fo/u fopkjr Hkh# tu] ugh vkjEHk dke] foifr n[k NkM rjr e/;e eu dj ';keA
i#"k flag ldYi dj] lgr foifr vud] ^cuk^ u NkM /;; dk] j?kcj jk[k VdAA

jfpr% ekuo /ke i.krk
lnx# Jh j.kNkMnklth egkjkt

STUDY PACKAGE

Subject : PHYSICS

Topic : KINEMATICS

Available Online : www.MathsBySuhag.com

Teko CLASSES ®
.....the support

Index

Student's Name :______________________

Class :______________________

Roll No. :______________________

Address : Plot No. 27, III- Floor, Near Patidar Studio,
Above Bond Classes, Zone-2, M.P. NAGAR, Bhopal
☎ : 0 903 903 7779, 98930 58881, WhatsApp 9009 260 559
www.TekoClasses.com **www.MathsBySuhag.com**

SHORT REVISION

THINGS TO REMEMBER :

1. $v = \frac{ds}{dt}$; $a = \frac{dv}{dt} = v\frac{dv}{ds}$; $s = \int v\,dt$; $v = \int a\,dt$; $\frac{v^2}{2} = \int a\,ds$

where the symbols have their usual meaning .

2. The equations of motion for a body moving in straight line with uniform acceleration, are

(i) $v = u + at$ **(ii)** $s = \left(\frac{u+v}{2}\right)t = ut + \frac{at^2}{2} = vt - \frac{at^2}{2}$ **(iii)** $v^2 = u^2 + 2as$

(iv) $s_n = u + \frac{1}{2}\,a\,(2n-1)$ **(v)** $S = \left(\frac{v+u}{2}\right)t$

3. If a body is thrown vertically up with a velocity u in the uniform gravitational field then (neglecting air resistance) :

(i) Maximum height attained $H = \frac{u^2}{2g}$ **(ii)** Time of ascent = time of descent = $\frac{u}{g}$

(iii) Total time of flight = $\frac{2u}{g}$ **(iv)** Velocity of fall at the point of projection = u downwards

4. KINEMATIC GRAPH :

Slope of the displacement time graph at any particular time gives the magnitude of the instantaneous velocity at that particular time .

Slope of the v-t graph will give the magnitude of the instantaneous acceleration.

The area between the v-t graph, the time axis and the ordinates erected at the beginning & end of time interval considered will represent the total displacement of the body.

5. RELATIVE VELOCITY :

(a) Velocity of 'A' relative to 'B' is given by $\vec{V}_{AB} = \vec{V}_A - \vec{V}_B$.

$\vec{V}_{AB}$ refers to the velocity which 'A' appears to have as seen by B. The above idea of 1 dimensional relative motion can be extended to motion in 2 dimensions.

(b) Angular velocity of A relative to B i.e. ω_{AB} is given by

$$\omega_{AB} = \frac{\text{velocity of A relative to B in a direction perpendicular to AB}}{AB}$$

6. LEVEL GROUND PROJECTILE MOTION :

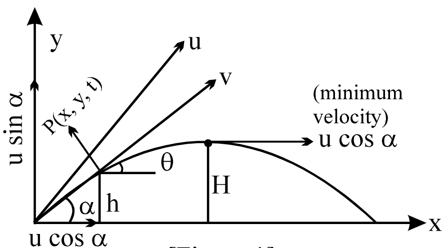
When a body is thrown obliquely (in a vertical plane) into the uniform gravitational field then the trajectory (actual path of motion) is a parabola. The horizontal component of velocity $u\cos\alpha$ remains unchanged where as vertical component decreases up to the maximum height and then increases .

