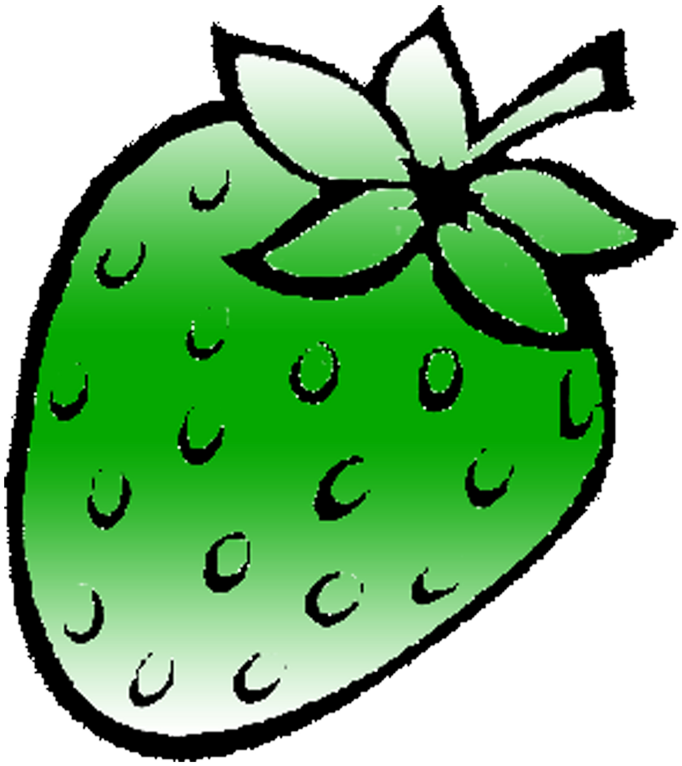
STRAWBERRY



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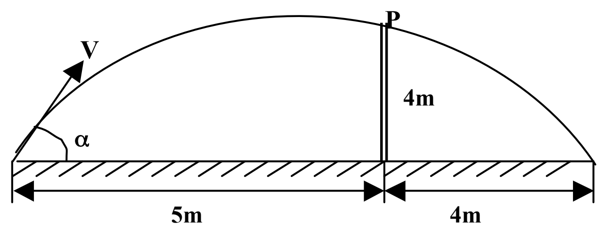
PROJECTILE MOTION

1. A projectile is aimed at a target on the horizontal plane and falls 12m short when the angle of projection is 15^0, while it overshoots by 24m when the angle is 45^0. Find the angle of projection to hit the mark.
   Ans.: $\alpha = 20.9^0$.

2. Find the least initial velocity with which a projectile is to be projected so that it clears a wall 4m height located at a distance of 5m and strikes the horizontal plane though the foot of the wall at a distance 4m beyond the wall as shown in figure. The point of projection is at the same level as the foot of the wall.
   Ans.: u = 10.2m/s



3. By what percentage the maximum range of projectile is increased if initial velocity is increased by 10%.
   Ans.: 21%

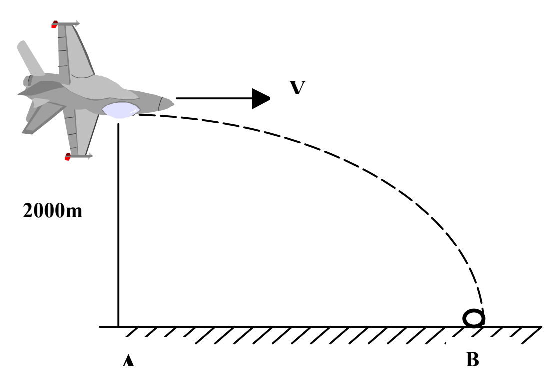
4. A ball can be thrown at a velocity of 20m/s. Find its maximum horizontal range inside a tunnel of a uniform height of 5m.
   Ans.: 35m

5. A stone is thrown from an elevation of 2m, such that it clears a wall 8m high, situated at a horizontal distance of 35m. if the angle of projection is 60^0 with respect to the horizontal, what should be the minimum velocity of projection. Take $g = 10m/s^2$.
   Ans.: 20.1 m/s

6. A shell is fired at a velocity of 50m/s and it hits a target 197.52m away from the gun and 10m above the level of it. Find the angle at which the shell is fired. Also find the angle of projection when target is 10m below the level of projection. Take $g = 10\ m/s^2$.
   Ans.: 30^0 & 62.9^0

7. A ball is thrown by player with an initial velocity of 15m/s from a point 1.5m above the ground. If the ceiling is 6m high, determine the highest point on the wall at which the ball strikes the wall 18m away. (T)
   Ans.: 4.04m

