

Vocabulary

projectile	object moving through the air, either initially thrown or dropped, subject only to the effects of gravity
trajectory	the path of a projectile, which is parabolic in two dimensions
projectile motion	movement of an object through the air, subject only to the effects of gravity
range	the maximum horizontal distance a projectile travels
launch angle	The angle of a projectile's initial velocity when measured from the horizontal direction. These angles are typically 90° or less

Kinematic Equations

- $V = \frac{\Delta \text{position}}{\Delta \text{time}}$
- $V_f = V_i + at$
- $V_f^2 = V_i^2 + 2aD$
- $D = V_i t + \frac{1}{2}at^2$
- $D = V_f t - \frac{1}{2}at^2$
- $D = \frac{1}{2}(V_f + V_i)t$

Common Mistakes and Misconceptions

- 1.) **Remember: What happens in the vertical direction does NOT affect the horizontal direction, and vice versa**
 - An object's horizontal position, velocity, or acceleration does not affect its vertical position, velocity, or acceleration.
- 2.) **It's easy to forget that horizontal motion has constant velocity (and zero acceleration) while vertical motion has constant acceleration**
 - This means for projectile motion, the initial velocity in the x-direction will be the same as the final velocity in the x-direction.
- 3.) **Make sure to define the coordinate axes and pay attention to the sign of the acceleration constant g .**

How to Solve (Launched at an Angle)

- 1.) **Draw a diagram of the scenario**
 - Make sure to label everything or draw a picture. Usually, you usually know the initial velocity, and you usually know the final velocity for y , when it reaches the ground.
 - 2.) **List our known and unknown variables**
 - Make a T-chart with an x and y column where you fill out the variables.
 - 3.) **Break the motion into horizontal and vertical components parallel to the path**
 - Motion in each dimension is independent of each other.
 - 4.) **Solve for the unknowns in two separate motions - one horizontal and one vertical**
 - Use the kinematic equations to solve. Usually, try to find time first.
- When solving for the initial velocities, you have to use trig, so x would be the initial velocity times $\cos(\theta)$ and y would be the initial velocity times $\sin(\theta)$.**

Tips (Horizontal Projectiles)

How to solve (Horizontal Projectiles)

- 1.) **List our known and unknown variables**
 - make a t-chart with an x and y column where you fill out the variables.
- 2.) **Break the motion into horizontal and vertical components parallel to the path**
 - Motion in each dimension is independent of each other.
- 3.) **Solve for the unknowns in two separate motions - one horizontal and one vertical**
 - Use the kinematic equations to solve. Usually try to find time first.

