

## Lesson 4: Increasing and Decreasing Functions

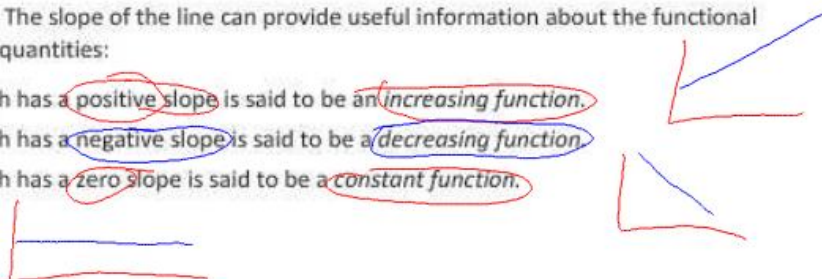
$$y = \underset{\substack{\uparrow \\ \text{slope}}}{m}x + b$$

### Classwork

Graphs are useful tools in terms of representing data. They provide a visual story, highlighting important facts that surround the relationship between quantities.

The graph of a linear function is a line. The slope of the line can provide useful information about the functional relationship between the two types of quantities:

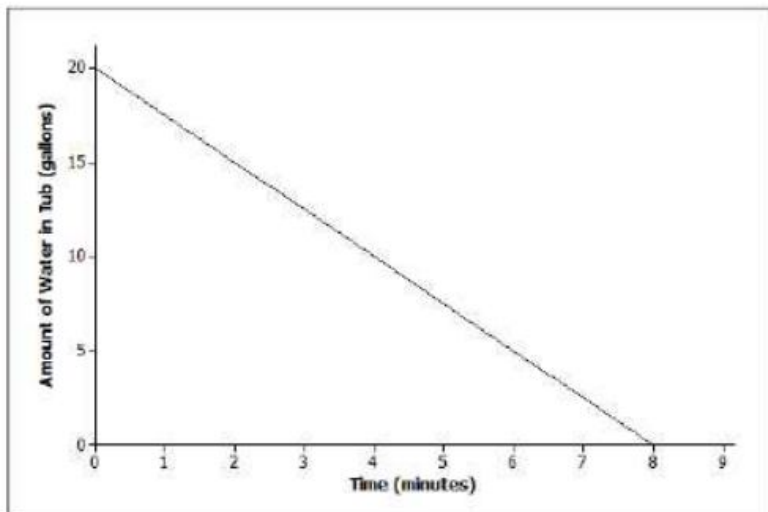
- A linear function whose graph has a positive slope is said to be an increasing function.
- A linear function whose graph has a negative slope is said to be a decreasing function.
- A linear function whose graph has a zero slope is said to be a constant function.



### Exercises

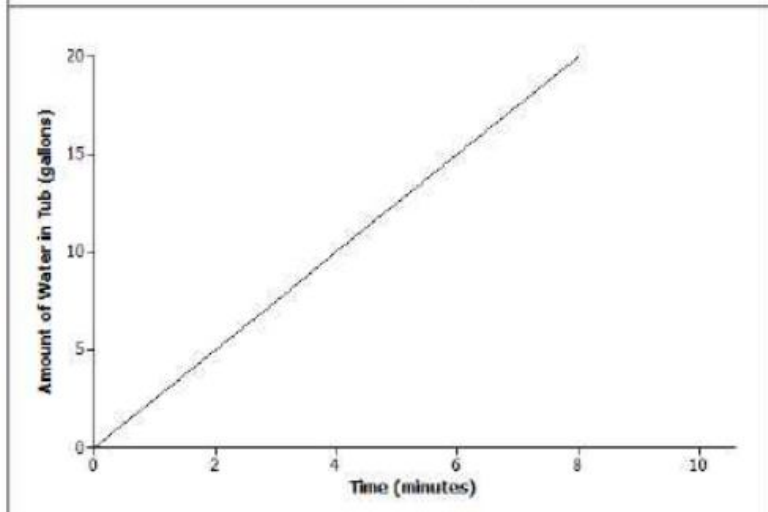
1. Read through each of the scenarios and choose the graph of the function that best matches the situation. Explain the reason behind each choice.
  - a. A bathtub is filled at a constant rate of 1.75 gallons per minute. *+ slope*
  - b. A bathtub is drained at a constant rate of 2.5 gallons per minute. *- slope*
  - c. A bathtub contains 2.5 gallons of water.
  - d. A bathtub is filled at a constant rate of 2.5 gallons per minute. *steeper graph than A*

