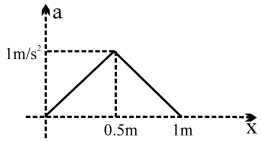
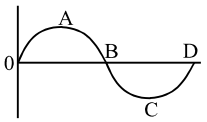
Q.1 The position of a particle moving along the y–axis is given as $y=3t^2-t^3$ where y is in metres and t is in sec. The time when the particle attains maximum positive y position will be
(A) 1.5 sec (B) 4 sec (C) 2 sec (D) 3 sec

Q.2 A body initially at rest, starts moving along x-axis in such a way so that its acceleration vs displacement plot is as shown in figure. The maximum velocity of particle is



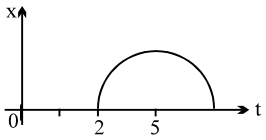
(A) 1 m/s (B) 6 m/s
(C) 2 m/s (D) none

Q.3 A particle has a rectilinear motion and the figure gives its displacement as a function of time. Which of the following statements are true with respect to the motion



(A) in the motion between O and A the velocity is positive and acceleration is negative
(B) between A and B the velocity and acceleration are positive
(C) between B and C the velocity is negative and acceleration is positive
(D) between C and D the acceleration is positive

Q.4 Position-time graph is shown which is a semicircle from t = 2 to t = 8 sec. Find time t at which the instantaneous velocity, is equal to average velocity over first t seconds



(A) 4.8 sec (B) 3.2 sec
(C) 2.4 sec (D) 5 sec

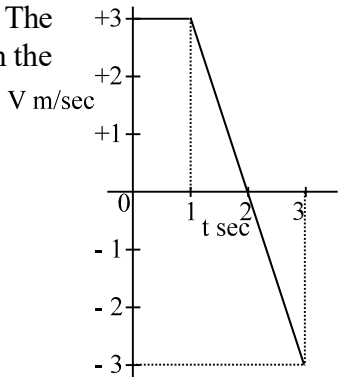
Q.5 Potential energy of an object at any position x is given by the following relation $U = \frac{Bx^2}{A+\sqrt{x}}$. Find out dimensions of A & B.

Q.6 The velocity of a certain particle moving along the x axis is proportional to x. At time t=0 the particle is located at x=2 and at time t=10 it is at x=4. Find the position at t=5.

Q.7 A particle moves along a horizontal straight line with acceleration proportional to cos t , where t is the time. When $t = 0$ the velocity of the particle is u. and when $t = \pi/2$ its velocity is 2u. Find the distance that the particle has travelled when $t = 2\pi$, and draw the velocity-time graph for the interval $0 \le t \le 2\pi$.

Q.8 A particle moves in the xy plane such that it has an acceleration a at time t where $a = 2i - j$. Initially the particle is at rest at the point whose position vector is $3i + j$. Find the position vector of the particle at time t.

Q.9 A particle moves along a straight line, x. At time t = 0, its position is at x = 0. The velocity, V, of the object changes as a function of time t, as indicated in the figure; t is in seconds, V in m/sec and x in meters.



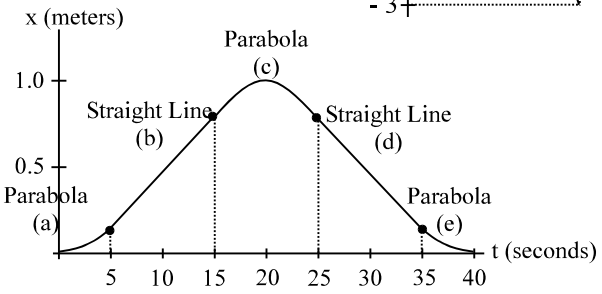
(a) What is x at t = 3 sec?

(b) What is the instantaneous acceleration (in m/sec^2) at t = 2 sec?

(c) What is the average velocity (in m/sec) between t = 0 and t = 3 sec?

(d) What is the average speed (in m/sec) between t = 1 and t = 3 sec?

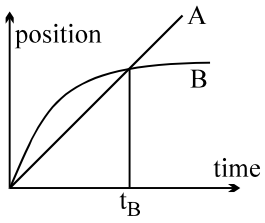
Q.10 The figure above is a displacement vs time plot for the motion of an object, answer questions (i) & (ii) with the letter of appropriate section of the graph.