8. An aeroplane flying in a horizontal direction with a velocity of 540km/hr and at a height of 2000m. When it is vertically above the point A on the ground, a body is dropped from it. The body strikes the ground at a point B. Calculate the distance AB (ignore air resistance). Solve it by both methods (1) finding time of journey (2) using the equation of the path.
   Ans.: 3028m



9. **A shot is fired with a velocity of 40 meters per second from a point 20 meters in front of a vertical wall 10 meters high. Find the angle of projection to the horizontal to enable the shot just to clear the top of the wall.**

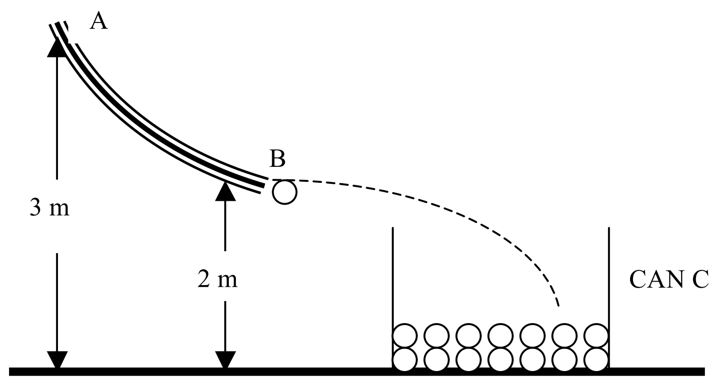
10. **A gun fires a projectile with velocity 300 m/s. Find the angle of inclination so that it strikes a target at horizontal distance of 4000 m from gun and 200 m above it.**
Ans. : 76.6^0

11. **A mortar fires a projectile across a level field so that the range 'r' is maximum and equal to 1,000 meters. Find the time of flight.**
Ans. : 14.14 sec

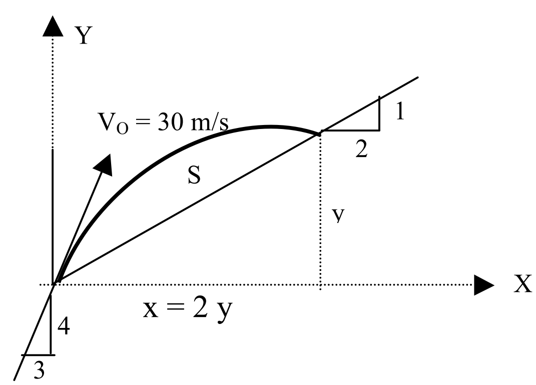
12. **A missile thrown at 30^0 to horizontal falls 10 m short of target, and goes 20m beyond the target when thrown at 40^0 to horizontal. Determine correct angle of projection if velocity remains the same in all the cases.**
Ans. : 32.49^0

13. **A stone is projected in a vertical plane from the ground with a velocity of 5 m/s at an elevation of 60^0. With what velocity must another stone by projected at an angle 45^0 in order to have the same horizontal range? What is the radius of curvature at t=0s?**
Ans. : u = 9 m/s; h_A = 44 m

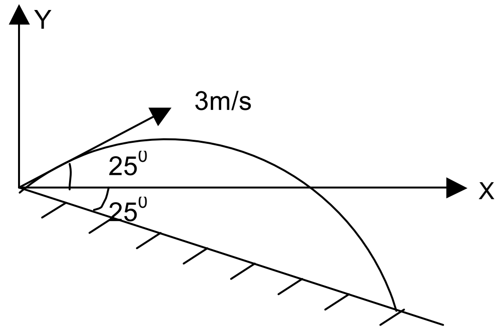
14. **Marbles having a mass 5 grams fall from rest at A through friction less glass tube and accumulate in the can C. Determine the placement of can C from the end of the tube and the speed at which the marbles fall in to the can. Neglect the size of the can and rotational effect of marbles in the glass tube. Marbles leave the tube at B horizontally. (T)**
Ans. : R = 2.828 m



15. **Determine the position at which a ball thrown up to the right will strike the inclined surface shown in figure. The initial velocity of the ball is 30m/s directed at θ = $\tan^{-1}(4/3)$ with the horizontal**
Ans.: s = 61.55m

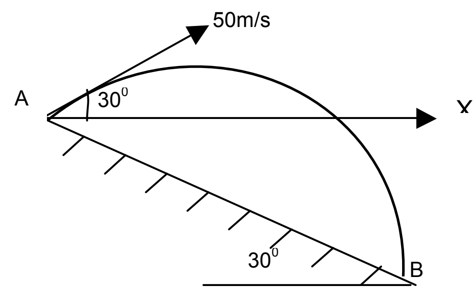


16. **A ball is projected from A with a speed of 3m/s at an angle of 25^0 as shown in figure. Determine the coordinated of point B at which the ball will hit the plane, which is 25^0 below the horizontal.**
Ans.: x=1.4m,y= - 0.655m

