt{5}m / s$

D. The maximum velocity of the train ins $16m/s$

Answer: B::C

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50. Man A is sitting in a car moving with a speed of 54 $\frac{km}{hr}$ observes a man B in front of the car crossing perpendicularly a road of width 15 m in three seconds. Then the velocity of man B (in $\frac{m}{s}$) will be:

A. Speed of man B is $5\sqrt{10}m/s$

B. Speed of man B is $5ms^{-1}$

C. Actual direction of motion of B is at an angle of $\tan^{-1}\left(\frac{1}{3}\right)$ with direction of motion of car

D. Actual direction of motion of B is at an angle of $\tan^{-1}(3)$ with direction opposite to the direction of motion of car.

Answer: A::C

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COMPREHENSION_TYPE

1. Velocity of a projectile at height $15m$ from ground is $v = \left(20\hat{i} + 10\hat{j}\right) m / s$. Here $\hat{i}$ is in horizontal direction and $\hat{j}$ is vertically upwards. Then

Speed with which particle is projected from ground is......... m/s

A. 30

B. $20\sqrt{2}$

C. $\sqrt{20}$

D. $3\sqrt{40}$

Answer: B

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2. Velocity of a projectile at height $15m$ from ground is $v = \left(20\hat{i} + 10\hat{j}\right)m/s$. Here $\hat{i}$ is in horizontal direction and $\hat{j}$ is vertically upwards. Then

Angle of projectile with ground is

A. 45°

B. 30°

C. 37°

D. 60°

Answer: A

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3. Velocity of a projectile at height $15m$ from ground is $v = \left(20\hat{i} + 10\hat{j}\right)m/s$. Here $\hat{i}$ is in horizontal direction and $\hat{j}$ is vertically upwards. Then

Maximum height from a ground is ....m

A. 30

B. 60

C. 40

D. 20

Answer: D

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4. Velocity of a projectile at height $15m$ from ground is $v = \left(20\hat{i} + 10\hat{j}\right)m/s$. Here $\hat{i}$ is in horizontal direction and $\hat{j}$ is vertically upwards. Then

Horizontal range of the ground is ....m

A. 60

B. 50

C. 80

D. 70

Answer: C

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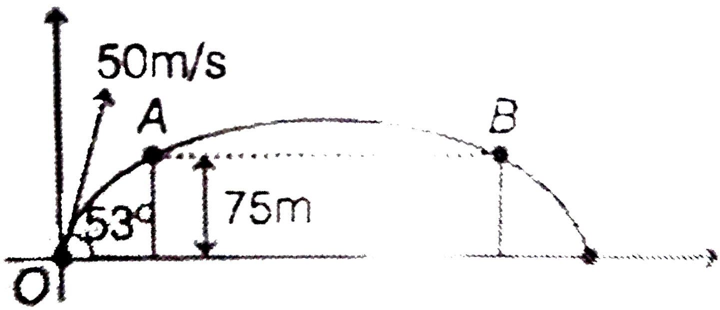
5. At $t = 0$ a projectile is fired from a point O (taken as origin) on the ground wita speed of $50m/s$ at an angle of 53° with the horizontal. It just passes two points A and B each at height $75m$ above horizontal.



The horizontal separation between the points A and B

A. $30m$

B. $60m$

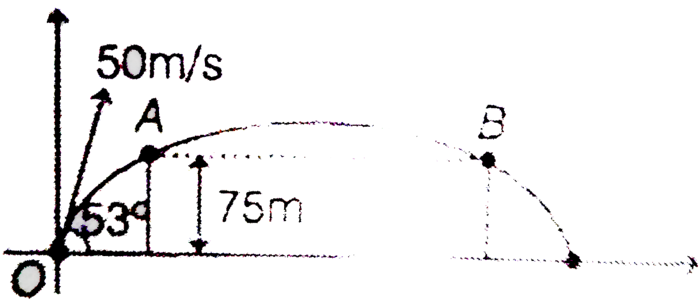
C. $90m$

D. none of these

Answer: B

Watch Video Solution

6. At $t = 0$ a projectile is fired from a point O (taken as origin) on the ground wita speed of $50m/s$ at an angle of 53° with the horizontal. It just passes two points A and B each at height $75m$ above horizontal.



The distance (in metre) of the particle from origin at $t = 2s$

A. $60\sqrt{2}$

B. 100

C. 60

D. 120

Answer: A

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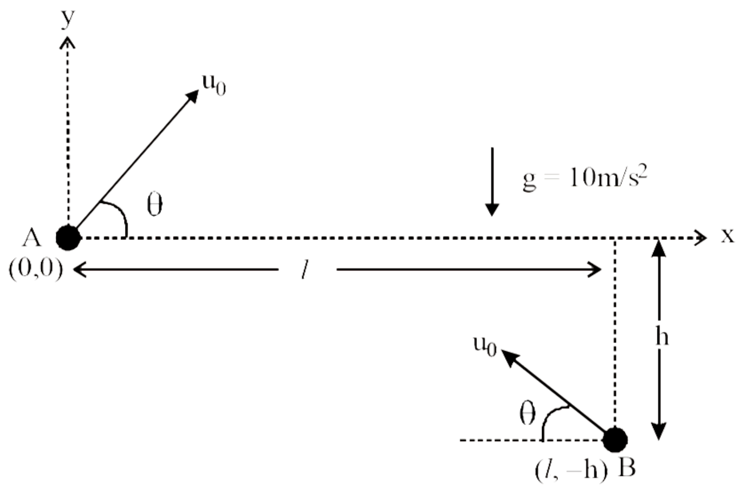
7. There of the fundamental constant of physics are the universal gravitational constant,

$G = 6.7 \times 10^{-11} m^3 kg^- s^{-2}$, the speed of light $c = 3.0 \times 10^8 m / s$ and Planck's constant, $h = 6.6 \times 10^{-34} Js^{-1}$. two particles A and V are projected in the vertical plane with same initial velocity u_0 fro part (0,0) and (l,-h) towards each other as shwon in figure

