Answers to Exercises

1. Solve for $y$: $-5y = -3x + 15 \Rightarrow y = \frac{3}{5}x - 3 \Rightarrow m = \frac{3}{5}, b = -3$. Plot the $y$-intercept $(0, -3)$ and apply the slope $\text{rise} = 3$ and $\text{run} = 5$.

2. Equation is in slope-intercept form: $m = \frac{2}{1} \quad b = -3$. Plot $(0, -3)$ and apply slope: right 1 and up 2.

3. Horizontal line: solve for $y$: $y = 3$.

4. 

5.
6. Vertical Line 2 units to the left of the y-axis.

![Slope not defined](image)

7. Solve for $y: y = x - 4$

![Slope equals 1](image)

8. Horizontal line 2 units above the x-axis.

![Slope equals 0.](image)

9.

![Slope equals $\frac{-3}{2}$](image)

10.

![Slope equals $-1$](image)

11. Since the slope is a ratio, the rise and the run must be written using the same units: feet or inches.

$$m = \frac{6 \text{ inch}}{72 \text{ inch}} = \frac{1}{12} \text{ or } m = \frac{1}{6 \text{ feet}} \cdot \frac{1}{12} = \frac{1}{12}.$$ In either case, $m = \frac{1}{12}$.
<table>
<thead>
<tr>
<th>Horizontal Distance Covered (in feet)</th>
<th>Vertical Distance Allowable (in feet)</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>.5</td>
</tr>
<tr>
<td>12</td>
<td>1</td>
</tr>
<tr>
<td>18</td>
<td>1.5</td>
</tr>
<tr>
<td>24</td>
<td>2</td>
</tr>
<tr>
<td>32</td>
<td>2 2/3</td>
</tr>
<tr>
<td>40</td>
<td>3 1/2</td>
</tr>
</tbody>
</table>

13. Find the slope of the line through each pair of points.
   a) Using the slope formula, \( m = \frac{y_1 - y_2}{x_1 - x_2} = \frac{-1 - 5}{-2 - 3} = \frac{-6}{-5} = \frac{6}{5} \)
   b) Using the slope formula, \( m = \frac{y_1 - y_2}{x_1 - x_2} = \frac{-3 - 1}{0 - (-4)} = \frac{4}{4} = -1 \)
   c) Using the slope formula, \( m = \frac{y_1 - y_2}{x_1 - x_2} = \frac{2 - (-3)}{-4 - (2)} = \frac{5}{-6} = -\frac{5}{6} \)
   d) Using the slope formula, \( m = \frac{y_1 - y_2}{x_1 - x_2} = \frac{\frac{2}{1} - \left(-\frac{5}{3}\right)}{\frac{1}{2} - \left(-\frac{2}{3}\right)} = \frac{1}{1} = 1 \)
   e) Using the slope formula, \( m = \frac{y_1 - y_2}{x_1 - x_2} = \frac{4.9 - (-7.5)}{-3.3 - 1.2} = \frac{12.4}{-4.5} = -\frac{124}{45} \)
   f) Using the slope formula, \( m = \frac{y_1 - y_2}{x_1 - x_2} = \frac{5 - (-5)}{3 - 3} = \frac{10}{0} = undefined \) Note that two points with the same x-coordinate must be located on a vertical line.
   g) Using the slope formula, \( m = \frac{y_1 - y_2}{x_1 - x_2} = \frac{-2 - (-2)}{0 - 3} = \frac{0}{-3} = 0 \) Note that two points with the same y-coordinate must be located on a horizontal line.

14. a) uphill– slope is positive.
    b) downhill–slope is negative.
    c) downhill–slope is negative.
    d) downhill–slope is negative.
    e) downhill–slope is negative.
    f) vertical–slope is undefined.
    g) horizontal–slope is zero.

15. Slopes of parallel lines are equal, so the slopes should be the same as the original line.
    a) \( \frac{6}{5} \)  b) -1  c) -\( \frac{5}{6} \)  d) -1  e) -\( \frac{124}{45} \)  f) undefined  g) 0

16. Slopes of perpendicular lines are negative reciprocals:
    a) -\( \frac{5}{6} \)  b) 1  c) \( \frac{6}{5} \)  d) 1  e) \( \frac{45}{124} \)  f) 0  g) undefined