(a) Time taken to reach the height point $t_H = \frac{u\sin\alpha}{g}$

(b) Maximum height $H = \frac{u^2\sin^2\alpha}{2g}$

(c) Total time of flight = $\frac{2u\sin\alpha}{g} = 2\,t_H$

(d) Horizontal range = $(u\cos\alpha)\,.\,T = \frac{2}{g}(u\cos\alpha)(u\sin\alpha) = \frac{u^2\sin 2\alpha}{g}$



[Figure 1]

(e) $R_{max} = \frac{u^2}{g}$ if $\alpha = 45°$

Note that for a given velocity of projection & a given horizontal range there are in general two directions of projection which are complement of each other and are equally inclined to the direction of the maximum range.

(f) VELOCITY & DIRECTION OF MOTION AT A GIVEN TIME :

$$\left.\begin{aligned} V\cos\theta &= u\cos\alpha \\ V\sin\theta &= u\sin\alpha - gt \end{aligned}\right]$$ Squaring & adding these 2 equations we will get the velocity of the projectile. Dividing the velocities in y and x directions gives the direction of motion.

(g) VELOCITY & DIRECTION OF MOTION AT A GIVEN HEIGHT h :

$$\left.\begin{aligned} V^2\cos^2\theta &= u^2\cos^2\alpha \\ V^2\sin^2\theta &= u^2\sin^2\alpha - 2gh \end{aligned}\right] \text{ on adding } V^2 = u^2 - 2gh$$

(h) EQUATIONS OF MOTION IN VECTOR NOTATION :

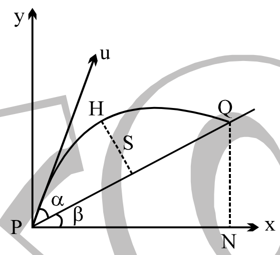
(i) $\vec{V} = \vec{u} + \vec{g}t$ **(ii)** $\vec{S} = \vec{u}t + \frac{1}{2}\vec{g}t^2$ **(iii)** $\vec{V}_{av} = \frac{\vec{S}}{t} = \vec{u} + \frac{1}{2}\vec{g}t$ ($\vec{V}_{av}$ = average velocity vector)

(i) EQUATION OF TRAJECTORY :

Oblique Projection (refer fig-1) $y = x\tan\alpha - \dfrac{gx^2}{2u^2\cos^2\alpha} = x\tan\alpha\left(1 - \dfrac{x}{R}\right)$

Note that $\frac{dy}{dx}$ represent the direction of motion .

7. PROJECTILE UP AN INCLINED PLANE :



(a) Total time of flight on the inclined plane

$$T = \frac{2u}{g}\,\frac{\sin(\alpha - \beta)}{\cos\beta}$$

(b) Range PQ on the inclined plane

$$PQ = \frac{2u^2}{g}\,\frac{\cos\alpha\,.\,\sin(\alpha - \beta)}{\cos^2\beta} = \frac{u^2}{g\cos^2\beta}\,[\sin(2\alpha - \beta) - \sin\beta]$$

(c) For Maxmimum range $2\alpha - \beta = \frac{\pi}{2} \Rightarrow \alpha = \frac{\pi}{4} + \frac{\beta}{2}$

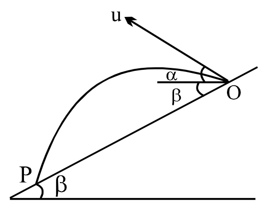
Hence the direction for maximum range bisects the angle between the vertical and the inclined plane .

(d) $R_{max} = \dfrac{u^2}{g(1 + \sin\beta)}$

(e) Greatest distance of the projectile from the inclined plane ;

$S = \dfrac{u^2\sin^2(\alpha - \beta)}{2g\cos\beta}$ when the projectile is at H, its velocity perpendicular to the plane is zero .

8. PROJECTILE DOWN AN INCLINED PLANE :



(a) Time of flight = $\dfrac{2u\sin(\alpha + \beta)}{g\cos\beta}$

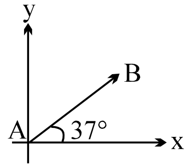
(b) Range OP = $\dfrac{2u^2\sin(\alpha + \beta)\,.\,\cos\alpha}{g\cos^2\beta}$

(c) Maximum range = $\dfrac{u^2}{g(1 - \sin\beta)}$

(d) Angle of projection α for maximum range = $\dfrac{\pi}{4} - \dfrac{\beta}{2}$

EXERCISE – I

Q.1 A butterfly is flying with velocity $10\hat{i}+12\hat{j}$ m/s and wind is blowing along x axis with velocity u. If butterfly starts motion from A and after some time reaches point B, find the value of u.