The path of particle A with respect to particle B will be

–



A. parabola

B. straight line parallel to y-axis

C. straight line parallel to x-axis

D. None of the above

Answer: C

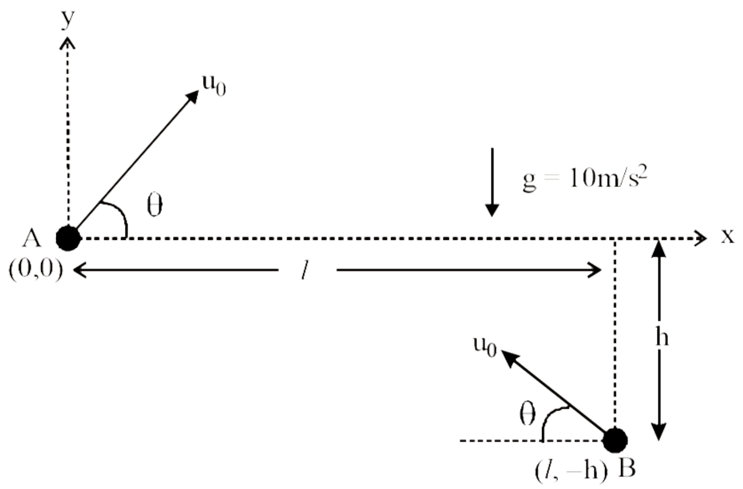
Watch Video Solution

8. There of the fundamental constant of physics are the universal gravitational constant, $G = 6.7 \times 10^{-11} m^3 kg^{-} s^{-2}$, the speed of light $c = 3.0 \times 10^8 m/s$ and Planck's constant, $h = 6.6 \times 10^{-34} Js^{-1}$. two particles A and V are projected in the vertical plane with same initial velocity u_0 fro part (0,0) and (l,-h) towards each other

as shwon in figure

Minimum distance between particle A and B during

motion



A. l

B. $\sqrt{l^2 + h^2}$

C. h

D. None of these

Answer: C

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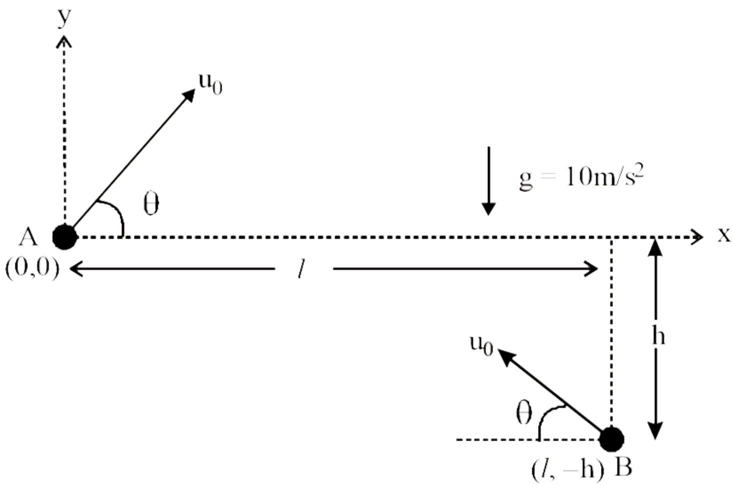
9. There of the fundamental constant of physics are the universal gravitational constant, $G = 6.7 \times 10^{-11} m^3 kg^{-} s^{-2}$, the speed of light $c = 3.0 \times 10^8 m/s$ and Planck's constant, $h = 6.6 \times 10^{-34} Js^{-1}$. two particles A and V are projected in the vertical plane with same initial velocity u_0 fro part (0,0) and (l,-h) towards each other as shwon in figure

The time when separation between A and B is minimum is



A. $\frac{h}{u \cos \theta}$

B. $\sqrt{(2h).\, g}$

C. $\frac{2l}{u \cos \theta}$

D. $\frac{l}{2u \cos \theta}$

Answer: D

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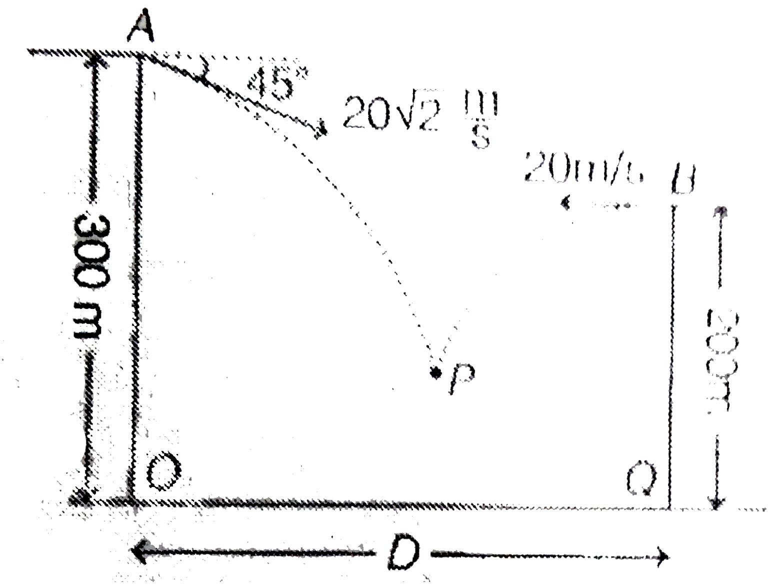
10. Two friends A and b playing a game of collision of balls and throwing balls from the top of two towers simultaneously as shown in the figure. If the balls collide in air at point P and point O is treated as origin then answer the following questions $(g = 10m/s^2)$



Distance D betwen the towers is:

A. $100m$

B. $200m$

C. $400m$

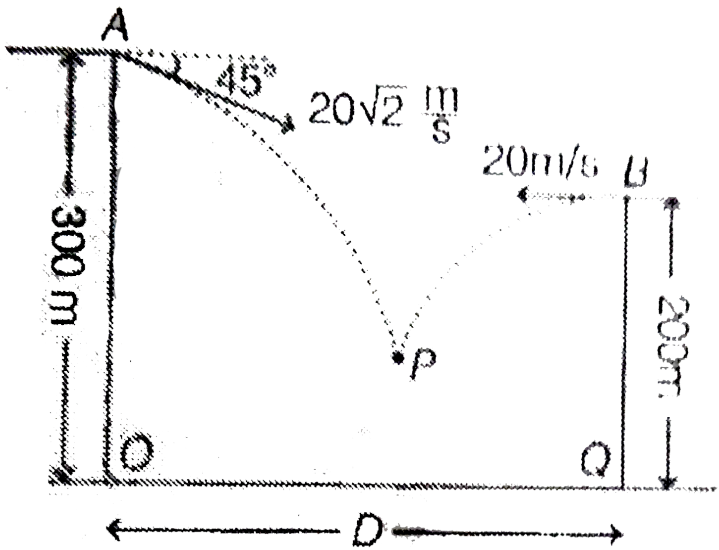
D. $800m$

Answer: B

Watch Video Solution

11. Two friends A and b playing a game of collisionn of balls and throwing balls from the top of two towers simultaneously as shown in the figure. If the balls collide in air at point P and point O is treated as origin then answer the following questions

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



Co-ordinates of the particles at point P are:

A. $(100, 75)m$

B. $(100, 125)m$

C. $(75, 100)m$

D. $(175, 100)m$

Answer: A

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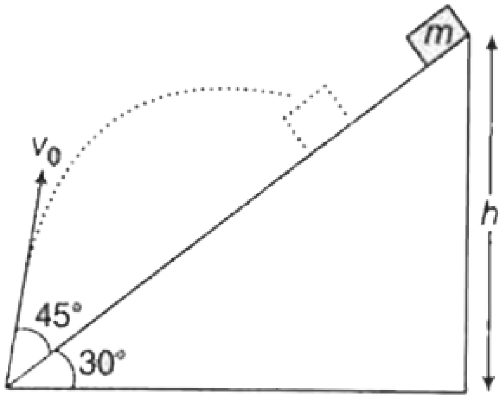
12. A particle of mass m is projected up from the bottom of an inclined plane with initial velocity v_0 at angle 45° with an inclined plane of inclineation 30° as shown in figure. At the same time a small block of same mass m is released from rest at a height h. The particle hits the block at some point on inclined plane.