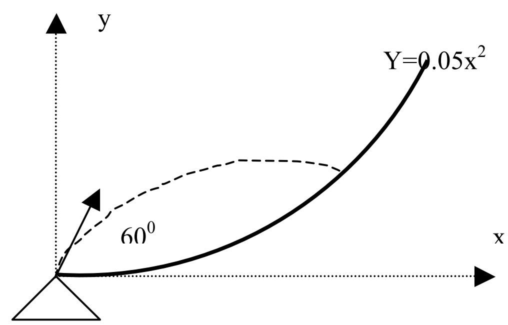


17. **A projectile is projected from position A on an inclined as shown in figure, with a velocity of 50m/s at an angle of 30 to the horizontal. Inline is making an angle of 30 with horizontal. Find when and where it strikes the incline again.**

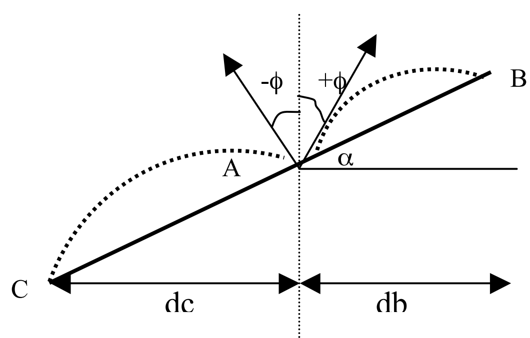
X=19.36 , y=-11.174



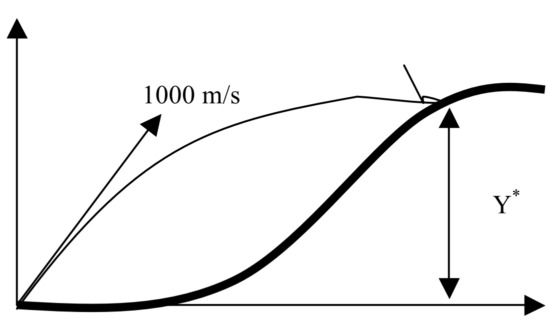
18. **The water sprinkler positioned at the base of a hill releases a stream of water with a velocity of 4.572m/s as shown. Determine the point B (x, y) where the water particles strike the ground on the hill. Assume that the hill is defined by the equation $y=0.1645x^2$ m, and neglect the size of the sprinkler. (x =1.569 m, y= 0.405m)**



19. **An oscillating water sprinkler is operated at point A on an incline which forms an angle α with the horizontal. The sprinkler discharges water with an initial velocity v_0 at an angle ϕ with the vertical which varies from $-\phi$ to $+\phi$. Knowing that v_0=8 m/s, $\phi=40^0$ and $\alpha=10^0$, determine the horizontal distance between sprinkler and points B and C which define watered area.**
Ans.: $d_{b=}$5.47m, dc=7.38 m



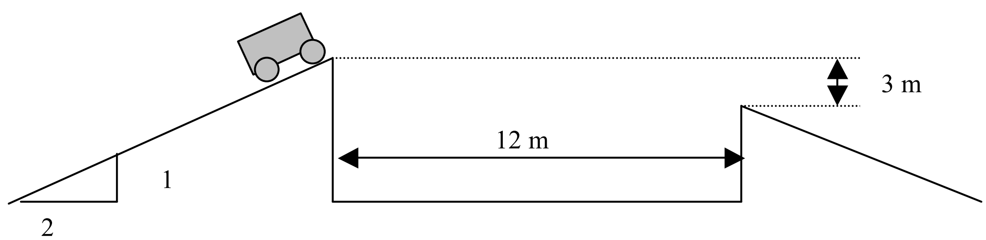
20. **A projectile is fired at an angle of 60^0. At what elevation y* does it strike the hill surface whose equation is $y = 10^{-8}x^2$? Neglect friction and take muzzle velocity as 1000 m/s.**
Ans. : x = 88235 m



21. A block of ice starts sliding down from the top of the inclined roof of a house (angle of inclination of roof = 30^0 with horizontal) along a line of maximum slope. The highest and the lowest point of the roof are 10.9m and 8.4m respectively from the ground. At what horizontal distance from the starting point will the block hit the ground? (neglect friction) (10.45m)

22. In a circus a stunt man is required to drive a jeep across the gap as shown in figure. Determine the minimum velocity of the jeep with which the stunt man should drive off a jeep so that the jeep will cross 12m wide gap. Find the angle θ of the landing ramp, so that landing will be smooth. Also find the time taken by the jeep to jump the gap. Assume length of the vehicle negligible. Take $g = 10 m/s^2$.