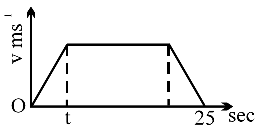


Q.2 Find the change in velocity of the tip of the minute hand (radius = 10 cm) of a clock in 45 minutes.

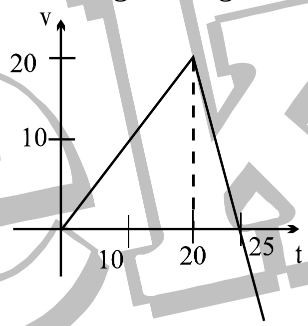
Q.3 A, B & C are three objects each moving with constant velocity. A's speed is 10 m/sec in a direction $\overrightarrow{PQ}$. The velocity of B relative to A is 6 m/sec at an angle of, $\cos^{-1}(15/24)$ to PQ . The velocity of C relative to B is 12 m/sec in a direction $\overrightarrow{QP}$, then find the magnitude of the velocity of C.

Q.4 Rain is falling vertically with a speed of 20 ms^{-1} relative to air. A person is running in the rain with a velocity of 5 ms^{-1} and a wind is also blowing with a speed of 15 ms^{-1} (both towards east). Find the angle with the vertical at which the person should hold his umbrella so that he may not get drenched.

Q.5 The velocity-time graph of the particle moving along a straight line is shown. The rate of acceleration and deceleration is constant and it is equal to 5 ms^{-2}. If the average velocity during the motion is 20 ms^{-1}, then find the value of t.



Q.6 The fig. shows the v–t graph of a particle moving in straight line. Find the time when particle returns to the starting point.



Q.7 A particle is projected in the X-Y plane. 2 sec after projection the velocity of the particle makes an angle 45° with the X - axis. 4 sec after projection, it moves horizontally. Find the velocity of projection (use g = 10 ms^{-2}).

Q.8 A stone is dropped from a height h . Simultaneously another stone is thrown up from the ground with such a velocity that it can reach a height of 4h. Find the time when two stones cross each other.

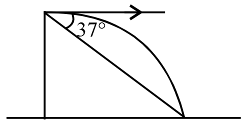
Q.9 A particle is projected upwards with a velocity of 100 m/sec at an angle of 60° with the vertical. Find the time when the particle will move perpendicular to its initial direction, taking g =10 m/sec^2.

Q.10 A balloon is ascending vertically with an acceleration of 0.2m/s^2. Two stones are dropped from it at an interval of 2 sec. Find the distance between them 1.5 sec after the second stone is released.(use g=9.8m/s^2)

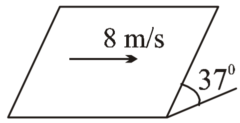
Q.11 A large number of bullets are fired in all direction with the same speed v. What is the maximum area on ground on which these bullets can spread?

Q.12 A boat starts from rest from one end of a bank of a river of width d flowing with velocity u. The boat is steered with constant acceleration a in a direction perpendicular to the bank. If point of start is origin, direction of bank is x axis and perpendicular to bank is y axis. Find the equation of trajectory of the boat .

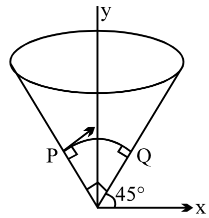
Q.13 A ball is thrown horizontally from a cliff such that it strikes ground after 5 sec. The line of sight from the point of projection to the point of hitting makes an angle of 37° with the horizontal. What is the initial velocity of projection.



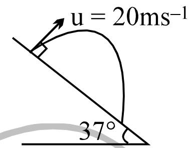
Q.14 A ball is projected on smooth inclined plane in direction perpendicular to line of greatest slope with velocity of 8m/s. Find it's speed after 1 sec.