The value of height h is

A. $\dfrac{v_0^2}{g}$

B. $\dfrac{\sqrt{3}v_0^2}{g}$

C. $\dfrac{2v_0^2}{\sqrt{3}g}$

D. $\dfrac{v_0^2}{\sqrt{3}g}$

Answer: D

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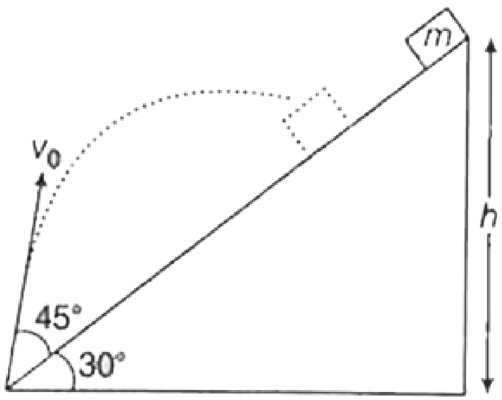
13. A particle of mass m is projected up from the bottom of an inclined plane with initial velocity v_0 at angle 45° with an inclined plane of inclineation 30° as shown in figure. At the same time a small block of same mass m is released from rest at a height h. The particle hits the block at some point on inclined plane.



If the particle sticks to the block after collision, the velocity of block parallel to the inclined plane just after collision will be (take $g = 10m/s^2$)

A. $\frac{v_0}{\sqrt{2}}$

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

C. $\frac{v_0}{2\sqrt{2}}\left(1-\frac{4}{\sqrt{3}}\right)$

D. $\frac{v_0}{2\sqrt{2}}\left(1+\frac{4}{\sqrt{3}}\right)$

Answer: C

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14. A particle starts from rest with a time varying acceleration $a=(2t-4)$. Here t is in second and a in m/s^2

Particle comes to rest after a time $t=$ .... second

A. 1

B. 4

C. 3

D. 2

Answer: B

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15. A particle starts from rest with a time varying acceleration $a = (2t - 4)$. Here t is in second and a in m / s^2

Maximum velocity of particle in negative direction is at

$t =$ .... second

A. 3

B. 4

C. 2

D. 1

Answer: C

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16. A particle starts from rest with a time varying

acceleration $a = (2t - 4)$. Here t is in second and a in

m/s^2

The velocity time graph of the particle is

A. parabola passing through origin

B. straight line not passing through origin

C. parabola not passing through origin

D. straight line passing through origin

Answer: A

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17. x and y co-ordinates of a particle moving in $x-y$ plane at some instant of time are $x=2t$ and $y=4t$

.Here x and y are in metre and t in second. Then

The distance travelled by the particle in a time from

$t = 0$ to $t = 2s$ is ....m

A. $2\sqrt{3}$

B. $4\sqrt{5}$

C. $\sqrt{2}$

D. $3\sqrt{40}$

Answer: B

Watch Video Solution

18. x and y co-ordinates of a particle moving in $x-y$ plane at some instant of time are $x=2t$ and $y=4t$ .Here x and y are in metre and t in second. Then The path of the particle is a.......

A. straight line

B. parabola

C. circle

D. ellipse

Answer: A

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19. At time $t=0$, particle A is at $(1m, 2m)$ and B is at $(5m, 5m)$. Velociyt of B is $\left(2\hat{i}+4\hat{j}\right)m/s$ Velocity of particle A is $\sqrt{2}v)$ at 45° with x-axis. A collides with B

.

Value of v is ....m/s

A. 5

B. 15

C. 25

D. 10

Answer: D

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20. At time $t=0$, particle A is at $(1m, 2m)$ and B is at $(5m, 5m)$. Velocity of B is $\left(2\hat{i}+4\hat{j}\right)m/s$ Velocity of particle A is $\sqrt{2}v)$ at 45° with x-axis. A collides with B .

Time when A will collide with B is ....second.

A. $0.5s$

B. $1.5s$

C. $4s$

D. $3s$

Answer: A

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21. The position of a particle is given by

$$x = 2(t - t^2)$$

where t is expressed in seconds and x is in metre.

The acceleration of the particle is

A. 0

B. $4m/s^2$

C. $-4m/s^2$

D. None of these

Answer: C

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22. The position of a particle is given by

$x = 2(t - t^2)$

where t is expressed in seconds and x is in metre.

The maximum value of position co-ordinate of particle

on positive x-axis is

A. $1m$

B. $2m$

C. $\frac{1}{2}m$

D. $4m$

Answer: C

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23. The position of a particle is given by

$$x = 2(t - t^2)$$

where t is expressed in seconds and x is in metre.

The particle

A. never does to negative x-axis

B. never goes to positive x-axis

C. starts from the origin goes up to $x = \frac{1}{2}m$ in the positive x -axis and then moves in opposites direction

D. has zero initial velocity

Answer: C

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24. The position of a particle is given by

$x = 2(t - t^2)$

where t is expressed in seconds and x is in metre.

The total distance travelled by the paticle between $t = 0$ to $t = 1s$ is

A. $0m$

B. $1m$

C. $2m$

D. $\frac{1}{2}m$

Answer: B

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25. The position of a particle is given by

$x = 2(t - t^2)$

where t is expressed in seconds and x is in metre.

When does the object return to its initial velocity?

A. Ate $t = 4s$

B. At $t = 7s$

C. At $t = 8s$

D. Impossible to determine the given information

Answer: B

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26. The position of a particle is given by

$x = 2(t - t^2)$

where t is expressed in seconds and x is in metre.

When is the object at rest?

