Algebra 1

Unit 2: Linear Functions

Romeo High School

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Algebra 1 - Unit 2: Linear Functions

Prior Knowledge GLCE
A.RP.08.01; A.PA.08.02; A.PA.08.03;
A.FO.08.04; A.RP.08.05; A.RP.08.06;
A.FO.08.07 – A.FO.08.09

HSCE Mastered Within This Unit
A3.1.1 – A3.1.4

HSCE Addressed Within Unit
A1.1.1; A1.1.3; A1.2.1 – A1.2.3;
A1.2.8; A2.1.1 – A2.1.3; A2.1.6;
A2.1.7; A2.2.1 – A2.2.3; A2.3.2;
A2.4.1 - A2.4.4; A3.1.2; A3.1.4;
L1.1.2 - L1.1.5

Visit http://michigan.gov/documents/mde/AlgebraI_216634_7.pdf for HSCE’s

After successful completion of this unit, you will be able to:

• Understand the concept of functions; independent and dependent relationships, concepts of variables.
  • Identify the zeros of a function and their role in solutions to equations.
  • Identify domain and range in context of a given situation.

• Understand linear functions have a constant rate of change and be able to identify it graphically, in a table, symbolically and verbally.

• Give the output, given the input and a function in function notation, table form or graphically.

• Identify the inverse of a function as a way to find the inputs for given multiple outputs.

• Solve equations algebraically by substituting one equivalent form of the equation for another equation or by converting from one form of an equation to another.

• Connect the concept of parallel lines and vertical translations (perpendicular lines) to solving equations.
  • Solve one or more inequalities graphically or algebraically.

• Determine if a given situation can be modeled by a linear function or not. If it is linear, write a function to model it.
## Algebra 1 - Unit 2: Linear Functions Alignment Record

<table>
<thead>
<tr>
<th>HSCE Code</th>
<th>Expectation</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1.1.1</td>
<td>Give a verbal description of an expression that is presented in symbolic form, write an algebraic expression from a verbal description, and evaluate expressions given values of the variables.</td>
</tr>
<tr>
<td>A1.2.1</td>
<td>Write and solve equations and inequalities with one or two variables to represent mathematical or applied situations.</td>
</tr>
<tr>
<td>A1.2.2</td>
<td>Associate a given equation with a function whose zeros are the solutions of the equation.</td>
</tr>
<tr>
<td>A1.2.3</td>
<td>Solve linear and quadratic equations and inequalities, including systems of up to three linear equations with three unknowns. Justify steps in the solutions, and apply the quadratic formula appropriately.</td>
</tr>
<tr>
<td>A1.2.8</td>
<td>Solve an equation involving several variables (with numerical or letter coefficients) for a designated variable. Justify steps in the solution.</td>
</tr>
<tr>
<td>A2.1.1</td>
<td>Recognize whether a relationship (given in contextual, symbolic, tabular, or graphical form) is a function and identify its domain and range.</td>
</tr>
<tr>
<td>A2.1.2</td>
<td>Read, interpret, and use function notation and evaluate a function at a value in its domain.</td>
</tr>
<tr>
<td>A2.1.3</td>
<td>Represent functions in symbols, graphs, tables, diagrams, or words and translate among representations.</td>
</tr>
<tr>
<td>A2.1.6</td>
<td>Identify the zeros of a function and the intervals where the values of a function are positive or negative. Describe the behavior of a function as x approaches positive or negative infinity, given the symbolic and graphical representations.</td>
</tr>
<tr>
<td>A2.1.7</td>
<td>Identify and interpret the key features of a function from its graph or its formula(e), (e.g., slope, intercept(s), asymptote(s), maximum and minimum value(s), symmetry, and average rate of change over an interval).</td>
</tr>
<tr>
<td>A2.2.1</td>
<td>Combine functions by addition, subtraction, multiplication, and division.</td>
</tr>
<tr>
<td>A2.2.2</td>
<td>Apply given transformations (e.g., vertical or horizontal shifts, stretching or shrinking, or reflections about the x- and y-axes) to basic functions and represent symbolically.</td>
</tr>
<tr>
<td>A2.2.3</td>
<td>Recognize whether a function (given in tabular or graphical form) has an inverse and recognize simple inverse pairs.</td>
</tr>
<tr>
<td>A2.3.2</td>
<td>Describe the tabular pattern associated with functions having constant rate of change (linear) or variable rates of change.</td>
</tr>
<tr>
<td>A2.4.1</td>
<td>Write the symbolic forms of linear functions (standard [i.e., Ax + By = C, where B ≠ 0], point-slope, and slope-intercept) given appropriate information and convert between forms.</td>
</tr>
<tr>
<td>A2.4.2</td>
<td>Graph lines (including those of the form x = h and y = k) given appropriate information.</td>
</tr>
<tr>
<td>A2.4.3</td>
<td>Relate the coefficients in a linear function to the slope and x- and y-intercepts of its graph.</td>
</tr>
<tr>
<td>A2.4.4</td>
<td>Find an equation of the line parallel or perpendicular to given line through a given point. Understand and use the facts that nonvertical parallel lines have equal slopes and that nonvertical perpendicular lines have slopes that multiply to give -1.</td>
</tr>
<tr>
<td>A3.1.2</td>
<td>Adapt the general symbolic form of a function to one that fits the specifications of a given situation by using the information to replace arbitrary constants with numbers.</td>
</tr>
<tr>
<td>A3.1.3</td>
<td>Using the adapted general symbolic form, draw reasonable conclusions about the situation being modeled.</td>
</tr>
<tr>
<td>A3.1.4</td>
<td>Use methods of linear programming to represent and solve simple real-life problems.</td>
</tr>
<tr>
<td>L1.1.2</td>
<td>Explain why the multiplicative inverse of a number has the same sign as the number, while the additive inverse has the opposite sign.</td>
</tr>
<tr>
<td>L1.1.3</td>
<td>Explain how the properties of associativity, commutativity, and distributivity, as well as identity and inverse elements, are used in arithmetic and algebraic calculations.</td>
</tr>
<tr>
<td>L1.1.4</td>
<td>Describe the reasons for the different effects of multiplication by, or exponentiation of, a positive number by a number less than 0, a number between 0 and 1, and a number greater than 1.</td>
</tr>
<tr>
<td>L1.1.5</td>
<td>Justify numerical relationships.</td>
</tr>
</tbody>
</table>
* Remember to distribute before your start the “undoing” process. (To distribute you need to take the number directly in front of the parenthesis and multiply it by everything inside the parenthesis. Be careful of your signs!!!)

* Don’t forget to combine like terms if they are on the same side of the equal sign. Only perform the opposite operation if you are moving a piece to the other side of the equal sign.

* You can check your answers by substituting the value you found for x into the original equation.

Solving Multi-Step Equations

1. \(2x + 6 = 4x - 2\)  
   \[-6\]
   \[2x = 4x - 8\]
   \[-4x\]
   \[-2x = -8\]
   \[-2 = -2\]
   \[x = 4\]

2. \(4x + 5 + 2x = 20 + 3x\)  
   \[-5\]
   \[6x + 5 = 20 + 3x\]
   \[-3x\]
   \[3x = 15\]
   \[3\]
   \[x = 5\]

3. \(3(2x + 4) = 48\)
   \[-12\]
   \[6x + 12 = 48\]
   \[-12\]
   \[6x = 36\]
   \[6\]
   \[x = 6\]

4. \(5(3 + 4x) + 9 = 15x - 1\)

5. \(-7x - 4 + 9 = 2x + 14\)

6. \(-10 + \frac{x}{4} + 2 = 3\)
7. \(-6x - 3 + 7 = 2x + 12\) 
8. \(2x + 3 + 7x = 13 + 4x\) 
9. \(3(8x + 5) = 63\) 

10. \(-5 + \frac{x}{3} + 2 = 8\) 
11. \(6x + 1 = 3x - 5\) 
12. \(4(2 + 7x) + 1 = 16x + 45\)
Solving Multi-Step Equations

1. \(4x - 6 = x + 9\)
2. \(-4x - 3 = -6x + 9\)
3. \(6(2 + y) = 3(3 - y)\)
4. \(6x - 9x - 4 = -2x - 2\)
5. \(3 - 6a = 9 - 5a\)
6. \(5x - 7 = -10x + 8\)
7. \(-3(y + 3) = 2y + 3\)

8. \(7x - 3 = 2(x + 6)\)

9. \(3(x + 2) = -5 - 2(x - 3)\)

10. \(\frac{1}{3}(6y - 9) = -2y + 13\)

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Test Practice

11. Which of the following illustrates the distributive property?
   a. \(3(x + 2) = 3x + 6\)
   b. \(5 + 3 = 3 + 5\)
   c. \(4(2 + 3) = 4(5)\)
   d. \(7 + -7 = 0\)

12. Which is the simplified expression for \(8x^2 - y^2 + 2 + 3y^2 - 2x^2\)?
   a. \(8x^2y^2 + 2\)
   b. \(6x^2 + 2y^2 + 2\)
   c. \(10x^2 - 4y^2 + 2\)
   d. \(10x^2 + 2y^2 + 2\)
Slope Introduction
Notes
Linear Unit
Algebra 1

\[ \text{Slope} = \frac{\text{Rise}}{\text{Run}} = \frac{\text{change in } y}{\text{change in } x} = m \]

Find the slope of the line:
\[ \frac{\text{Rise}}{\text{Run}} = \frac{(\text{Up} / \text{Down})}{(\text{Right} / \text{Left})} \]

Find the slope of each line.

2. Positive Slope
3. Negative Slope
4. Zero Slope
5. Undefined Slope

\[
\begin{align*}
\text{Slope} &= \quad \text{Slope} = \quad \text{Slope} = \quad \text{Slope} = \\
\text{Given 2 Points:} &\quad (x_1, y_1) \quad (x_2, y_2) \\
&\quad m = \frac{y_2 - y_1}{x_2 - x_1}
\end{align*}
\]

Determine the slope passing through the two given points.

6. (3,-9) (4,-12)
7. (-5,3) (2,1)
8. (4,3) (1,-1)

\[
\begin{align*}
m &= \frac{y_2 - y_1}{x_2 - x_1} \\
m &= \frac{-12 - (-9)}{4 - 3} \\
m &= \frac{-12 + 9}{4 - 3} \\
m &= \frac{-3}{1} \\
m &= -3
\end{align*}
\]
Find the slope of the line based on the given tables.

9. 

<table>
<thead>
<tr>
<th>x</th>
<th>-2</th>
<th>0</th>
<th>2</th>
<th>4</th>
<th>6</th>
<th>8</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>y</td>
<td>-3</td>
<td>0</td>
<td>3</td>
<td>6</td>
<td>9</td>
<td>12</td>
<td>15</td>
</tr>
</tbody>
</table>

* Find the difference or change in y-values and place that number over the difference or change in x-values.

\[
\frac{\Delta y}{\Delta x} = \frac{3}{2} \quad m = \frac{3}{2}
\]

10. 

<table>
<thead>
<tr>
<th>x</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>y</td>
<td>5</td>
<td>7</td>
<td>9</td>
<td>11</td>
<td>13</td>
<td>15</td>
<td>17</td>
</tr>
</tbody>
</table>

11. 

<table>
<thead>
<tr>
<th>x</th>
<th>y</th>
</tr>
</thead>
<tbody>
<tr>
<td>-3</td>
<td>5</td>
</tr>
<tr>
<td>-1</td>
<td>4</td>
</tr>
<tr>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>7</td>
<td>0</td>
</tr>
<tr>
<td>9</td>
<td>-1</td>
</tr>
</tbody>
</table>

12. 

<table>
<thead>
<tr>
<th>x</th>
<th>y</th>
</tr>
</thead>
<tbody>
<tr>
<td>-1</td>
<td>5</td>
</tr>
<tr>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>5</td>
<td>5</td>
</tr>
</tbody>
</table>

Determine the value of $r$, so the line passing through the two points has the indicated slope.

13. (-8, $r$) (-10, 6); $m = \frac{-3}{2}$

14. (2, 6) (-5, $r$); $m = -r$
Find the slope of each line.

1.  
   \[ \text{m} = \underline{\phantom{0000}} \]

2.  
   \[ \text{m} = \underline{\phantom{0000}} \]

3.  
   \[ \text{m} = \underline{\phantom{0000}} \]

4.  
   \[ \text{m} = \underline{\phantom{0000}} \]

5.  
   \[ \text{m} = \underline{\phantom{0000}} \]

6.  
   \[ \text{m} = \underline{\phantom{0000}} \]

7.  
   \[ \text{m} = \underline{\phantom{0000}} \]

8.  
   \[ \text{m} = \underline{\phantom{0000}} \]

9.  
   \[ \text{m} = \underline{\phantom{0000}} \]
Find the slope of the line based on the given tables.

10. 

<table>
<thead>
<tr>
<th>$x$</th>
<th>$y$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>2</td>
<td>8</td>
</tr>
<tr>
<td>3</td>
<td>12</td>
</tr>
<tr>
<td>4</td>
<td>16</td>
</tr>
<tr>
<td>5</td>
<td>20</td>
</tr>
<tr>
<td>6</td>
<td>24</td>
</tr>
<tr>
<td>7</td>
<td>28</td>
</tr>
</tbody>
</table>

11. 

<table>
<thead>
<tr>
<th>$x$</th>
<th>$y$</th>
</tr>
</thead>
<tbody>
<tr>
<td>-5</td>
<td>28</td>
</tr>
<tr>
<td>-3</td>
<td>18</td>
</tr>
<tr>
<td>-1</td>
<td>8</td>
</tr>
<tr>
<td>1</td>
<td>-2</td>
</tr>
<tr>
<td>3</td>
<td>-12</td>
</tr>
<tr>
<td>5</td>
<td>-22</td>
</tr>
<tr>
<td>7</td>
<td>-32</td>
</tr>
</tbody>
</table>

Slope =

12. 

<table>
<thead>
<tr>
<th>$x$</th>
<th>6</th>
<th>12</th>
<th>18</th>
<th>24</th>
<th>30</th>
<th>36</th>
<th>42</th>
</tr>
</thead>
<tbody>
<tr>
<td>$y$</td>
<td>0</td>
<td>2</td>
<td>4</td>
<td>6</td>
<td>8</td>
<td>10</td>
<td>12</td>
</tr>
</tbody>
</table>

Slope =

13. 

<table>
<thead>
<tr>
<th>$x$</th>
<th>-1</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>$y$</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
</tbody>
</table>

Slope =

14. 

<table>
<thead>
<tr>
<th>$x$</th>
<th>-5</th>
<th>0</th>
<th>5</th>
<th>10</th>
<th>15</th>
<th>20</th>
<th>25</th>
</tr>
</thead>
<tbody>
<tr>
<td>$y$</td>
<td>12</td>
<td>15</td>
<td>18</td>
<td>21</td>
<td>24</td>
<td>27</td>
<td>30</td>
</tr>
</tbody>
</table>

Slope =

Determine the slope passing through the two given points.

15. (3, 2) (3, -2)
16. (-2, 4) (10, 0)
17. (2, 7) (-2, -3)

Determine the value of $r$, so the line passing through the two points has the indicated slope.

18. (7, -4) (-1, $r$); $m = \frac{9}{8}$
19. (4, 12) (11, $r$); $m = \frac{-r}{7}$
20. (2, $r$) (5, -3); $m = \frac{r}{3}$

21. (6, 3) ($r$, 2); $m = \frac{1}{2}$
22. ($r$, 3) (-4, 5); $m = \frac{-2}{5}$
23. (9, $r$) (6, 2); $m = r$
**Point-Slope Form**

For any given point \((x_1, y_1)\) with a slope \(m\), the point-slope form of a linear equation is:

\[ y - y_1 = m(x - x_1). \]

**Example:** \((3,-2); \; m = \frac{1}{4}\)

\[ y - (-2) = \frac{1}{4} (x - 3) \text{ or } y + 2 = \frac{1}{4} (x - 3) \]

* Plug in -2 for your \(y\)-value, 3 for your \(x\)-value and \(\frac{1}{4}\) for your \(m\) or slope.

* Two negatives (minus negative) become a positive for left side of the equation.

Graph each equation.

1. \(y + 1 = \frac{-3}{4} (x - 2)\)
2. \(y + 2 = \frac{1}{3} (x + 4)\)
3. \(y - 3 = 2(x + 1)\)

<table>
<thead>
<tr>
<th>Point:</th>
<th>Slope:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

4. \(y - 6 = \frac{-2}{3} (x - 2)\)
5. \(y - 4 = \frac{1}{2} (x + 7)\)
6. \(y + 5 = 3(x + 1)\)

<table>
<thead>
<tr>
<th>Point:</th>
<th>Slope:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

RHS Mathematics Department
Algebra 1 Linear Unit 2012-2013
Write the equation of the line in point-slope form (answers will vary).

7.  

Give the slope and a point through which the line passes through for each linear equation.

10. \( y - 3 = 2(x - 4) \)  
11. \( y + 7 = -\frac{1}{2}(x + 3) \)  
12. \( y - 4 = \frac{4}{5}(x + 1) \)

Write an equation in point-slope form of the line passing through the given points and slopes.