(i) Which section represents motion in the forward direction with positive acceleration?

(ii) Which section represents uniform motion backwards (–x direction)?

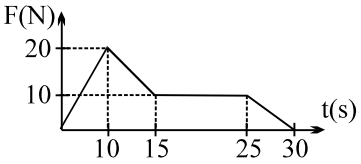
Q.1 The graph shows position as a function of time for two trains running on parallel tracks. Which statement is true?



(A) At time t_B, both trains have the same velocity.
(B) Both trains have the same velocity at some time after t_B
(C) Both trains have the same velocity at some time before t_B.
(D) Somewhere on the graph, both trains have the same acceleration.

Question No. 2 to 5 (4 questions)

In figure shown, the graph shows the variation of a uni-directional force F acting on a body of mass 10 kg (in gravity free space), with time t. The velocity of the body at t = 0 is zero



Q.2 The velocity of the body at t = 30 s is
(A) 30 m/s (B) 20 m/s (C) 40 m/s (D) none

Q.3 The power of the force at t = 12 s is
(A) 225.0 W (B) 217.6 W (C) 226.7 W (D) none

Q.4 The average acceleration of the body from t = 0 to t = 15 s is
(A) 1.25 m/s^2 (B) 4/7 m/s^2 (C) 5/6 m/s^2 (D) 7/6 m/s^2

Q.5 The change in momentum of the body between the time t = 10 s to 15 s is
(A) 100 kg.m/s (B) 75 kg.m/s (C) 125 kg.m/s (D) none

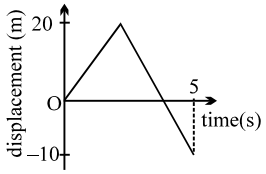
Q.6 A bodies move from the same point along a straight line. The first body moves with velocity $v = (3t^2 - 6t)$ m/s, the second with velocity $v = (10t + 20)$ m/s . At what instant and at what distance from the initial point will they meet .

Q.7 A particle moves in a straight line with acceleration $(-\frac{1}{3v^2})$ where v is its velocity at time t. Initially the particle is at O, a fixed point on the line, with velocity u. Find in terms of u the time at which the velocity is zero and the displacement of the particle from O at this time.

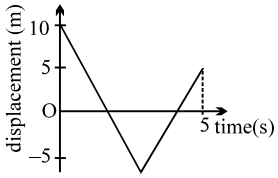
Q.8 $\vec{F} = (\sin t)\mathbf{i} + (\cos t)\mathbf{j}$, m = 1, $\vec{r}_0 = -\mathbf{j}$, $\vec{v}_0 = \mathbf{i}$. Find $\vec{v}$ and $\vec{r}$.

Q.9 Starting from rest at t = 0, a particle moves in a straight line away from the origin with a speed given by $v = Bt^2$, where B is a constant equal to 3 m/s^2.
(a) How far from the origin is the particle after 2 seconds?
(b) What is the average acceleration of the particle over the interval from 0 to 2 seconds?

Q.10
(a) The diagram shows the displacement-time graph for a particle moving in a straight line. Find the average velocity for the interval from t = 0 to t = 5.



(b) The diagram shows the displacement-time graph for a particle moving in a straight line. Find the average speed for the interval from t = 0 to t = 5.

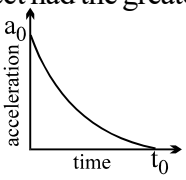


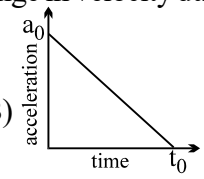
Q.1 Three particles start from origin at the same time with a velocity $2ms^{-1}$ along positive x-axis, the second with a velocity $6ms^{-1}$ along negative y-axis. Find the velocity of the third particle along x = y line so that the three particles may always lie in a straight line

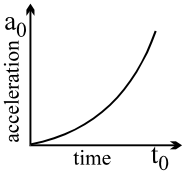
(A) $-3\sqrt{3}$ (B) $3\sqrt{2}$ (C) $-3\sqrt{2}$ (D) $2\sqrt{2}$

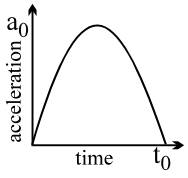
Q.2 A particle moving with a speed v changes direction by an angle θ, without change in speed.
(A) The change in the magnitude of its velocity is zero.
(B) The change in the magnitude of its velocity is $2v\sin(\theta/2)$.
(C) The magnitude of the change in velocity is $2v\sin(\theta/2)$
(D) The magnitude of the change in its velocity is $v(1-\cos\theta)$.

