Brockton High School
Content: Math I
Week of: May 18 to May 22, 2020

Greetings Math I Students! We hope you are safe and well with your families! This assignment is for this week, use your time wisely. You do not have to complete this in one sitting. Here is the lesson plan for this week:

Goals For This Week
Learning Objectives: Students will be able to: 1. Write and understand sequences as linear functions 2. Explore and identify key characteristics of graphs of linear functions 3. Model parallel and perpendicular lines 4. Extend equations to solve literal equations *(Standards F.IF.1, F.IF.6, A.REI.10, F.BF.3 and G.-GPE.2.5)*
Literacy Objectives: Students will be able to: 1. Read, break down, and solve a word problem. 2. Identify a pattern, explain a pattern, and/or make a prediction based on a pattern. 3. Create, interpret and explain a table, chart or graph. *(https://www.bpsma.org/schools/brockton-high-school/about-us/mission-literacy-charts)*
Standards for Mathematical Practice: Students should always look to develop the following habits of mind when working on mathematics: • Make sense of problems and persevere in solving them. • Reason abstractly and quantitatively. • Construct viable arguments and critique the reasoning of others. • Model with mathematics. • Use appropriate tools strategically. • Attend to precision. • Look for and make use of structure. • Look for and express regularity in repeated reasoning.

Carnegie Learning (use with Carnegie Resources provided below)
(Log-in through Clever – see below)

Instructional Video Links: Please watch at least one of these videos to help guide you.

- Video 1: Making Sense of Different Representations of A Linear Function Overview 1
- Video 2: Making Sense of Different Representations of A Linear Function Overview 2

Printable Resources:
Please see the attached lesson document "Fun with Functions, Linear Ones"
(starting on page M2-23)

Practice Activities:
On-Line:
All students now have access to an on-line learning program called Mathia!

- If you are new to Mathia: Please see the log-in information below
- If you are able to get online, please complete
  - IM 1 Mod 3: Exploring Linear Functions: Linear Functions Overview, Graphs of Linear Functions, Parallel and Perpendicular Lines, Linear Equations (Units 1 – 4)

No Internet Access:
Please see information on printable resources.

Key Terms:

- **polynomial** – a polynomial is an expression of the form $a_0 + a_1x + a_2x^2 + \cdots + a_nx^n$ where the coefficients $(a_0, a_1, a_2, \ldots)$ are real numbers or complex numbers and the exponents are nonnegative integers.
- **degree** – the degree of a polynomial in one variable is the exponent of that variable with the largest numerical value.
- **leading coefficient** – the leading coefficient of a polynomial is the numeric coefficient of the term with the greatest power.
- **zero of a function** – a zero of a polynomial function f is a value of x for which $f(x) = 0$.

Extension Activities:
See *Stretch* on page 20 of the document (M2-40).
A pretzel manufacturer has two production lines, Line A produces a variety of pretzel that is sold for $2.40 per bag. Line A typically produces 3 bags per day that do not meet the company standards and cannot be sold. Line B produces a variety of pretzel that is sold for $3.60 per bag. Line B typically produces 4 bags per day that do not meet the company standards and cannot be sold. Line A produces 3 times as many bags as Line B each day. Write a linear function that represents the total number of bags the line can produce combined.

Log-in Information

1. Log-in to Clever
2. Click on the Carnegie Learning logo

Additional Support

Email:
Please email your math teacher with specific questions.

Office Hours:
For a list of office hours for all BHS Math teachers, please click here. Your teacher is available to help you during their scheduled office hours.

2

Fun with Functions, Linear Ones

Making Sense of Different Representations of a Linear Function

Warm Up

Determine the slope of the line between each pair of points.

1. (0, 10) and (3, 12)

2. (−1, 4.5) and (1, −4.5)

3. (−1, 0) and (0, 12)

Learning Goals

- Determine whether a scenario, equation, table, or graph represents a linear relationship.
- Calculate the average rate of change from a table.
- Write functions given a table of values.
- Interpret expressions that represent different quantities in terms of a context and a graph.
- Compare different equation representations of linear functions.

