Projectile Motion

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Leave all answers in the a form with only variables given or any constants needed.

1 Problems

1. Patrick is in the middle of two walls which are at a distance d from each other. He throws a rubber ball straight forward at one of the walls from a distance h above the ground. The ball bounces off the first wall, flies past the him to the wall behind him, and then finally makes it back to him and lands on the ground. What is the initial velocity which Patrick threw the ball at? Assume that all collisions are elastic.

   Remark. *Do not split this problem into pieces. Do it all at once.*

2. Patrick has a massive pool table. It is 73 meters in width and 120 meters in length. Suppose that Patrick places a pool ball 63 meters along the length of the table so that the ball is initially touching the table. He then gives the ball some velocity so that it goes off at a 45 degree angle to the length side. After how many bounces will the ball go into one of the pockets located at the corners.

   Remark. *The pockets only lie on the vertices of the table. Use symmetry to help you*

3. Patrick is allergic to most fruits, but not watermelon. On top of a ramp of height h with angle of inclination θ Matthew fires a watermelon from the top of the ramp with velocity v perpendicular to the ramp and Patrick catches it at an angle of α from the ramp at the bottom of the ramp. At the same time, Patrick shoots a cart full of cookies to Matthew. Assume that Matthew and Patrick obtain their gifts at the same time. At what velocity v_c does Patrick fire the cookies.

4. Patrick is on a date when suddenly Matthew drops a boulder separating him from his date. The bolder has a diameter of d and in a startling attempt to prove his athletic abilities Patrick jumps with some initial velocity v to just clear the bolder (this means he is a minimalist to the max). What is his minimum initial jumping velocity?

   Remark. *This problem is an example of maximization which can be done without calculus and instead with inequalities.*

5. Patrick and his two imaginary friends (because he lacks real ones) stand at the vertices of an equilateral triangle of side length ℓ. They all move towards each other in a way so that one friend is always moving in the direction of the friend he sees in front of him. This means that their movements eventually spirals into center. If each person moves at a speed of v, how long does it take for everyone meet up.