	<p>Scenario: C</p> <p>Explanation: water level stays the same.</p>
--	--



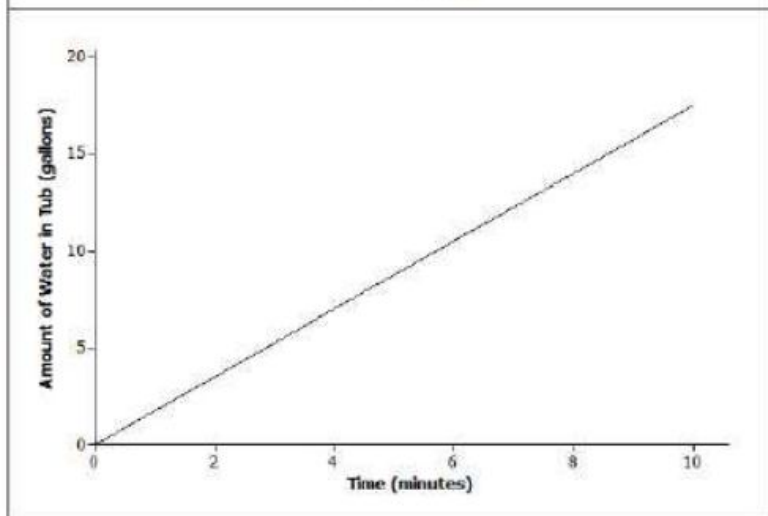
Scenario: B

Explanation:  
~~to~~  
 20 gals. of H<sub>2</sub>O are being drained out of the bath tub



Scenario: D

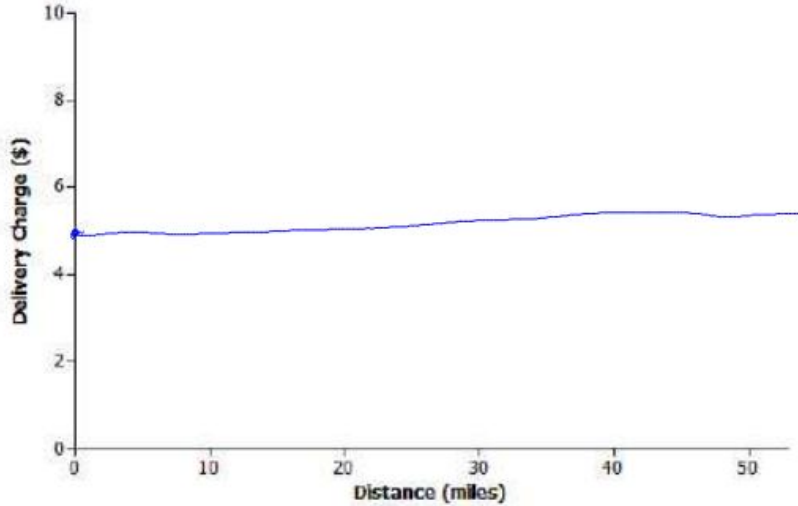
Explanation:  
 The bath tub is filling at a faster rate than part A



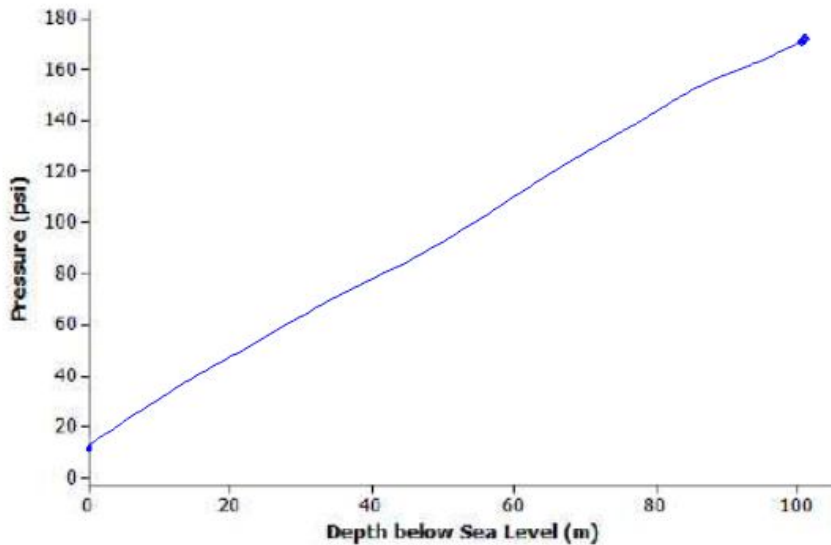
Scenario: A

Explanation:

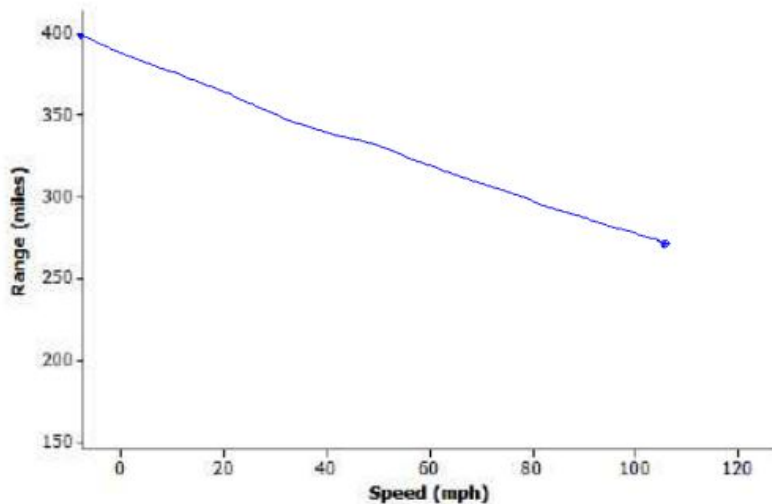
2. Read through each of the scenarios, and sketch a graph of a function that models the situation.
- a. A messenger service charges a flat rate of \$4.95 to deliver a package regardless of distance to the destination.



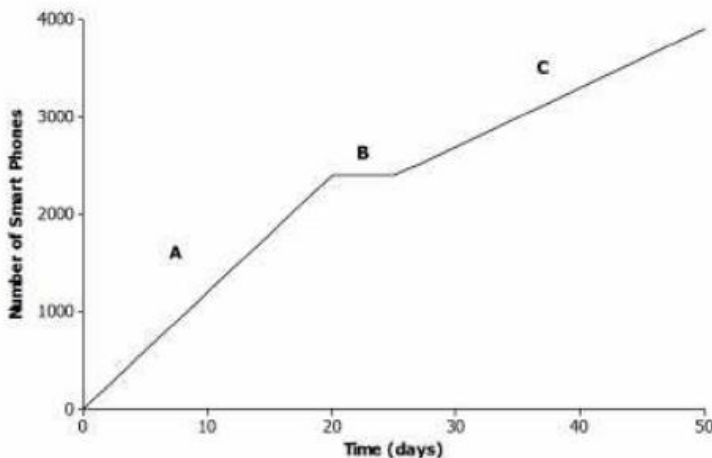
- b. At sea level, the air that surrounds us presses down on our bodies at 14.7 pounds per square inch (psi). For every 10 meters that you dive under water, the pressure increases by 14.7 psi.



- c. The range (driving distance per charge) of an electric car varies based on the average speed the car is driven. The initial range of the electric car after a full charge is 400 miles. However, the range is reduced by 20 miles for every 10 mph increase in average speed the car is driven.



- 3. The graph below represents the total number of smart phones that are shipped to a retail store over the course of 50 days.



Match each part of the graph (A, B, and C) to its verbal description. Explain the reasoning behind your choice.

- i. Half of the factory workers went on strike, and not enough smartphones were produced for normal shipments.

*Part C, not as many phones produced*

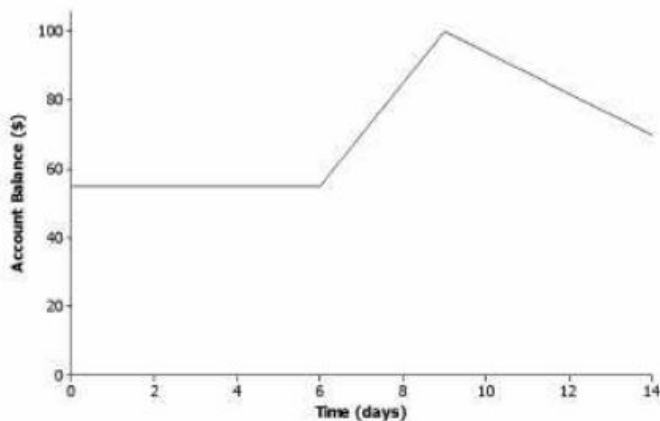
- ii. The production schedule was normal, and smartphones were shipped to the retail store at a constant rate.

