Name: _Key_

Date: _____ Period: _____

As you have seen, many everyday situations can be modeled by linear functions. One example is the formula such as distance as a function of your rate of speed x the length of time you traveled. Given situations that involve these quantities, you can apply a known model or formula. This is also true for quadratic functions.

An example of where a known formula can be applied is in problems involving vertical motion. Many years ago, Galileo discovered that vertical motion is the motion of an object that is thrown, hit, dropped, or shot straight up or down. He found that vertical motion can be modeled by the following equation:

$$y = -\frac{1}{2}(32)t^2 + vt + h$$

In this equation, y is the number of feet above the ground, t is the time in seconds from the moment the object starts moving, v is the initial upward/downward velocity in feet per second, and h is the height measured in feet. The coefficient of t^2 deals with acceleration due to gravity. The acceleration due to gravity is actually -32 feet/second^2 and the coefficient of t^2 is $-\frac{1}{2}(32) or -16$.

Problems:

1. Barry Bonds, a well-known baseball player and a big hitter, was playing in a critical game for his team. He hit a foul ball straight up with an initial velocity of 160 feet/second. His bat made contact with the ball 4 feet about the ground.

   Represent the situation mathematically.

   $$y = -16t^2 + 160t + 4$$

   Represent the situation graphically.

   Using the graph, determine how high the ball is after:

   a. 1 second _148 ft_
   b. 2 seconds _260 ft_
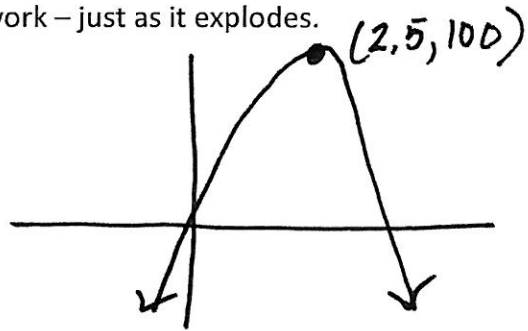   c. 10 seconds _4 ft_
   d. 15 seconds _-1196 ft_

   Do the answers you found make sense based on the situation? Explain.

   all but D — ball won't travel below level of ground

2. Some fireworks are fired vertically into the air from the ground at an initial velocity of 80 feet per second. Find the highest point reached by the firework – just as it explodes.
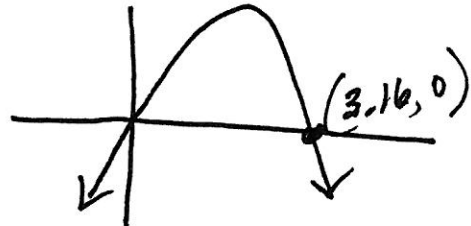
$$y = -16t^2 + 80t$$

(100 ft)

(2.5, 100)

3. A ball is thrown vertically upward with an initially 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.
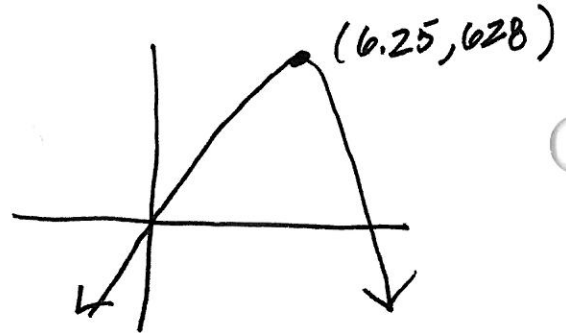
$$y = -16t^2 + 48t + 8$$

(3.16 sec)

(3.16, 0)

4. A pistol is accidentally discharged vertically upward from a height of 3 feet above the ground. If the bullet has an initial velocity of 200 feet per second, what maximum height will it reach before it starts to fall back down to the ground?
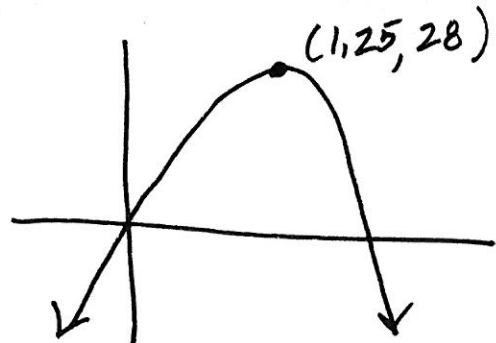
$$y = -16t^2 + 200t + 3$$

(628 ft)

(6.25, 628)

5. A tennis ball is propelled upward from the face of a racket at 40 feet per second. The racket face is 3 feet above ground when it makes contact with the ball. At what time will the ball be at its highest point? How high is that highest point?

$$y = -16t^2 + 40t + 3$$

1.25 sec
28 ft.

(1.25, 28)

6. A red ball is kicked upward from the ground with an initial velocity of 44 feet/second. A green ball is kicked upward from the ground with an initial velocity of 40 feet/second. Which ball is in the air for more time? How much more time is it in the air than the other?

__red__   __green__

$$y = -16t^2 + 44t + 0$$ $$y = -16t^2 + 40t + 0$$

green→ ←red
2.75
2.50

red : ¼ sec. longer