13. \((3,-5); \ m = \frac{2}{3}\)  
14. \((0,4); \ m = -2\)  
15. \((-7,1); \ m = \frac{1}{4}\)

Write an equation in point-slope form for the line that passes through the two given points.

16. \((5,4) \ (6,3)\)  
17. \((-8,2) \ (-1,-2)\)  
18. \((-3,-7) \ (-4,-8)\)
Write an equation in point-slope form of the line passing through the given point and with the given slope.

1. (2,-4); \( m = \frac{1}{3} \)  
   2. (-2,0); \( m = -2 \)  
   3. (-3,2); \( m = -\frac{1}{4} \)

Write an equation in point-slope form for the line that passes through the two given points.

4. (1,5) (-1,-5)  
   5. (-2,-5) (7,-6)  
   6. (-9,20) (-4,-3)

Write the equation of the line in point-slope form.
Graph each equation.

10. \( y + 3 = \frac{-1}{2}(x - 6) \)  
11. \( y - 1 = 2(x + 5) \)  
12. \( y - 4 = 3(x + 2) \)

Point: Slope:  
Point: Slope:  
Point: Slope:

13. \( y - 2 = \frac{-4}{5}(x - 1) \)  
14. \( y - 5 = \frac{2}{3}(x + 7) \)  
15. \( y + 6 = -1(x + 8) \)

Point: Slope:  
Point: Slope:  
Point: Slope:

Test Practice

16. What is the solution of \(-3x - 2 = 10\)?
   a. \(-4\)
   b. \(-8/3\)
   c. 9
   d. 15

17. Your softball team is ordering equipment from a catalog. Each bat costs $42. The cost of shipping is $12 no matter how much you order. The total cost is $348. How many bats did your team order?
   a. 8
   b. 9
   c. 10
   d. 11
1. The cost to place an ad in a newspaper for one week is a linear function of the number of lines in the ad. The costs for 3, 5, and 10 lines are shown.

<table>
<thead>
<tr>
<th>Newspaper Ad Costs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lines</td>
</tr>
<tr>
<td>Cost ($)</td>
</tr>
</tbody>
</table>

a. Define the variables.

b. Find the slope and explain what it means in the context of this situation.

c. Write an equation that represents the function.

d. Find the cost of 18 lines.

2. An oil tank is being filled at a constant rate. The depth of the oil is a function of the number of minutes the tank has been filling, as shown in the table.

<table>
<thead>
<tr>
<th>Time (min)</th>
<th>Depth (ft)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>10</td>
<td>5</td>
</tr>
<tr>
<td>15</td>
<td>6</td>
</tr>
</tbody>
</table>

a. Define the variables.

b. Find the slope and explain what it means in the context of this situation.

c. Write an equation that represents the function.

d. Find the depth of the oil after one-half hour.
3. A photo lab manager graphed the cost of having photos developed as a function of the number of photos in the order. The graph is a line with a slope of 1/10 that passes through (10, 6). Write an equation that describes the cost to have photos developed. How much does it cost to have 25 photos developed? Remember to define the variables.
For problems 1-3, use the following information.
A burglar alarm company provides security systems for $5 per week, plus an installation fee. The total cost for installation and 12 weeks of service is $210.

1. Define your variables, then, find the slope and explain what the slope means in the context of this situation.

2. Write the point-slope form of an equation to find the total fee \( y \) for any number of weeks \( x \). (Hint: The point (12, 210) is a solution to the equation.)

3. What is the flat fee for installation?

For problems 4-6, use the following information.
Between 2001 and 2003, the number of movie screens in the United States increased at an average of 410 screens each year. In 2001, there were about 35,170 movie screens.

4. Define your variables, then, find the slope and explain what the slope means in the context of this situation.

5. Write the point slope form of an equation to find the total number of screens \( y \) for any year \( x \).

6. Predict the number of movie screens in the United States in 2020.
7. Tanya and Akira wrote the point-slope form of an equation for a line that passes through (-2, -6) and (1, 6). Tanya says that Akira’s equation is wrong. Akira says they are both correct. Who is correct? Explain.

**Tanya:** \[ y + 6 = 4(x + 2) \]

**Akira:** \[ y - 6 = 4(x - 1) \]

8. Compose a real-life scenario that has a constant rate of change and whose value at a particular time is \((x, y)\). Represent this situation using an equation in point-slope form.

9. Find an equation for the line that passes through (-4, 8) and (3, -7). What is the slope?

10. Barometric pressure is a linear function of altitude. At an altitude of 2 kilometers, the barometric pressure is 600 mmHg. At 7 kilometers, the barometric pressure is 300 mmHg. Find a formula for the barometric pressure in point slope form. Also, explain what the slope means in the context of this situation.

11. A line contains the points (9, 1) and (5, 5). Make a convincing argument that the same line intersects the x-axis at (10, 0).
The **Slope-Intercept Form** of an equation is written as \( y = mx + b \), where \( b \) is the y-intercept and \( m \) is the slope.

Example: \( y = \frac{2}{3} x + 1 \)  
Slope or \( m = \frac{2}{3} \) and y-intercept or \( b = 1 \).

* When graphing slope-intercept form, first graph the y-intercept then extend your line based on your slope.

* Remember slope is \( \frac{\text{rise}}{\text{run}} \) where rise is up/down and run right/left. (Rise first, Run second)

For the following, give the slope and y-intercept and graph.

1. \( y = \frac{3}{5} x + 2 \)  
   \( m = \frac{3}{5} \)  \( b = 2 \)  
   *Start on the y-intercept at (0, 2)
   *Continue the positive slope by going up 3 and right 5.
   *(Reverse down 3 and left 5.)

2. \( y = -5x - 3 \)

3. \( y = \frac{1}{2} x + 4 \)
Find the slope given two points and write an equation in slope-intercept form.

4. (10,7) & (-5,4)

5. (6,-2) & (-7,-2)

Find the slope and y-intercept given on each graph, and write an equation in slope-intercept form.

6.

7.
For the following, give the slope and y-intercept and then graph.

1. \( y = \frac{1}{3}x + 6 \)
2. \( y = 4x - 1 \)
3. \( y = -\frac{3}{4}x + 5 \)
4. \( y = \frac{1}{6}x + 2 \)
5. \( y = -1x - 3 \)
6. \( y = -\frac{1}{2}x + 8 \)
Find the slope and y-intercept given on each graph, and write an equation in slope-intercept form.

7. 

8. 

Find the slope given two points and write an equation.

9. (0,3) & (-1,4) 

10. (8, -1) & (5, 8)

Find “r.”

11. (9, r) & (4, -8); \( m = \frac{3}{5} \)

12. (4, r) & (r, 12); \( m = -\frac{15}{7} \)

Graph.

13. \( y + 3 = -\frac{2}{3}(x - 1) \)

14. \( y - 4 = 3(x + 8) \)

15. \( y + 6 = \frac{1}{4}(x + 2) \)
1. To rent a van, a moving company charges $30.00 plus $0.50 per mile.
   a. Define the variables and find and explain the rate of change (slope).
   b. Write an equation that represents the cost as a function of miles.
   c. Find the cost of the van for 150 miles.

2. A caterer charges a $200 fee plus $18 per person served.
   a. Define the variables and find and explain the rate of change (slope).
   b. Write an equation that represents the cost as a function of the number of guests.
   c. Find the cost of the van for 200 guests.
3. The Culligan man came to Betty’s and Jane’s houses to fix the water tank. Betty was charged $395 for 4 hours of work. Jane was charged $545, which included a new water tank and 3 hours of labor. If the cost of labor is a linear function of time:

a. What is the cost per hour of work?

b. What is the cost of a new water tank?

c. Write an equation in slope intercept form that represents cost as a function of time for the two type of scenarios:
   -someone who does not need to buy a new water tank
   -someone who needs to purchase a new water tank
1. What was the annual rate of change of women competing in triathlons from 1995 to 2003? Define all variables, and explain the meaning of the rate of change.

<table>
<thead>
<tr>
<th>Women Competing in Triathlons</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Year</strong></td>
</tr>
<tr>
<td>1995</td>
</tr>
<tr>
<td>2003</td>
</tr>
</tbody>
</table>

2. In 2000, 5% of teens had cell phones. By 2004, 56% of teens had cell phones. Find the annual rate of change in the percent of teens with cell phones from the year 2000 to the year 2004. Describe what the rate of change means.

*For problems 3 – 5 use the following information.*

The ideal maximum heart rate for a 25 year old exercising to burn fat is 117 beats per minute. For every 5 years someone is older than 25, the ideal heart rate decreases by 3 beats per minute.

3. Write a linear equation in slope-intercept form to find the ideal maximum heart rate for anyone over 25 who is exercising to burn fat. Remember to define all variables.

4. Graph the equation.

5. Find the ideal maximum heart rate for a 55 year old person exercising to burn fat.
For problems 6 – 8, use the following information.
Most animals age more rapidly than humans do. The chart below shows the equivalent ages for horses and humans.

<table>
<thead>
<tr>
<th>Horse Age (x)</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Human Age (y)</td>
<td>0</td>
<td>3</td>
<td>6</td>
<td>9</td>
<td>12</td>
<td>15</td>
</tr>
</tbody>
</table>

6. Find the rate of change and explain its meaning in the context of this situation.

7. Write an equation that relates human age to horse age.

8. Find the equivalent horse age for a human who is 27 years old.

For problems 9 and 10, use the following information.
A rental company on Padre Island charges $8 per hour to rent a mountain bike plus a $5 fee for a helmet.

9. Write a linear equation in slope-intercept form for the total rental cost for a helmet and bicycle for \( t \) hours. Then graph the equation.

10. Find the cost of a 2 hour rental.
You are filling a swimming pool with water. The pool holds 15,000 gallons of water and you can put in 1,000 gallons of water per hour. When you start filling the pool it already has 6,000 gallons of water in it from last year.

1. Before you start filling the pool, how much water is in the pool?

2. If you run the water into the pool for 3 hours, how much water is in the pool?

3. If you run the water into the pool for 6.5 hours, how much water is in the pool?

4. How long will it take to have 10,000 gallons in the pool?

5. What is the constant rate of change in this situation?

   Explain why.
6. Set up a table for this situation.

<table>
<thead>
<tr>
<th>Hours</th>
<th>Gallons</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
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<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

7. Graph this situation. Label the axes correctly. Write a function that models the data.

Function:

Identify the y-intercept __________________
What does it mean in the context of this situation?

Identify the x-intercept __________________
What does it mean in the context of this situation?

What is the domain and range of this situation?

Explain why.

8. If it costs you $0.02 per gallon of water, how much does it cost to fill the pool?
9. How would the table, graph and function change if your pool had 4,000 gallons in it before you started instead of 6,000 gallons?

<table>
<thead>
<tr>
<th>Hours</th>
<th>Gallons</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
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<tr>
<td></td>
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<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Graph this situation. Label the axes correctly.

Function:

Does the domain and range change?

Explain your reasoning?
Terri is filling her gas tank with gasoline. Her car’s tank holds 20 gallons of gasoline and she can put in 4 gallons per minute. When she starts filling the tank, it already has 2 gallons in it.

1. Before Terri starts filling the gas tank, how much gasoline was in it?

2. If she pumps gas for 2 minutes, how much gasoline is in the tank?

3. If she pumps gas for 3.5 minutes, how much gasoline is in the tank?

4. How long will it take for 20 gallons to be in the tank?

5. What is the constant rate of change in this situation?

   Explain why?
6. Set up a table for this situation.

<table>
<thead>
<tr>
<th>Minutes</th>
<th>Gallons</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

7. Graph this situation. Label the axes correctly. Write a function that models the data.

Function____________________________

Identify the y-intercept __________

What does the y-intercept mean in the context of this situation?

Identify the x-intercept __________

What does the x-intercept mean in the context of this situation?

What is the domain and range of this situation?

Explain why?

8. If it costs $2.80 per gallon of gasoline, how much does it cost to fill the tank?
9. How would the table, graph, and function change if Terri had 6 gallons of gasoline in her car before she started instead of 2 gallons?

Function: ___________________________

<table>
<thead>
<tr>
<th>Minutes</th>
<th>Gallons</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Does the domain and range change?

Explain your reasoning.

Mixed Review

Graph each equation.

1. \( y = -2x - 3 \)
2. \( y + 3 = \frac{1}{5}(x - 1) \)
3. \( y = -\frac{1}{2}x + 7 \)
Write an equation of the line with the given information.

4. \( b = -11, m = \frac{5}{2} \)  

5. \( (4,2), m = -3 \)

6. \( (4,1), (5,3) \)  

7. \( (0,-1), (2,-3) \)

8. \( (0, 7), m = -\frac{1}{8} \)  

9. \( (-3,0), (1,2) \)

Test Practice

10. What is the value of \( f(-4) \) when \( f(x) = 3x^2 + 5x - 9 \)?
   a. 5/2
   b. 5
   c. 17/6
   d. 30
   e. 34

11. You rollerblade for 45 minutes along a 3 mile trail. What is your average speed in miles per hour?
   a. -4 mph
   b. 0.25 mph
   c. 2.25 mph
   d. 4 mph
   e. 15 mph

12. What is the value of \( x \)?
   a. \( \frac{1}{2} \)
   b. \( \frac{2}{3} \)
   c. 2
   d. 4
   e. \( \frac{9}{2} \)
Standard Form

Ax + By = C

A, B, and C are integers and A & B are both not zero.
(A and B must be on the left and A must be positive.)

*Solve standard form of a linear equation for y and compare standard form to slope-intercept form.

Ax + By = C
By = -Ax + C

y = -\frac{A}{B}x + \frac{C}{B} (Slope is -\frac{A}{B} and the y-intercept is \frac{C}{B})

*Therefore, if the equation is given in standard form and B is not zero,
the slope = -\frac{A}{B} and y-intercept = \frac{C}{B}.

Example: 2x + 3y = -12

A = 2  B = 3  C = -12  slope = -\frac{2}{3}  y-intercept = -\frac{12}{3} or -4

Finding and Graphing x and y-intercepts from Standard Form

When finding an x-intercept, y = zero and when finding a y-intercept, x = zero.

x-intercept: (x, 0)  y-intercept: (0, y)

Graph the following lines by finding the x- and y- intercepts. Then, give the slope of the line.

1. 2x + 4y = 16

x-intercept: (8,0)  y-intercept: (0,4)

2x + 4(0) = 16  2(0) + 4y = 16
2x + 0 = 16  0 + 4y = 16
2x = 16  4y = 16

\frac{2x}{2} = \frac{16}{2}  \frac{4y}{4} = \frac{16}{4}
x = 8  y = 4

m = -\frac{A}{B} = -\frac{2}{4} = -\frac{1}{2}
2. \(6x - 4y = 12\)

\[\text{x-intercept: ( , )} \quad \text{y-intercept: ( , )}\]

\[m = \phantom{000}\]

3. \(3x - 9y = -9\)

\[\text{x-intercept: ( , )} \quad \text{y-intercept: ( , )}\]

\[m = \phantom{000}\]

4. \(9x + 12y = 36\)

\[\text{x-intercept: ( , )} \quad \text{y-intercept: ( , )}\]

\[m = \phantom{000}\]
With each standard form equation, give the A, B and C value. Then, find the slope and y-intercept. Simplify fractions where necessary.

1. \(3x + 15y = 30\) 
2. \(10x - 2y = 20\) 
3. \(6x - 3y = -12\) 

4. \(4x + 8y = 16\) 
5. \(12x - 9y = 33\) 
6. \(5x + y = 50\)

Graph the following lines by finding the x- and y-intercepts. Then, give the slope of the line.

7. \(5x + 2y = 20\)

x-intercept: ( , )   y-intercept: ( , )

\[ m = \boxed{\text{ }} \]
8. $2x - 3y = 6$

x-intercept: ( , )  y-intercept: ( , )

9. $6x - 3y = -12$

x-intercept: ( , )  y-intercept: ( , )

10. $3x + 4y = 24$

x-intercept: ( , )  y-intercept: ( , )

m = _____________
Complete each table, find the slope and write the equation of the line in slope-intercept form, point-slope form or standard form.

1. 

<table>
<thead>
<tr>
<th>X</th>
<th>-2</th>
<th>-1</th>
<th>0</th>
<th>1</th>
<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Y</td>
<td>5</td>
<td>9</td>
<td>13</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Slope = \( \frac{\text{rise}}{\text{run}} = \frac{4}{1} \)

y-intercept = \( b = 5 \)

Fill in -3 and 1 to the empty boxes because the y-values are increasing by 4.

In slope-intercept form the equation to the table is \( y = 4x + 5 \).

2. 

<table>
<thead>
<tr>
<th>X</th>
<th>-4</th>
<th>-2</th>
<th>0</th>
<th>2</th>
<th>4</th>
<th>6</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Y</td>
<td>14</td>
<td>10</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

3. 

<table>
<thead>
<tr>
<th>X</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Y</td>
<td>4</td>
<td>8</td>
<td>12</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

4. 