*Part A*

- iii. A defective electronic chip was found, and the factory had to shut down; so, no smartphones were shipped.

*Part B No phones shipped*

- 4. The relationship between Jameson’s account balance and time is modeled by the graph below.



- a. Write a story that models the situation represented by the graph.
- b. When is the function represented by the graph increasing? How does this relate to your story?
- c. When is the function represented by the graph decreasing? How does this relate to your story?



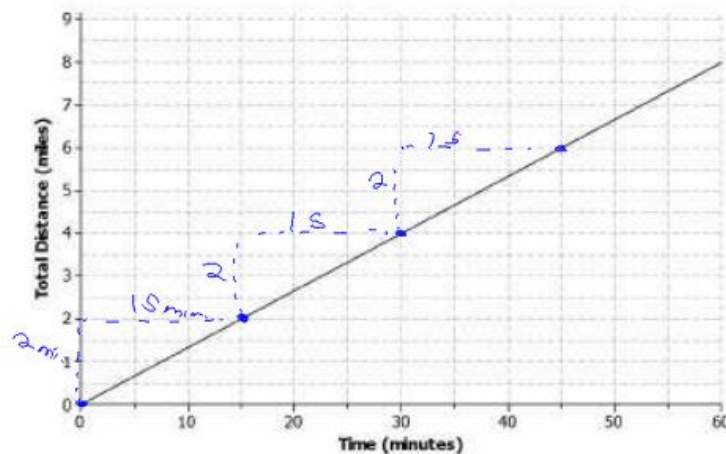
## Lesson 5: Increasing and Decreasing Functions

### Classwork

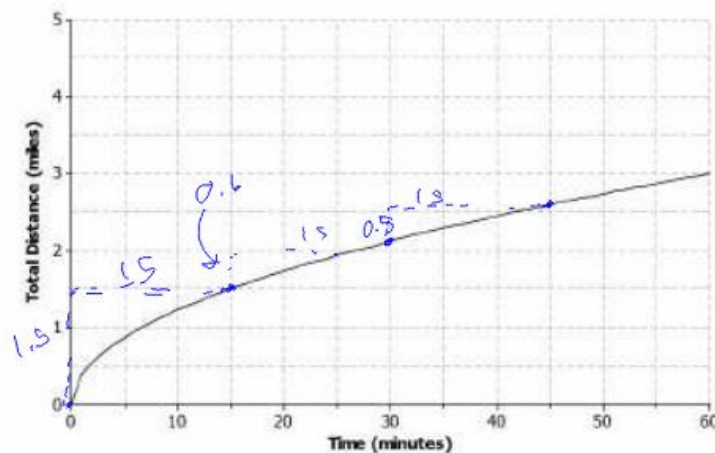
#### Example 1: Nonlinear Functions in the Real World

Not all real-world situations can be modeled by a linear function. There are times when a nonlinear function is needed to describe the relationship between two types of quantities. Compare the two scenarios:

- a. <sup>JCP</sup>Steph is running at a constant rate on a flat paved road. The graph below represents the total distance he covers with respect to time.



- b. Shannon is running on a flat, rocky trail that eventually rises up a steep mountain. The graph below represents the total distance she covers with respect to time.



## Exercises 1–2

1. In your own words, describe what is happening as Aleph is running during the following intervals of time.

a. 0 to 15 minutes

2 mi in 15 mins

b. 15 to 30 minutes

2 mi in 15 mins

c. 30 to 45 minutes

2 mi in 15 mins

d. 45 to 60 minutes

2 mi in 15 mins

2. In your own words, describe what is happening as Shannon is running during the following intervals of time.

a. 0 to 15 minutes

1.5 mi in 15 mins

b. 15 to 30 minutes

0.6 mi in 15 mins

c. 30 to 45 minutes

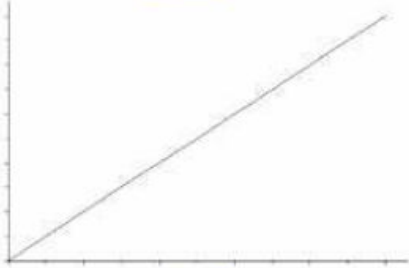

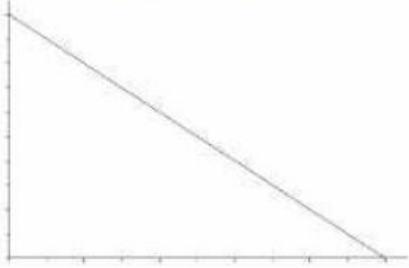
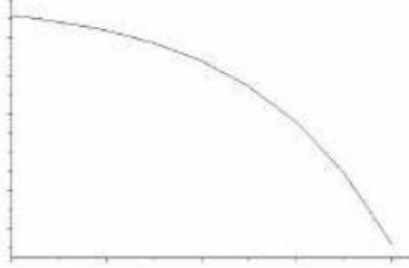
0.5 mi in 15 mins

d. 45 to 60 minutes

0.4 miles in 15 mins.