17. Since the line through (1,5) and \((6,y_2)\) must be parallel to the line \(3x - 5y = 10\), the slopes must be equal. Find the slope of \(3x - 5y = 10\) by solving for \(y\): \(y = \frac{3}{5}x - 2 \Rightarrow m = \frac{3}{5}\). Express the slope of the line through the two points using the slope formula,
   \( m = \frac{y_1 - y_2}{x_1 - x_2} = \frac{5 - y_2}{1 - 6} = \frac{5 - y_2}{-5} \).
   Set the two equal to each other and solve for \(y_2\):
   \( \frac{5 - y_2}{-5} = \frac{3}{5} \Rightarrow 25 - 5y_2 = -15 \Rightarrow y_2 = 8 \)
18. To show that $\triangle ABC$ is a right triangle, we must show that it has a right angle. Since right angles are formed by the intersection of perpendicular lines, we will find the slope of each line forming the triangle and determine if any pair of the lines are perpendicular.

$$m_{AB} = 4 \quad m_{BC} = -\frac{1}{4}$$

Slopes are negative reciprocals $\Rightarrow AB \perp BC \Rightarrow \angle B$ is a right angle. Therefore, $\triangle ABC$ is a right triangle.

19. 
   a) $m = -1 \Rightarrow$ decreasing  
   b) $m = \frac{2}{3}$ is positive $\Rightarrow$ increasing  
   c) $m = 2$ is positive $\Rightarrow$ increasing  
   d) $m = \frac{2}{3}$ is positive $\Rightarrow$ increasing  
   e) $m = 0 \Rightarrow$ horizontal  
   f) $m$ is undefined $\Rightarrow$ vertical

20.

21. 

22. a) Given a point and the slope we use point-slope form to write the equation: $y - y_1 = m(x - x_1) \Rightarrow y - 3 = -1(x - 2) \Rightarrow y - 3 = -x + 2$
   i) simplifying to slope-intercept we solve for $y: y = -x + 5$
   ii) simplifying to general form we bring all terms to the left side: $x + y - 5 = 0$
b) Use point-slope: \( y - (-1) = \frac{3}{2}(x - 5) \). Multiply both sides by 5 to clear fractions:
\[ 5(y + 1) = 5 \cdot \frac{3}{2}(x - 5) \Rightarrow 5y + 5 = 2(x - 5) \Rightarrow 5y + 5 = 2x - 10 \]
i) solve for \( y \): \( y = \frac{3}{2}x - 3 \)
ii) \( 2x - 5y - 10 = 0 \) (We usually manipulate the equation to get the first term to be positive.)

e)

i) Since \((0, 3)\) is the \( y \)-intercept and \( m = -\frac{3}{4} \), we can substitute into the slope-intercept form: \( y = mx + b \) : \( y = -\frac{3}{4}x + 3 \)
ii) We must clear the equation of fractions by multiplying through by 4: \( 4y = -3x + 12 \). Bringing all terms to the left gives us the equation in general form: \( 3x + 4y - 12 = 0 \)

d) We must find the slope using the slope formula: \( m = \frac{\Delta y}{\Delta x} = \frac{3}{2} \). Substituting into point-slope using either of the two given points we get \( y - 2 = -\frac{3}{2}(x - 4) \Rightarrow y = -3x + 18 \)
i) Solve for \( y \): \( y = 3x - 16 \)
ii) Bring all terms to the left: \( 3x - y - 16 = 0 \)

e) Since both \( y \)-coordinates are \(-2\), the line is the horizontal line 2 units below the \( x \)-axis.

i) \( y = -2 \) (Note that the slope is 0 and the \( y \)-intercept is \(-2\).)
ii) \( y + 2 = 0 \)

f) Find the slope using the slope formula: \( m = \frac{\Delta y}{\Delta x} = \frac{2}{3} \). Substituting into point-slope form:
\( y = mx + b \) :

i) \( y = -\frac{2}{3}x + 6 \)
ii) Clear fractions and bring all terms to the left. \( 8x + 5y - 30 = 0 \)

g) Since the \( x \)-terms are equal, the line is the vertical line 4 units to the right of the \( y \)-axis.

i) There is no slope intercept form of the equation \( x = 4 \)
ii) \( x - 4 = 0 \)

h) All points on the vertical line through \((5, 9)\) must have an \( x \)-intercept of 5. Thus,

i) no slope intercept for the equation \( x = 5 \)
ii) \( x - 5 = 0 \)

i) Horizontal line must have all points with a \( y \)-coordinate of 9. Thus,

i) \( y = 9 \)
ii) \( y - 9 = 0 \)