<table>
<thead>
<tr>
<th>X</th>
<th>3</th>
<th>6</th>
<th>9</th>
<th>12</th>
<th>15</th>
</tr>
</thead>
<tbody>
<tr>
<td>Y</td>
<td>-3</td>
<td></td>
<td>-9</td>
<td>-11</td>
<td></td>
</tr>
</tbody>
</table>
5. \[
\begin{array}{c|cccccc}
X & -5 & -3 & -1 & 1 & 5 & 7 \\
Y & 28 & 18 & 8 & & & \\
\end{array}
\]

6. \[
\begin{array}{c|cccccc}
X & -18 & -15 & -12 & -9 & -6 & -3 \\
Y & 32 & 27 & & & & 7 \\
\end{array}
\]

7. \[
\begin{array}{c|cccccc}
X & -7 & -6 & -5 & -4 & -3 & \\
Y & -1 & & 5 & & 11 & \\
\end{array}
\]

8. \[
\begin{array}{c|c}
X & Y \\
-2 & \\
& -14 \\
0 & -6 \\
1 & 2 \\
2 & 10 \\
3 & \\
\end{array}
\]

9. \[
\begin{array}{c|c}
X & Y \\
3 & \\
-3 & 2 \\
0 & 1 \\
3 & 0 \\
& -1 \\
& -2 \\
\end{array}
\]
Complete each table, find the slope and write the equation of the line in slope-intercept form, point-slope form or standard form.

1. | X | 4 | 3 | 2 | 1 | 0 |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Y</td>
<td>15</td>
<td>20</td>
<td>30</td>
<td></td>
</tr>
</tbody>
</table>

2. | X | -9 | -6 | -3 | 9 |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Y</td>
<td>8</td>
<td>6</td>
<td>4</td>
<td>-2</td>
</tr>
</tbody>
</table>

3. | X | 7  | 6  | 5  | 4  | 3  | 2  |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Y</td>
<td>13</td>
<td>10</td>
<td>4</td>
<td>1</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

4. | X | -12| -6 |    |    | 12 |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Y</td>
<td>4</td>
<td>8</td>
<td>12</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
“Fix My Mistake” Given the following problems, find the mistake and correct the rest of the steps.

7. \[2x - 2 = 5(x - 7)\]
   \[2x - 2 = 5x - 7\]
   \[+2\quad +2\]
   \[2x = 5x - 5\]
   \[-5x - 5x\]
   \[-3x = -5\]
   \[x = \frac{5}{3}\]

8. \[y - 7 = -4(x + 1)\]
   \[m = -4, \text{ point } = (1,-7)\]

9. \[y = 3 + \frac{1}{5}x\]
   \[m = 3, \text{ y-intercept } = \frac{1}{5}\]
A **horizontal line** extends left to right and crosses the y-axis. Therefore a horizontal line has different x-values for each point it contains with the same y-values.

For example: (-1, 3) (2, 3) (4, 3)

\[
\begin{align*}
\text{y} &= # \\
y &= 3
\end{align*}
\]

A **vertical line** extends bottom to top and crosses the x-axis. Therefore a vertical line has the same x-values for each point it contains with different y-values.

For example: (6, -1) (6, 3) (6, 5)

\[
\begin{align*}
\text{x} &= # \\
x &= 6
\end{align*}
\]

Practice Graphing

\[
\begin{align*}
\text{y} &= -4 \\
\text{x} &= 2
\end{align*}
\]
1. In what form are coordinates written?

2. Plot the following points: (7, -1) (7, 3) (7, 5) (7, 2) (7, 9) (7, -4)

3. Draw a line through the points.

4. What pattern do you see?

5. Where on the ___-axis does your line hit?

6. What is the slope of this line?

Plot your 6 favorite points on the line.

7. Give the coordinates of these points.

8. What pattern do you see?

9. Where on the ___-axis does your line hit?

10. What is the slope of this line?
Horizontal and Vertical Lines

HW
Linear Unit
Algebra 1

1. In what form are coordinates written?

2. Plot the following points: (-1, 2) (5, 2) (0, 2) (1, 2) (-3, 2) (-2, 2)

3. Draw a line through the points.

4. What pattern do you see?

5. Where on the ___-axis does your line hit?

6. What is the slope of this line?

Plot your 6 favorite points on the line.

7. Give the coordinates of these points.

8. What pattern do you see?

9. Where on the ___-axis does your line hit?

10. What is the slope of this line?
11. Graph each line and label it on the coordinate plane.

   a. \( x = 1 \)
   b. \( y = -3 \)
   c. \( x = 4 \)
   d. \( y = -5 \)
   e. \( y = 8 \)
   f. \( x = -9 \)

12. Find the slope and the equation of the line.

   Slope:______________        Slope:______________                Slope:______________
   Equation:___________              Equation:____________               Equation:____________
13. Write the equations for each line.
   a. The line through the points (6, -3) and (6, 5).

   b. The line with slope 0 through the point (-2, 7).

   c. The line with an undefined slope through the point (8, -6).

   d. The horizontal line through the point (1, 9).

   e. The vertical line through the point (-5, -3).

Graphing Practice

14. \( y = -\frac{4}{5}x + 1 \)  

15. \( x = -5 \)

16. \( 4x - 6y = -12 \)  

17. \( y = 4 \)
18. \( y + 3 = -2(x + 1) \) 
19. \( x - y = -6 \) 

20. \( x = 8 \) 
21. \( y - 7 = \frac{4}{5}(x - 2) \) 

22. \( y = 3x + 1 \) 
23. \( y = \frac{2}{3}x + 5 \)
Linear Inequalities

Notes

Linear Unit

Algebra 1

Name____________________________

Hour________________ Date________

Linear inequalities have an “x” and “y” variable. A solution to a linear inequality is any coordinate that makes the inequality true. Shading a portion of the graph represents all the coordinate points that make the inequality true.

If given \( \leq \) or \( \geq \), the line drawn must be _____________________.

If given < or >, the line drawn must be _____________________.

Example: Graph \( y \leq \frac{4}{3}x + 1 \). This follows the format of \( y = mx + b \). Draw a solid line.

Slope = \( \frac{4}{3} \) and the y-intercept = 1.

*To decide where to shade. Test a point above or below the line drawn.

- Test (3,8) \( x = 3, y = 8 \). Plug the x and y values into the inequality to see if the inequality is True or False.

\[
\begin{align*}
y &\leq \frac{4}{3}x + 1 \\
8 &\leq \frac{4}{3}(3) + 1 \\
8 &\leq 4 + 1 \\
8 &\leq 5
\end{align*}
\]

This is a false statement because 8 is not less than or equal to 5.

Because (3,8) is in a False area, you must shade on the other side of the line, because you want to shade in the area that is True.

*Any coordinate contained within the shaded region will hold true in the inequality

\( y \leq \frac{4}{3}x + 1 \).
Let’s graph the following inequalities.

1. $y + 4 \geq -\frac{2}{3}(x + 7)$  
point tested:

2. $2x + 3y \leq 12$  
point tested:

3. $y > \frac{1}{5}x + 2$  
point tested:

4. $x > 4$  
point tested:
Linear Inequalities and Graphing Practice

Graph the following equations or inequalities, give the form and answer the question based on each graph.

1. \( y - 3 \leq 2(x + 6) \)
   
   Form: __________________

2. \( x - 8y = -8 \)
   
   Form: __________________

3. \( x < -5 \)
   
   Form: __________________

4. \( x = 8 \)
   
   Form: __________________

5. \( 5x - 2y \geq 10 \)
   
   Form: __________________

6. \( y < \frac{7}{4}x - 8 \)
   
   Form: __________________
7. \( x + y > 7 \)

Form: \\

\[ \begin{array}{c}
\text{Graph} \\
\end{array} \]

\( m = \) \\
\( y\)-intercept = \\
range =

8. \( y < -3 \)

Form: \\

\[ \begin{array}{c}
\text{Graph} \\
\end{array} \]

\( m = \) \\
\( y\)-intercept = \\
range =

9. \( y + 5 = 6(x + 1) \)

Form: \\

\[ \begin{array}{c}
\text{Graph} \\
\end{array} \]

\( m = \) \\
\( y\)-intercept = \\
range =

10. \( y - 6 > -\frac{1}{2}(x - 4) \)

Form: \\

\[ \begin{array}{c}
\text{Graph} \\
\end{array} \]

starting point = \\
\( m = \) \\
\( m = \)

11. \( y = -9 \)

Form: \\

\[ \begin{array}{c}
\text{Graph} \\
\end{array} \]

starting point = \\
\( m = \) \\
\( m = \)

12. \( y \geq \frac{4}{3}x - 2 \)

Form: \\

\[ \begin{array}{c}
\text{Graph} \\
\end{array} \]

starting point = \\
\( m = \) \\
\( m = \)
13. \( y + 2 = -2(x - 1) \)
Form: __________________

range = ____________

14. \( y = \frac{-3}{4}x + 4 \)
Form: __________________

behavior = ____________

m = ____________

15. \( y \leq 3x + 1 \)
Form: __________________

16. \( y + 4 < \frac{5}{2}(x - 1) \)
Form: __________________

starting point = _________

17. \( y \geq 2 \)
Form: __________________

point tested = _________

18. \( 3x + 6y < -24 \)
Form: __________________

slope = _________

True or False?
Parallel and Perpendicular Lines

Name____________________________

Notes

Linear Unit

Hour___________Date______________

Algebra 1

**Parallel Lines** (symbol is //) have the **same** slope as the original line. Parallel lines never intersect.

Example: Original Line 1: \( m = \frac{1}{2} \) Parallel Line 2: \( m = \frac{1}{2} \)

Find the equation of the line, in any form, **parallel** to and passing through the given point.

1. \( y = \frac{4}{3} x + 5; \ (12, \ 3) \)
   
   // \( m = \frac{4}{3} \)
   
   \( y = \frac{4}{3} x + b \)
   
   \( 3 = \frac{4}{3} (12) + b \)
   
   \( 3 = 16 + b \)
   
   \( -16 \)
   
   \( -13 = b \)

   \( y = \frac{4}{3} x - 13 \)

2. Graph \( y = -\frac{2}{3} x + 1 \).
3. Plot the point \((-3, \ 0)\).
4. Graph the parallel line through this point.
5. Give the equation of the parallel line through \((-3, \ 0)\).
6. Give the equation of the line parallel to $x - 4y = 8$; through (-8, 3).

7. Give the equation of the line parallel to $y + 5 = 4(x - 2)$; through (-3, 6).

8. Give the equation of the line parallel to $x = -3$; through (7, 2).
**Perpendicular Lines** (symbol is \( \perp \)) have the **opposite** and **inverse** slope of the original line. The slope is **flipped** and the **sign is changed**. Perpendicular lines meet at a 90° angle.

Example: Original Line 1: \( m = \frac{3}{4} \)  
Perpendicular Line 2: \( m = -\frac{4}{3} \)

Find the equation of the line, in any form, **perpendicular** to and passing through the given point.

9. \( y = -3x + 1; (3, 2) \)
   \( \perp \) \( m = \frac{1}{3} \)
   \( y - 2 = \frac{1}{3} (x - 3) \)

10. Graph \( y = \frac{1}{2} x - 4. \)

11. Plot the point (-2, -1).

12. Graph the perpendicular line through this point.

13. Give the equation of the perpendicular line through (-2, -1).

14. Give the equation of the line perpendicular to \( 2x + y = -4; \) through (6, 1).
15. Give the equation of the line perpendicular to \( y - 7 = \frac{2}{3}(x + 5) \); through (-3, -2).

16. Give the equation of the line perpendicular to \( y = 4 \); through (6, -1).
Find the equation of the line in any form parallel to and passing through the given point.

1. \( y = \frac{2}{5} x + 4; (-6, -8) \)

2. \( y = -\frac{3}{4} x - 2; (-12, 3) \)

Find the equation of the line in any form perpendicular to and passing through the given point.

3. \( y = -2x + 1; (1, 5) \)

4. \( y = 9x + 1; (3, 1) \)
5. \(3x - 6y = 18\)

Find the following:

a. \(x\)-intercept_____________________

b. \(y\)-intercept_____________________

c. slope_________________________

d. graph the equation and label the line

e. slope of a parallel line____________

f. equation of parallel line through (-2, 2) _____________________________

g. graph the parallel line in part f and label the line

h. slope of a perpendicular line____________

i. equation of a perpendicular line through (-4, 7)______________________________

j. graph the perpendicular line in part i and label the line
Graph the parallel or perpendicular line to the given equation through the given point. Graph both lines, and label each one on the coordinate plane.

6. // line to \( y = \frac{-2}{3}x + 4 \) through (5, -6).

7. \( \perp \) line to \( y + 7 = 3(x - 2) \) through (-1, 6).

8. // line to \( y = -7 \) through (3, 1).

9. \( \perp \) line to \( x = 5 \) through (-3, -8).
For each of the following, given the information, write an equation to the line in one of the three forms: slope-intercept form, point-slope form, or standard form. Then, graph the line(s).

1. (5,4), \( m = -\frac{2}{3} \)  
2. (4,-2), (4,8)  
3. (-6,0), (0,-2)

4. A line parallel to \( 3x - 2y = 6 \) through (8,-7)  
5. Vertical intercept of 8 and a horizontal intercept of -3
6. \( (4,-3), m = 2 \)  
7. \( (8,-1), (7,-1) \)  
8. A line perpendicular to \( y = \frac{2}{5}x - 6 \) with \( b = 4 \) 

9. \( // \) to \( x = 5 \) through \( (-3,7) \)  
10. \( (8,1), (6,-1) \)  
11. A line parallel to \( y = 2x + 4 \) with \( b = 1 \) 

12. A line \( \perp \) to \( 5x + 4y = 20 \)  
13. \( m = \text{undefined}, (-2,1) \)  
14. \( (-6,1), m= \frac{3}{2} \)
through (10,1)

15. \( m = 0, (3,5) \)

16. (2,0), (0,3)

17. \( m = \frac{4}{5}, b = -3 \)
Linear Review (halfway!)

HW
Linear Unit
Algebra 1

1. Solve for x.
   a. $2(x + 6) - 4 = 6$
   b. $4(x + 2) = 6(x - 2)$
   c. $3x + 2 - x = 3(x - 4)$
   d. $5x - 3 + 3x = 6 + 2x - 3$

2. Find the slope.
   a. $(4, -3) \& (-2, 9)$
   b. $(7, -1) \& (7, 4)$
   c. 
   d. 

<table>
<thead>
<tr>
<th>x</th>
<th>-12</th>
<th>-9</th>
<th>-6</th>
<th>-3</th>
</tr>
</thead>
<tbody>
<tr>
<td>y</td>
<td>13</td>
<td>11</td>
<td>9</td>
<td>7</td>
</tr>
</tbody>
</table>
3. Given two coordinates and the slope, find the value of \( r \).
   a. \((r, 3)\) and \((-4, r)\) with \( m = 6 \)
   
   b. \((-4, 3)\) and \((8, r)\) with \( m = \frac{1}{2} \)

4. Write the equation of the line, in any form, with the given information.
   a. \((3, 8)\) and \( m = -1 \)  
       b. \((5, 6)\) and \((-9, 2)\)
   c. \( y\)-intercept = -4, \( x\)-intercept = 6, \( m = \frac{2}{3} \)
   d. \( m = -\frac{1}{2} \) and \( b = -5 \)
g. \((-4, -7)\) and \((3, -7)\)  

h. \(\perp\) line to \(y = 4x + 8\) through \((-5, 1)\)

i. 

<table>
<thead>
<tr>
<th>x</th>
<th>-4</th>
<th>-2</th>
<th>0</th>
<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td>y</td>
<td>10</td>
<td>7</td>
<td>4</td>
<td>1</td>
</tr>
</tbody>
</table>

j. 

<table>
<thead>
<tr>
<th>x</th>
<th>-12</th>
<th>-10</th>
<th>-8</th>
<th>-6</th>
</tr>
</thead>
<tbody>
<tr>
<td>y</td>
<td>12</td>
<td>11</td>
<td>10</td>
<td>9</td>
</tr>
</tbody>
</table>

k. \((-3, -5)\) and \((-3, 6)\)  

l. \(\parallel\) line to \(y - 4 = \frac{2}{5} (x + 7)\) through \((0, 6)\)

m. 

n. 
5. Give the form of each equation, then graph it.

a. $3x - 6y = -12$
   
   Form: __________________________
   
   x-int: ___________ y-int: ___________
   
   $m = _____________$

b. $x = 4$
   
   Form: __________________________
   
   $m = _____________$

c. $y + 3 = 2(x - 5)$
   
   Form: __________________________
   
   point: ___________ slope: ___________

d. $y < -x + 5$
   
   Form: __________________________
   
   slope: ___________ y-int: ___________
e. $12x + 3y = 24$

Form: ________________________________

x-int: ______________ y-int: ____________

$m = ______________$

f. $y = -2$

Form: ________________________________

$m = ______________$

g. $y - 7 \geq \frac{2}{3}(x + 5)$

Form: ________________________________

slope: ___________ point: ______________

h. $y = -\frac{1}{3}x + 4$

Form: ________________________________

y-int: ______________ slope: ___________
6. Graph the parallel or perpendicular line to the given equation through the given point. Graph both lines, and label each one on the coordinate plane.

   a. // to \( y = \frac{4}{3}x - 6 \) through \((3, 7)\)

   b. \( \perp \) to \( y - 2 = -2(x + 3) \) through \((6, 4)\)

   c. \( \perp \) to \( y = -\frac{1}{2}x + 4 \) through \((3, -2)\)

   d. // to \( 6x - 3y = 7 \) through \((-4, -2)\)
7. 4x – 6y = 12
a. Slope?   b. x-intercept?   c. y-intercept?

d. Graph the line and label it.

e. Complete the table of values using your line or the table on your calculator:

<table>
<thead>
<tr>
<th>x</th>
<th>-9</th>
<th>-6</th>
<th>-3</th>
<th>0</th>
<th>3</th>
<th>6</th>
<th>9</th>
</tr>
</thead>
<tbody>
<tr>
<td>y</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

f. What is the slope of a line parallel to the given line?

g. Write the equation of the line parallel to the given one and through the point (-3, 7)? Graph the line above and label it.

h. What is the slope of a line perpendicular to the given line?

i. Write the equation of the line perpendicular to the given one and through the point (3, -6)? Graph the line above and label it.
8. Tom and Mary are getting married. Tom has a savings account with $2000 in it and adds $150 per **month** to the account. Mary has a savings account with $2500 in it and deposits $125 per **week**.

   a. Not counting interest, write a function for both Tom and Mary’s savings plans.

   b. After they are married, Tom and Mary plan to continue their savings plans but want to join them in one account. Write a function that would model the savings plan for this new account.

   c. After Tom and Mary are married, how much money will they have in their savings account at 3 months?
SYSTEM – a group of equations

SOLUTION – intersection of equations

Graph the system of equations and give the solution.

\[ y = -2x + 3 \]
\[ x - y = 6 \]

*You are finding the one point that both lines have in common.

