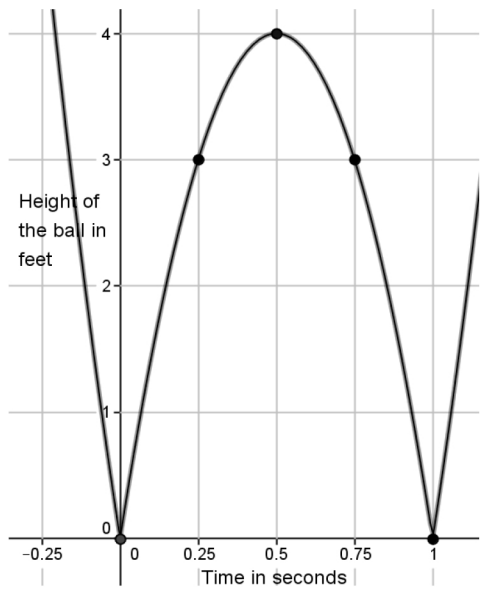
Name _____ Date _____

The Concept of a Function

A ball bounces across the school yard. It hits the ground at $(0,0)$ and bounces up and lands at $(1,0)$ and bounces again. The graph shows only one bounce.

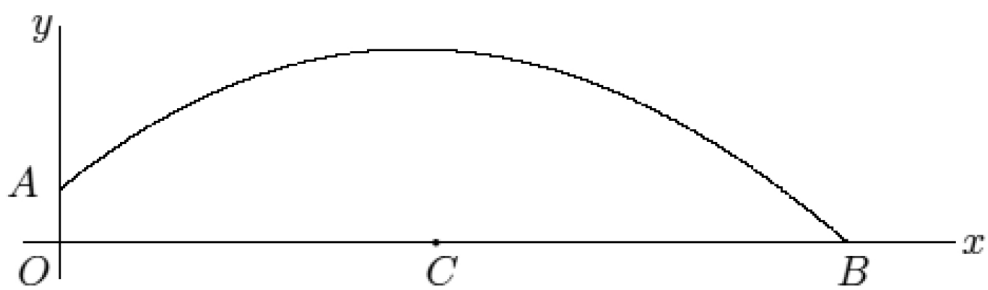


a. Identify the height of the ball at the following values of t: $0, 0.25, 0.5, 0.75, 1$.

b. What is the average speed of the ball over the first 0.25 second? What is the average speed of the ball over the next 0.25 second (from 0.25 to 0.5 second)?

c. Is the height of the ball changing at a constant rate?

1. A ball is thrown across the field from point A to point B. It hits the ground at point B. The path of the ball is shown in the diagram below. The x-axis shows the distance the ball travels, and the y-axis shows the height of the ball. Use the diagram to complete parts (a)–(g).



   a. Suppose A is approximately 6 feet above ground and that at time $t = 0$ the ball is at point A. Suppose the length of OB is approximately 88 feet. Include this information on the diagram.

   b. Suppose that after 1 second, the ball is at its highest point of 22 feet (above point C) and has traveled a distance of 44 feet. Approximate the coordinates of the ball at the following values of t: 0.25, 0.5, 0.75, 1, 1.25, 1.5, 1.75, and 2.

   c. Use your answer from part (b) to write two predictions.

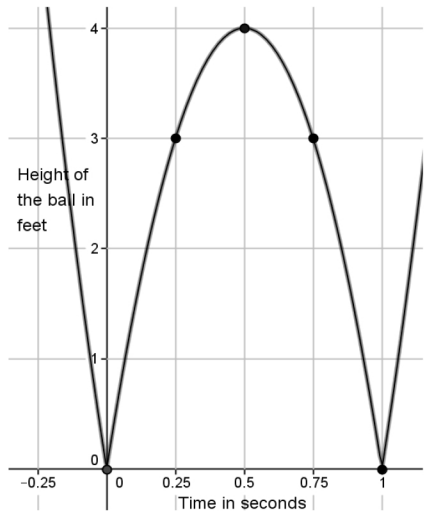
   d. What is the meaning of the point $(88, 0)$?

   e. Why do you think the ball is at point $(0, 6)$ when $t = 0$? In other words, why isn't the height of the ball 0?

   f. Does the graph allow us to make predictions about the height of the ball at all points?

2. In your own words, explain the purpose of a function and why it is needed.

A ball is bouncing across the school yard. It hits the ground at $(0, 0)$ and bounces up and lands at $(1, 0)$ and bounces again. The graph shows only one bounce.



a. Identify the height of the ball at the following time values: $0, 0.25, 0.5, 0.75, 1$.