Key Terms

- polynomial
- degree
- leading coefficient
- zero of a function

You know how to determine whether a relationship represents a linear function, and you know how to write an equation for the function. How can you use the structure of the equation to identify characteristics of the function?

Well, Are Ya or Aren't Ya?

1. Determine whether each representation models a linear or nonlinear function. Explain your reasoning.

Scenario A
A tree grows 3.5 inches each year.

Scenario B
The strength of a medication decreases by 50% each hour it is in the patient's system.

Scenario C
The area of a square depends on its side length.

Equation A
$y = 14 - 9x$

Equation B
$y = 2^x + 1$

Equation C
$y = \frac{1}{4}(x + 7) - 1$

Table A

x	y
1	3
1	4
1	5

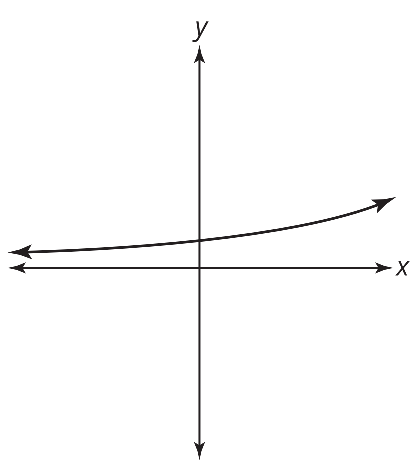
Table B

x	y
3	1
4	1
5	1

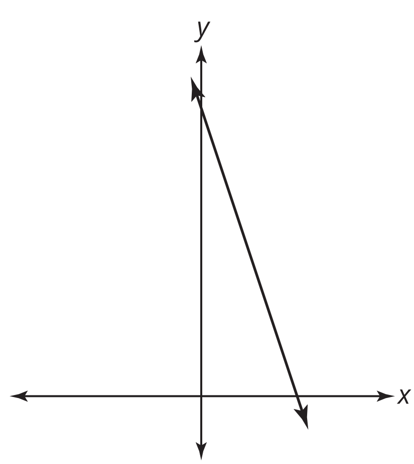
Table C

x	y
−9	45
−8	30
−7	15

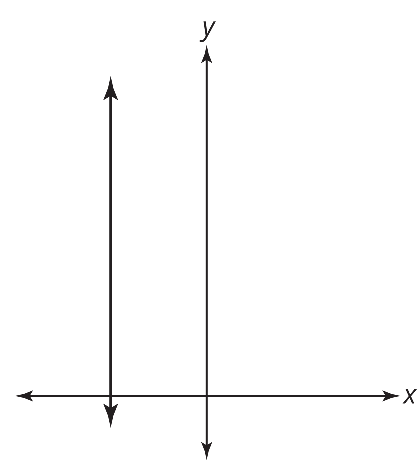
Graph A



Graph B



Graph C



ACTIVITY
2.1

Interpreting Linear Functions

Each table of values in the previous activity had consecutive input values. Tables in that format allow you to use differences to determine whether the representation is linear. Often, input values are in intervals other than 1, and sometimes the input values are in random order. To determine whether these tables represent linear functions, you need to make sure the slope, or average rate of change, is constant between all given points.

1. Determine whether each table represents a linear function. If so, write the function.

a.

x	y
−2	5.5
1	4.75
4	4
7	3.25

b.

x	y
0	5
2	13
4	21
8	29

Ask yourself:

Is there a pattern in the input values?

Analyze each situation represented as a table of values.

2. Dillan sells pretzels at festivals on weekends. The table shown is a record of past sales.

Number of Pretzels Sold	Amount of Money Earned (dollars)
15	37.5
42	105
58	145
29	72.5

a. What does this table tell you about his sales?

b. How much money would Dillan earn if he sold 75 pretzels?