Q.3 Acceleration versus time graphs for four objects are shown below. All axes have the same scale. Which object had the greatest change in velocity during the interval?

(A) 

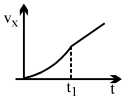
(B) 

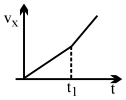
(C) 

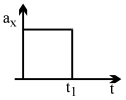
(D) 

Q.4 A bird flies for 4 sec with a velocity of $|t-2|$ m/s in a straight line, where t = time in seconds. It covers a distance of
(A) 2 m (B) 4 m (C) 6 m (D) 8 m

Q.5 The position of a particle with time is given by
$(x, y) = (8t^2, 3)$ for $t \le t_1$
$= (8t\, t_1, 3)$ for $t > t_1$
Choose the correct alternative
(A) Particle moves along a straight line parallel to x axis.

(B) 

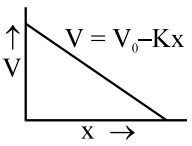
(C) 

(D) 

Q.6 First, an auto starts from rest and accelerates uniformly for 15 s acquiring a velocity of 30 m/s. Secondly, the auto then moves at this constant velocity of 30 m/s for the next 15 s, afterwhich thirdly, the auto decelerates uniformly by braking at 1.5 m/s^2 until it stops.
(a) Sketch the velocity time graph. (b) Sketch the acceleration time graph for auto.
(c) Sketch displacement time graph for auto.

Q.7 A police officer sits on a parked motorcycle. A car travelling at a constant speed of $v_0 = 40.0$ m/s passes by at t = 0. At that instant, the officer accelerates the motorcycle at a constant rate, and at time $t_1 = 20.0$s overtakes the speeder.
(a) (i) Find the acceleration of the motorcycle.
(ii) Find the speed of the motorcycle at the instant it overtakes the car.
(b) In the same graph, sketch the position–time graph of the car and that of the motorcycle. Label clearly.

Q.8 A particle is moving along x-axis with velocity V which varies according to the law $V = V_0 - Kx$ here V_0 & K are constant. Plot acceleration vs time plot for the time interval when particle moves from $x = 0$ to $x = \frac{V_0}{K}$.



Q.9 A particle of mass m moves in a straight line under the section of a force F where $F = -mk \sin 3t$ at time t and k is a positive constant. The particle is at O , a point on the line, when $t = 0$, with a velocity u .Find expressions for the acceleration, velocity and displacement from O at time t.

Q.10 A body thrown up from the ground vertically up passes from the height of 10.2 m twice in an interval 10 sec. Its initial velocity was……m/s and its time of journey upwards was…… s ($g = 10\ m/s^2$).

Q.1 A man holds four balls 180 m above the ground and drops them at regular intervals of time so that when the first ball hits ground, the fourth ball is just leaving his hand. At this time, the second and thrid balls from the ground are at the positions

(A) 160 m and 100 m respectively (B) 80 m and 20 m respectively

(C) 20 m and 80 respectively (D) 100 m and 160 m respectively

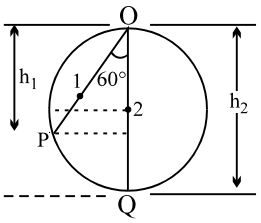
Q.2 The greatest acceleration or deceleration that a train may have is a. The minimum time in which the train may reach from one station to the other separated by a distance d is

(A) $\sqrt{\frac{d}{a}}$ (B) $\sqrt{\frac{2d}{a}}$ (C) $\frac{1}{2}\sqrt{\frac{d}{a}}$ (D) $2\sqrt{\frac{d}{a}}$

Q.3 A ball is thrown vertically upwards from the ground. It crosses a point at the height of 25 m twice at an interval of 4 secs. The ball was thrown with the velocity of

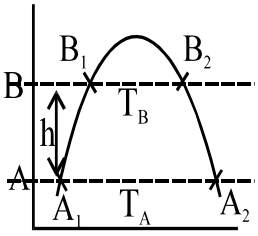
(A) 20m/sec. (B) 25 m/sec. (C) 30m/sec. (D) 35 m/sec.