Q.15 A particle is projected from point P with velocity $5\sqrt{2}$ m/s perpendicular to the surface of a hollow right angle cone whose axis is vertical. It collides at Q normally. Find the time of the flight of the particle.

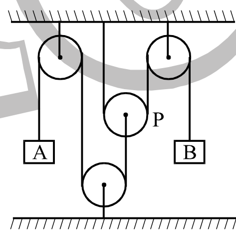


Q.16 Find range of projectile on the inclined plane which is projected perpendicular to the incline plane with velocity 20m/s as shown in figure.

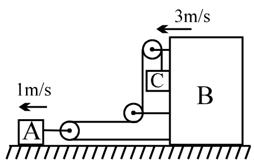


Q.17 Initial acceleration of a particle moving in a straight line is a_0 and initial velocity is zero. The acceleration reduces continuously to half in every t_0 seconds as $a = \frac{a_0}{2^{t/t_0}}$. Find the terminal velocity of the particle.

Q.18 Find the acceleration of movable pulley P and block B if acceleration of block A = 1 m/s^2 ↓.



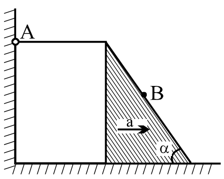
Q.19 The velocities of A and B are marked in the figure. Find the velocity of block C (assume that the pulleys are ideal and string inextensible).



Q.20 A particle is moving in x-y plane such that x = t + sin(t) meter , y = cos (t) meter. t is the time in sec. Find the length of the path taken by the particle from t = 0 to t = 2π sec.

Q.21 The speed of a particle when it is at its greatest height $\sqrt{2/5}$ is of its speed 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.22 A weightless inextensible rope on a stationary wedge forming angle α with the horizontal. One end of the rope is fixed to the wall at point A. A small load is attached to the rope at point B. The wedge starts moving to the right with a constant acceleration. Determine the acceleration a_1 of the load when it is still on the wedge.



Teko Classes, Maths : Suhag R. Kariya (S. R. K. Sir), Bhopal Phone : 0 903 903 7779, 0 98930 58881.

Q.23 The horizontal range of a projectiles is R and the maximum height attained by it is H. A strong wind now begins to blow in the direction of motion of the projectile, giving it a constant horizontal acceleration = g/2. Under the same conditions of projection, find the horizontal range of the projectile.

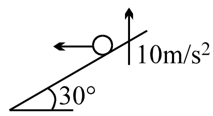
Q.24 A rocket is launched at an angle 53° to the horizontal with an initial speed of 100 ms^{-1} . It moves along its initial line of motion with an acceleration of 30 ms^{-2} for 3 seconds. At this time its engine falls & the rocket proceeds like a free body. Find :

(i) the maximum altitude reached by the rocket

(ii) total time of flight .

(iii) the horizontal range . [sin 53° = 4/5]

Q.25 A particle is thrown horizontally with relative velocity 10 m/s from an inclined plane, which is also moving with acceleration 10 m/s^2 vertically upward. Find the time after which it lands on the plane (g = 10 m/s^2)



List of recommended questions from I.E. Irodov.

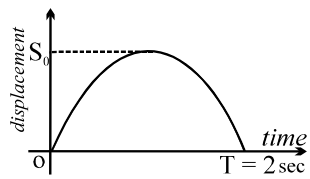
1.1, 1.4 to 1.8, 1.10, 1.11, 1.14, 1.15, 1.17, 1.18, 1.19, 1.21, 1.24, 1.26, 1.27, 1.31, 1.32, 1.33, 1.34(a)

EXERCISE–II

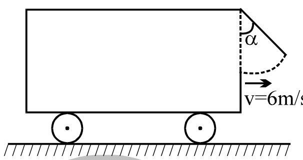
Q.1 A train takes 2 minutes to acquire its full speed 60kmph from rest and 1 minute to come to rest from the full speed. If somewhere in between two stations 1 km of the track be under repair and the limited speed on this part be fixed to 20kmph, find the late running of the train on account of this repair work, assuming otherwise normal at running of the train between the stations.