3. **Delany and her friends recently went to the community fair. They had to pay an entrance fee and then purchase 1 ticket for each ride. Dakota is going to the fair tomorrow and wants to know the cost of each ride ticket. Delany and her friends help Dakota by writing down how much money they spent and the number of tickets they purchased.**

Number of Ride Tickets	Amount of Money Spent (dollars)
2	7.5
4	9
6	10.5
11	14.25

a. **What does this table tell you about the cost to go to the fair and ride the rides?**

b. **If Dakota has $20 to spend, how many ride tickets can she buy?**

4. **The local pet store has a fish tank on display at the community fair. Darren is responsible for draining the tank at the end of the fair. The pet store manager provides him with this information from when they drained the tank at the end of the fair last year.**

Time (hours)	Amount of Water Remaining (gallons)
$\frac{1}{4}$	169
$\frac{1}{2}$	163
$\frac{3}{4}$	157
1	151

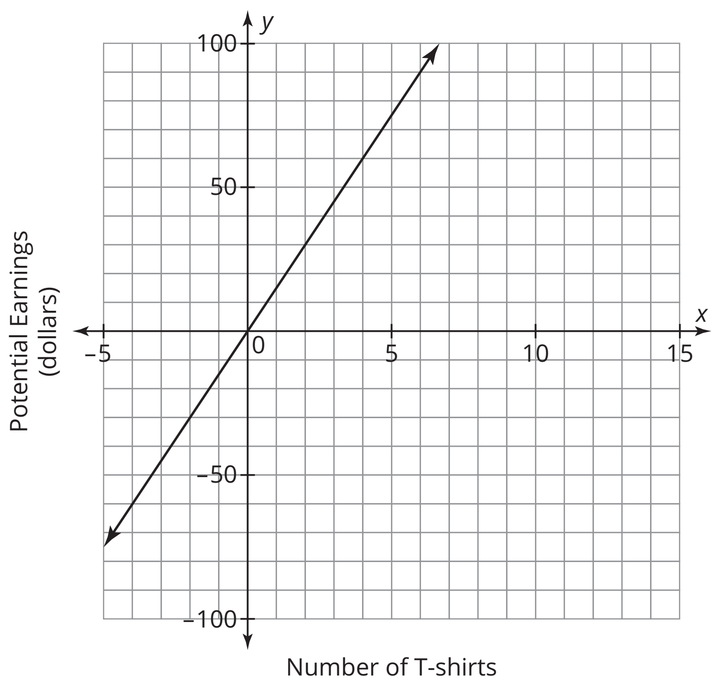
a. **How many gallons did the fish tank hold?**

b. **When will the tank be empty?**

ACTIVITY
2.2

Interpreting Graphs of Linear Functions

Marilynn sells silk screened T-shirts for her mom at local festivals. After each festival, she returns whatever money she earns to her mom. The graph shown represents her potential earnings based on the number of T-shirts she sells.



Ask yourself:

What is the meaning of the slope, *x*- and *y*-intercepts, domain, and range in terms of this situation?

1. **Analyze and interpret the graph. List as many facts as you can about the scenario based on what you see in the graph and describe how they relate to the scenario.**

2. **Interpret the meaning of the origin.**

3. **Write a function, *E*(*t*), to model Marilynn's potential earnings given the number of T-shirts she sells.**

4. What does (t, $E(t)$) represent in terms of the function and the graph?

5. Evaluate each and interpret the meaning in terms of the equation, the graph, and the scenario.

a. $E(2)$ **b.** $E(5)$ **c.** $E(2.75)$

Marilynn has a goal to earn $100 at the festival. Let's consider how to determine the number of T-shirts she needs to sell to meet her goal.

Worked Example

To determine the number of T-shirt sales it takes to earn $100 using the function, $E(t) = 15t$, substitute 100 for $E(t)$ and solve.

$$E(t) = 15t$$
$$100 = 15t$$
$$\frac{100}{15} = t$$
$$6.67 = t$$

6. Consider the worked example.

a. Interpret the meaning of $t = 6.67$.

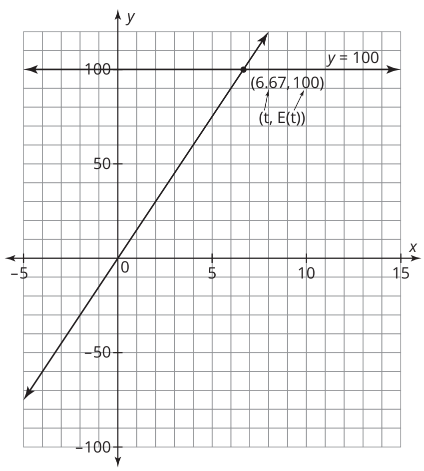
b. Why can you substitute 100 for $E(t)$?