A. At $t = 0s$

B. At $t = 4s$

C. Between $t = 4s$ and $t = 8s$

D. Impossible to determine from the given information

Answer: D

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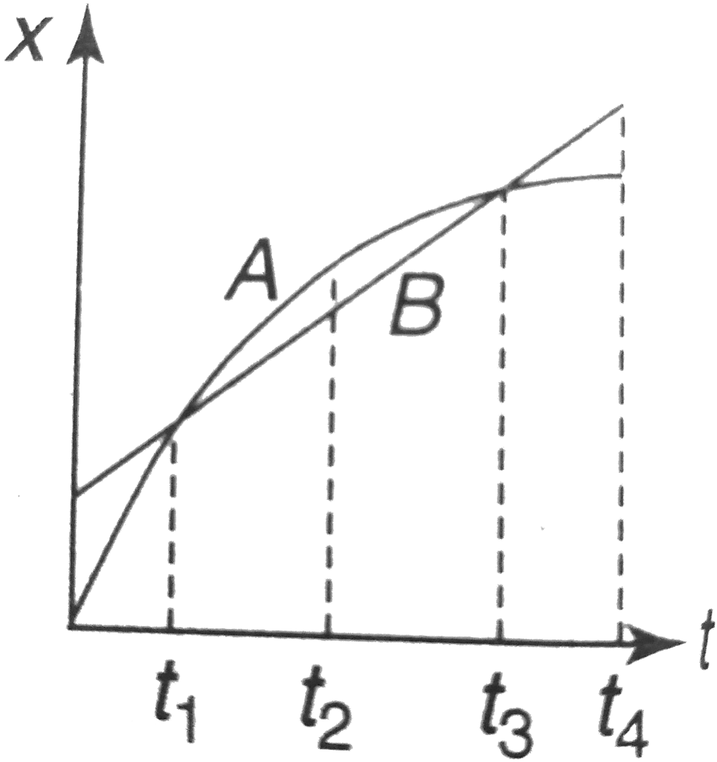
27. The graph given shows the positions of two cars, A and B, as a function of time. The cars move along the x-axis on parallel but separate tracks, so that they can pass each other's position without colliding. At which instant in time is car-A overtaking the car-B ?



A. t_1

B. t_2

C. t_3

D. t_4

Answer: A

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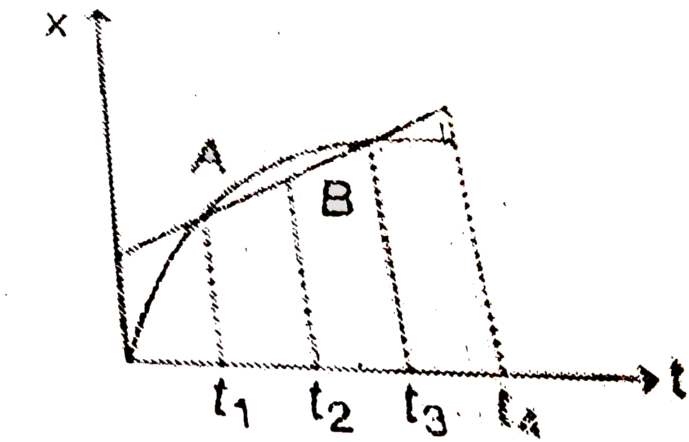
28. The graph given show the position of two cars A and B as a function of time. The cars move along the x axis on parallel but separate tracks, so that they can pass each other's position without colliding.



At time t_3 which car is moving faster?

A. car A

B. car B

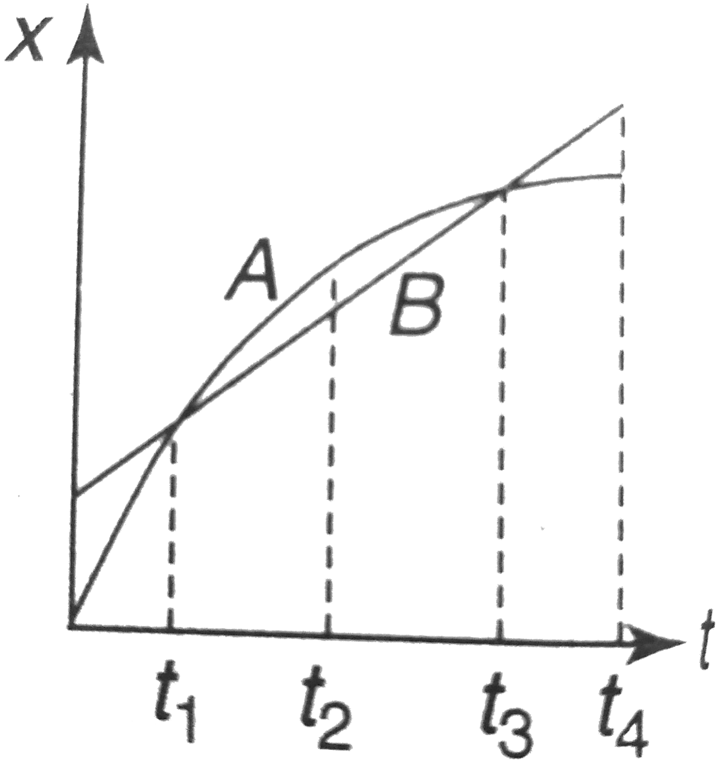
C. same sped

D. None of these

Answer: B

Watch Video Solution

29. The graph given shows the positions of two cars, A and B, as a function of time. The cars move along the x-axis on parallel but separate tracks, so that they can pass each other's position without colliding. At which instant in time is car-A overtaking the car-B ?



A. t_1

B. t_2

C. t_3

D. t_4

Answer: B

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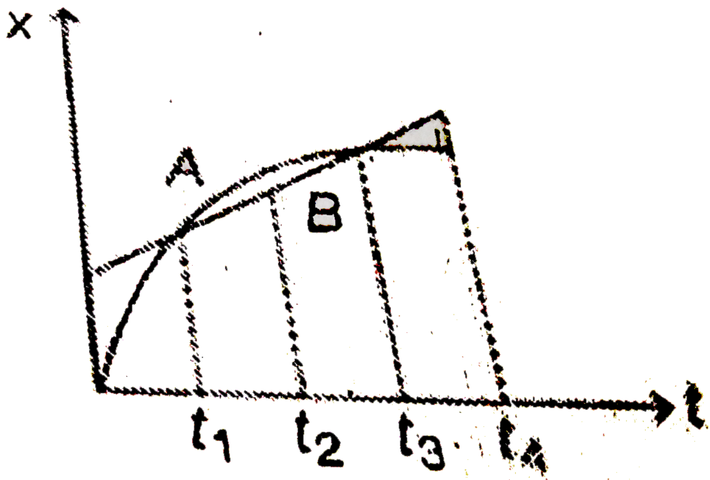
30. The graph given show the position of two cars A and B as a function of time. The cars move along the x axis on parallel but separate tracks, so that they can pass each other's position without colliding.



Which one of the following best describes the motion of car A as shown on the graphs?

A. speeding up

B. constant velocity

C. slowing down

D. first speeding up, then slowing down

Answer: C

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31. Two trains A and B are approaching each other on a straight track, the former with a uniform velocity of

25 m/s and other with 15m/s, when they are 225 m a part brakes are simultaneously applied to both of them. The deceleration given by the brakes to thetrain B increases linearly with time by $0.3m/s^2$ every second, while the train A is given a uniform deceleration, (a) What must be the minimum deceleration of the train A so that the trains do not collide ? (b) What is the time taken by the trains to come to stop ?

A. $5s$

B. $25s$

C. $15s$

D. $10s$

Answer: D

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32. Two trains A and B are approaching each other on a straight track, the former with a uniform velocity of 25 m/s and other with 15m/s, when they are 225 m a part brakes are simultaneously applied to both of them. The deceleration given by the brakes to thetrain B increases linearly with time by $0.3m/s^2$ every second, while the train A is given a uniform deceleration, (a) What must be the minimum deceleration of the train A so that the trains do not collide ? (b) What is the time taken by the trains to come to stop ?