Q.2 A speeder in an automobile passes a stationary policeman who is hiding behind a bill board with a motorcycle. After a 2.0 sec delay (reaction time) the policeman accelerates to his maximum speed of 150 km/hr in 12 sec and catches the speeder 1.5 km beyond the billboard. Find the speed of speeder in km/hr.

Q.3 A particle is moving on a straight line. Its displacement from the initial position is plotted against time in the graph shown. What will be the velocity of the particle at 2/3 sec? Assume the graph to be a sine curve.



Q.4 A glass wind screen whose inclination with the vertical can be changed, is mounted on a cart as shown in figure. The cart moves uniformly along the horizontal path with a speed of 6 m/s. At what maximum angle α to the vertical can the wind screen be placed so that the rain drops falling vertically downwards with velocity 2 m/s, do not enter the cart?



Q.5 An aeroplane is observed by two persons travelling at 60 km/hr in two vehicles moving in opposite directions on a straight road. To an observer in one vehicle the plane appears to cross the road track at right angles while to the observer in the other vehicle the angle appears to be 45°. At what angle does the plane actually cross the road track and what is its speed relative to the ground.

Q.6 How long will a plane take to fly around a square with side a with the wind blowing at a velocity u, in the two cases

(a) the direction of the wind coincides with one of the sides

(b) the direction of the wind coincides with one diagonal of the square. The velocity of the plane in still air is $v > u$.

Q.7 Two ships A and B originally at a distance d from each other depart at the same time from a straight coastline. Ship A moves along a straight line perpendicular to the shore while ship B constantly heads for ship A, having at each moment the same speed as the latter. After a sufficiently great interval of time the second ship will obviously follow the first one at a certain distance. Find the distance.

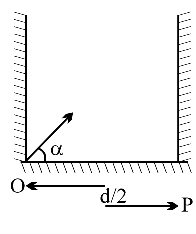
Q.8 The slopes of the wind-screen of two motorcars are $\beta_1 = 30^0$ and $\beta_2 = 15^0$ respectively. The first car is travelling with a velocity of v_1 horizontally. The second car is travelling with a velocity v_2 in the same direction. The hail stones are falling vertically. Both the drivers observe that the hail stones rebound vertically after elastic collision with the wind-screen. Find the ratio of v_1/v_2.

Q.9 A small ball is thrown between two vertical walls such that in the absence of the wall its range would have been 5d. The angle of projection is α. Given that all the collisions are perfectly elastic, find

(a) Maximum height attained by the ball.

(b) Total number of collisions before the ball comes back to the ground, and

(c) Point at which the ball falls finally. The walls are supposed to be very tall.

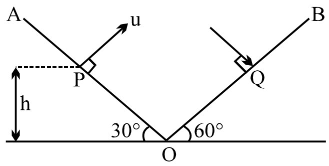


Teko Classes, Maths : Suhag R. Kariya (S. R. K. Sir), Bhopal Phone : 0 903 903 7779, 0 98930 58881.

Q.10 A hunter is riding an elephant of height 4m moving in straight line with uniform speed of 2m/sec. A deer running with a speed V in front at a distance of $4\sqrt{5}$m moving perpendicular to the direction of motion of the elephant. If hunter can throw his spear with a speed of 10m/sec. relative to the elephant, then at what angle θ to it's direction of motion must he throw his spear horizontally for a successful hit. Find also the speed 'V' of the deer.

Q.11 A projectile is to be thrown horizontally from the top of a wall of height 1.7 m. Calculate the initial velocity of projection if it hits perpendicularly an incline of angle 37° which starts from the ground at the bottom of the wall. The line of greatest slope of incline lies in the plane of motion of projectile.