Q.4 Two particles 1 and 2 are allowed to descend on two frictionless chords OP and OQ as shown. The ratio of the speeds of the particles 1 and 2 respectively when they reach on the circumference is



(A) 1/4 (B) 1/2 (C) $\frac{1}{2\sqrt{2}}$ (D)1

Q.5 The acceleration of gravity can be measured by projecting a body upward and measuring the time that it takes to pass two given lines in both directions (upward motion & downward motion). If the time the body takes to pass a horizontal line A in both direction (from A_1 to A_2) is T_A, and the time to go by a second line B in both directions is (from B_1 to B_2) T_B, then assuming that theacceleration A due to gravity to be constant, its values is



(A) $\frac{8h}{T_A^2 - T_B^2}$ (B) $\frac{8h}{T_A^2 + T_B^2}$ (C) $\frac{8h}{T_A^2 T_B^2}$ (D) $\frac{8hT_AT_B}{T_A^2 T_B^2}$

Q.6 A particle is uniformly accelerated from A to B a distance of 192m and is then uniformly retarded from B to C, a distance of 60m. The speeds of the particles at A and B are 4m/s and V m/s respectively and the particle comes to rest at C. Express in terms of V only, the times taken by the particle to move from A to B and from B to C.

Given that the total time taken by the particle to move from A to C is 22 sec. find

(a) the value of V

(b) the acceleration and the retardation of the particle.

Q.7 **Reaction time:** When a situation demands our immediate action, it takes some time before we really respond. Reaction time is the time a person takes to observe, think and act. For example, if a person isdriving and suddenly a boy appears on the road, then the time elasped before he slams the breaks of the car is the reaction time. Reaction time depends on complexity of the situation and on individual. You can measure your reaction time by a simple experiment. Take a ruler and ask your friend to drop it vertically through the gap between your thumb and forefinger. After you catch it, find the distance d travelled by the ruler. In a particular case, d was found to be 20 cm. [$g = 10\ m/s^2$]

(a) Estimate reaction time.

(b) Now if you are driving a car at a speed of 54 km/h and the brakes cause a deceleration of 6.0 m/s^2, find the distance travelled by the car after you see the need to put the brakes on.

Q.8 A particle moving with uniform acceleration along a straight line passes three successive points A, B & C where the distances AB : BC is 3 : 5 & the time taken from
A to B is 40 sec. If the velocities at A & C are 5 m/s & 15 m/s respectively. Find
(a) the velocity of the particle at B
(b) acceleration of the particle
(c) time taken to cover B to C
(d) total distance from A to C.

Q.9 A boy is throwing balls at a regular time interval of 1 s . When he is about to throw the fifth ball, the first ball comes back to his hands.
(i) Each ball remains in air for the time interval equal to _____ .
(ii) The velocity with which each ball is thrown is given by _____.
(iii) The maximum height attained by each ball is _____ .

Q.10 Two trains A and B are travelling from station P to Q starting from P and stopping at Q. Train A has constant acceleration a for (1/3)rd of time, constant velocity for second $(1/3)^{rd}$ of time and constant retardation a for last (1/3)rd of time. Train B has same constant acceleration a for first (1/3)rd of distance, constant velocity for 2nd (1/3)rd of distance & constant retardation a for last (1/3)rd of distance. Find the ratio of time taken by train A and train B from P to Q.

Q.1 The equation of the path of the projectile is $y = 0.5x - 0.04x^2$. The initial speed of the projectile is
(A) 10 m/s (B) 15 m/s (C) 12.5 m/s (D) None

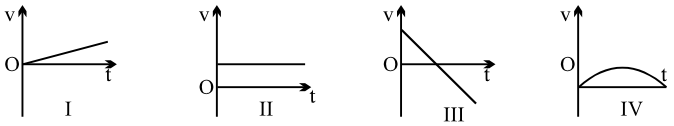
Q.2 Two bullets are fired at angles θ and $90 - \theta$, the ratio of their time of flights is :
(A) 1 : 1 (B) $\tan\theta$: 1 (C) 1: $\tan\theta$ (D) $\tan^2\theta$: 1