Graph and label each line.

The intersection of the lines is the solution. The solution is at (3, -3).
Find a solution for each system.

1. \( y = -x + 7 \)
   \( y = x - 3 \)

2. \( 2x - y = 4 \)
   \( 3x + y = 6 \)

3. \( y = x \)
   \( y = \frac{1}{2}x - 3 \)

4. \( x + y = 4 \)
   \( y = \frac{1}{2}x + 1 \)
5. \( y = 5x + 10 \)
\[-10x + 2y = 20\]

6. \( y = \frac{1}{2}x \)
\[y = \frac{1}{2}x + 3\]

7. What is the same in #6?

8. What type of lines were graphed in #6?

9. So __________________ lines have the same __________________.

10. Parallel lines have how many solutions?
Graph each system of equations.

1. \( x + y = 3 \)
   \( y = 2x - 3 \)

2. \( x + 5y = 10 \)
   \( y = 2 \)

3. \( y = -3x - 8 \)
   \( -6x - 2y = 6 \)

4. \( 2x + y = 4 \)
   \( x - 3y = 9 \)
Carlos was climbing a mountain that Vijay was descending when they met. Carlos left at 8:00 am from an altitude of 350 feet and gained 100 ft/hr. Vijay left at 8 am from an altitude of 1850 feet and lost 150 ft/hr.

5. Complete the following table:

<table>
<thead>
<tr>
<th>Time of Day</th>
<th>Carlos' Altitude</th>
<th>Vijay's Altitude</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
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<td></td>
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</tr>
</tbody>
</table>

6. What is Carlos’ constant rate of change?

7. What is Vijay’s constant rate of change?

8. What is the y-intercept for Carlos?

9. What is the y-intercept for Vijay?

10. Give the equation for Carlos.

11. Give the equation for Vijay.

12. What time did they meet?

13. What altitude did they meet?

14. Graph
   (Titles, Labels, Units, etc.)
Test Practice

15. What is the range of \{(2, 4), (3, -2), (-3, 7), (5, 2), (9, 4)\}?  
   a. \{-3, 2, 3, 5, 9\}  
   b. \{2, 3, 5, 9\}  
   c. \{-2, 2, 4, 7\}  
   d. \{-2, 2, 3, 4, 9\}  

16. Which of the following functions is linear?  
   a. \(f(x) = |x| - 2\)  
   b. \(f(x) = 2x + 4\)  
   c. \(f(x) = x^2 + 3x\)  
   d. \(f(x) = x^3 - 1\)  

17. Which of the following functions is quadratic?  
   a. \(f(x) = |x| - 2\)  
   b. \(f(x) = 2x + 4\)  
   c. \(f(x) = x^2 + 3x\)  
   d. \(f(x) = x^3 - 1\)  

18. Which of the following functions is cubic?  
   a. \(f(x) = |x| - 2\)  
   b. \(f(x) = 2x + 4\)  
   c. \(f(x) = x^2 + 3x\)  
   d. \(f(x) = x^3 - 1\)  

19. Which of the following functions is absolute value?  
   a. \(f(x) = |x| - 2\)  
   b. \(f(x) = 2x + 4\)  
   c. \(f(x) = x^2 + 3x\)  
   d. \(f(x) = x^3 - 1\)  

20. Which set of points would give a slope of \(-3/2\)?  
   a. \((5, 7), (7, 4)\)  
   b. \((3, 2), (1, -3)\)  
   c. \((-3, 0), (0, -2)\)  
   d. \((5, 2), (8, 0)\)  

21. Which represents the slope of a line that is perpendicular to a line with a slope of 4?  
   a. -4  
   b. \(-1/4\)  
   c. \(1/4\)  
   d. 4  

22. Which is the equation of the line that passes through the point \((-4, 4)\) and is parallel to the line \(y = \frac{1}{2} x - 4\)?  
   a. \(y = 2x + 12\)  
   b. \(y = \frac{1}{2} x - 6\)  
   c. \(y = \frac{1}{2} x + 6\)  
   d. \(y = 2x + 4\)
A buddy of yours wants to open up a canoe shop. She plans on making the canoes herself. The building rental costs her $3000. Her electric bill is $1200. The wood and metal-working equipment costs her $4800. The wood for each canoe costs $120. The wood for each set of paddles costs $15. The lacquer for each canoe and paddle set costs $45. The metal that she uses for all of the fasteners/joints cost $10 per canoe.

1. List the type and cost for each of the fixed costs to produce the canoes.

2. List the type and cost for the rate per canoe.

3. If \( x \) = the number of canoes she makes, and \( C(x) \) = the cost to make \( x \) canoes, write a function for \( C(x) \).

Your friend plans on charging $500 per canoe.

4. If \( R(x) \) = the revenue from selling \( x \) canoes, write a function for \( R(x) \).

5. What does the break-even point of this system of equations represent?

6. Give the coordinates for cost and revenue for 15 canoes.

7. Using that information, create a window to view \( C(x) \) and \( R(x) \) on your calculator. What is your window?
8. Graph C(x) and R(x) below. Be sure to include all the important labels on your graph.

9. Using the INTERSECTION function on your calculator, determine the break-even point.

Now, let’s say that she wants to make more money. She does two things: she raises the price of each canoe by $50, and she rents out half of her building to another small business. She charges them $1600.

10. List the type and cost for each of the fixed revenues to produce the canoes.

11. List the type and cost for the rate of revenue per canoe.

12. What is the new revenue function for R(x)?

13. What is the new break-even point for her canoe business?

14. Since Profit = Revenue – Cost, write the equation for P(x).
15. What is C(50)?

16. What is R(50)?

17. Find R(50) – C(50).

18. Find P(50)?

19. Does R(50) – C(50) equal P(50)? Should they match? Why or why not?
A buddy of yours wants to open up a canoe shop. She plans on making the canoes herself. The building rental costs her $4000. Her electric bill is $1600. The wood and metal-working equipment costs her $3000. The wood for each canoe costs $150. The wood for each set of paddles costs $25. The lacquer for each canoe and paddle set costs $35. The metal that she uses for all of the fasteners/joints cost $20 per canoe.

1. List the type and cost for each of the fixed costs to produce the canoes.

2. List the type and cost for the rate per canoe.

3. If x = the number of canoes she makes, and C(x) = the cost to make x canoes, write a function for C(x).

Your friend plans on charging $600 per canoe.

4. If R(x) = the profit from selling x canoes, write a function for R(x).

5. What does the break-even point of this system of equations represent?

6. Give the coordinates for cost and revenue for 20 canoes.

7. Using that information, create a window to view C(x) and R(x) on your calculator. What is your window?
8. Graph C(x) and R(x) below. Be sure to include all the important labels on your graph.

9. Using the INTERSECTION function on your calculator, determine the break-even point.

Now, let’s say that she wants to make more money. She does two things: she raises the price of each canoe by $50, and she rents out half of her building to another small business. She charges them $2000.

10. List the type and cost for each of the fixed revenues to produce the canoes.

11. List the type and cost for the rate of revenue per canoe.

12. What is the new revenue function for R(x)?

13. What is the new break-even point for her canoe business?

14. Since Profit = Revenue – Cost, write the equation for P(x).
15. What is $C(100)$?

16. What is $R(100)$?

17. Find $R(100) - C(100)$. Does this value match $P(100)$?

18. How does her new strategy benefit her canoe business? How does the new strategy hurt her business?

19. If you were the one in charge of the canoe shop, what would you do to improve the business?
Linear inequalities have an “x” and “y” variable. A solution to a linear inequality is any coordinate that makes the inequality true.

Graph the following system linear inequalities.

\[ y \leq \frac{2}{3}x + 4 \]

\[ 3x + y > 6 \]

**Graph the inequalities you are given.**

Choose a point not on the boundary line to test; a “true” point gets shaded, a “false” point does not get shaded.

**Recap:**

<table>
<thead>
<tr>
<th>&lt; or &gt;</th>
<th>\leq or \geq</th>
</tr>
</thead>
</table>

\[ y \leq \frac{2}{3}x + 4 \]

Test (0,0)

\[ 0 \leq \frac{2}{3} (0) + 4 \]

\[ 0 \leq 0 + 4 \]

\[ 0 \leq 4 \]

*True – shade the side of the line where (0,0) is located*

\[ 3x + y > 6 \]

Test (0,0)

\[ 3(0) + 0 > 6 \]

\[ 0 + 0 > 6 \]

\[ 0 > 6 \]

*False – shade the side of the line where (0,0) is not located*
Always shade where a point tests TRUE.

Be sure that the overlapping section is clearly darker than the others.

Graph the following systems of linear inequalities.

1. \( y > \frac{1}{2}x - 3 \)
   \( 4x + 6y < 12 \)

2. \( y > x + 2 \)
   \( y < -2x - 1 \)

3. \( x - y \geq 6 \)
   \( y \leq -\frac{2}{5}x + 2 \)
Write the inequalities for the graph below.

Write the equation of each line in slope intercept form.

\[ y = -3 \quad y = x - 1 \quad y = -x + 5 \]

Since \((3, 0)\) is “True” for all of the graphs, substitute \((3,0)\) into the equation and choose the symbol that makes the statement “True.”

\[ y = -3 \]
Substitute \((3, 0)\)
\[ 0 \geq -3 \]
Use greater than or equal to because the graph has a solid line.
So, \(y \geq -3\)

\[ y = x - 1 \]
Substitute \((3,0)\)
\[ 0 \leq 3 - 1 \]
\[ 0 \leq 3 \]
Use less than because the graph has a dotted line.
So, \(y < x - 1\)

\[ y = -x + 5 \]
Substitute \((3,0)\)
\[ 0 \leq -3 + 5 \]
\[ 0 \leq 2 \]
Use less than because the graph has a dotted line.
So, \(y < -x + 5\)

The inequalities for the graph above are \(y \geq -3\), \(y < x - 1\), and \(y < -x + 5\).
Graph the following systems of linear inequalities.

1. \(2x + 3y \leq 6\)
   \(y > x + 2\)

2. \(y < -6\)
   \(x > 5\)

3. \(y < 2x - 1\)
   \(2x + y \geq 8\)

4. \(y > \frac{3}{8}x + 2\)
   \(2x - 5y > 10\)

5. \(x + y \leq 10\)
   \(y \leq 2x\)

6. \(y \geq -3\)
   \(x \leq 4\)
   \(y \leq 2x - 5\)
Write the inequalities for each graph below.

7.

8.

9.
Solving Systems by Substitution #1

You can find the solution to a system of linear equations without graphing. Use substitution when you can replace x or y.

Find the solution to the system by substitution.

\[ y = 2x \]
\[ 2x + 5y = -12 \]

*We know that y is 2x. Where we see y, substitute in the 2x.*
\[ 2x + 5(2x) = -12 \]

*Solve for x.*
\[ 2x + 10x = -12 \]
\[ 12x = -12 \]
\[ x = -1 \]

*Substitute x to find y.*
\[ y = 2x \]
\[ y = 2(-1) \]
\[ y = -2 \]

*The solution is (-1, -2). What does this mean?*

Solve each system by substitution.

1. \[ x = y + 2 \]
   \[ 3x + y = 2 \]
2. \( y = 3x \)  
   \( x + 2y = -21 \)

3. \( y = 2x + 4 \)  
   \( y = 3x - 9 \)

4. \( y = \frac{3}{2}x - 3 \)  
   \( 3x - 2y = 12 \)

Let’s show what this looks like on a graph.

5. \( y = 3x - 7 \)  
   \( 3x - y = 7 \)

Let’s show what this looks like on a graph.
Solving Systems by Substitution #1

Solve each system by substitution.

1. \( y = -3x + 5 \)
   \( 5x - 4y = -3 \)

2. \( y = 4x + 6 \)
   \( y = -5x - 21 \)

3. \( x = 11 + 2y \)
   \( 7x + 2y = 13 \)

4. \( y = -3x + 5 \)
   \( 6x + 2y = 10 \)
5. \( y = \frac{1}{3} x + 1 \)
\( 7x - 8y = 5 \)

6. \( y = x + 3 \)
\( 3x - 3y = -4 \)

7. What is point-slope form?

8. What is slope-intercept form?

9. What is standard form?

10. A line goes through the point (10, -1) with a slope of \(-\frac{4}{5}\). Write an equation to the line.

11. A line goes through the point (0, 5) with a slope of \(\frac{3}{2}\). Write an equation to the line.
The perimeter of a rectangle is 32 cm. The length is 1 cm more than twice the width. Find the dimensions of the rectangle.

Define each variable and set up two equations.

- L = length of the rectangle
- W = width of the rectangle
- \(2L + 2W = 32\)
- \(L = 2W + 1\)

Substitute \(2W + 1\) for \(L\) in the first equation.

\[
2L + 2W = 32
\]
\[
2(2W + 1) + 2W = 32
\]
\[
4W + 2 + 2W = 32
\]
\[
6W + 2 = 32
\]
\[
6W = 30
\]
\[
W = 5
\]

The width is 5 cm.

The width of the rectangle is 5 cm. To find the length, plug in 5 for \(W\) in the second equation.

\[
L = 2W + 1
\]
\[
L = 2(5) + 1
\]
\[
L = 10 + 1
\]
\[
L = 11
\]

The length is 11 cm.

The rectangle is 5cm × 11cm.
Use two equations and two variables to solve each problem using substitution. Be sure to define each variable!

1. The perimeter of a rectangle is 56 cm. The length of the rectangle is 2 cm more than the width. Find the dimensions of the rectangle.

2. Mrs. Bruce lacks 1 year from being 5 times as old as her son. Five years from now, she will lack 1 year from being 3 times as old as her son will be then. Find each of their ages.

3. Mr. Johnson is 3 times as old as his daughter. Ten years ago, he was 5 times as old as his daughter was then. Find each of their ages.
Use two equations and two variables to solve each problem using substitution. Be sure to define each variable!

1. The perimeter of a rectangle is 42 cm. The length of the rectangle is 3 cm more than twice the width. Find the dimensions of the rectangle.

2. The perimeter of a rectangle is 62 cm. The length of the rectangle is 1 cm more than twice the width. Find the dimensions of the rectangle.

3. Mr. Lopez is 1 year more than 3 time as old as his daughter. Six years from now, he will lack 1 year from being 2 ½ times as old as she will be in six years from now. Find each of their ages.

4. Mr. King is 4 times as old as his daughter. Four years ago he was 6 times as old as she was then. Find each of their ages.
5. What is the formula for slope between two points?

6. What is point-slope form?

7. What is slope-intercept form?

8. What is standard form?

9. A line goes through the points (-2, 12) and (3, 2). Write an equation to the line.

10. Graph the following equations.
   a.) \( y = 2x - 8 \)
   b.) \( 3x + 2y = -18 \)
   c.) \( x = -7 \)
Function Based Approach John & Steve

Name____________________________

Linear Unit

Algebra 1

Hour___________Date______________

Steve           John

Sleep Rite Motel   Green’s Campground   Denver, Colorado

John is pulling a trailer behind his Ford pick-up truck and can only travel an average of 55 miles per hour. He leaves the Green’s Campground at 8:00am, which is 10 miles East of the Sleep Rite Motel, traveling towards Denver, Colorado. Steve is driving a Ford pick-up truck and he averages 70 miles per hour. Steve leaves the Sleep Rite Motel at 10:00am traveling towards Denver, Colorado.

If John and Steve are hoping to have dinner together, how long will it take for them to meet? How far will they have traveled?

**Step 1: Write an equation for John and Steve’s distance as a function of time.**

John: J(t) = __________________________

Steve: S(t) = _________________________

**Step 2: Solving graphically.**

Enter John and Steve into Y1 and Y2 in your calculator. Sketch the graphs.