You can also use the graph to determine the number of T-shirts Marilynn needs to sell to earn \$100.

Worked Example

To determine the number of T-shirts sales it takes to earn \$100 using your graph, you need to determine the intersection of the two lines represented by the equation $100 = 15t$.

First, graph the function defined by each side of the equation, and then determine the intersection point of the two graphs.



$h(t) = 15t$

$100 = 15t$

$y = 100$ $y = 15x$

Solution: (6.67, 100)

In terms of the graph, Marilynn needs to sell 6.67 T-shirts to earn \$100. In terms of the context, she needs to sell 7 T-shirts.

Remember:

The graph of an equation plotted on the coordinate plane represents the set of all its solutions.

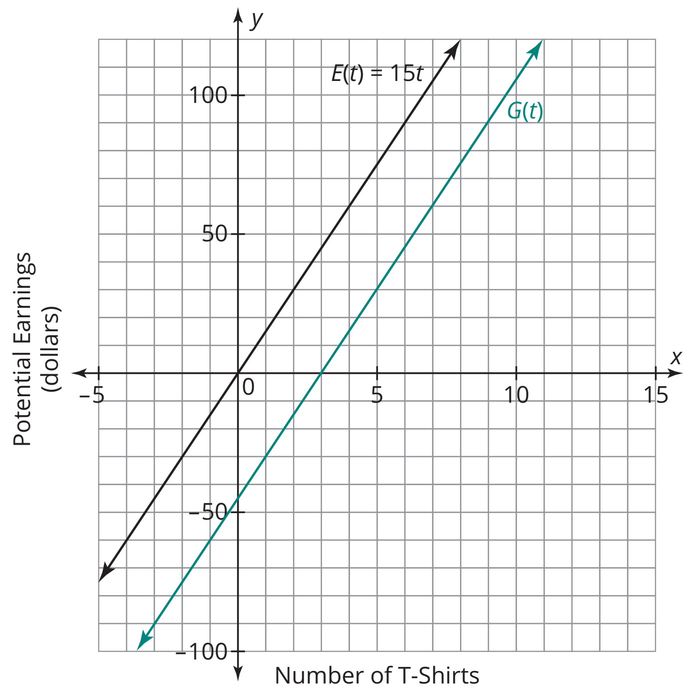
7. Consider the equation and graphical representations. What are the limitations of using each to answer questions about the number of T-shirts sold or the amount of money earned?

a. equation

b. graph

ACTIVITY 2.3 Interpreting Changes to the Graph of a Linear Function

For the next festival, Marilynn's mom suggests that she still sells each T-shirt for \$15, but should give away 3 T-shirts in a raffle. This new relationship, $G(t)$, is shown on the graph.



1. Compare the two graphs. What do you notice?

a. How do the graphs show the selling price per T-shirt remains the same?

b. Determine and interpret the meaning of $y = G(0)$ in terms of the graph and this scenario. Label the point on the graph.

c. Determine and interpret the meaning of $G(t) = 0$ in terms of the graph and this scenario. Label the point on the graph.

Michelle and Myra each wrote an equation to describe the effect of giving away three T-shirts.

Michelle
Marilynn is giving away 3 T-shirts, so she has 3 fewer shirts to sell.
$G(t) = 15(t - 3)$

Myra
The cost of giving away three shirts is $45.
$G(t) = 15t - 45$

2. Verify the two equation representations are equivalent.

3. How many T-shirts will Marilynn need to sell to earn $100? Use the graph and an equation.

4. Consider the expressions in the first two rows that define the quantities of the function and then the parts of each equation written by Michelle and Myra to complete the table. First, determine the unit of measure for each expression. Then describe the contextual meaning and the mathematical meaning of each part of the function.