23. a) Line perpendicular to \( y = -\frac{3}{2}x + 1 \) must have a slope \( \frac{2}{3} \). \((0, 3) \Rightarrow b = 3 \). Using slope intercept, we get the equation to be \( y = \frac{2}{3}x + 3 \).

b) Find slope of the given line by writing in slope intercept form: \( y = -3x + 2 \) \( \Rightarrow m = -3 \) so the slope of our parallel line is the same, \(-3\). \((0, -1) \Rightarrow b = -1 \). Using slope-intercept form: \( y = -3x - 1 \).

c) Find slope of given line: \( y = 2x - 5 \Rightarrow m = 2 \Rightarrow m \parallel = 2 \). We cannot use slope intercept because \((4, 0)\) is and \( x \)-intercept, not a \( y \)-intercept, so we must use point-slope. \( y - 0 = 2(x - 4) \Rightarrow y = 2x - 8 \)

d) Slope of given line: \( y = 2x - 5 \Rightarrow m = 2 \) so that \( m_\perp = -\frac{1}{2} \). Using point slope: \( y - 2 = -\frac{1}{2}(x - 5) \Rightarrow y = -\frac{1}{2}x + \frac{9}{2} \Rightarrow y = -\frac{1}{2}x + \frac{9}{2} \)
24. Graph \( y = 2x - 1 \) using a solid line since the inequality is \( \leq \). Shade below the line for \( < \).

25. Solve for \( y \): \( y > -\frac{2}{3}x + 2 \). Graph the line \( y = -\frac{2}{3}x + 2 \) using a dotted line since the points on the line are not included \( (>, \text{ not } \geq) \). Shade above the line for \( > \).

26. Shade to the right of the vertical line \( x = -4 \) for \( > \). Use a solid line since the inequality includes the points where the \( x = 4 \) \( (\geq) \).

27. Solve the inequality for \( y \). Remember to change the order of the inequality if you divide by a negative number.: \( -y > x - 2 \Rightarrow y < -x + 2 \). Graph the line \( y = -x + 2 \) with a dotted line (no = sign). Shade below \( (<) \).
28. Graph the horizontal line \( y = -6 \) with a solid line. Shade above.

```
-6
-4
-2
0
2
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29.

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-5 -4 -3 -2 -1 0 1 2 3 4 5
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30.

Using points that the line goes through: (40, 18) and (−10, −52), the slope is \( m = \frac{−52−18}{−10−40} = \frac{−70}{−50} = \frac{7}{5} \). The \( y \)-intercept appears to be about −41. Therefore, we can approximate the line of best fit to be \( y = \frac{7}{5}x - 41 \), where \( y \) is the wind chill at 20 mph for actual temperature \( x \).

a. Substitute \( x = 15 \) into your model, and solve for \( y \). Approximately \(-20^\circ F\)

b. Substitute \( y = -85 \) into your model, and solve for \( x \). Approximately 31.4\(^\circ F\)

c. \(-35^\circ F\). If the wind speed is higher than 20 \( mph \), then the wind chill would be lower than \(-24^\circ F\).

31. 120 feet

32. Your explanation.
33. a) 

![Graph showing the relationship between the number of quilts and the total cost of quilts.](image)

Slope: \( m = 20 \) \( \Rightarrow \) cost/quilt  
\( y \)-intercept: \( b = 25 \) \( \Rightarrow \) rent of booth

b) 

![Graph showing the relationship between the number of years and the value of the complex.](image)

\( m = -20000 \) \( \Rightarrow \) depreciation/year  
\( b = 240,000 \) \( \Rightarrow \) original value of complex

c) 

![Graph showing the relationship between the number of miles driven and the total rental.](image)

\( m = .25 \) \( \Rightarrow \) rate/mile each day  
\( b = 25 \) \( \Rightarrow \) flat rate each day

d) 

![Graph showing the relationship between sales and salary.](image)

\( m = .05 \) \( \Rightarrow \) commission rate  
\( b = 1000 \) \( \Rightarrow \) base salary
34. Let \( x \) = number of miles driven \( y = \) total pay for the day Model: \( y = 10x + 20 \)

![Graph showing the relationship between daily pay and number of miles driven.]

35. Let \( x \) = number of tons of widgets produced \( y = \) total cost of producing \( x \) widgets Model: 
\[
y = 200x + 3500
\]

![Graph showing the relationship between total cost and number of widgets produced.]

36. \( y = \frac{-5}{2}x + \frac{11}{2} \)