CLASS NOTES

8.11 Maximum/Minimum Problems Day 1

Quadratic Equations are often used to find maximums and minimums for problems involving projectile motion. For example, you would use a quadratic equation to determine how many seconds would be needed for a ball to reach its maximum height when it was thrown directly upward with an initial velocity of 96 feet per second from a cliff looming 200 feet above a beach.

To solve quadratic equations involving maximums and minimums for projectile motion, it is necessary to

- know how to solve quadratic equations
- know vertex formula for a parabola
- write and solve an equation for the problem

Let's solve the example of a quadratic equation involving maximums and minimums for projectile motion given above: A ball is thrown directly upward from an initial height of 200 feet with an initial velocity of 96 feet per second. After how many seconds will the ball reach its maximum height? What is the maximum height?

To analyze our problems, we will be using a formula for a freely falling body in which we can ignore any effects of air resistance.

$$h(t)=-16t^2+vt+h$$

- $h(t)$ represents the projectile's height at any time t
- v represents initial velocity
- h represents the initial height from which the projectile is released
- t represents time in seconds after the projectile is released

Example 1: A ball is thrown directly upward from an initial height of 200 feet with an initial velocity of 96 feet per second. After how many seconds will the ball reach its maximum height? What is the maximum height?

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Example 2: A ball is thrown vertically upward with an initial velocity of 48 feet per second. If the ball started from a height of 8 feet off the ground, determine the **time** it will take for the ball to hit the ground.

Example 3: The height h(t) in feet of a projectile launched vertically upward from the top of a 32-foot-tall bridge is given by $h(t) = -16t^2 + 16t + 38$ where **t** is the time in seconds. When does the projectile reach a maximum height and how long will it take for the projectile to strike the ground?