When $t = 0$, the height of the ball is 0 feet above the ground. It has just hit the ground.

When $t = 0.25$, the height of the ball is 3 feet above the ground.

When $t = 0.5$, the height of the ball is 4 feet above the ground.

When $t = 0.75$, the height of the ball is 3 feet above the ground.

When $t = 1$, the height of the ball is 0 feet above the ground. It has hit the ground again.

b. What is the average speed of the ball over the first 0.25 second? What is the average speed of the ball over the next 0.25 second (from 0.25 to 0.5 second)?

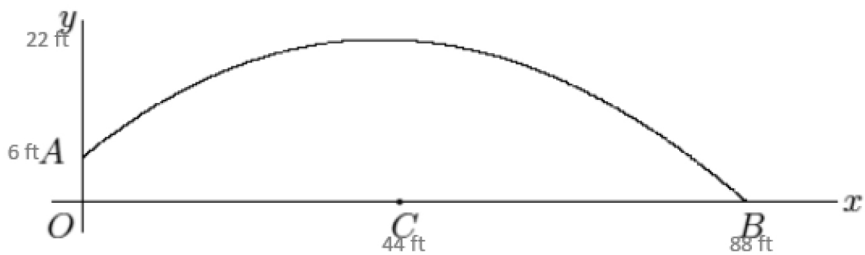
$$\frac{\text{distance traveled over a given time interval}}{\text{time interval}} = \frac{3-0}{0.25-0} = \frac{3}{0.25} = 12 \text{ feet per second}$$

$$\frac{\text{distance traveled over a given time interval}}{\text{time interval}} = \frac{4-3}{0.5-.25} = \frac{1}{0.25} = 4 \text{ feet per second}$$

c. Is the height of the ball changing at a constant rate?

No, it is not. If the ball were traveling at a constant rate, the average speed would be the same over any time interval.

1. A ball is thrown across the field from point A to point B. It hits the ground at point B. The path of the ball is shown in the diagram below. The x-axis shows the distance the ball travels, and the y-axis shows the height of the ball. Use the diagram to complete parts (a)–(g).



a. Suppose A is approximately 6 feet above ground and that at time $t = 0$ the ball is at point A. Suppose the length of OB is approximately 88 feet. Include this information on the diagram.

Information noted on the diagram in red.

b. Suppose that after 1 second, the ball is at its highest point of 22 feet (above point C) and has traveled a distance of 44 feet. Approximate the coordinates of the ball at the following values of t: 0.25, 0.5, 0.75, 1, 1.25, 1.5, 1.75, and 2.

*Most answers will vary because students are approximating the coordinates. The coordinates that must be correct because enough information was provided are denoted by a *.*

At $t = 0.25$, the coordinates are approximately $(11, 10)$.

At $t = 0.5$, the coordinates are approximately $(22, 18)$.

At $t = 0.75$, the coordinates are approximately $(33, 20)$.

**At $t = 1$, the coordinates are approximately $(44, 22)$.*

At $t = 1.25$, the coordinates are approximately $(55, 19)$.

At $t = 1.5$, the coordinates are approximately $(66, 14)$.

At $t = 1.75$, the coordinates are approximately $(77, 8)$.

**At $t = 2$ the coordinates are approximately $(88, 0)$.*

c. Use your answer from part (b) to write two predictions.

Sample predictions:

At a distance of 44 feet from where the ball was thrown, it is 22 feet in the air. At a distance of 66 feet from where the ball was thrown, it is 14 feet in the air.

d. What is the meaning of the point $(88, 0)$?

At point $(88, 0)$, the ball has traveled for 2 seconds and has hit the ground a distance of 88 feet from where the ball began.

e. **Why do you think the ball is at point $(0, 6)$ when $t = 0$? In other words, why isn't the height of the ball 0?**

The ball is thrown from point A to point B. The fact that the ball is at a height of 6 feet means that the person throwing it must have released the ball from a height of 6 feet.

f. **Does the graph allow us to make predictions about the height of the ball at all points?**

While we cannot predict exactly, the graph allows us to make approximate predictions of the height for any value of horizontal distance we choose.

2. **In your own words, explain the purpose of a function and why it is needed.**

A function allows us to make predictions about a motion without relying on the assumption of constant rate. It is needed because the entire story of the movement of an object cannot be told with just a few data points. There are an infinite number of points in time in which a distance can be recorded, and a function allows us to calculate each one.