<table>
<thead>
<tr>
<th>John</th>
<th>Steve</th>
</tr>
</thead>
<tbody>
<tr>
<td>Y1</td>
<td>Y2</td>
</tr>
</tbody>
</table>

- Label the graph with Time and Distance.
- Use a different color for John and Steve’s Graphs.

When do the two graphs intersect?

What does the intersection point mean?

If John and Steve are hoping to have dinner together, how long will it take for them to meet?

How far will they have traveled?
Step 3: **Solving using a table.**

Leave both equations in the calculator. Fill in the table below to show when John and Steve meet.

<table>
<thead>
<tr>
<th>Time (Hour)</th>
<th>John’s Distance (Miles)</th>
<th>Steve’s Distance (Miles)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
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<tr>
<td>4</td>
<td></td>
<td></td>
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<tr>
<td>5</td>
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<td>10</td>
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<tr>
<td>11</td>
<td></td>
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<tr>
<td>12</td>
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<tr>
<td>13</td>
<td></td>
<td></td>
</tr>
<tr>
<td>14</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Step 4: **Solving algebraically.**

Set John and Steve’s equations equal to each other and solve.

Double check that steps 2, 3 and 4 all produced the same answer.
Function Based Approach John & Steve

Name____________________________

Hour___________ Date______________

Linear Unit
Algebra 1

Steve

John

Sleep Rite Motel
Green’s Campground
Denver, Colorado

John is pulling a camper behind his GM pick-up truck and can only travel an average of 40 miles per hour. He leaves the Green’s Campground at 7:30am, which is 45 miles East of the Sleep Rite Motel, traveling towards Denver, Colorado. Steve is driving a GM pick-up truck and he averages 65 miles per hour. Steve leaves the Sleep Rite Motel at 9:30am traveling towards Denver, Colorado.

If John and Steve are hoping to have dinner together, how long will it take for them to meet? How far will they have traveled?

**Step 1: Write an equation for John and Steve’s distance as a function of time.**

John: \( J(t) = \) __________________________

Steve: \( S(t) = \) _________________________

**Step 2: Solving graphically.**

Enter John and Steve into \( Y_1 \) and \( Y_2 \) in your calculator. Sketch the graphs.

John
\( Y_1 = \) ________________

Steve
\( Y_2 = \) ________________

- Label the graph with Time and Distance.
- Use a different color for John and Steve’s Graphs.

When do the two graphs intersect?

What does the intersection point mean?

If John and Steve are hoping to have dinner together, how long will it take for them to meet?

How far will they have traveled?
Step 3: **Solving using a table.**

Leave both equations in the calculator. Fill in the table below to show when John and Steve meet.

<table>
<thead>
<tr>
<th>Time (Hour)</th>
<th>John’s Distance (Miles)</th>
<th>Steve’s Distance (Miles)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
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<td>2</td>
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<td>3</td>
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<td>4</td>
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<td>5</td>
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<td>10</td>
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<td>11</td>
<td></td>
<td></td>
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<tr>
<td>12</td>
<td></td>
<td></td>
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<tr>
<td>13</td>
<td></td>
<td></td>
</tr>
<tr>
<td>14</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Step 4: **Solving algebraically.**

Set John and Steve’s equations equal to each other and solve.

Double check that steps 2, 3 and 4 all produced the same answer.
You can find the solution to a system of linear equations, without graphing or using substitution, but by using elimination. Use elimination when both equations are in standard form.

Find the solution to the system by elimination.

16x – 10y = 10
8x + 6y = -6

Choose a multiplier that allows one set of coefficients to be additive inverses of each other.

16x – 10y = 10
-2(8x + 6y = -6)  -Multiply by -2 to cancel x’s
16x – 10y = 10  - Re-write the 1st equation
-16x – 12y = 12  - Distribute the 2nd equation
-22y = 22  - Combine like terms
-22  -22  - Divide both sides by -22
y = -1

Substitute y into one of the equation to find x.

16x – 10y = 10
16x – 10(-1) = 10  - Substitute for y
16x + 10 = 10  - Multiply -10 and -1
-10  -10  - Subtract 10 from both sides
16x = 0  - Combine like terms
16  16  - Divide both sides by 16
x = 0

The solution is (0, -1). What does this mean?

Solve each system by elimination.

1. 4x + 8y = 20
   16x – 8y = 120
2. \[5x + y = 9\]
   \[10x - 7y = -18\]

3. \[4x + 2y = -14\]
   \[10x - 7y = 25\]

4. \[2x + 3y = -6\]
   \[4x + 6y = 12\]

Let’s show what this looks like on a graph.

5. \[-x + 3y = 6\]
   \[-2x + 6y = 12\]

Let’s show what this looks like on a graph.
Solving Systems by Elimination #1

Name____________________________

Hour___________Date______________

Algebra 1

Solve each system by elimination.

1. \(2x - y = 20\)  
   \(2x + y = 48\)

2. \(2x + 3y = 12\)  
   \(5x - y = 13\)

3. \(16x - 10y = 10\)  
   \(8x + 6y = -6\)

4. \(5x - 2y = 7\)  
   \(10x - 4y = -3\)
5. \[2x + 4y = -4\]
   \[3x + 5y = -3\]

6. \[5x + 2y = -1\]
   \[3x + 7y = 11\]

Use two equations and two variables to solve each problem using substitution or elimination. Be sure to define each variable!

7. The perimeter of a rectangle is 66 m. The length is 1 m more than three times the width. Find the dimensions of the rectangle.

8. Mr. Entz lacks 1 year from being 4 times as old as his son. Fifteen years from now he will be 4 years more than 2 times as old as his son will be then. Find both of their ages.
Cody and Shayna are selling flower bulbs for a school fundraiser. Customers can buy bags of windflower bulbs and bags of daffodil bulbs. Cody sold 10 bags of windflower bulbs and 12 bags of daffodil bulbs for a total of $380. Shayna sold 6 bags of windflower bulbs and 8 bags of daffodil bulbs for a total of $244. What is the cost for one bag of windflower bulbs and one bag of daffodil bulbs?

Define each variable and set up two equations.  
\[ W = \text{cost per bag of windflower bulbs} \]
\[ D = \text{cost per bag of daffodil bulbs} \]
\[ 10W + 12D = 380 \]
\[ 6W + 8D = 244 \]

Solve by elimination. Choose a multiplier that allows one set of coefficients to be additive inverses of each other.
\[ 6(10W + 12D = 380) \]
\[ -10(6W + 8D = 244) \]
\[ 60W + 72D = 2280 \]  \[ -60W - 80D = -2440 \]
\[ -8D = -160 \]
\[ D = 20 \]

Each bag of daffodil bulbs costs $20.

Now, substitute 20 for D in one of the equations and solve for W.
\[ 10W + 12(20) = 380 \]  \[ -Substitute 20 \]
\[ 10W + 240 = 380 \]  \[ -Multiply 12 and 20 \]
\[ -240 \]
\[ 10W = 140 \]
\[ W = 14 \]

Each bag of windflower bulbs costs $14.
Use two equations and two variables to solve each problem using substitution or elimination. Be sure to define each variable!

1. Find the value of two numbers if their sum is 12 and their difference is 4.

2. The school that Stefan goes to is selling tickets to a choral performance. On the first day of ticket sales the school sold 3 senior citizen tickets and 1 child ticket for a total of $38. The school took in $52 on the second day by selling 3 senior citizen tickets and 2 child tickets. Find the price of a senior citizen ticket and the price of a child ticket.

3. The sum of 6 times Jack’s age and 5 times Larry’s age is 63. Jack is 1 year less than 3 times as old as Larry. Find each of their ages.
4. The state fair is a popular field trip destination. This year the senior class at Romeo High School and the senior class at Utica High School both planned trips there. The senior class at Romeo rented and filled 8 vans and 8 buses with 240 students. Utica rented and filled 4 vans and 1 bus with 54 students. Every van had the same number of students in it as did the buses. Find the number of students in each van and in each bus.

5. The cost of 3 boxes of envelopes and 4 boxes of note paper is $13.25. Two boxes of envelopes and 6 boxes of note paper cost $17. Find the cost of each box of envelopes and each box of note paper.
Use two equations and two variables to solve each problem using substitution or elimination. Be sure to define each variable!

1. The difference of two numbers is 3. Their sum is 13. Find the numbers.

2. The senior classes at Ford and Eisenhower planned separate trips to New York City. The senior class at Ford rented and filled 1 van and 6 buses with 372 students. Eisenhower rented and filled 4 vans and 12 buses with 780 students. Each van and each bus carried the same number of students. How many students did a van carry? How many students did a bus carry?

3. Brenda’s school is selling tickets to a spring musical. On the first day of ticket sales the school sold 3 senior citizen tickets and 9 child tickets for a total of $75. The school took in $67 on the second day by selling 8 senior citizen tickets and 5 child tickets. What is the price for each senior citizen ticket and each child ticket?
4. Matt and Carl are selling fruit for a school fundraiser. Customers can buy small boxes of oranges and large boxes of oranges. Matt sold 3 small boxes of oranges and 14 large boxes of oranges for a total of $203. Carl sold 11 small boxes of oranges and 11 large boxes of oranges for a total of $220. Find the cost each of small box of oranges and each large box of oranges.

5. The sum of 4 times Lisa’s age and 7 times Jane’s age is 169. Jane is 1 year more than twice as old as Lisa. Find each of their ages.

6. The cost of 8 boxes of small paper clips and 7 boxes of large paper clips is $44.95. Five boxes of small paper clips and 3 boxes of large ones cost $22.80. Find the cost of a box of each size of paper clips.
7. Write an equation for the line that goes through the points (-4, 1) and (0, -3).

8. Graph the following lines.
   a.) parallel line to $y = -5x - 4$ through (-6, 5)
   b.) perpendicular line to $x = 7$ through (-2, -3)
   c.) $y > -5$
   d.) $y = \frac{2}{3}x + 1$
Pure tin (100%) was mixed with a 4% tin alloy to produce an alloy that was 16% tin. How much of the pure tin and how much 4% alloy were used to produce 32 kg of 16% alloy?

Define each variable and set up two equations. Be sure to change all percentages to decimals!

\[ X = \text{amount of 100\% pure tin} \]
\[ Y = \text{amount of 4\% tin alloy} \]
\[ 1X + 0.04Y = 0.16(X + Y) \]
\[ X + Y = 32 \]

Re-write the equations in standard form. Only the 1st equation needs to be adjusted.

\[ 1X + 0.04Y = 0.16(X + Y) \]
\[ 1X + 0.04Y = 0.16X + 0.16Y \quad \text{-Distribute 0.16} \]
\[ -0.16X - 0.16Y - 0.16X - 0.16Y \quad \text{-Subtract .16X and .16Y from both sides} \]
\[ 0.84X - 0.12Y = 0 \quad \text{-Combine like terms} \]

Write down both standard form equations, and choose a multiplier that allows one set of coefficients to be additive inverses of each other.

\[ 0.84X - 0.12Y = 0 \]
\[ X + Y = 32 \]

\[ 0.84X - 0.12Y = 0 \quad \text{-If choose to eliminate y's, multiply 2nd eq. by 0.12} \]
\[ 0.12(X + Y = 32) \]
\[ 0.84X - 0.12Y = 0 \quad \text{-Re-write the 1st equation, and distribute the 0.12} \]
\[ 0.12X + 0.12Y = 3.84 \]
\[ 0.96X = 3.84 \quad \text{-Combine like terms} \]
\[ 0.96 \quad 0.96 \quad \text{-Divide both sides by 0.96} \]
\[ X = 4 \]

4 kg of pure tin was used in the mixture.

Now, substitute 4 for X in one of the equations and solve for Y.

\[ X + Y = 32 \]
\[ 4 + Y = 32 \quad \text{-Substitute 4 for X} \]
\[ -4 \quad -4 \quad \text{-Subtract 4 on both sides} \]
\[ Y = 28 \]

28 kg of 4\% tin alloy was used in the mixture.
Use two equations and two variables to solve each problem using substitution or elimination. Be sure to define each variable!

1. Candy worth $1.05 a pound was mixed with candy worth $1.35 a pound to produce a mixture worth $1.17 a pound. How many pounds of each kind of candy were used to make 30 pounds of the mixture?

2. A 3% solution of sulfuric acid was mixed with an 18% solution of sulfuric acid to produce an 8% solution. How much 3% solution and how much 18% solution were used to produce 15 L of 8% solution?

3. Pure copper (100%) was mixed with a 10% copper alloy to produce an alloy that was 25% copper. How much of the pure copper and how much 10% alloy were used to produce 36 kg of 25% alloy?
Use two equations and two variables to solve each problem using substitution or elimination. Be sure to define each variable!

1. Peanuts worth $2.25 a pound were mixed with cashews worth $3.25 a pound to produce a mixture worth $2.65 a pound. How many pounds of each kind of nuts were used to produce 35 pounds of the mixture?

2. A 25% solution of sulfuric acid was mixed with an 18% solution of sulfuric acid to produce a 20% solution. How much 25% solution and how much 18% solution were used to produce 28 L of 20% solution?
3. The sum of 6 times Petra’s age and 8 times Kathy’s age is 162. Kathy is 1 year more than twice as old as Petra. Find each of their ages.

4. The cost of 8 avocados and 3 tomatoes is $8.39. Four avocados and 12 tomatoes cost $11.44. Find the cost of each avocado and each tomato.

5. The sum of two numbers is 26 and their difference is 20. Find each of the numbers.

6. The sum of two numbers is 6 less than twice the first number. Their difference is 10 less than four times the second number. Find each of the numbers.
You have a pink candle that is 15 cm tall that costs $3.00; after burning for five hours it is 12 cm tall. You also have a blue candle 20 cm tall that costs $0.75; after burning for 20 minutes it is 18 cm tall.

1. Complete the tables below in minutes for the information given:

<table>
<thead>
<tr>
<th>Pink Candle</th>
<th>Time (minutes)</th>
<th>Height (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Blue Candle</th>
<th>Time (minutes)</th>
<th>Height (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2. What is the independent variable?

3. What axis is the independent variable on?

4. What is the dependent variable?

5. What axis is the dependent variable on?

6. On the Graph:
   - Title the graph
   - Label the axes in words and units
   - Plot the points
   - Connect the points to create a line
   - Label each line by color of candle
7. Estimate the intersection of the two lines______________________________.

8. Write a sentence explaining the meaning of that intersection point.

9. Complete the table:

<table>
<thead>
<tr>
<th></th>
<th>Pink</th>
<th>Blue</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Slope</strong> (show work)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>y-intercept</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Equation in</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Slope-Intercept Form</strong></td>
<td>P(t) =</td>
<td>B(t) =</td>
</tr>
</tbody>
</table>

10. Using the two equations you just found, solve for \( t \) by substitution:

11. Now substitute the number you found for \( t \) into the \( P(t) \) equation and solve for \( P(t) \).
12. Now substitute the number you found for $t$ into the $B(t)$ equation and solve for $B(t)$.

13. What coordinate did you find?

14. Write a sentence explaining the meaning of that point.

15. Find how long it took the Pink candle to burn down to a height of 0.

16. How many hours is this?

17. Find how long it took the Blue candle to burn down to a height of 0.

18. How many hours is this?
Now, let’s use the results found in questions 15-18 to answer the next three questions.

19. What is the cost to burn the Pink candle per hour?

20. What is the cost to burn the Blue candle per hour?

21. Explain which candle is the better buy.
You have a yellow candle that is 20 cm tall that costs $5.00; after burning for 10 hours it is 8 cm tall. You also have a green candle 25 cm tall that costs $1.00; after burning for 24 minutes it is 23 cm tall.

1. Complete the tables below in minutes for the information given:

<table>
<thead>
<tr>
<th>Time (minutes)</th>
<th>Height (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Time (minutes)</th>
<th>Height (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2. What is the independent variable?

3. What axis is the independent variable on?

4. What is the dependent variable?

5. What axis is the dependent variable on?

6. On the Graph:
   - Title the graph
   - Label the axes in words and units
   - Plot the points
   - Connect the points to create a line
   - Label each line by color of candle
7. Estimate the intersection of the two lines ________________________________.

8. Write a sentence explaining the meaning of that intersection point.

9. Complete the table.

<table>
<thead>
<tr>
<th></th>
<th>Yellow</th>
<th>Green</th>
</tr>
</thead>
<tbody>
<tr>
<td>Slope (show work)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>y-intercept</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Equation in</td>
<td>Y(t) =</td>
<td>G(t)</td>
</tr>
<tr>
<td>Slope-Intercept Form</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

10. Using the two equations you just found, solve for \( t \) by substitution:

11. Now substitute the number you found for \( t \) into the \( Y(t) \) equation and solve for \( Y(t) \).
12. Now substitute the number you found for $t$ into the $G(t)$ equation and solve for $G(t)$.

13. What coordinate did you find?

14. Write a sentence explaining the meaning of that point.

15. Find how long it took the Yellow candle to burn down to a height of 0.

16. How many hours is this?

17. Find how long it took the Green candle to burn down to a height of 0.

18. How many hours is this?
19. What is the cost to burn the Yellow candle per hour?

20. What is the cost to burn the Green candle per hour?

21. Explain which candle is the better buy.

Test Practice
22. Which graph shows $f(x) = -|x - 3| + 7$?

   a. 
   b. 
   c. 
   d. 