Q.12 Two inclined planes OA and OB having inclination (with horizontal) 30° and 60° respectively, intersect each other at O as shown in fig. A particle is projected from point P with velocity $u = 10\sqrt{3}$ m s^{-1} along a direction perpendicular to plane OA. If the particle strikes plane OB perpendicularly at Q, calculate

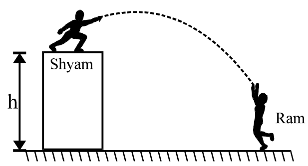


(a) velocity with which particle strikes the plane OB,
(b) time of flight,
(c) vertical height h of P from O,
(d) maximum height from O attained by the particle and
(e) distance PQ

Q.13 A particle is projected with a velocity $2\sqrt{ag}$ so that it just clears two walls of equal height 'a' which are at a distance '2a' apart. Show that the time of passing between the walls is $2\sqrt{a/g}$.

Q.14 A stone is projected from the point of a ground in such a direction so as to hit a bird on the top of a telegraph post of height h and then attain the maximum height 2h above the ground. If at the instant of projection, the bird were to fly away horizontally with a uniform speed, find the ratio between the horizontal velocities of the bird and the stone, if the stone still hits the bird while descending.

Q.15 Two persons Ram and Shyam are throwing ball at each other as shown in the figure. The maximum horizontal distance from the building where Ram can stand and still throw a ball at Shyam is d_1. The maximum horizontal distance of Ram from the building where Shyam can throw a ball is d_2. If both of them can throw ball with a velocity of $\sqrt{2gk}$, find the ratio of d_1/d_2. Neglect the height of each person.



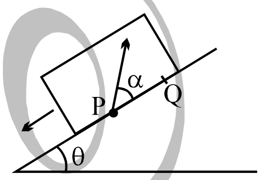
EXERCISE # III

Q.1 The motion of a body is given by the equation $\frac{d\,v(t)}{dt} = 6.0 - 3\,v(t)$; where $v(t)$ is the speed in m/s & t in sec., if the body has v = 0 at t = 0 then
(A) the terminal speed is 2.0 m/s
(B) the magnitude of the initial acceleration is 6.0 m/s^2
(C) the speed varies with time as $v(t) = 2(1 - e^{-3t})$ m/s
(D) the speed is 1.0 m/s when the acceleration is half the initial value. [JEE '1995]

Q.2 Two guns, situated at the top of a hill of height 10 m, fire one shot each with the same speed $5\sqrt{3}$ m/s at some interval of time. One gun fires horizontally and other fires upwards at an angle of 60° with the horizontal. The shots collide in air at a point P. Find
(a) the time interval between the firings, and
(b) the coordinates of the point P. Take origin of the coordinates system at the foot of the hill right below the muzzle and trajectories in X-Y plane. [JEE'1996]

Q.3 The trajectory of a projectile in a vertical plane is $y = ax - bx^2$, where a, b are constants & x and y are respectively the horizontal & vertical distances of the projectile from the point of projection . The maximum height attained is ______ & the angle of projection from the horizontal is ______. [JEE '1997]

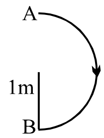
Q.4 A large heavy box is sliding without friction down a smooth plane of inclination θ. From a point P on the bottom of a box, a particle is projected inside the box. The initial speed of the particle with respect to box is u and the direction of projection makes an angle α with the bottom as shown in figure.



(a) Find the distance along the bottom of the box between the point of projection P and the point Q where the particle lands. (Assume that the particle does not hit any other surface of the box. Neglect air resistance).
(b) If the horizontal displacement of the particle as seen by an observer on the ground is zero, find the speed of the box with respect to the ground at the instant when the particle was projected. [JEE'1998]

Q.5 A particle of mass 10^{-2} kg is moving slong the positive x-axis under the influence of a force $F(x) = \frac{-K}{2x^2}$ where $K = 10^{-2}\ N\ m^2$. At time t = 0 it is at x = 1.0 m & its velocity is v = 0 . Find :
(i) its velocity when it reaches x = 0.50 m
(ii) the time at which it reaches x = 0.25 m . [JEE '1998]

