Section 4: Quadratic Equations and Functions – Part 1
Section 4 – Topic 1
Real-Life Examples of Quadratic Functions

What can be said of the rate of change of a linear function?

constant

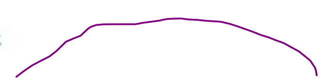
How is the rate of change of a quadratic function different from that of a linear function?

not constant

Which of the following are examples of a quadratic function? Select all that apply.

- [ ] A car is driven at a constant rate of 55 mph. The graph shows the car's distance over a specific time period.
- [x] A water balloon is dropped from a 3rd floor balcony. The graph shows the balloon's height over the time period after the balloon is dropped.

- [x] A quarterback throws a football. The graph shows the football's height over the time period after the football is thrown.



- [ ] A class is taking a field trip to see Les Miserables. The student ticket price is $10. The graph shows the total cost based on the number of students attending.
- [x] A diver jumps from a high dive platform. The graph shows the diver's height over the time period after he jumps.

A quadratic equation is used for a free-falling body where any effects of air resistance are ignored and the coefficient for the quadratic term is constant based on the gravitational force of the earth, $-16\ \text{ft/sec}^2$ or $-4.9\ \text{m/sec}^2$.

$$f(x) = ax^2 + bx + c$$

Gravity (a), Initial Velocity (b), Initial Height (c)

a < −16 ft/s², −4.9 m/s²

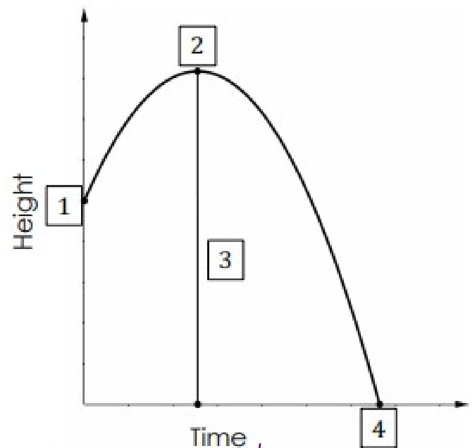
Suppose a volleyball player serves from one meter behind the back line. If no other player touches the ball, it will land inbounds. The equation $h = -4.9t^2 + 3.28t + 1.7$ gives the ball's height, h, in meters in terms of time, t, in seconds.

We can infer several things about this situation by looking at the quadratic function that models it.

From what height was the ball served? 1.7 m

velocity = 3.28 m/s

We can also gather information about a quadratic function by looking at a graph.



Box 1: Initial Height - starting point, when time = 0

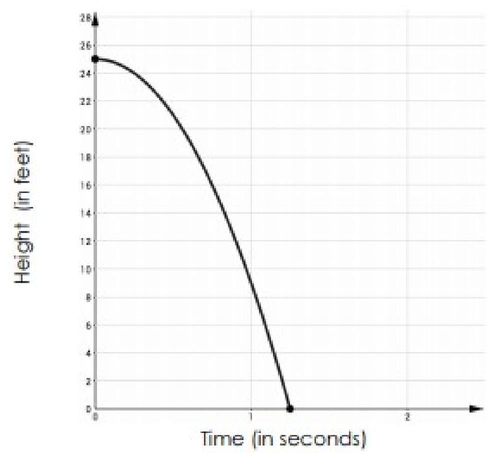
Box 2: Vertex - maximum height of the object

Box 3: Axis of Symmetry - time it takes to reach the maximum height

Box 4: x -Intercept

time it takes for object to hit ground.

The following graph represents the height over time of a water balloon being dropped from a 3rd story window.



From what height was the water balloon dropped?

25 ft

After how many seconds does the water balloon hit the ground?

approximately 1.25 seconds

Try It!

1. Suppose a rocket is launched from a platform. The equation $h = -4.9t^2 + 200t + 25$ gives the rocket's height, h, in meters in terms of time, t, in seconds.

   a. What was the initial velocity of the rocket?

   200 m/s

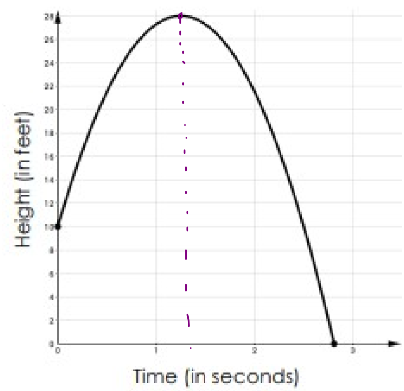
   b. From what height was the rocket launched?

   25 m

   c. If we measure the height in feet, how would the function change? What would be the gravity coefficient?

   -4.9

2. The following graph represents the height over time of a ball tossed into the air from a first story balcony.



Gravity $= -16$

a. From what height was the ball tossed? 10 ft

b. What was the maximum height of the ball? 28 ft

c. How long did it take the ball to reach its maximum height?

Approximately 1.25

BEAT THE TEST!

1. A ball is tossed in the air with an initial velocity of 12 feet per second from a height of 5.5 feet. Which of the following equations represents the ball's height, h, in feet over time, t, in seconds.

   Ⓐ $h = -12t^2 + 5.5$
   Ⓑ $h = -16t^2 + 5.5$
   Ⓒ $h = -16t^2 + 12t + 5.5$
   Ⓓ $h = -4.9t^2 + 12t + 5.5$

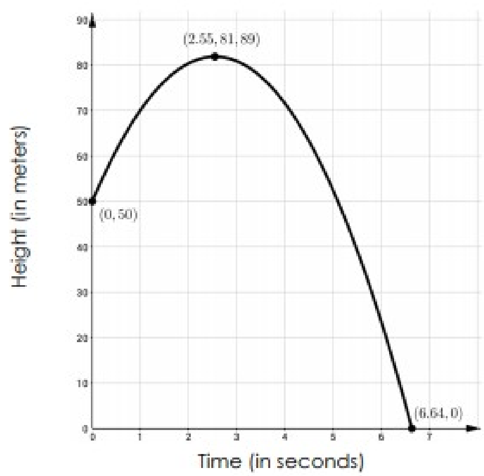
$ax^2 + bx + c$

Gravity — initial velocity — initial height

ft = -16

m = -4.9

2. Consider the following graph that represents a projectile fired from a cannon from the roof of a high-rise building.



Which of the following statements are true? Select all that apply.

- ☐ The cannon was fired from a height of 25 meters.
- ☐ The initial velocity of the projectile was 4.9 meters per second squared.
- ☑ It took the projectile approximately 2.6 seconds to reach its maximum height.
- ☐ The maximum height of the projectile was 50 feet.
- ☑ It took the projectile approximately 6.6 seconds to hit the ground.