23. Give the equations for the incorrect choices in #22.
A machine shop produces two types of items, type X and type Y. The production of these items requires the use of two machines, Machine A and Machine B. To produce one type X product requires 1 hour on Machine A and 1 hour on Machine B. To produce one type Y product requires Machine A for 1 hour and Machine B for 3 hours. Machine A is available only 50 hours per week, while Machine B is available for up to 90 hours per week. The machine shop can make a profit of $2.00 on every type X item sold and $3.00 on every type Y item sold. The owners of the machine shop, the Greedy brothers, have agreed to pay you a handsome consulting fee if you can help them to maximize their profits. Your task is to determine how many of each type of item they should make each week to give them the largest possible profit.

1. Set up a table for the hours on Machine A and B for Products X and Y.

<table>
<thead>
<tr>
<th></th>
<th>Product X</th>
<th>Product Y</th>
<th>Maximum Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Machine A</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Machine B</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2. Let ________ be the number of Product X made.

3. Let ________ be the number of Product Y made.

4. Using your unknowns in #2 and #3, and your table in #1, set up inequalities for the given conditions.
5. Create a graph with your inequalities and shade in the feasibility region. Be sure to label everything!

6. Set up a profit equation and test your possibilities.

\[ P(x, y) = \]

7. How much of each product should the Greedy brothers make to maximize their profits?
The liquid portion of a diet is to provide at least 180 units of vitamin A and 80 units of vitamin C daily. A cup of dietary drink X provides 15 units of vitamin A and 10 units of vitamin C. A cup of dietary drink Y provides 24 units of vitamin A and 8 units of vitamin C. Now suppose that dietary drink X costs $0.12 per cup and drink Y costs $0.15 per cup. How many cups of each drink should be consumed each day to minimize the cost and still meet the stated daily requirements?

1. **Set up a table.**

   |   |   |   |
---|---|---|
   |   |   |   |
   |   |   |   |

2. **Set up the unknowns.**

3. **Using your unknowns in #2 and your table in #1, set up inequalities for the given conditions.**
4. Create a graph with your inequalities and shade in the feasibility region. Be sure to label everything!

5. Set up a cost equation and test your possibilities.

6. How many cups of each drink should be consumed each day to minimize the cost and still meet the stated daily requirements?

Solve the following systems.

7. \( y > 5x - 2 \)
   \( x + y > 6 \)

8. \( y - 4 = \frac{2}{3}(x - 1) \)
   \( y = 8x - 4 \)
Example: Solve the inequality $x + 3 \leq 5$ graphically.

*Graph the left side of the equation $(x + 3)$ by graphing the slope intercept form of the line.*

*Graph the right side of the equation (5) as a horizontal line. Since the inequality states, "x plus 3 is greater than 5," the horizontal line 5 is the greatest and should be shaded darker.*
Draw a solid (because of \( \leq \)) vertical line through the intersection of the two lines.

Shade to the left of the vertical line because to the left is where the greater line is above the lesser line.

Solve the inequality algebraically.

\[
x + 3 \leq 5
\]

\[
\begin{align*}
-3 & -3 \\
x & \leq 2
\end{align*}
\]

- Subtract 3 from both sides

Summary: any \( x \) value less than or equal to 2 will satisfy the inequality (the inequality will stay TRUE).

Show the solution on a number line.
For each of the following:
- solve the inequality graphically on the coordinate plane
- solve the inequality algebraically
- show the solution on the number line

1. \( x - 6 > 2 \)

2. \( 2x + 1 \neq -5 \)

3. \( -3x + 2 \leq 8 \)

4. \( \frac{1}{2}x + 3 \leq 5 \)

5. \( \frac{2}{3}x + 9 \neq 7 \)
Example: Solve the inequality \( \frac{-3x - 8}{5} \leq 2 \) algebraically.

\[
\begin{align*}
5 \cdot \frac{-3x - 8}{5} & \leq 2 \cdot 5 \\
-3x - 8 & \leq 10 \\
+8 & +8 \\
-3x & \leq 18 \\
-3 & -3 \\
x & \geq -6
\end{align*}
\]

*When ÷ or • by a negative #, you must flip the inequality.*

Solve the inequality algebraically and show the solution on the number line.

6. \( \frac{5 - 3x}{2} \leq 10 \)

7. \( \frac{-5}{2}x + 1 > -4 \)

8. \( 4x - 5 < -21 \)

Example: Write an inequality for the number line.

\( x > 4 \)
Solve the following inequalities graphically and algebraically and show the solution on the number line.

1. \( x - 4 > -8 \)

2. \( -3x > -6 \)

3. \( \frac{5}{4}x + 2 \neq -3 \)

4. \( \frac{3}{2}x - 6 \leq -9 \)
Give an example of an inequality for each graph.

5.  \[ \text{ } \]
6.  \[ \text{ } \]

Use two equations and two variables to solve each problem using substitution or elimination. Be sure to define each variable!

7. The perimeter of a rectangle is 76 cm. The length of the rectangle is 2 cm more than twice the width. Find the dimensions of the rectangle.

8. The cost of 12 oranges and 7 apples is $5.36. Eight oranges and 5 apples cost $3.68. Find the cost of each orange and each apple.

9. The sum of two numbers is 18 and their difference is 12. Find each of the numbers.
Example: Solve the inequality \(-4x - 9 > \frac{1}{2}x\) graphically.

Graph the left side of the equation \((-4x - 9)\) by graphing the slope intercept form of the line. Since the inequality states, "negative four x minus nine is greater than one-half x," the line \(-4x - 9\) is the greatest and should be shaded darker.

Recap:

Graph the right side of the equation \(\left(\frac{1}{2}x\right)\) by graphing the slope intercept form of the line.
Draw a dotted (because of >) vertical line through the intersection of the two lines.

Shade to the left of the vertical line because to the left is where the greater line is above the lesser line.

Solve the inequality algebraically.

\[-4x - 9 > \frac{1}{2}x\]
\[-\frac{1}{2}x - \frac{1}{2}x\]
\[-\frac{1}{2}x - 9 > 0\]
\[+9\]
\[\frac{-4\frac{1}{2}x}{-4\frac{1}{2}} > \frac{9}{-4\frac{1}{2}}\]
\[\frac{x}{-4\frac{1}{2}} < -2\]

Summary: any x value less than -2 will satisfy the inequality (the inequality will stay TRUE).
For each of the following:
- solve the inequality graphically on the coordinate plane
- solve the inequality algebraically
- show the solution on the number line

1. \(x + 5 \geq \frac{1}{2}x + 3\)

2. \(5x - 4 \neq -x + 2\)

3. \(-3x < x + 8\)
Solve the inequality algebraically and show the solution on the number line.

4. \(2(6 - x) \leq 4x\)

5. \(-4x + 9 < 5x - 9\)

6. \(-4x - 9 \geq \frac{1}{2}x\)

7. \(\frac{2x - 16}{8} \geq -6\)
Solve the following inequalities graphically, show the solution on the number line and write the solution as an inequality.

1. \(-\frac{1}{4}x - 2 \leq \frac{3}{2}x - 9\)

2. \(-\frac{4}{3}x + 5 > 2x - 5\)

3. \(-5x - 6 < \frac{1}{2}x + 5\)

4. \(-\frac{2}{3}x - 4 \neq \frac{1}{3}x + 5\)
Solve the inequality algebraically and show the solution on the number line.

5. \( \frac{6x - 2}{4} \neq 7 \)

6. \( \frac{1}{2}x - 5 \geq -2x + 10 \)

7. \( \frac{3}{2}x + 4 \leq -\frac{1}{2}x + 8 \)
8. \(-\frac{1}{3}x + 1 \neq -\frac{2}{5}x + 7\)

9. \(6(1 - x) \geq 3x\)

10. \(\frac{5x + 8}{-3} > 4\)
Example: Solve the inequality $4 < x + 2 < 8$ graphically.

Graph the middle portion of the equation $(x + 2)$ by graphing the slope intercept form of the line.

Graph the horizontal lines 4 and 8.

$y = x + 2$

$y = 4$

$y = 8$
Draw dotted (because of <) vertical lines through the intersections.

\[
\begin{align*}
y &= 8 \\
y &= 4 \\
y &= x + 2
\end{align*}
\]

Shade between the vertical lines because \( x \) is between these two intersections.

Solve the inequality algebraically.

\[
\begin{align*}
4 < x + 2 &< 8 \\
-2 &-2 &-2 \\
2 < x &< 6
\end{align*}
\]

- Subtract 2 from all three sections

Show the solution on a number line.

\[\begin{array}{c}
\circ \\
2
\end{array} \quad \begin{array}{c}
2 \\
6 \\
\circ \\
\end{array}\]
For each of the following:

- solve the inequality graphically on the coordinate plane
- solve the inequality algebraically
- show the solution on the number line

1. \(-9 < x - 7 < 1\)

2. \(-5 \leq 2x + 3 \leq 9\)

3. \(-4 < 3x + 5 \leq 8\)
Solve the inequality algebraically and show the solution on the number line.

4. \( 5 \geq -3x - 7 > -10 \)

5. \( 4 < \frac{2}{3}(x + 3) < 10 \)

Write the compound inequality for each graph.

6. \[ -7 \quad 3 \]

7. \[ 6 \quad 8 \]
Inequalities – Compound #1

Name______________________

HW
Linear Unit
Algebra 1

Hour______ Date_____________

Solve the following inequalities graphically, show the solution on the number line and write the solution as a compound inequality.

1. $-5 < x + 1 < 2$

2. $5 < 4x + 1 < 9$

3. $-3 < \frac{2}{3}x - 5 < 1$

Solve the inequality algebraically and show the solution on the number line.

4. $5 \leq 4x - 3 < 9$
5. \(-10 < 5 + 3x < 8\)

6. \(18 \leq 2(x + 7) \leq 32\)

Use two equations and two variables to solve each problem using substitution or elimination. Be sure to define each variable!

7. A 12% acid solution was mixed with a 16% acid solution to produce a 15% acid solution. How much of the 12% solution and how much of the 16% solution were used to produce 40 L of the 15% solution?

8. The sum of two numbers is 15 less than twice the first number. Their difference is 5 less than twice the second number. Find each of the numbers.
**Example: Solve the inequality** \( x - 4 \leq -3 \) OR \( x - 2 > 1 \) **graphically.**

*Graph the left side of each equation on its own coordinate plane by graphing the slope intercept form of the line.*

*Graph the right side of each equation as a horizontal line. Be sure that in each graph the greater line is thicker.*
Draw a solid (because of ≤) vertical line and dotted (because of >) vertical line through the intersection of the two lines.

\[ y = x - 4 \]
\[ y = 1 \]
\[ y = x - 2 \]
\[ y = -3 \]

Shade on the side where the thicker line is greater than the thinner line.

\[ x \leq 1 \]
\[ x > 3 \]

Solve the inequality algebraically.

\[
\begin{align*}
  x - 4 & \leq -3 \\
  +4 & \quad +4 \\
  x & \leq 1
\end{align*}
\]
- Add 4 to both sides

\[
\begin{align*}
  x - 2 & > 1 \\
  +2 & \quad +2 \\
  x & > 3
\end{align*}
\]
- Add 2 to both sides

Show the solution on a number line.
For each of the following:
- solve the inequality graphically on the coordinate plane
- solve the inequality algebraically
- show the solution on the number line

1. \[3x < 6 \quad \text{or} \quad 2x \geq 10\]

2. \[-3x + 5 > 2 \quad \text{or} \quad -2x < -8\]

3. \[\frac{5}{2}x + 6 \leq 1 \quad \text{or} \quad \frac{7}{4}x - 8 \geq 6\]
Write the compound inequality for each graph.

4. 

5. 
Solve the following inequalities graphically, show the solution on the number line and write the solution as a compound inequality.

1. \( \frac{2}{3}x - 1 \leq 1 \text{ or } \frac{1}{2}x > 4 \)

2. \( -\frac{4}{3}x - 5 > 7 \text{ or } -\frac{4}{5}x - 3 < 1 \)

3. \( -4x + 6 > -2 \text{ or } 5x - 8 \geq 7 \)
Solve the inequality algebraically and show the solution on the number line.

4. \[ 2x - 5 \leq -25 \quad \text{or} \quad 3x - 2 \geq 10 \]

5. \[ 2x < 18 - x \quad \text{or} \quad 5x > x + 36 \]

6. \[ 9 - x > 5x \quad \text{or} \quad 20 - 3x < 17 \]
Use two equations and two variables to solve each problem using substitution or elimination. Be sure to define each variable!

7. The sum of 4 times Joan’s age and 3 times Jim’s age is 47. Jim is 1 year less than twice as old as Joan. Find each of their ages.

8. Coffee worth $3.75 a pound was mixed with coffee worth $4.35 a pound to produce a blend worth $4.11 a pound. How much of each kind of coffee was used to produce 40 pounds of blended coffee?
**Example: Solve the inequality** \(|x| + 5 \leq 8\) **graphically.**

**Graph the left side of the equation.** The absolute value graph is shifted up 5.

![Graph of \(y = |x| + 5\)](image1)

**Graph the right side the equation as a horizontal line.** Be sure that the greater line is thicker.

![Graph of \(y = 8\) and \(y = |x| + 5\)](image2)
Draw solid (because of \( \leq \)) vertical lines through the intersections.

Shade to the where the thicker line is greater than the thinner line.

Show the solution on a number line.

Show the solution as an inequality.

\[-3 \leq x \leq 3\]
For each of the following:
- solve the inequality graphically on the coordinate plane
- show the solution on the number line
- write the solution as an inequality

1. $|x| - 7 = 1$

2. $-|x + 4| > -3$

3. $-|x - 5| \leq -2$

4. $|x - 2| + 4 = -3$

5. $-|x - 9| \leq 7$
Example: Given the number line, write an absolute value inequality.

Determine the center of the graph. Where has the center been shifted to?

The center of the graph is at 2. This can be found by taking the average of the two points given. So, the graph has been shifted right 2.

Find the distance from the center to each endpoint.

The distance from 2 to 7 or from 2 to -3 is 5.

Choose the less than or equal to sign because the values less than a distance of 5 have been shaded and included.

Final answer:

\[ |x - 2| \leq 5 \]

Basic Formula:

\[ |x - \text{midpoint}| > \text{distance from center to endpoint} \]

Choose a symbol based on shading and inclusion of points: \(<, >, \leq, \geq, =\)

For each of the following number lines, write an absolute value inequality.

6.  

7.  

8.  

9.  
For each of the following:
- solve the inequality graphically on the coordinate plane
- show the solution on the number line
- write the solution as an inequality

1. \(|x| - 8 < -6\)

2. \(-|x| - 4 = -7\)

3. \(-|x + 6| > 9\)

4. \(|x - 6| + 2 \geq -5\)
5. $|x + 3| - 7 > -5$

6. $|x - 5| + 2 = 3$

For each of the following number lines, write an absolute value inequality.

7.  

8.  

9.  

10.  

11.  

Solve each of the following graphically, show the solution on the number line and write the solution as an inequality.

1. \( x + 7 \leq -2 \)

2. \( |x + 1| - 4 = 2 \)

3. \( \frac{4}{7}x + 2 > 2x - 8 \)

4. \( 2x + 6 \leq -2 \) or \( \frac{3}{2}x - 3 > 6 \)
5. \(-|x - 7| + 4 \leq 6\)

6. \(-7 < \frac{-3}{2}x - 1 < 2\)

7. \(-|x + 5| + 7 \geq 4\)

8. \(\frac{1}{7}x - 5 \neq -6\)

9. \(4 < \frac{1}{4}x + 5 < 7\)

10. \(3x - 5 \leq -2x + 5\)
Solve the following inequalities algebraically and show the solution on the number line.

11. \( \frac{4}{5}x - 7 \leq 1 \quad \text{or} \quad -\frac{5}{2}x + 43 \leq -12 \)

12. \( -\frac{3}{4}x + 9 > 5 \)

13. \( -\frac{1}{3}x < 2 \)

14. \( 3x - 2(8x - 9) \leq 3 - (2x + 7) \)
15. \[ 5 < \frac{3}{2}x + 8 < 14 \]

16. \[ \frac{1}{3}x - 10 < -2 \]

17. \[ \frac{3}{4} (4x - 44) \leq -\frac{5}{6} (6x - 18) \]

For each of the following number lines, write an absolute value inequality.