Ans.: v_{min} = 9.899m/s, t = 1.355sec, $\theta = -45^0$ landing ramp should be at an angle of 45^0

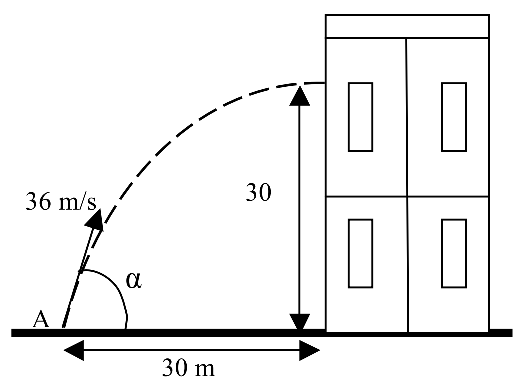


23. Find the direction in which a rifle must be pointed so that the bullet may strike a body let fall from a balloon at the instant of firing, find also the point where the bullet meets the body. The balloon is 200m high and its angle of elevation from the position of the rifleman is 30^0, the velocity of projection of the bullet is 400m/s.

Ans.: $\theta = 30^0$, 195.5m

24. A fire nozzle located at A discharges water with initial velocity v = 36 m/s. Knowing that the stream of water strikes the building at a height = 30 meters above the ground determine the angle α made by the nozzle with the horizontal. (T)

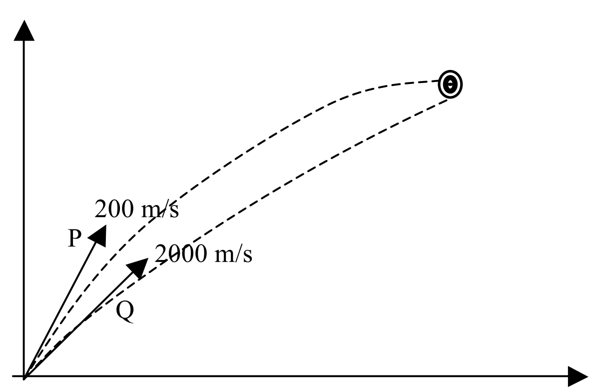
Ans. : $\alpha = 83.42^0$ or $\alpha = 7.385$



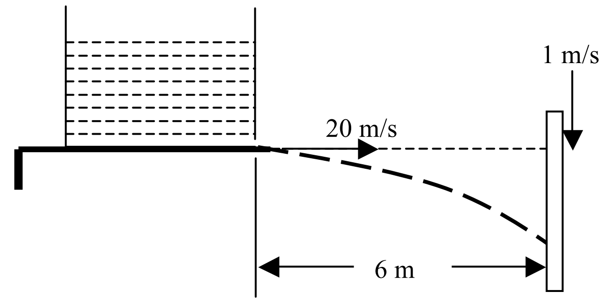
25. A projectile P is fired at a muzzle velocity of 200 m/s at an angle of elevation of 60^0. After some time a missile M is fired at 2000 m/s muzzle velocity and at an angle of elevation of 45^0 from the same point to destroy the projectile P. Find (i) Height (ii) horizontal distance and (iii) time with respect to P firing at which the destruction takes place. (T)

Ans. : S = distance = 9600 m, V = Vmax = 420 m/s,

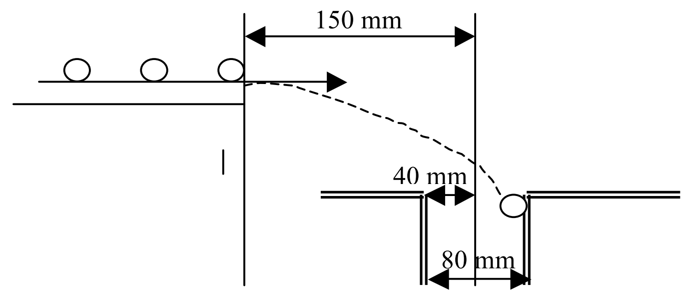
(i) h = 1494.4 m, (ii) x = 1499.9 m, (iii) Time lag = 14 sec.



26. A jet of water is discharged at A with a velocity of 20 m/s to strike a moving plate. If the plate is moving downwards with a velocity of 1 m/s. Determine the relative velocity of water w.r.t. the plate just before it strikes.
Ans. : | V_{AB} | = 20.09 m/s



27. Balls of 10mm diameter (of ball bearings) leave the horizontal through with an initial horizontal velocity V_0 to fall through a gap of 80mm size as shown in figure. Calculate permissible range of velocity V_0 that will enable the balls to enter the gap.



28. It is observed that a skier leaves the platform at A and then hits the ramp at B as shown in figure in 5 seconds. Calculate the initial speed U_A and the launch angle α.