Q3. After what time a ball thrown at an inclination α with speed u, will appear to be at inclination β as observed from the point of throw?

Q4. A particle was thrown over a triangle from one end of the horizontal base. It grazes the vertex and falls on the other vertex on the base. If α & β are the base angles then find the elevation angle of the particle thrown.

Q5. A cannon ball has the same range R on a horizontal plane for two angle of projection. If h_1 and h_2 are the greatest heights in the two paths for which this is possible, then what is the ratio $\dfrac{R^2}{h_1 h_2}$?

Q6. A gun is mounted on a platform which can move forward or backward with a constant velocity v_0. If the ranges of the shot are observed to be a & b for the platform moving forward & backward respectively then what is the inclination of the gun?

Q7. A particle is projected horizontally with speed u from the top of an inclined plane of inclination θ. What is the range of the projectile on the inclined plane?

Q8. A particle is projected up an inclined plane of inclination β at an elevation α to the horizontal ($\alpha > \beta$). What is the relation between the two angles if the particle strikes the plane perpendicularly?

Q9. A particle is projected perpendicular to an inclined plane of inclination θ with speed u. What is the range of the projectile on the plane?

Q10. A projectile has to be thrown horizontally with speed u from some point on an inclined hill slope of angle 45°. If it is required that the projectile does not land on the horizontal ground then what should be the minimum height of the point of throw?

Q11. A perfectly elastic ball is thrown from the foot of a plane whose inclination to the horizontal is β. After striking the plane at a distance R from the point of projection it rebounds and retraces it path. Find the initial speed of throw.

Q12. A particle is thrown horizontally from a point at a height h directly above the foot of an inclined plane of inclination θ. What should be the speed if it has to strike the plane normally?

Q13. Consider a long inclined plane of inclination β. A particle falls from rest through a height h and hits at certain point P on the plane. After rebounding elastically it again hits another point Q on the inclined plane. Find the distance PQ.

Shrinivas Academy

Physics Foundation Batch – IXth Standard.

Physics Tutorial Sheet No. 1.4 (2-D Motion under Gravity - Projectiles)

By Sanjeet Singh Adarsh (9822793601 sadarsh@iitbombay.org)

Take g = 10 m/s² wherever necessary.

----------------------------------- *Level 1* -----------------------------------

Q1. From a point in air two stones are thrown horizontally in opposite directions with velocities v_1 & v_2 respectively. Find the separation between them when their velocities are mutually perpendicular.

Q2. A boat is moving with velocity v_1 directly away from a gun mounted on the shore. A shell fired with speed v_2 at an elevation θ hits the boat. How far is the gun from the boat when the shell was fired?

Q3. What is the average velocity of a projectile between the instants it crosses half of the maximum height reached? The speed of throw is u & the elevation is θ.

Q4. A projectile is thrown to have its maximum height as H. For what height h the ratio of times of being there will be η?

Q5. What is the range of a projectile if it crosses the points (a, b) & (b, a) in its path? Consider the projection on a horizontal level ground.

Q6. The speed of a projectile at its highest point is η times the speed at half the maximum height. What is the inclination of the projectile?

Q7. A particle is projected with a velocity u at an inclination θ to the ground. At what time its velocity is normal to the initial velocity?

Q8. At what angle a gun should be inclined so as to hit an object flying at a constant altitude h with a uniform velocity u? The shot is fired when the object was directly overhead the gun and it is required that the shot velocity should be the least. What is this velocity?

----------------------------------- *Level 2* -----------------------------------

Q1. Two shots are fired from the top and bottom of a vertical tower of height h with inclinations α & β respectively. If the shots collide at some point on the ground find the distance of this point from the foot of the tower.

Q2. A stone is thrown so that it would just hit a bird at and then reach a maximum height double that of the bird's height. At the moment of throwing the bird flies horizontally. If the bird gets hit still then what is the ratio between the velocity of the bird and the horizontal velocity of the stone.

Q3. After what time a ball thrown at an inclination α with speed u, will appear to be at inclination β as observed from the point of throw?

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