

PH 221 Week 3

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Spring 2024

Activity

You are standing in a large building, and there is a single window right up by the ceiling. This window opens on an alleyway, and the building on the other side has an open window below the level of your building's window. You want to launch something from your building into the other, right through the center of each window. You know the heights of the windows and the width of the alley, so what do you need to do to throw it correctly?

- (1) Draw a physical representation of the situation. On this drawing, indicate the height of the center of the first window h_1 , the height of center of the second window h_2 , the width of the alley w , the initial velocity \vec{v}_0 , the launch angle θ , and your distance to the wall of the first window d . Add a coordinate system (indicate the directions of $+x$ and $+y$), and indicate the direction of gravitational acceleration \vec{g} . What are your unknowns?
- (2) Since the window is right by the ceiling, you cannot arc your projectile too high. Suppose for simplicity that you want it to reach its maximum height right as it goes through the first window. What must its initial velocity be in the y direction for this to happen?
- (3) Exiting the first window, the object only has velocity in the x direction. How long does it take to fall to the height of the second window? How fast must it be going to cross the alley in this time and enter the second window?
- (4) Given the horizontal and vertical components of initial velocity, how far back from the first window do you have to stand to get the object through it?
- (5) Given the components of initial velocity, what is the magnitude of initial velocity? At what angle with respect to the floor must the object be launched?