18. -20 -6

19. 18 32
One Step Equations
Supplemental Problems
Linear Unit
Algebra 1

1. \(x + 7 = -13\)  
2. \(x + 7 = 4\)  
3. \(-14 + y = -17\)

4. \(y - 11 = 14\)  
5. \(y - 5 = -7\)  
6. \(-20 + x = -80\)

7. \(6 + x = 29\)  
8. \(a + 32 = -4\)  
9. \(-2 = x - 2\)

10. \(-19 + y = 42\)  
11. \(16 = z - 10\)  
12. \(y + 73 = 0\)

13. \(-100 = b + (-72)\)  
14. \(w - 5 = (8 - 13)\)  
15. \(x + 2.5 = -4.7\)

16. \(a + 3.6 = -0.2\)  
17. \(x - 6 \frac{1}{4} = 12 \frac{1}{2}\)  
18. \(2 \frac{1}{5} + x = -3 \frac{1}{2}\)

19. \(n + \frac{1}{2} = \frac{3}{4}\)  
20. \(b - 1 \frac{1}{3} = -3 \frac{5}{6}\)
21. \(-2p = -38\)  
22. \(\frac{b}{8} = -24\)  
23. \(-85 = 17r\)  

24. \(-32 = \frac{c}{22}\)  
25. \(-13a = 52\)  
26. \(\frac{1}{47}d = -26\)

27. \(-12f = -180\)  
28. \(\frac{1}{0.16}x = 0.7\)  
29. \(-77.4 = 9a\)  

30. \(-\frac{1}{6}q = -11\)  
31. \(16 = \frac{n}{-21}\)  
32. \(0.7h = -0.112\)

33. \(-80 = \frac{p}{15}\)  
34. \(792 = -33y\)  
35. \(-5.2 = \frac{m}{30.1}\)

36. \(-11.2x = -60.48\)  
37. \(\frac{1}{-26}r = -66\)  
38. \(315 = 21s\)

39. \(\frac{z}{0.06} = -7.98\)  
40. \(-14g = 406\)
Two Step Equations
Supplemental Problems
Linear Unit
Algebra 1

1. $13 + -3p = -2$
2. $\frac{-5a}{2} = 75$
3. $6x - 4 = -10$

4. $9 = 2y + 9$
5. $-10 + \frac{a}{4} = 9$
6. $17 = 5 - x$

7. $-7r - 8 = -14$
8. $\frac{4y}{3} = 8$
9. $16 + \frac{x}{3} = -10$

10. $\frac{-4z}{5} = -12$
11. $-22 = 3s - 8$
12. $\frac{-a}{6} - 31 = 64$
Multi-Step Equations and Inequalities
Supplemental Problems
Linear Unit
Algebra 1

1. \(3(x + 8) = -6\)  
2. \(-36 = 6(y - 2)\)

3. \(-8(y - 6) = -16\)  
4. \(20 = 4\left(\frac{t}{4} - 2\right)\)

5. \(\frac{7}{8}h - \frac{5}{8} = 2\)  
6. \(93.96 = 4.7p + 8.7p - 2.6p\)
7. $7x + 9 = 4x$  
8. $3(n - 5) = -2n$

9. $4(y - 9) = 3(2y - 8)$  
10. $8m - 5 = 5m + 7$

11. $\frac{3x}{5} = \frac{2x}{5} + 10$  
12. $k + k + k = k + 18$
13. \(-8x \leq 40\)  
14. \(x + 2 < -1\)

15. \(36 > -3(x - 5)\)  
16. \(-3x \geq -6\)

17. \(-4(7 - t) > -28\)  
18. \(18 \leq -8 -13a\)

19. \(-10(5 - c) \leq 25\)  
20. \(0.27 < -0.06h\)
Graph the solution set.

21. $5x - 5y > 10$

22. $y \geq \frac{-3}{2}x + 3$
Write the equation of the line, in any form, that passes through the two given points.

1. (-2, 1), (3, -4)  
2. (3, 6), (0, 5)

3. (-4, 3), (2, 3)  
4. (0, 2), (2, 6)

5. (7, 4), (9, -3)  
6. (5, 0), (-7, -2)

7. (2, 5), (-1, 1)  
8. (-1, -3), (-4, -1)
9. (4, -2), (4, 7) \hspace{2cm} 10. (3, -6), (7, -3)

**Write the equation of the line, in any form, that is parallel to the given line and passes through the given point.**

11. \( y - 6 = 2(x + 7) \) \hspace{2cm} 12. \( y = 4 \) \hspace{1cm} (1, 4) \hspace{1cm} (-2, -3)

13. \( y = -\frac{1}{2}x \) \hspace{2cm} 14. \( y = 2x + 3 \) \hspace{1cm} (4, 5) \hspace{1cm} (0, -1)

15. \( y + 5 = -\frac{1}{2}(x - 8) \) \hspace{2cm} 16. \( x + y = 1 \) \hspace{1cm} (-6, 3) \hspace{1cm} (-4, -4)
<table>
<thead>
<tr>
<th></th>
<th>Equation 1</th>
<th>Equation 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>17.</td>
<td>$y - 7 = 3(x - 6)$</td>
<td>$(2, 1)$</td>
</tr>
<tr>
<td>18.</td>
<td>$y = -\frac{1}{3}x + 4$</td>
<td>$(6, -2)$</td>
</tr>
<tr>
<td>19.</td>
<td>$2x + 2y = -2$</td>
<td>$(1, 3)$</td>
</tr>
<tr>
<td>20.</td>
<td>$y = \frac{1}{2}x + 6$</td>
<td>$(0, 0)$</td>
</tr>
</tbody>
</table>

**Write the equation of the line, in any form, that is perpendicular to the given line and passes through the given point.**

<table>
<thead>
<tr>
<th></th>
<th>Equation 1</th>
<th>Equation 2</th>
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<tbody>
<tr>
<td>21.</td>
<td>$y = -4x - 6$</td>
<td>$(1, 2)$</td>
</tr>
<tr>
<td>22.</td>
<td>$y = \frac{1}{2}x + 3$</td>
<td>$(-2, 6)$</td>
</tr>
<tr>
<td>23.</td>
<td>$x = 1$</td>
<td>$(-3, -4)$</td>
</tr>
<tr>
<td>24.</td>
<td>$x + 2y = -7$</td>
<td>$(0, 0)$</td>
</tr>
</tbody>
</table>
25. \( y = \frac{1}{3}x - 4 \) (4, 1) 
26. \( y - 5 = -\frac{1}{2}(x - 1) \) (0, 2) 
27. \( y - 7 = 4(x + 2) \) (-5, -8) 
28. \( 3x + y = 4 \) (5, -3) 
29. \( y = 3x \) (3, 6) 
30. \( y = -2 \) (-1, 7)
Systems Review
Supplemental Problems
Linear Unit
Algebra 1

Solve the following systems by graphing.

1. \[ x + 2y = 2 \]
   \[ y = -\frac{1}{2}x + 8 \]

2. \[ y = -2x + 6 \]
   \[ y = \frac{5}{2}x - 3 \]

3. \[ 7x + y > 2 \]
   \[ x - 2y \leq -8 \]

4. \[ 4x - 2y = 8 \]
   \[ y = 3 \]
Solve the following systems by substitution or elimination.

5. \[ 4x + y = -1 \]
   \[ 2x - y = -5 \]

6. \[ x + y = 12 \]
   \[ 2x + 5y = 27 \]

7. \[ 3x + y = 2 \]
   \[ y = -4x \]
8. \[ y = \frac{1}{3}x - 6 \]
\[ y = -2x + 1 \]

9. \[ x + 2y = -1 \]
\[ x + y = 2 \]

10. \[ 3x + 4y = -25 \]
\[ 2x - 3y = 6 \]
11. \[ 2 + 2y = x \]
    \[ 6x = -8 + 2y \]

12. \[ 6y = -21 + 3x \]
    \[ y = 5x - 8 \]

Solve the following story problems using systems of equations.

13. Find two numbers whose sum is 64 and whose difference is 42.

15. A 2% solution of acid was mixed with a 12% solution of acid to produce an 8% solution. How much 2% solution and 12% solution were used to produce 10 L of 8% solution?

16. The perimeter of a rectangle is 84 m. The length is 2 ½ times the width. Find the dimensions of the rectangle.

17. The sum of 3 times Darlene’s age and 7 times Sharon’s age is 163. Darlene is 2 years less than twice as old as Sharon is. Find each of their ages.
18. Marcus descends at a rate of 2 feet per second from the surface of the ocean. Toshiko is 45 feet below sea level and she is rising to the surface at a rate of 3 feet per second.

   a. Complete the following table:

<table>
<thead>
<tr>
<th>Marcus’ Time (seconds)</th>
<th>Marcus’ Depth (feet)</th>
<th>Toshiko’s Time (seconds)</th>
<th>Toshiko’s Depth (feet)</th>
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   b. What is Marcus’ equation?

   c. What is Toshiko’s equation?

   d. What time did they meet?

   e. At what altitude did they meet?

   f. Graph
      (Titles, Labels, Units, etc.)
1. A line passes through the points (0,3) and (-2,5). What is the slope of a line that is parallel to the original?

2. Write the equation of the line that is parallel to problem 1 and passes through the point (-3, 6).

3. \( y = \frac{2}{3}x + 1 \). Write the equation of the line that is \textit{perpendicular} to this line and passes through the point (2,6). Graph both lines, and label each one.

4. Find the equation for the line, in slope-intercept form and point-slope form, containing these points.

<table>
<thead>
<tr>
<th>X</th>
<th>4</th>
<th>3</th>
<th>2</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Y</td>
<td>7</td>
<td>9</td>
<td>11</td>
<td>13</td>
</tr>
</tbody>
</table>
5. A line has a y-intercept of 7 and an x-intercept of -1. Find the slope of the line with the given intercepts. After, write out the equation of the line in any form.

6. Solve the system of equations algebraically and graphically.

\[ \begin{align*}
  y &= -6x - 3 \\
  y &= 2x + 5
\end{align*} \]

Algebraically: 

Graphically:

7. Write an equation of the line passing through the point (2,3), with the slope of \( \frac{1}{5} \).

8. Solve algebraically \( 4x + 8 \leq 2x + 5 \).
9. Solve the system of equations by using the substitution method.
   
   \[ y = \frac{5}{2} x - 9 \]
   \[ 2x + y = 9 \]

10. Solve the system of equations by using the elimination method.
   
   \[ 5x + y = 9 \]
   \[ 10x - 7y = -18 \]

11. Graph the system of inequalities.
   
   \[ y \geq \frac{1}{3} x + 1 \]
   \[ y < -2x + 3 \]

12. Simplify: \[ n^2 + 4(3n^2 - 4n + 2) + 2n - 1. \]
13. Solve the following two inequalities graphically. Graph the solution on the number line and write the solution as an inequality statement.

\[ 6 \leq 4x - 2 \]

\[ |x - 2| + 3 > 6 \]

14. Solve the following inequality algebraically and graph the solution on the number line.

\[-4 \leq 3(x - 1) < 7\]

15. **FIX MY MISTAKE** Find the slope of the line passing through the points (-2,3) and (8,-3).

\[
m = \frac{8 - 3}{-2 - 8} = \frac{10}{-10} = -\frac{5}{3}
\]
Using the graphing method, find the solution to the given systems.

16. \[ \begin{align*}
    x + 5y &= 10 \\
    y &= x + 2
\end{align*} \]

17. \[ \begin{align*}
    5x - 5y &= -10 \\
    y &= x + 2
\end{align*} \]

18. Solve the following compound inequality both algebraically and graphically. Write out your solution both as an inequality statement and on the given number line.

\[-3x + 5 > 2 \text{ or } -2x \leq -10\]

Graphically:

Algebraically:

Solution:
Graph the following equations or inequalities, give the form and answer the question based on each graph.

19. \( y - 1 \leq 3(x + 4) \)  
Form: 

\[
\begin{array}{c}
\text{starting point} = \_ \\
\text{y-intercept} = \_ \\
\text{m} = \\
\end{array}
\]

20. \( y = 2x + 7 \)  
Form: 

\[
\begin{array}{c}
\text{starting point} = \_ \\
\text{y-intercept} = \_ \\
\text{m} = \\
\end{array}
\]

21. \( x < -4 \)  
Form: 

\[
\begin{array}{c}
\text{starting point} = \_ \\
\text{y-intercept} = \_ \\
\text{m} = \\
\end{array}
\]

22. \( y = 8 \)  
Form: 

\[
\begin{array}{c}
\text{domain} = \\
\text{m} = \\
\text{testing point} = \\
\end{array}
\]

23. \( 5x - 10y = 30 \)  
Form: 

\[
\begin{array}{c}
\text{domain} = \\
\text{m} = \\
\text{testing point} = \\
\end{array}
\]

24. \( y > -\frac{3}{2}x + 4 \)  
Form: 

\[
\begin{array}{c}
\text{domain} = \\
\text{m} = \\
\text{testing point} = \\
\end{array}
\]

True / False
25. Mr. and Mrs. Smith have been advised by their accountant to separate their bank account for tax purposes. As a couple, the account has $7650 in it and weekly deposits of $450 were made.

a. Not including interest, write a function of the Smith’s savings account.

b. The Smiths have decided to create 2 separate accounts. They have determined that each account will start with the same amount and Mrs. Smith will continue with her bi-weekly deposits of $300. Not including interest, write a function of Mrs. Smith’s new account.

c. Determine the function for Mr. Smith’s new account.

Be sure to define your variables in all of the story problems!

26. The perimeter of a rectangle is 104 inches. The length of the rectangle is 4 inches more than three times the width. Find the dimensions of the rectangle.

27. The perimeter of a rectangle is 52 inches. The length is 2 inches less than 3 times the width. Find the dimensions of the rectangle.
28. Walnuts worth $1.35 a pound were mixed with pecans worth $1.05 a pound to produce a mixture of nuts worth $1.17 a pound. How many pounds of each kind of nut were used to produce 25 pounds of the nut mixture?

29. Mr. Peters is 1 less than 7 times as old as his daughter. In three years, Mr. Peters will be 5 less than five times as old as his daughter. Find each of their ages.

30. This year, Romeo juniors and seniors are going on a trip to Cedar Point. The seniors needed to use 4 vans and 9 busses for 506 students. The juniors needed to use 5 van and 6 busses for 370 students. Each van holds the same number of students. Each bus holds the same number of students. Find the number of students that each van and each bus can hold.
Example: Solve the piecewise function for each value given.

\[ f(x) = \begin{cases} 3x - 5, & x < 1 \\ -2x + 3, & x \geq 1 \end{cases} \]

1. \( f(-4) \)
2. \( f(3) \)
3. \( f(1) \)

Based on the x-value for the input, you are forced to choose the appropriate function. The number lines might be useful when deciding which piece of the function you should use.

When x-values are less than 1 \((x < 1)\), the function \(3x - 5\) is used. The number line below is the visual representation:

![Number line for 3x - 5](image)

When the x-values are greater than or equal to 1 \((x \geq 1)\), the function \(-2x + 3\) is used. The number line below is the visual representation:

![Number line for -2x + 3](image)

1. Find \( f(-4) \):
   Since \(-4 < 1\), the function \(3x - 5\) will be used.
   \[
   f(x) = 3x - 5 \\
   f(-4) = 3(-4) - 5 \\
   f(-4) = -12 - 5 \\
   f(-4) = -17 	ext{ or } (-4, -17)
   \]

2. Find \( f(3) \):
   Since \(3 > 1\), the function \(-2x + 3\) will be used.
   \[
   f(x) = -2x + 3 \\
   f(3) = -2(3) + 3 \\
   f(3) = -6 + 3 \\
   f(3) = 1 	ext{ or } (3, 1)
   \]

3. Find \( f(1) \):
   Since \(1 \geq 1\), the function \(-2x + 3\) will be used.
   \[
   f(x) = -2x + 3 \\
   f(1) = -2(1) + 3 \\
   f(1) = -2 + 3 \\
   f(1) = 1 	ext{ or } (1, 1)
   \]
In-Class Practice:

4. \( f(x) = \begin{cases} 
-4x + 2, & x < -2 \\
-8, & x \geq -2 
\end{cases} \)
   
a. \( f(-5) \)

   b. \( f(0) \)

   c. \( f(-2) \)

5. \( f(x) = \begin{cases} 
2x + 20, & 0 \leq x \leq 6 \\
6x + 23, & 6 < x \leq 12 \\
4x + 25, & 12 < x \leq 36 
\end{cases} \)
   
a. \( f(4) \)

   b. \( f(25) \)

   c. \( f(-3) \)

   d. \( f(7.5) \)
Draw and label a number line for each function.

1. \( f(x) = \begin{cases} 
  x - 7, & x < -4 \\
  -\frac{2}{3}x + 8, & x \geq -4 
\end{cases} \)

   a. \( f(-3) \) 
   c. \( f(12) \)

   b. \( f(-10) \) 
   d. \( f(24) \)

2. \( f(x) = \begin{cases} 
  2x + 5, & x < -1 \\
  7, & -1 \leq x < 8 \\
  \frac{1}{2}x - 6, & x \geq 8 
\end{cases} \)

   a. \( f(8) \) 
   c. \( f(10) \)

   b. \( f(5) \) 
   d. \( f(-4) \)
3. \[ f(x) = \begin{cases} 
\frac{5}{3}x + 1, & x < 0 \\
\frac{2}{7}x - 9, & 0 \leq x < 25 \\
-\frac{9}{4}x + 3, & x \geq 25 
\end{cases} \]

a. \( f(21) \)  

d. \( f(-18) \)

b. \( f(36) \)  

e. \( f(40) \)

c. \( f(-15) \)  

f. \( f(14) \)
Example: Graph the piecewise function.

\[ f(x) = \begin{cases} 
3x - 5, & x < 1 \\
-2x + 3, & x \geq 1 
\end{cases} \]

Start by graphing and labeling each line on the graph.

Draw vertical lines at all of the restrictions for x.