Q.3 Two particles A & B projected along different directions from the same point P on the ground with the same speed of 70 m/s in the same vertical plane . They hit the ground at the same point Q such that PQ = 480 m. Then : (Use $g = 9.8$ m/s^2, $\text{Sin}^{-1}\, 0.96 = 74°$, $\text{Sin}^{-1} 0.6 = 37°$)
(A) ratio of their times of flights is 4 : 5
(B) ratio of their maximum heights is 9 : 16
(C) ratio of their minimum speeds during flight is 4 : 3
(D) the bisector of the angle between their directions of projection makes 45° with horizontal.

Q.4 A particle is projected from a point O with a velocity u in a direction making an angle α upward with the horizontal . At P it is moving at right angles to its initial direction . Its velocity at P is :
(A) u tan α (B) u cot α (C) u cosec α (D) u sec α

Q.5 A projectile is fired with a velocity u making an angle θ with the horizontal. What is the change in velocity when it is at the highest point ?
(A) u cos θ (B) u (C) u sin θ (D) u cos θ- u

Q.6 A stone is thrown at an angle of 45° above the horizontal x-axis in the +x-direction. If air resistance is ignored, which of the velocity versus time graphs shown above best represents v_x versus t and v_y versus t, repectively?



v_x vs. t v_x vs. t v_y vs. t v_y vs. t

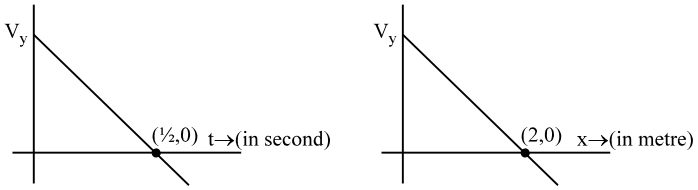
(A) I IV
(B) II I
(C) II IV
(D) II III

Q.7 A ball is rolled off along the edge of a horizontal table with velocity 4 m/s. It hits the ground after time 0.4 s. Which of the following are correct?
(A) The height of the table is 0.8 m
(B) It hits the ground at an angle of 60° with the vertical
(C) It covers a horizontal distance 1.6 m from the table
(D) It hits the ground with vertical velocity 4 m/s

Q.8 A projectile is projected with initial velocity 40 m/s. The particle is seen at the same height at 1 sec and 3 sec after it was thrown. The time of flight of projectile is _____, the angle of projection is _____ and the height at those instants is _____. ($g = 10$ m/s^2)

Q.9 A projectile, 1 sec after its projection is found to make an angle of 45° with the horizontal. After another one second it is travelling horizontally. Find the magnitude of its initial velocity and angle of projection.

Q.10 Two graphs of the same projectile motion (in the xy plane) projected from origin as shown. X axis is along horizontal direction & Y axis is vertically upwards. Take $g = 10\ m/s^2$. Find:



(i) Y component of initial velocity and

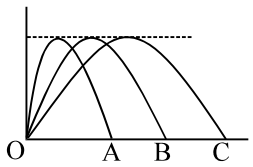
(ii) X component of initial velocity

Q.1 Suppose a player hits several baseballs. Which baseball will be in the air for the longest time?
(A) The one with the farthest range.
(B) The one which reaches maximum height.
(C) The one with the greatest initial velocity.
(D) The one leaving the bat at 45° with respect to the ground.

Q.2 A food packet is dropped from the plane moving horizontally with velocity 50 ms^{-1} and at a height of 500m. Find the angle with horizontal which the velocity vector makes at the time when it reaches the ground.Neglect air resitance.
(A) $\tan^{-1}(-2)$ (B) $\tan^{-1}(1/2)$ (C) $-45°$ (D) 53°

Q.3 Two particles are fired from the same point, with speeds 100 m/s and 100 m/s, and firing angles with horizontal = 60° and 120° respectively. The time after which their velocity vectors become perpendicular to each other, is
(A) 5 s (B) $5(\sqrt{3}-1)$ s (C) $5\sqrt{3}$ s (D) $5\sqrt{3}/2$ s

Q.4 Three projectiles A, B and C are thrown simultaneously from the same point in the same vertical plane. Their trajectories are shown in the figure. Then which of the following statement is **false**.