		What It Means	
Expression	Unit	Contextual Meaning	Mathematical Meaning
t			
$G(t)$			
15			
$(t - 3)$			
$15t$			
-45			

The linear functions that Michelle and Myra each wrote are equivalent; however, they are written in different forms. The linear function $G(t) = 15(t - 3)$ is written in factored form and $G(t) = 15t - 45$ is written in general form.

Polynomial comes from *poly-* meaning "many" and *-nomial* meaning "term," so it means "many terms."

A linear function can also be referred to as a *polynomial* function. A **polynomial** is a mathematical expression involving the sum of powers in one or more variables multiplied by coefficients. The **degree** of a polynomial is the greatest variable exponent in the expression. The **leading coefficient** of a polynomial is the numeric coefficient of the term with the greatest power.

When you graph a polynomial the degree tells you the maximum number of times the graph can cross the x-axis.

Worked Example

A few examples of polynomial functions.

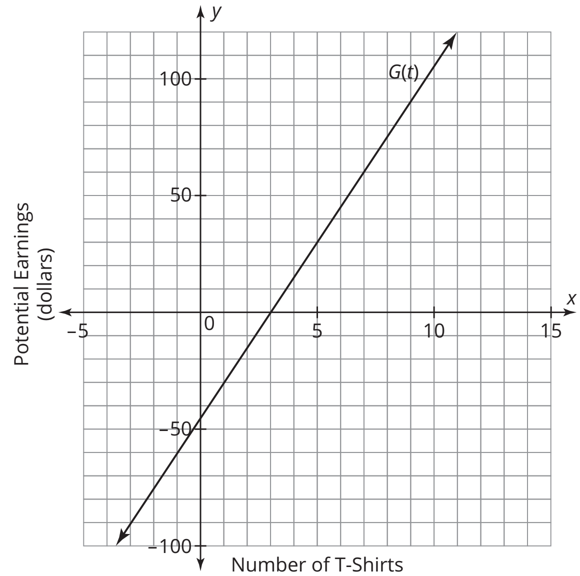
Polynomial Functions		Degree
Constant	$P(x) = 7$	0
Linear	$P(x) = 2x - 5$	1
Quadratic	$P(x) = 3x^2 - 2x + 4$	2
Cubic	$P(x) = 4x^3 - 2$	3

The variables used to represent any real number in the general linear form are irrelevant. Think about the position of the number as either the leading coefficient or a constant and the potential effect on the function.

The structure of each linear function tells you important information about the graph. Let's consider the general form of a linear function, $f(x) = ax + b$, where a and b are real numbers and $a \neq 0$. In this form, the a-value is the leading coefficient, which describes the steepness and direction of the line. The b-value describes the y-intercept.

You know the form $y = mx + b$ as slope-intercept form, where m represents the slope and b represents the y-intercept. Notice that the general form has the same structure. The general form shows that a linear equation is a polynomial of degree 1. You will learn more about polynomials as you progress through high school mathematics.

5. Consider the general form of the linear function $G(t)$.



a. Label a on the graph.

b. Label b on the graph.

Next, consider the factored form of a linear function, $f(x) = a(x - c)$, where a and c are real numbers and $a \neq 0$. When a polynomial is in factored form, the value of x that makes the factor $(x - c)$ equal to zero is the x-intercept. This value is called the *zero of the function*. A **zero of a function** is a real number that makes the value of the function equal to zero, or $f(x) = 0$.

You can set $(x - c)$ equal to zero and determine the point where the graph crosses the x-axis.