Erase the sections of the graph where the functions do not exist. Use open and closed circles on the endpoints based on the inequality symbol.
In-Class Practice:

1. \[ f(x) = \begin{cases} 
-4x + 5, & x < 2 \\
-8, & x \geq 2 
\end{cases} \]

2. \[ f(x) = \begin{cases} 
2x + 7, & x \leq -3 \\
-\frac{1}{3}x - 2, & -3 < x \leq 3 \\
\frac{5}{3}x - 4, & 3 < x 
\end{cases} \]
piecewise functions - graphing

hw
linear unit
algebra 1

1. \( f(x) = \begin{cases} 
-4x + 9, & x \leq 4 \\
3x - 7, & x > 4 
\end{cases} \)

2. \( f(x) = \begin{cases} 
\frac{2}{3}x - 8, & x < 0 \\
-4x + 6, & x \geq 0 
\end{cases} \)

3. \( f(x) = \begin{cases} 
5x + 10, & x \leq -2 \\
7, & -2 < x \leq 5 \\
-\frac{3}{5}x + 2, & 5 < x 
\end{cases} \)

4. \( f(x) = \begin{cases} 
6, & x < -2 \\
-\frac{7}{2}x + 1, & -2 \leq x \leq 2 \\
-5, & 2 < x 
\end{cases} \)
Example: Write the equation of the function.

\[
\begin{align*}
\text{If } & x \leq -6, \quad f(x) = \frac{-4}{3}x - 3 \\
\text{If } & -6 < x \leq 6, \quad f(x) = \frac{1}{6}x + 5 \\
\text{If } & 6 < x, \quad f(x) = \frac{1}{3}x
\end{align*}
\]

Extend the lines to determine the slopes and y-intercepts. Use vertical lines to find the domain for each piece of the function.

In-Class Practice:
1. 
2.
Write the equation for each function:

1.

2.

3.
Examples:

1. Southeast Electric charges .09 cents per kilowatt-hour for the first 200 kWh. The company charges .11 cents per kilowatt-hour for all electrical usage in excess of 200 kWh. How many kilowatt-hours were used if a monthly electric bill was $57.06? Write an equation, graph the function, and solve.

2. A construction worker earned $17 per hour for the first 40 hr of work and $25.50 per hour for work in excess of 40 hr. One week she earned $896.75. How much overtime did she work? Solve and write an equation.
In-Class Work:

3. Arnold is working in a job that pays him $8/hr, if he works for 40 hours or less for a week. He gets time and a half (1.5 times) his hourly rate for the hours he works beyond 40 hours. How long did Arnold work if his check was for $740? Write an equation, graph the function, and solve.
1. You have a summer job that pays time and a half for overtime. (If you work more than 40 hours) After that, it is 1.5 times your hourly rate of $7.00/hour.
   a. Write and graph a piecewise function that gives your weekly pay $P$ in terms of the number of hours you work $h$.
   b. How much will you make if you work 35 hours?
   c. How much will you make if you work 45 hours?

2. Every avid ebayer knows that shipping is an important consideration when listing an item for auction. For infrequent selling, there is not much money to be gained or lost on the transaction, but for the diehard, inaccurate shipping costs can lead to stacked losses over time. Knowing the postal rate scale and what to charge for a given item is paramount. The cost $C$ (in dollars) of sending priority mail, depending on the weight (in ounces) of a package up to five pounds is given by the function below. Graph the function.

   \[ C(x) = \begin{cases} 
   13.65, & 0 < x \leq 15 \\
   17.00, & 15 < x \leq 30 \\
   20.25, & 30 < x \leq 55 \\
   23.50, & 55 < x \leq 70 \\
   26.25, & 70 < x \leq 80 
   \end{cases} \]
3. You will be renting a car for a six-day trip and are comparing two rental options. The first plan charges $50 per day, allows 500 miles for free, and charges 25 cents for each additional mile. The second plan charges $30 per day, allows 200 miles for free, and charges 35 cents for each additional mile.

   a. If you’re going to drive 300 miles over the course of the six-day trip, which plan should you choose?

   b. If you’re going to drive 800 miles over the course of the six-day trip, which plan should you choose?

   c. Write a piecewise function for the cost of Plan 1 for a six-day trip of x miles.

   d. Write a piecewise function for the cost of Plan 2 for a six-day trip of x miles.

   e. Make a graph of both functions on the same set of axes.

   f. After how many miles does Plan 1 become cheaper?
Scatterplots and Regression Lines

Notes
Modeling Unit
Algebra 1

Scatterplots:

Line of Regression/Line of Best Fit:

Shapes of Scatterplots

<table>
<thead>
<tr>
<th></th>
<th>Positive</th>
<th>Negative</th>
</tr>
</thead>
<tbody>
<tr>
<td>Linear</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Quadratic</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cubic</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cluster</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The following graph shows hair length vs. height. Label the graph. What conclusions can you make from the graph? Would you be willing to predict the hair length of a student who is 66 inches?
The following table gives information about 10 females who were given a reading comprehension test.

<table>
<thead>
<tr>
<th>Shoe Size</th>
<th>Test Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>12</td>
</tr>
<tr>
<td>2.5</td>
<td>15</td>
</tr>
<tr>
<td>3</td>
<td>19</td>
</tr>
<tr>
<td>4</td>
<td>25</td>
</tr>
<tr>
<td>5.5</td>
<td>38</td>
</tr>
<tr>
<td>6</td>
<td>42</td>
</tr>
<tr>
<td>7.5</td>
<td>43</td>
</tr>
<tr>
<td>8.5</td>
<td>67</td>
</tr>
<tr>
<td>9</td>
<td>75</td>
</tr>
<tr>
<td>9</td>
<td>58</td>
</tr>
</tbody>
</table>

1. Label the scatterplot:

2. The equation of the regression line is \( y = 7.3x - 1.5 \). Add this line to your graph.

3. What does the slope mean in the context of this problem?

4. What does the \( y \)-intercept mean in the context of this problem?

5. DSW funded this study. When the results were published they made signs for all of their stores that read, "Bigger shoes make you smarter. Big shoe sale next week." Comment on the appropriateness of these signs.
Crickets

It is thought that the speed at which crickets chirp can be used to estimate temperature, using a linear model. The following table shows experimental data that relate the number of cricket-chirps in 15 seconds to the temperature in degrees Fahrenheit. As you answer the following questions, use “Chirps per 15 Seconds” as the independent variable, and “Temperature in °F” as the dependent variable.

<table>
<thead>
<tr>
<th>Chirps in 15 Seconds</th>
<th>Temperature (°F)</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>89</td>
</tr>
<tr>
<td>16</td>
<td>72</td>
</tr>
<tr>
<td>20</td>
<td>93</td>
</tr>
<tr>
<td>18</td>
<td>84</td>
</tr>
<tr>
<td>17</td>
<td>81</td>
</tr>
<tr>
<td>16</td>
<td>75</td>
</tr>
<tr>
<td>15</td>
<td>70</td>
</tr>
<tr>
<td>17</td>
<td>82</td>
</tr>
<tr>
<td>15</td>
<td>69</td>
</tr>
<tr>
<td>16</td>
<td>83</td>
</tr>
<tr>
<td>15</td>
<td>80</td>
</tr>
<tr>
<td>17</td>
<td>83</td>
</tr>
<tr>
<td>16</td>
<td>81</td>
</tr>
<tr>
<td>17</td>
<td>84</td>
</tr>
<tr>
<td>14</td>
<td>76</td>
</tr>
</tbody>
</table>

1. Label the scatterplot below:

2. The equation of the regression line is $y = 3.2x + 26.7$. Add the line to the graph.
3. What does the slope mean in the context of this problem?

4. What does the y-intercept mean in the context of this problem?

5. Does the y-intercept make sense? Why or why not?

6. If you had a listening device and used it in the morning to measure a cricket chirping at a rate of 18 chirps in 15 seconds, what would you estimate the temperature to be?

7. If the temperature reached 100°F, at what rate (in chirps per 15 seconds) would you expect the crickets to be chirping?

8. As temperature rises, do crickets chirp faster or slower?

9. In reality there should be restrictions on the domain and the range. What are these restrictions and why?
Leaning Tower of Pisa
In 1173 C.E., the Tower of Pisa was built on soft ground and, ever since, has been leaning to one side. This 8-story, 191-foot tower was built with only 7-foot-deep foundation. The tower was completed in the mid-1300s even though it started to lean after the first 3 stories were completed. The amount of lean (mm) for nine different years is listed below.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Lean (mm)</td>
<td>5336</td>
<td>5352</td>
<td>5363</td>
<td>5391</td>
<td>5403</td>
<td>5414</td>
<td>5428</td>
<td>5454</td>
<td>5467</td>
</tr>
</tbody>
</table>

10. Label the scatterplot below:

11. The equation of the regression line is \( y = 1.6x + 2206 \). Add the line to the graph.

12. What does the slope mean in the context of this problem?

13. What does the y-intercept mean in the context of this problem?

14. Does the y-intercept make sense? Why or why not?
Correlation Coefficient (r) – describes the strength and direction of the regression line.

Facts about correlation:
- Positive r indicates a positive association between variables (both variables increase)
- Negative r indicates a negative association between variables (one variable increases while the other decreases)
- \(-1 \leq r \leq 1\)
- If \(r = 0\) there is no relationship between the variables
- If \(r\) is close to zero, the relationship is weak
- If \(r = \pm 1\), it is a perfect correlation – perfect linear relationship
- Just because there is a strong correlation, it does not mean there is a causation

For the following pairs of variables, would you expect a negative, positive, or no correlation?

a.) The weights and ages of children.

b.) The amount of vacations taken and the amount of money in the bank.
Daryl is concerned the amount of energy used to heat his home is increasing. He calculates the average amount of gas used per day and the average monthly temperature because colder temperatures require more heat.

<table>
<thead>
<tr>
<th>Month</th>
<th>Oct</th>
<th>Nov</th>
<th>Dec</th>
<th>Jan</th>
<th>Feb</th>
<th>Mar</th>
<th>Apr</th>
<th>May</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average Temperature</td>
<td>49.4</td>
<td>38.2</td>
<td>27.2</td>
<td>28.6</td>
<td>29.5</td>
<td>46.4</td>
<td>49.7</td>
<td>57.1</td>
</tr>
<tr>
<td>Gas Used (cubic ft/day)</td>
<td>520</td>
<td>610</td>
<td>870</td>
<td>850</td>
<td>880</td>
<td>490</td>
<td>450</td>
<td>250</td>
</tr>
</tbody>
</table>

1. Label the following scatterplot:

2. The line of regression is $y = -19.9x + 1425$. Add this line to the graph above.

3. What does the slope mean in the context of this problem?

4. What does the $y$-intercept mean in the context of this problem?

5. What is the meaning of the correlation if $r = -0.983$?

**Correlation Activity**

Go to [http://istics.net/stat/Correlations/](http://istics.net/stat/Correlations/). You will match the appropriate correlation with the regression line. Each session consists of 4 matching graphs. You will need to click “New Plots” each time you would like 4 new questions. Click “Answers” to see how you did.
Guess the Correlation for #1 – 6: For each of the following pairs of variables, would you expect a negative, positive or no correlation?
1. The ages of secondhand cars and their prices.

2. The weight of new cars and their gas mileages in miles per gallon.

3. The heights and the weights of adult men.

4. The heights and the IQ scores of adult men.

5. The heights of daughters and the heights of their mothers.

6. Give an example of two variables with a negative correlation.

7. Give an example of two variables with a positive correlation.

8. Give an example of two variables with no correlation.
9. Match the following scatterplots with the correct r-value. Also, name the type of correlation (positive/negative with strong/moderate/weak):

<table>
<thead>
<tr>
<th>r-value</th>
<th>Scatterplot 1</th>
<th>Scatterplot 2</th>
<th>Scatterplot 3</th>
<th>Scatterplot 4</th>
<th>Scatterplot 5</th>
<th>Scatterplot 6</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.93</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.71</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.30</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-0.40</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-0.63</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-0.84</td>
<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>
Line of Regression/Line of Best Fit – a linear model that fits a set of points better than any other

Observed Values – data that is collected

Predicted values – estimating from the regression line
  Interpolation – predicting within the observed values
  Extrapolation – predicting beyond the observed data, not always reliable

Imagine that before showering in the morning, you weigh your bar of soap in your shower, and have recorded your data in the table in grams. The weight goes down as the soap is used. Notice that you forget to weigh the soap on some days.

<table>
<thead>
<tr>
<th>Day</th>
<th>1</th>
<th>2</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>12</th>
<th>13</th>
<th>16</th>
<th>18</th>
<th>19</th>
<th>20</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight</td>
<td>124</td>
<td>121</td>
<td>103</td>
<td>96</td>
<td>90</td>
<td>84</td>
<td>78</td>
<td>71</td>
<td>58</td>
<td>50</td>
<td>27</td>
<td>16</td>
<td>12</td>
<td>8</td>
</tr>
</tbody>
</table>

1. Make a scatterplot of the weight of the bar soap against the day.

2. The equation for the regression line is $y = -6.4x + 134$. Add this line to your graph.

3. Explain the meaning of slope in the context of this problem.
4. Explain the meaning of y-intercept in the context of this problem.

5. You did not measure the weight of the soap on day 4. Use the regression equation to predict the weight. Is this an example of interpolation or extrapolation?

**Olympic Times:** The table below shows the winning times of the 100 meter run for each year of the Summer Olympics (except for 1940 and 1944, due to World War II).

<table>
<thead>
<tr>
<th>Year</th>
<th>Men’s Time</th>
<th>Women’s Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>1928</td>
<td>10.8</td>
<td>12.2</td>
</tr>
<tr>
<td>1932</td>
<td>10.3</td>
<td>11.9</td>
</tr>
<tr>
<td>1936</td>
<td>10.3</td>
<td>11.5</td>
</tr>
<tr>
<td>1948</td>
<td>10.3</td>
<td>11.9</td>
</tr>
<tr>
<td>1952</td>
<td>10.4</td>
<td>11.5</td>
</tr>
<tr>
<td>1956</td>
<td>10.5</td>
<td>11.5</td>
</tr>
<tr>
<td>1960</td>
<td>10.2</td>
<td>11</td>
</tr>
<tr>
<td>1964</td>
<td>10</td>
<td>11.4</td>
</tr>
<tr>
<td>1968</td>
<td>9.95</td>
<td>11</td>
</tr>
<tr>
<td>1972</td>
<td>10.14</td>
<td>11.07</td>
</tr>
<tr>
<td>1976</td>
<td>10.06</td>
<td>11.08</td>
</tr>
<tr>
<td>1980</td>
<td>10.25</td>
<td>11.06</td>
</tr>
<tr>
<td>1984</td>
<td>9.99</td>
<td>10.97</td>
</tr>
<tr>
<td>1988</td>
<td>9.92</td>
<td>10.54</td>
</tr>
<tr>
<td>1992</td>
<td>9.96</td>
<td>10.82</td>
</tr>
<tr>
<td>1996</td>
<td>9.84</td>
<td>10.94</td>
</tr>
<tr>
<td>2000</td>
<td>9.87</td>
<td>10.75</td>
</tr>
<tr>
<td>2004</td>
<td>9.85</td>
<td>10.93</td>
</tr>
</tbody>
</table>

1. Label the scatterplot below.
2. The line of regression for the men’s times is: \( y = -0.009289x + 28.433 \). What does the men’s slope represent in the context of this problem?

3. The line of regression for the women’s times is: \( y = -0.01681x + 44.331 \). What does the women’s slope represent in the context of this problem?

4. Who is improving faster? How do you know?

5. Extrapolate to determine the outcomes of the races in the 2120 Olympics.
The weights of children in the Egyptian village of Maya were recorded. Here are the mean weights of the 170 children in that village:

<table>
<thead>
<tr>
<th>Age (months)</th>
<th>Weight (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>4.3</td>
</tr>
<tr>
<td>2</td>
<td>5.1</td>
</tr>
<tr>
<td>3</td>
<td>5.7</td>
</tr>
<tr>
<td>4</td>
<td>6.3</td>
</tr>
<tr>
<td>5</td>
<td>6.8</td>
</tr>
<tr>
<td>6</td>
<td>7.1</td>
</tr>
<tr>
<td>7</td>
<td>7.2</td>
</tr>
<tr>
<td>8</td>
<td>7.2</td>
</tr>
<tr>
<td>9</td>
<td>7.2</td>
</tr>
<tr>
<td>10</td>
<td>7.2</td>
</tr>
<tr>
<td>11</td>
<td>7.5</td>
</tr>
<tr>
<td>12</td>
<td>7.8</td>
</tr>
</tbody>
</table>

1. Label the scatterplot below:

2. The equation of the regression line is $y = 0.27x + 4.88$. Add this line to your graph.

3. What does the slope mean in the context of this problem?
4. What does the y-intercept mean in the context of this problem? Does it make sense in the context of the problem?

5. Interpolate for a baby who is 3 ½ months old.

6. Extrapolate for a baby who is 18 months old. Are you comfortable with this extrapolation?

7. How old is a baby who weighs 8.5 kg? Is this an example of interpolation or extrapolation? How do you know?

8. Linear regression is a good model that gives a correlation coefficient of $r = 0.907$. However, there is another regression that we should use based on the shape of the graph that gives a correlation of $r = 0.996$. What is the shape of this scatterplot?

9. Describe the correlation with this scenario. Is it positive or negative? Strong, moderate or weak? How do you know?