(A) The time of flight is the same for all the three.
(B) The launch speed is greatest for particle C.
(C) The vertical velocity component for particle C is greater than that for the other particles
(D) Y–coordinate of all particles is always same

Q.5 A falling stone takes 0.2 seconds to fall past a window which is 1 m high. From how far above the top of the window was the stone dropped ?

Q.6 A stone is thrown horizontally . In 0.5 second after the stone began to move, the magnitude of its velocity was 1.5 times its initial velocity. Find the initial velocity of the stone.

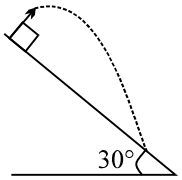
Q.7 A stone thrown with the velocity $v_0 = 12$ m/s at an angle $\alpha = 45°$ to the horizontal, dropped to the ground at a distance s from the point where it was thrown . From what height h should the stone be thrown in a horizontal direction with the same initial velocity v_0 for it to fall at the same spot ?

Q.8 The velocity of a particle when it is at its greatest height $\sqrt{2/5}$ is of its velocity when it is at its half the maximum height . The angle of projection is _____ and the velocity vector angle at half the maximum height is _____ .

Q.9 A target is fixed on the top of a pole 13 m high. A person standing at a distance of 50 m from the pole is capable of projecting a stone with a velocity of $10\sqrt{g}$ m/s. If his aim is to strike the target in least time what should be the angle of elevation of the stone.

Q.10 A projectile is thrown from a platform at a height 10 m above the ground with velocity of 20 m/sec. At what angle should the projectile be thrown to reach the farthest point from O, which is vertically below the point from which it is thrown. [$g = 10$ m/s^2]

Q.1 A ball is projected from point A with velocity 10m/sec. perpendicular to the inclined plane as in figure. Range of the ball on the incline is



(A) $40\sqrt{3}$m (B) 20/13 m (C) 13/20 m (D) 40/3m

Q.2 On an inclined plane inclined at an angle of 30° to the horizontal, a ball is thrown upwards with a velocity of 10 m/s, at an angle of 60° to the inclined plane. Its range on the inclined plane is :

(A) 10 m (B) $5\sqrt{3}$ m (C) 0 m (D) $10\sqrt{3}$ m

Q.3 A projectle is fired horizontally from an inclined plane (of inclination 45° with horizontal) with speed = 50 m/s. If g = 10 m/s^2, the range measured along the incline is

(A) 500 m (B) $500\sqrt{2}$ m (C) $200\sqrt{2}$ m (D) none of these

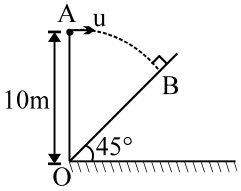
Q.4 A projectile is thrown from ground. With what minimum velocity, the projectile should be thrown so that is passes through a point (3, 4). (Take g = 10 m/s^2)

Q.5 A body is thrown with velocity 20 m/s at an angle of 60° with the horizontal. Find the time gap between the two positions of body where velocity of body makes an angle of 30° with horizontal

(A) 1.15 sec. (B) 0.95 sec. (C) 1 sec. (D) 1.5 sec.

Q.6 A man can throw a stone with initial speed of 10 m/s. Find the maximum horizontal distance to which he can throw the stone in a room of height h m for : (i) h = 2 m & (ii) h = 4 m

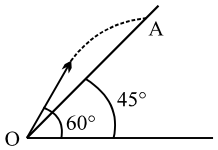
Q.7 A particle is projected horizontally with speed *u* from point A, which is 10 m above the ground. If the particle hits the inclined plane perpendicularly at point B. [g = 10 m/s^2]



(a) Find horizontal speed with which the particle was projected.
(b) Find the length OB along the inclined plane.

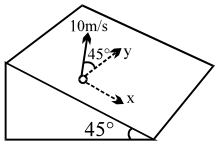
Q.8 A particle P is projected horizontally, with speed V, from a point O on a plane which is inclined at an angle β to the horizontal. The particle hits the plane at a point A which is on the line of greatest slope through O. (a) Find the time of flight. (b) Find the tangent of the acute angle between the horizontal and the direction of motion of P when P reached A. A second particle Q is projected from O, with speed V, in a direction perpendicular to the plane. (c) Find the time taken for Q to return to the plane and (d) show that Q hits the plane at A.