6. Consider the factored form of the linear function $G(t)$.

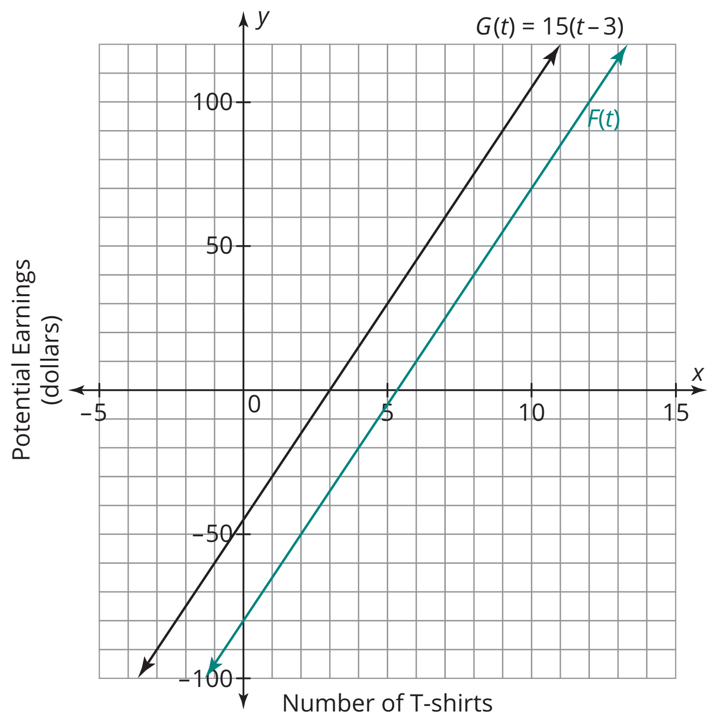
a. Label a on the graph.

b. Label c on the graph.

7. What is the zero of $G(t)$? Explain your reasoning.

ACTIVITY
2.4
Interpreting More Changes to the Graph of a Linear Function

The next festival that Marilynn is attending charges a $35 fee to rent a booth. She is still selling her mom's T-shirts for $15 each and giving 3 away in a raffle. The graph shows this new relationship, $F(t)$.



1. Consider the relationship between graphs of $G(t)$ and $F(t)$.

a. How do the graphs show that the selling price per T-shirt remains the same?

b. How did the new booth fee of $35 change the graph?

c. How many T-shirts will Marilynn need to sell before she will have any money to return to her mom? Explain your reasoning.

d. How many T-shirts will Marilynn need to sell to earn $100?

2. Consider the relationship between the equations of $G(t)$ and $F(t)$.

a. Write the function $F(t)$ in terms of $G(t)$.

b. Rewrite $F(t)$ in general form. Then describe how the a- and b-values are represented on the graph.

The general form of a linear function is $f(x) = ax + b$.

c. Rewrite $F(t)$ in factored form. Use a fraction to represent the c-value. Then describe how the a- and c-values are represented on the graph.

The factored form of a linear function is $f(x) = a(x - c)$.

The values a, b, and c are real numbers and $a \neq 0$.

NOTES

TALK the TALK

Reading Between the Lines

Complete each "I can" sentence using *always*, *sometimes*, or *never*.

1. Suppose you are given a dependent value and need to calculate an independent value of a linear function.

a. I can ______________________ use a table to determine an *approximate* value.

b. I can ______________________ use a table to calculate an *exact* value.

c. I can ______________________ use a graph to determine an *approximate* value.

d. I can ______________________ use a graph to calculate an *exact* value.

e. I can ______________________ use an equation to determine an *approximate* value.

f. I can ______________________ use an equation to calculate an *exact* value.

2. Write the function that models each table of values. Then evaluate the function for each independent and dependent value.

a.

x	1	2	3	4	5
$f(x)$	−20	5	30	55	80

$f(x) =$

$f(12) =$

$f(x) = -145$

NOTES

b.

x	1	3	5	7	9
$g(x)$	18	6	−6	−18	−30

$g(x) =$

$g(-9) =$

$g(x) = -54$

3. Complete the graphic organizer located at the end of this lesson for the linear function $f(x) = 2x - 8$.

   a. Write $f(x)$ in general form. Then describe the information given in this form.

   b. Write $f(x)$ in factored form. Then describe the information given in this form.

   c. Graph $f(x)$. Describe how you know this graph can cross the x-axis only one time.

   d. Create a table of values for $f(x)$.