A. $5m/s^2$

B. $2.5m/s^2$

C. $1.5m/s^2$

D. $7.5m/s^2$

Answer: B

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MATCH THE COLUMN

1. A particle is projected with velocity $20\sqrt{2}m/s$ at 45° with horizontal. After $1s\left(g=10m/s^{2}\right)$ match the following table

Table-1	Table-2
(A) Average velocity	(P) $10\sqrt{5}$ m/s
(B) Change in velocity	(Q) 25 m/s
(C) Instantaneous velocity	(R) 10 m/s
	(S) None

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2. Trajectory of a particle in a projectile motion is given as $y=x-\dfrac{x^{2}}{80}$. Here x and y are in metre. For this projectile motion the following with $g=10m/s^{2}$.

Table-1	Table-2
(A) Angle of projootion	(P) 20 m
(B) Angle of velocity with horizontal after 4s	(Q) 80 m

Table-1	Table-2
(A) Angle of projootion	(P) 20 m
(B) Angle of velocity with horizontal after 4s	(Q) 80 m

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3. A ball is projected from a $500m$ high towe with velocity of $100\frac{m}{s}$ horizontally. It lands on a $375cm$ high tower. Take $g = 10m/s^2)$ Match the following two Tables.

Table-1	Table-2
(A) Distance between the towers in meter	(P) 50
(B) Minimum velocity during the motion in m/s	(Q) 500
(C) Maximum vertical velocity of the ball in m/s	(R) 250
(D) Value of $\sqrt{5}$ times the maximum speed during the motion in m/s	(S) 100

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4. Match the following Table-1 to Table-2

Table-1	Table-2
(A) $\frac{dv}{dt}$	(P) Acceleration
(B) $\frac{d\|v\|}{dt}$	(Q) Magnitude of acceleration
(C) $\frac{dr}{dt}$	(R) Velocity
(D) $\frac{d\|r\|}{dt}$	(S) Magnitude of velocity
	(T) None

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5. Velocity of a particle is in negative direction with constant acceleration in positive direction. Then match the following:

Table-1	Table-2
(A) Velocity-time graph	(P) Slope $\rightarrow$ negative
(B) Acceleration-time graph	(Q) Slope $\rightarrow$ positive
(C) Displacement-time graph	(R) Slope $\rightarrow$ zero
	(S) $\mid$Slope$\mid \rightarrow$ increasing
	(T) $\mid$Slope$\mid \rightarrow$ decreasing
	(U) $\mid$Slope$\mid \rightarrow$ constant

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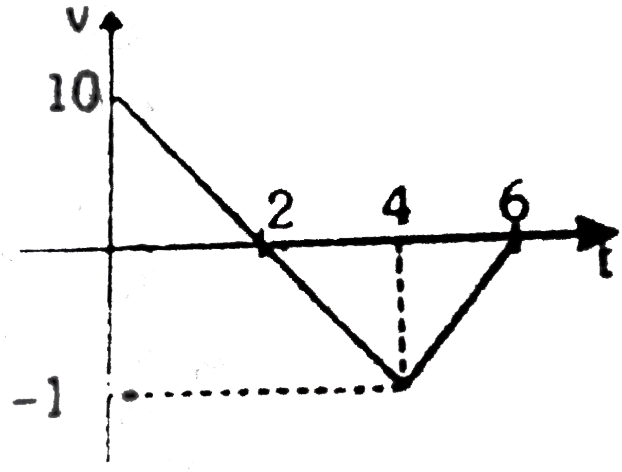
6. For the velocity -time graph shown in figure, in a time interval from $t = 0$ to $t = 6s$, match the following:



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

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7. Let us call a motion, A when velocity is positive and increasing A^{-1} when velocity is negative and increasing R when velocity is positive and decreasing and R^{-1} when velociyt is negative and decreasing. Now match the following two tales for the given $s-t$ graph

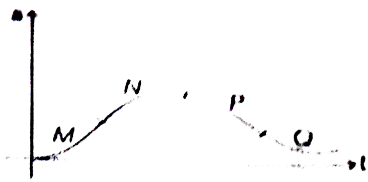

Table-1		Table-2	
(A)	M	(P)	A^{-1}
(B)	N	(Q)	R^{-1}
(C)	P	(R)	A
(D)	Q	(S)	R

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8. In the $s - t$ equations $\left(s = 10 + 20t - 5t^2\right)$ match the following

Table-1	Table-2
(A) Distance travelled in 3s	(P) -20 unit
(B) Displacement in 1s	(Q) 15 unit
(C) Initial acceleration	(R) 25 unit
(D) Velocity at 4s	(S) -10 unit

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9. Match the following

Table-1	Table-2
(A) Constant positive acceleration	(P) Speed may increase
(B) Constant negative acceleration	(Q) Speed may decrease
(C) Constant displacement	(R) Speed is zero
(D) Constant slope of a-t graph	(S) Speed must increa
	(T) Speed must decre

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10. A balloon rises up with constant net acceleration of $10m/s^2$. After 2 s a particle drops from the balloon. After further 2 s match the following :

$(\text{Take} g = 10m/s^2)$

	Column I		Column II
(A)	Height of perticle from ground	(p)	Zero
(B)	Speed of particle	(q)	$10 SI$ units
(C)	Displacement of Particle	(r)	$40 SI$ units
(D)	Acceleration of particle	(s)	$20 SI$ units

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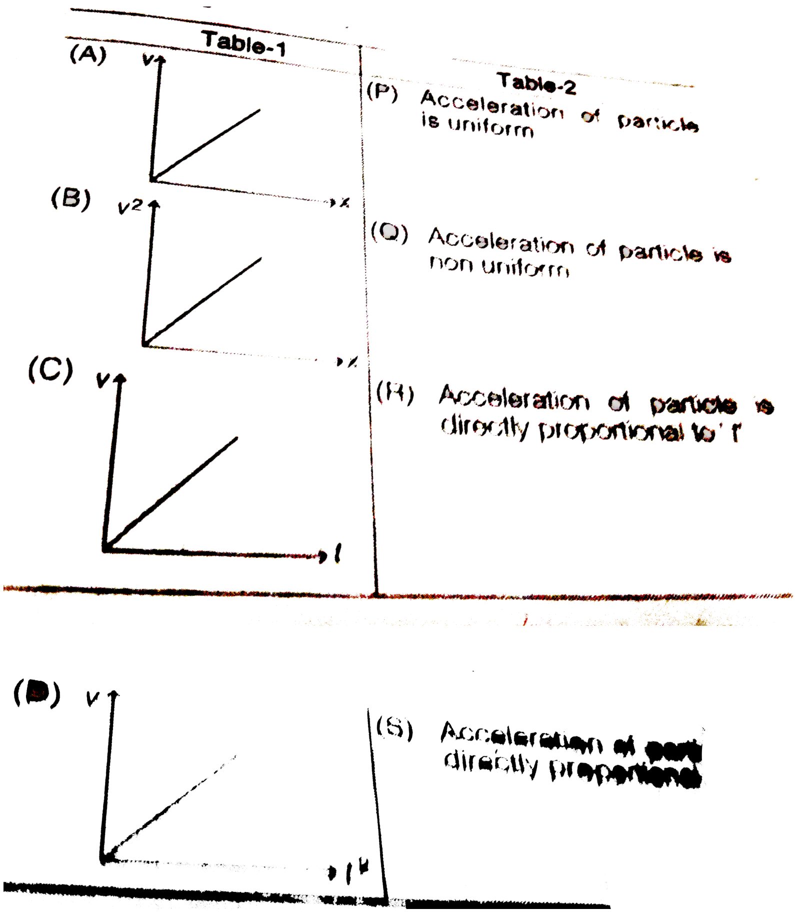
11. Table -1 gives some graph for a particle moves along x-axis in positive x-direction. The variables v, x