Q.9 A particle is projected with an initial velocity of 20 m/s at 60° to the horizontal from a point O at the bottom of a plane inclined at 45° to the horizontal. The particle hits the plane again at a point A where OA is a line of greatest slope find



(a) the time of flight.
(b) the range OA on the plane.

Q.10 The small marble is projected with a velocity of 10 m/s in a direction 45° from the horizontal y-direction on the smooth inclined plane. Calculate the magnitude v of its velocity after 2 seconds. Take g =10 m/s^2.



Q.1 A stone is released from an elevator going up with an acceleration a. The acceleration of the stone after the release is
(A) a upward (B) (g – a) upward (C) (g – a) downward (D) g downward

Q.2 Three ships A, B & C are in motion. The motion of A as seen by B is with speed v towards north – east. The motion of B as seen by C is with speed v towards the north – west. Then as seen by A, C will be moving towards
(A) north (B) south (C) east (D) west

Q.3 Men are running in a line along a road with velocity 9 Km/hr behind one another at equal intervals of 20m. Cyclist are also riding along the same line in the same direction at 18 Km/hr at equal intervals of 30m. The speed with which an observer must travel along the road so that whenever he meets a runner he also meet a cyclist is
(A) 9km/h (B) 12 Km/h (C) 18 Km/h (D) 6 Km/h

Q.4 Two ships are 10km apart on a line running south to north. The one further north is steaming west at 40km/hr. The other is steaming north at 40km/hr. What is their distance of closest approach and how long do they take to reach it?

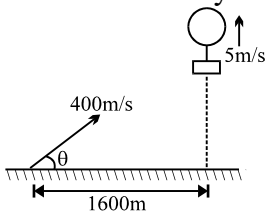
Q.5 A man holding a flag is running in North-East direction with speed 10 m/s. Wind is blowing in east direction with speed $5\sqrt{2}$ m/s. Find the direction in which flag will flutter.

Q.6 A man who can swim at the rate of 2 km/hr. crosses a river to an exactly opposite point on the other bank by swimming in a direction of 120° to the flow of the water in the river. The velocity of the water current in km/hr is _____.

Q.7 A man can swim at 4 m/s in a still water swimming pool. He enters a 200 m wide river at one bank and swims (w.r.t. water) at an angle of 60° to the river flow velocity. The river flow velocity is 5 m/s. In how much time does he cross the river? Calculate his drift.

Q.8 A man can row a boat in still water at 3 km/h. He can walk at a speed of 5 km/h on the shore. The water in the river flows at 2 km/h. If the man rows across the river and walks along the shore to reach the opposite point on the river bank find the direction with the river flow in which he should row the boat so that he could reach the opposite shore in the least possible time. The width of the river is 500 m.

Q.9 A gun crew observes a remotely controlled balloon launching an instrumented spy package in enemy territory. When first noticed the balloon is at an altitude of 800 m and moving vertically upward at a constant velocity of 5 m/s and 1600 m away. Shells fired from the gun have an initial velocity of 400 m/s at a fixed angle θ ($\sin\theta = 3/5$ and $\cos\theta = 4/5$). The gun crew waits and fires so as destroy the balloon. Assume $g = 10\ m/s^2$. Neglect air resistance.
(a) What is the flight time of the shell before it strikes the balloon?
(b) What is the altitude of the collision?
(c) How long did the gun crew wait before they fired?



Q.10 A level flight plane flying at an altitude of 1024ft with a speed of 240ft/sec. is overtaking a motor boat travelling at 80ft/sec. in the same direction as the plane. At what horizontal distance before the boat should a bag be dropped from the plane in order to hit the boat? [$g = 32 ft/s^2$]

Q.1 To man running at a speed of 5 m/sec,the rain drops appear to be falling at an angle of 45° from the vertical. If the rain drops are actually falling vertically downwards , then velocity in m/sec is

(A) 5 (B) $5\sqrt{3}$ (C) $5\sqrt{2}$ (D) 4

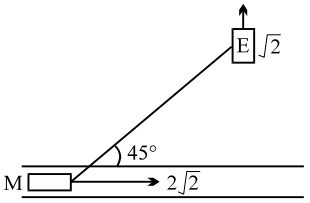
Q.2 A ball is thrown vertically upwards with a velocity 'u' from the balloon descending with velocity V. The ball will pass by the balloon after time.