Graphic Organizer

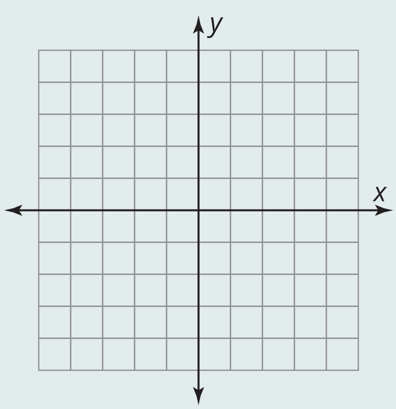
General Form

$f(x) = ax + b$, where a and b are real numbers and $a \neq 0$

Factored Form

$f(x) = a(x - c)$, where a and c are real numbers and $a \neq 0$

$f(x) = 2x - 8$



Graph

x	***y***

Table

Assignment

Write

Describe a zero of a function in your own words.

Remember

The general form of a linear function is $f(x) = ax + b$, where a and b are real numbers and $a \neq 0$. In this form, the a-value is the leading coefficient which describes the steepness and direction of the line. The b-value describes the y-intercept.

The factored form of a linear function is $f(x) = a(x - c)$, where a and c are real numbers and $a \neq 0$. In this form, the a-value is the slope and the value of x that makes the factor $(x - c)$ equal to zero is the x-intercept.

Practice

Determine whether the table of values represents a linear function. If so, write the function.

1.

x	y
-2	$5\frac{2}{3}$
0	5
2	$4\frac{1}{3}$
4	$3\frac{2}{3}$

2.

x	y
-5	-27
0	-2
5	20
10	48

For each scenario, write a linear function in factored form and in general form. Then sketch a graph and label the x- and y-intercepts. Finally, answer each question.

3. Carlos prints and sells T-shirts for \$14.99 each. Each month 5 T-shirts are misprinted and cannot be sold. How much money will he earn if he prints 22 T-shirts? How many T-shirts will he need to sell to earn \$200?
4. Mei paints and sells ceramic vases for \$35 each. Each month she typically breaks 3 vases in the kiln. How much money will she earn if she sells 17 ceramic vases? How many ceramic vases will she need to sell to earn \$600?
5. Emilio builds and sells homemade wooden toys for \$12 each. The festival he is attending charges \$50 to set up his booth. How much money will he earn if sells 35 wooden toys? How many wooden toys will he need to sell to earn \$250?

Stretch

A pretzel manufacturer has two production lines. Line A produces a variety of pretzel that is sold for \$2.40 per bag. Line A typically produces 3 bags per day that do not meet company standards and cannot be sold. Line B produces a variety of pretzel that is sold for \$3.60 per bag. Line B typically produces 4 bags per day that do not meet company standards and cannot be sold. Line A produces 3 times as many bags as Line B each day.

Write a linear function that represents the total number of bags the lines can produce combined.

Review

1. Determine whether each relationship shows a constant difference. If so, write the linear function that represents the relationship.

a.

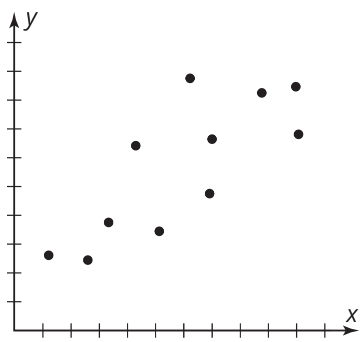
x	y
2	9
3	11
4	13
5	15

b.

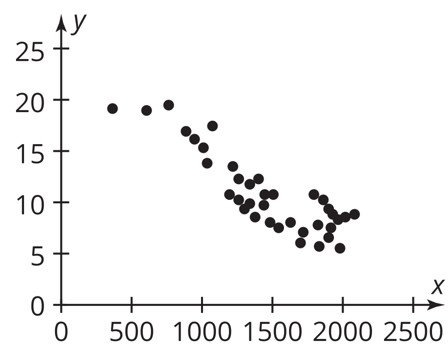
x	y
1	2
2	1
3	$\frac{1}{2}$
4	$\frac{7}{2}$

2. Determine whether the points in each scatter plot have a positive association, a negative association, or no association. Explain your reasoning.

a.



b.



3. Solve each equation.

a. $\frac{1}{3}x + 2 = 11$

b. $-5p - 12 = 19$