and t represent speed of particle, x-coordinate of particle and time respectively. Table -2 gives certain resulting interpretation. Match the graph in Table -1 with the statements in Table -2.



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12. Velocity (in m/s) of a particle moving in a straight line given by $v = \left(t^2 - 2t_1\right)$. Match Table-1 with Table -2

Table-1	Table-2
(A) Velocity (in m/s) of particle at $t = 3$ s is	(P) 1
(B) Acceleration (in m/s^2) of particle at $t = 2$ s is	(Q) 2
(C) Time (in s) when particle is at rest is	(R) 3
(D) Magnitude of average acceleration (in m/s^2) of particle in first one second is	(S) 4

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13. A ball of mas $2gm$ is thrown vertically upwards with a speed of $30m/s$ from a tower of height $35m$. (Given

$g = 10m / s^2$)

Table-1	Table-2
(A) Displacement (in m) in first 2 s	(P) 10
(B) Magnitude of average acceleration (in m/s^2) in first 6 s	(Q) 0
(C) Distance travelled (in m) in 0-4 s	(R) 40
(D) Speed (in m/s) at $t = 4$ s is	(S) None of these

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INTEGER_TYPE

1. A particle is projected with velocity $2\left(\sqrt{gh}\right)$, so that it just clears two walls of equal height h which are at a distance of 2h form each other. Show that the time of passing between the walls is $2\left(\sqrt{\frac{h}{g}}\right)$. [Hint : First find velocity at height h. Treat it as initial velocity and 2h as the range.]

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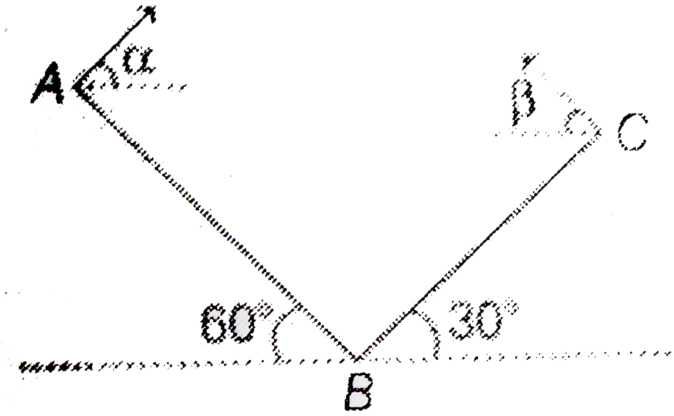
2. Two inclined planes AB and BC are at inclinations of 60° and 30° as shown in the figure. The two projectiles are thrown simultaneously from A and C with speed $2m/s$ and v_0 respectively. They strike at B with same speed. If length of AB is $\frac{1}{\sqrt{3}}m$and BC is

$1m$, then find the value of v_0 (in m/s)



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3. A particle moves along a parabolic path $y = -9x^2$ in such a way that the x component of velocity remains constant and has a value $\frac{1}{3} m/s$. Find the instantaneous acceleration of the projectile (in m/s^2)

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4. A ground to ground projectile is at point A at $t = \frac{T}{3}$ is at point B at $t = \frac{5T}{6}$ and reaches the ground at $t = T$.The difference in heights between points A and$B$ is $\frac{gT^2}{6x}$. Find value of x

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5. An object is projected with a velocitiy of $20m/s$ making an angle of 45° with horizontal. The equation for trajectory is $h = Ax - Bx^2$ where h is height x is horizontal distance. A and B are constants. The ratio $A.B$ is $\frac{x}{0.1}$. Find value of x. $(g = 10m/s^2)$

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6. A ball is thrown from the ground to clear a wall $3m$ high at a distance of $6m$ and falls $18m$ away from the wall, the angle of projection of ball is $\tan^{-1}\left(\frac{2}{x}\right)$. Find value of x.

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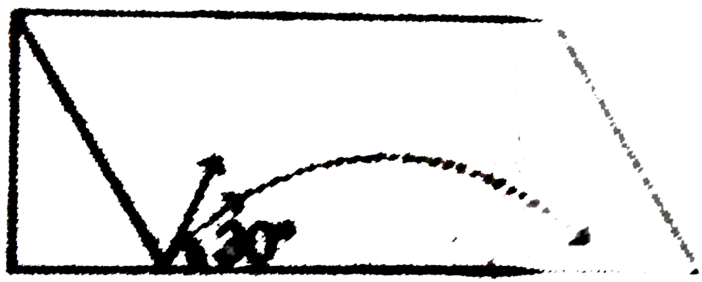
7. A small ball is projected up a smooth inclined plane with an initial speed of $10m/s$ at 30° from the bottom edge of the slope. It returns to the edge after $2s$. The ball is in contact with the inclined plane throughout the process. The inclination angle (in degree) of the plane is N. The value of $N/6$ is



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8. A particle is thrown from the origin,at an angle $\theta(0 < \theta < 90^\circ)$ such that it just crosses a wall of height $9m$. Wall is at $x = 12m$. Speed of projection is $n\sqrt{3}\frac{m}{s}$ and particle strikes the ground at $x = 48m$. Value of n is $(g = 10m/s^2)$

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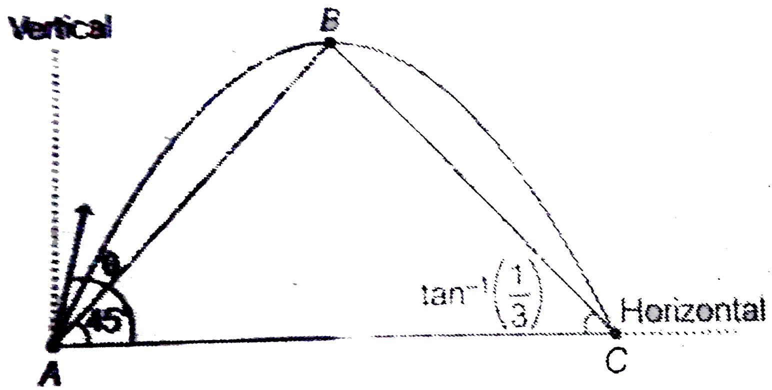
9. ABC is a triangle in vertical plane. Its two base angles $\angle BAC$ and $\angle BCA$ are 45° and $\tan^{-1}\frac{1}{3}$ respectively. A particle is projected from point A such that is passes through vertices B and C. Angle of projectio is θ. Find the value of $3\tan\theta$.