(A) $\frac{u-V}{2g}$ (B) $\frac{u+V}{2g}$ (C) $\frac{2(u-V)}{g}$ (D) $\frac{2(u+V)}{g}$

Q.3 Two particles are simultaneously projected in opposite directions horizontally from a given point in space where gravity 'g' is uniform. If u_1 and u_2 be their initial speeds then the time 't' after which their velocities are mutually perpendicular is given by

(A) $\frac{\sqrt{u_1u_2}}{g}$ (B) $\frac{\sqrt{u_1^2+u_2^2}}{g}$ (C) $\frac{\sqrt{u_1(u_1+u_2)}}{g}$ (D) $\frac{\sqrt{u_2(u_1+u_2)}}{g}$

Q.4 A bow man is riding on a horse moving with speed of $2\sqrt{2}$ ms^{-1} along a straight road. He aims at his enemy moving perpendicularly to the road at speed of $\sqrt{2}$ ms^{-1}. At the instant when he fires the arrow, the line joining man and his enemy makes an angle of 45° with the road. Find the angle with the road at which he should aim to hit his enemy? Muzzle velocity of arrow is $5ms^{-1}$. (given that $\sin 37° = 3/5$). Neglect effect of gravity.



Q.5 Velocity of water current in a river is 2 km/hr. A boat rowing with a velocity of 8 k /hr. A boat rowing with a velocity of 8 km/hr. is directed towards exactly opposite point on the other side of the bank. However the boat strikes the opposite bank 75 m away from the desired point. The width of the river is _____.

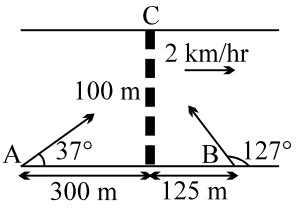
Q.6 A man wishes to cross a river to an exactly opposite point on the other bank ; if he can pull his boat with twice the velocity of the current, find at what inclination to the current he must point the boat.

Q.7 A mass crosses a river in a boat. If he crosses the river in minimum time he takes 10 minutes with a drift 120 m. If he crosses the river taking shortest path, he takes 12.5 minute, find

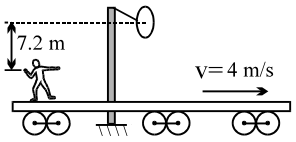
(i) width of the river,
(ii) velocity of the boat with respect to water,
(iii) speed of the current.

Assume $v_{b/r} > v_r$

Q.8 Two swimmers start a race. One who reaches the point C first on the other bank wins the race. A makes his strokes in a direction of 37^0 to the river flow with velocity 5km/hr relative to water. B makes his strokes in a direction 127^0 to the river flow with same relative velocity. River is flowing with speed of 2km/hr and is 100m wide. Who will win the race? Compute the time taken by A and B to reach the point C if the speeds of A and B on the ground are 8km/hr and 6km/hr respectively.



Q.9 A man is riding a flatcar travelling with constant speed of 4 m/s. There is a stationary ring above the line of motion of the car. Height of the ring above man's hand is 7.2 m. He wishes to throw a ball through the ring in such a manner that the ball passes through the ring moving horizontally. He throws the ball with a speed of 20 m/s with respect to himself (car).



(a) What must be the vertical component of the initial velocity of the ball?

(b) How many seconds after he releases the ball will it pass through the ring?

(c) When the ball leaves the man's hand, what is the direction of its velocity relative to the frame of reference of the flatcar?

(d) At what horizontal distance in front of the ring must he release the ball?

Q.10 A very broad elevator is going up vertically with a constant acceleration 1 ms^{-2}. At the instant when the velocity of the lift is 2 m/s, a stone is projected from the floor of the lift with a speed of 2 m/s relative to the floor at an elevation 30º. Find :

(a) the time taken by the stone to return to the floor.

(b) the range of the stone over the floor of the lift. [$g = 10\ ms^{-2}$]

(c) angle of projection in ground frame