**Example 2: Increasing and Decreasing Functions**

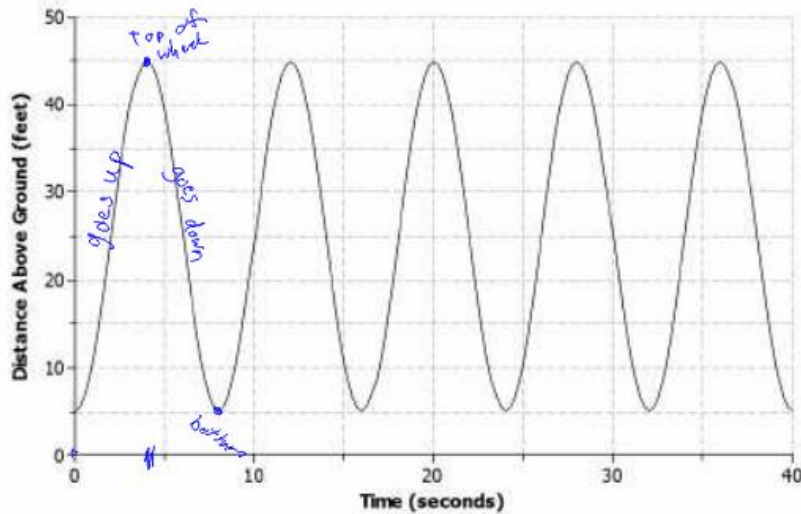
The rate of change of a function can provide useful information about the relationship between two quantities. A linear function has a constant rate of change. A nonlinear function has a variable rate of change.

Linear Functions	Nonlinear Functions																								
<p>Linear function <i>increasing</i> at a constant rate</p> 	<p>Nonlinear function <i>increasing</i> at a variable rate</p> 																								
<p>Linear function <i>decreasing</i> at a constant rate</p> 	<p>Nonlinear function <i>decreasing</i> at a variable rate</p> 																								
<p>Linear function with a constant rate</p> <table border="1"> <thead> <tr> <th>x</th> <th>y</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>7</td> </tr> <tr> <td>1</td> <td>10</td> </tr> <tr> <td>2</td> <td>13</td> </tr> <tr> <td>3</td> <td>16</td> </tr> <tr> <td>4</td> <td>19</td> </tr> </tbody> </table> <p>Handwritten blue arrows show a constant change of 1 in x and 3 in y between consecutive rows.</p>	x	y	0	7	1	10	2	13	3	16	4	19	<p>Nonlinear function with a variable rate</p> <table border="1"> <thead> <tr> <th>x</th> <th>y</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>0</td> </tr> <tr> <td>1</td> <td>2</td> </tr> <tr> <td>2</td> <td>4</td> </tr> <tr> <td>3</td> <td>8</td> </tr> <tr> <td>4</td> <td>16</td> </tr> </tbody> </table> <p>Handwritten blue arrows show a constant change of 1 in x and a doubling of y between consecutive rows.</p>	x	y	0	0	1	2	2	4	3	8	4	16
x	y																								
0	7																								
1	10																								
2	13																								
3	16																								
4	19																								
x	y																								
0	0																								
1	2																								
2	4																								
3	8																								
4	16																								



**Example 3: Ferris Wheel**

Lamar and his sister are riding a Ferris wheel at a state fair. Using their watches, they find that it takes 8 seconds for the Ferris wheel to make a complete revolution. The graph below represents Lamar and his sister’s distance above the ground with respect to time.



**Exercises 6–9**

- 6. Use the graph from Example 3 to answer the following questions.
  - a. Is the function represented by the graph linear or nonlinear?

*Non linear, curved graph.*

- b. Where is the function increasing? What does this mean within the context of the problem?

- c. Where is the function decreasing? What does this mean within the context of the problem?