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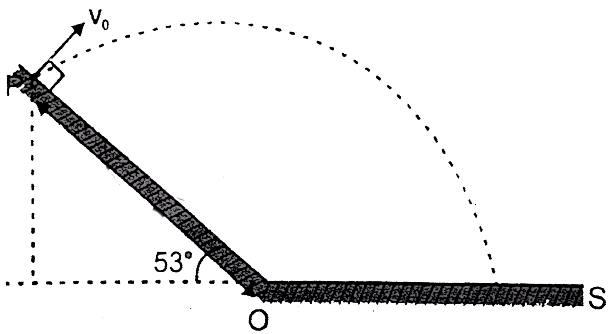
10. A stone is projected from point P on the inclined plane with velocity $v_0 = 10m / \sec$ directed perpendicular to the plane. The time taken (in second) by the stone to strike the horizontal ground S is (Given $PO = l = 10$meter)(Take $g = 10m / s^2$)



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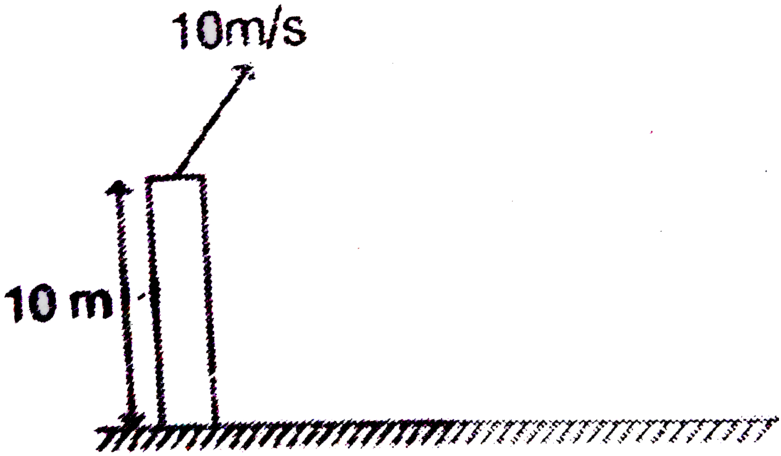
11. A stone is thrown from the top of a tower of height $h = 10m$ with speed $v - 10m / s$. The distance of the landing point on the ground from the foot of the tower is $R \leq 2\sqrt{3}k$ in meter. Calculate k. Take $g = 10m/s^2$



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12. A stone is dropped form certain height which can reach the ground in $5s$. If the stone is stopped after $3s$ of its fall and then allowed to fall again. Find the time taken (in second) by the stone to reach the ground for the remaining distance.

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13. A car starts moving along a line, first with acceleration $a = 5m/s^2$ starting from rest then uniformly and finally decelerating at the same rate till it comes to rest. The total of motion is $25s$. The average speed during the time is $20m/s$. The particle moves uniformly for $(2.5x)$ second. Find the value of x

.

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14. Two particles P and Q simultaneously start moving from point A with velocities $15m/s$ and $20m/s$ respectively. The two particles move with acceleration equal in magnitude but opposite in direction. When P overtakes Q at point B then its velocity is $30m/s$, the velocity of Q at point B will be

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15. If a particle takes t second less and acquire a velocity of vms^{-1} more in falling through the same disance on two planets where the accelerations due to gravity are $2g$ and $8g$ respectively, then $v = x >$. Find value of x

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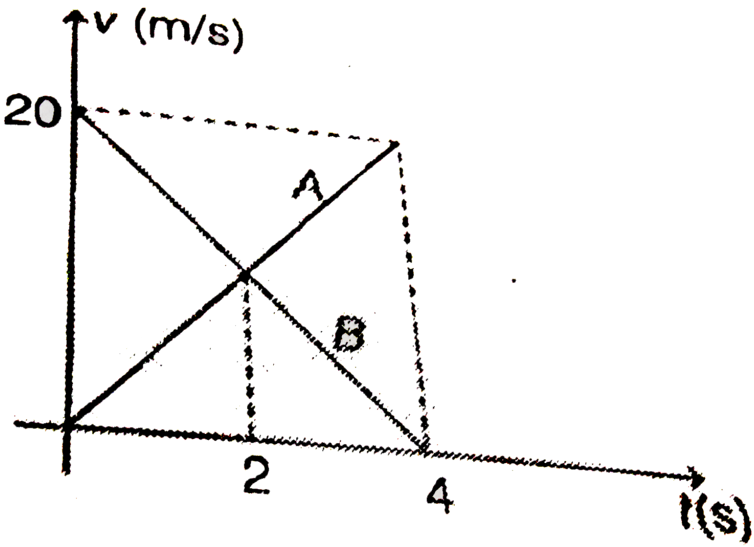
16. Speed time graph of two cars A and B approaching towards each other is shown in figure. Initial distance between them is $60m$. The two cars will cross each other after t secons. Find value of it t.



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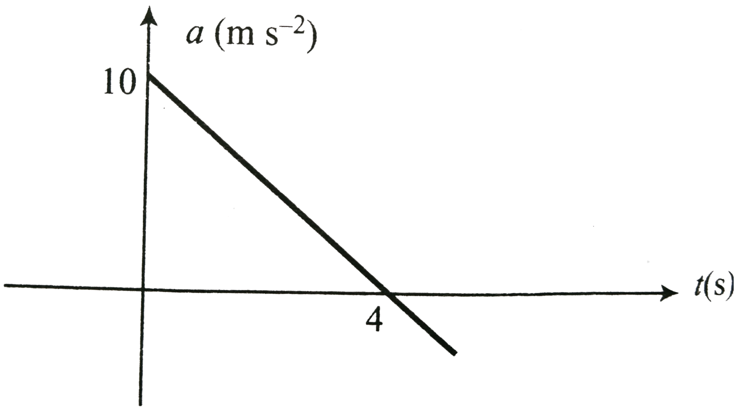
17. The acceleration-time graph of a particle moving along a straight line is as shown in. At what time the particle acquires its initial velocity?



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18. A lift performs the first part of its ascent with uniform acceleration a and the remaining with uniform retardation $2a$. If t is the time of ascent, find the depth of the shaft.