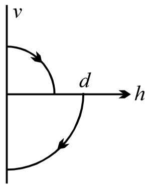
Q.6 In 1.0 sec. a particle goes from point A to point B moving in a semicircle of radius 1.0 m. The magnitude of average velocity is : [JEE '99]

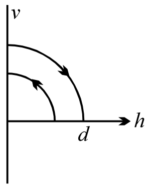


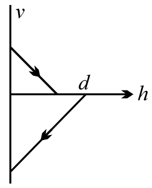
(A) 3.14 m/sec (B) 2.0 m/sec
(C) 1.0 m/sec (D) zero

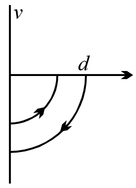
Q.7 The co-ordinates of a particle moving in a plane are given by $x(t) = a\cos(\pi t)$ and $y(t) = b\sin(\pi t)$ where a, b (<a) & π are positive constants of appropriate dimensions.
(A) the path of the particle is an ellipse
(B) the velocity & acceleration of the particle are normal to each other at $t = \pi/(2\pi)$
(C) the acceleration of the particle is always directed towards a focus
(D) the distance travelled by the particle in time interval $t = 0$ o $t = \pi/(2\pi)$ is a . [JEE '1999]

Q.8 A ball is dropped vertically from a height d above the ground it hits the ground and bounces up vertically to a height $d/2$. Neglecting subsequent motion and air resistances, its velocity v varies with the height h above the ground as [JEE'2000 (Scr)]

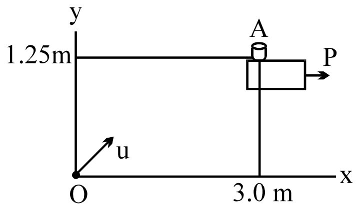
(A) 

(B) 

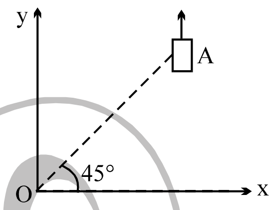
(C) 

(D) 

Q.9 An object A is kept fixed at the point x = 3 m and y = 1.25 m on a plank P raised above the ground. At time t = 0 the plank starts moving along the + x direction with an acceleration 1.5 m/s^2. At the same instant a stone is projected from the origin with a velocity u as shown. A stationary person on the ground observes the stone hitting the object during its downward motion at an angle of 45° to the horizontal. All the motions are in x-y plane. Find u and the time after which the stone hits the object. Take g = 10 m/s^2. [JEE 2000]



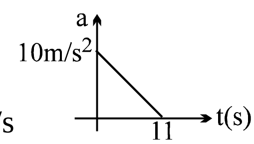
Q.10 On a frictionless horizontal surface, assumed to be the x-y plane, a small trolley A is moving along a straight line parallel to the y-axis (see figure) with a constant velocity of $(\sqrt{3}-1)$ m/s. At a particular instant, when the line OA makes an angle of 45° with the x-axis, a ball is thrown along the surface from the origin O. Its velocity makes an angle ϕ with the x-axis and it hits the trolley.



(a) The motion of the ball is observed from the frame of trolley. Calculate the angle θ made by the velocity vector of the ball with the x-axis in this frame.

(b) Find the speed of the ball with respect to the surface, if $\phi = \frac{4\theta}{3}$. [JEE 2002]

Q.11 A particle starts from rest. Its acceleration (a) versus time (t) is as shown in the figure. The maximum speed of the particle will be [JEE' 2004 (Scr)]

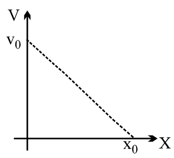


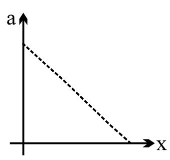
(A) 110 m/s (B) 55 m/s (C) 550 m/s (D) 660 m/s