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19. A small electric car has a maximum constant acceleration of $1m/s^2$, a maximum constant deceleration of $2m/s^2$ and a maximum speed of $20m/s$. The amount of minimum time it would take to drive this car $1km$ starting from rest is $(13n)$ second. Find value of n

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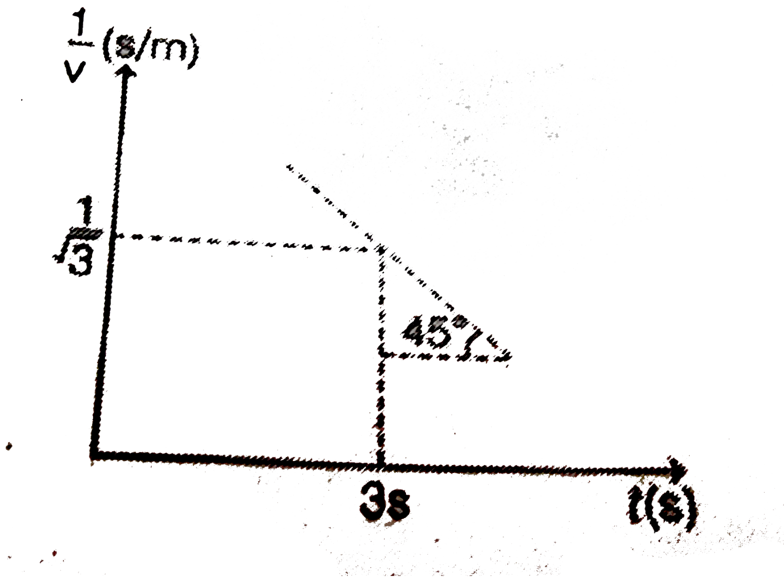
20. The diagram shows the variatioin of $1/v$ (where v is velocity of the particle) with respect to time. At time $t = 3s$ using the details given in the graph, find the instantaneous acceleration (in m/s^2)



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21. Two particles are moving with velocities $v_1 = \hat{i} + t\hat{j} + \hat{k}$ and $v_2 = t\hat{i} + t\hat{j} + 2\hat{k}m / s$ respectively. Time at which they are moving perpendicular to each other is.__________(second)

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22. A particle A moves with velocity $\left(2\hat{i} - 3\hat{j}\right)m / s$ from a point $(4, 5m)m$. At the same instant a particle B, moving in the same plane with velocity $\left(4\hat{i} + \hat{j}\right)m / s$ passes through a point $C(0, -3)m$. Find the x-coordinate (in m) of the point where the particles collide.

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23. A ball is thrown upwards with a speed of $40m/s$. When the speed becomes half of the initial speed, gravity is switched off for next 2 second. After that gravity is again switched on but magnitude gravity is doubled. The total distance travelled by the ball from $t=0$ to the time when the ball reaches the maximum heighth is 55β. Find the value of β.

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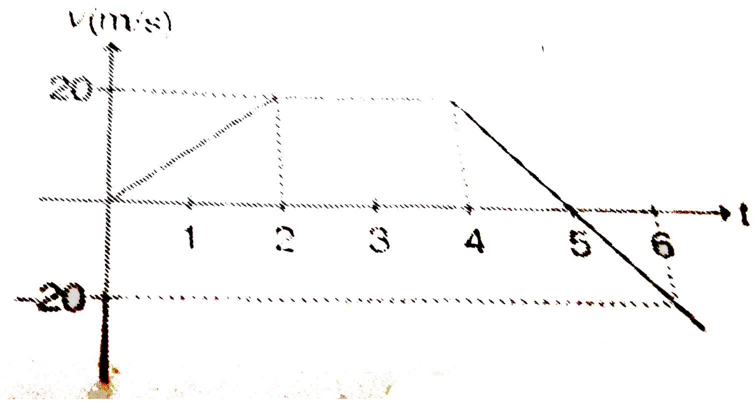
24. Figure shows the velocity time graph for a particle travelling along a straight line. The magnitude of average velocity (in m/s) of particle during the time interval from $t = 0$ to $t = 6s$ is 10α. Find the value of α.



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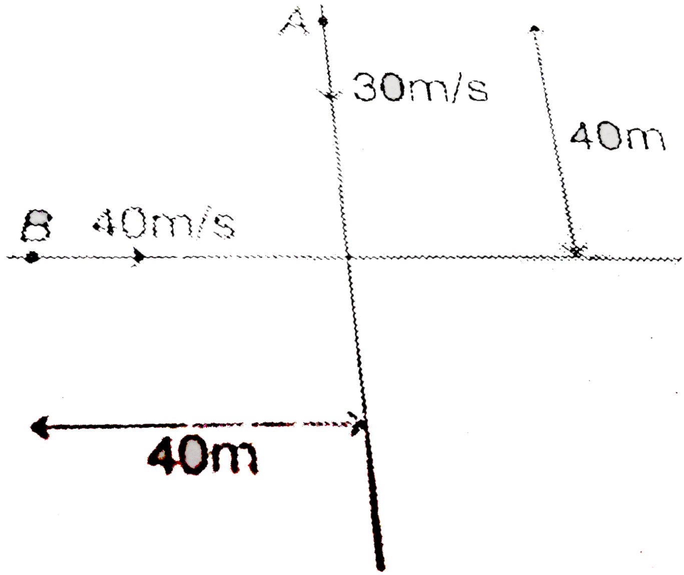
25. Two bodies A and B are moving along y-axis and x-axis as shown. Find the minimum distance between A

and B is subsequent motion (in m)



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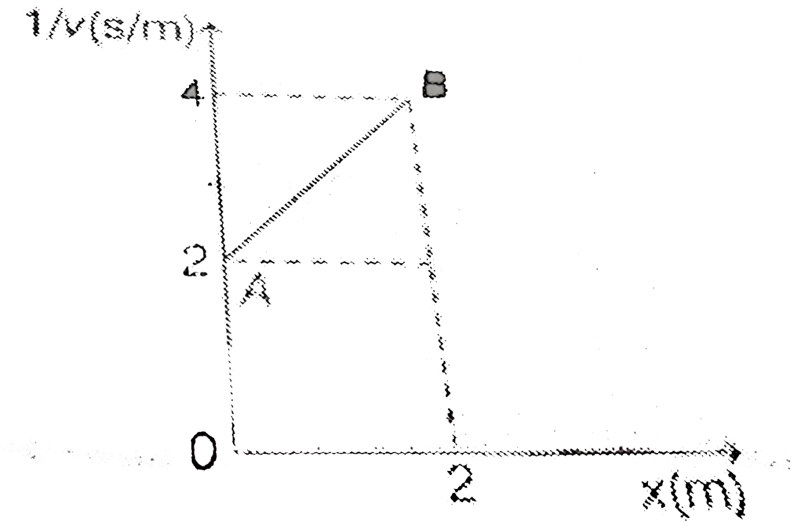
26. The $1/v$ versus positions graph of a particle is shown in the figure, where v is the velocity of the particle. The particle is moving in a straight line aloing positive x- axis.Find the time taken by the particle to reach from the point A to B in second.



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