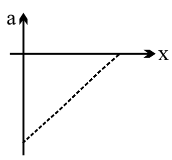
Q.12 A small block slides without friction down an inclined plane starting from rest. Let Sn be the distance travelled from time t = n - 1 to t = n. Then $\frac{S_n}{S_{n+1}}$ is [JEE' 2004 (Scr)]

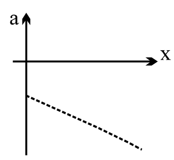
(A) $\frac{2n-1}{2n}$ (B) $\frac{2n+1}{2n-1}$ (C) $\frac{2n-1}{2n+1}$ (D) $\frac{2n}{2n+1}$

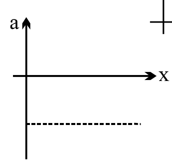
Q.13 The velocity displacement graph of a particle moving along a straight line is shown. The most suitable acceleration-displacement graph will be



(A) 

(B) 

(C) 

(D) 

[JEE' 2005 (Scr)]

ANSWER KEY

EXERCISE # I

Q.1 6 m/s   Q.2 $\left(\frac{\pi\sqrt{2}}{3}\right)$ cm/min   Q.3 5 m/sec   Q.4 $\tan^{-1}(1/2)$

Q.5 5 s   Q.6 36.2 sec.   Q.7 $20\sqrt{5}$ Q.8 $\sqrt{\left(\frac{h}{8g}\right)}$

Q.9 20 sec   Q.10 50m   Q.11 $\frac{\pi v^4}{g^2}$ Q.12 $y = \frac{a x^2}{2u^2}$

Q.13 100/3 m/s   Q.14 10 m/s   Q.15 1 sec   Q.16 75 m

Q.17 $\frac{a_0 t_0}{ln(2)}$ Q.18 $a_P = 1$ m/s² ↓, $a_B = 2$ m/s² ↑   Q.19 5 m/s

Q.20 8 m   Q.21 60^0, $\tan^{-1}\left(\sqrt{3/2}\right)$ Q.22 $2a\sin(\alpha/2)$

Q.23 R + 2H   Q.24 (i) 1503.2 m (ii) 35.54 sec (iii) 3970.56 m

Q.25 $\frac{1}{\sqrt{3}}$ sec

EXERCISE # II

Q.1 160 sec   Q.2 122.7 km/hr   Q.3 $\frac{S_0\pi}{4}$

Q.4 $2\tan^{-1}(1/3)$ Q.5 $\theta = \tan^{-1}2$, v = 134.16 km/h

Q.6 (a) $\frac{2a\left(v+\sqrt{v^2-u^2}\right)}{v^2-u^2}$, (b) $\frac{2\sqrt{2}a\left(\sqrt{2v^2-u^2}\right)}{v^2-u^2}$ Q.7 $\frac{d}{2}$ Q.8 3

Q.9 (a) 5d/4 tanα, (b) 9, (c) point O   Q.10 $\theta = 37^0$, v = 6m/s

Q.11 u = 3m/s   Q.12 (a) 10 ms^{-1}, (b) 2 sec, (c) 5 m, (d) 16.25 m, (e) 20 m

Q.14 $\frac{2}{\sqrt{2}+1}$ Q.15 $\sqrt{\frac{k-h}{k+h}}$

EXERCISE # III

Q.1 A, B, C, D   Q.2 (a) 1 sec, (b) ($5\sqrt{3}$ m, 5 m)   Q.3 $\frac{a^2}{4b}$, $\tan^{-1}a$

Q.4 (a) $\frac{u^2\sin 2\alpha}{g\cos\theta}$, (b) $v = \frac{u\cos(\alpha+\theta)}{\cos\theta}$ Q.5 (i) $\vec{V} = -1\ \hat{i}$ m/s (ii) $t = \frac{\pi}{3}+\frac{\sqrt{3}}{4}$

Q.6   Q.7 A, B   Q.8 A   Q.9 u = 7.29 m/s, t = 1 sec

Q.10 (a) 45°, (b) 2 m/sec   Q.11 B   Q.12 C   Q.13 B

