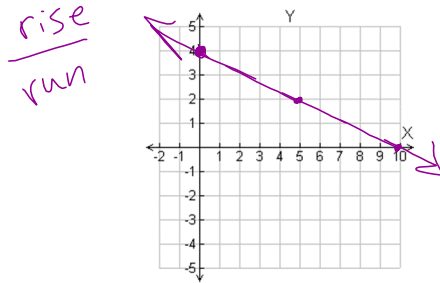


4.6 Slope Intercept Form

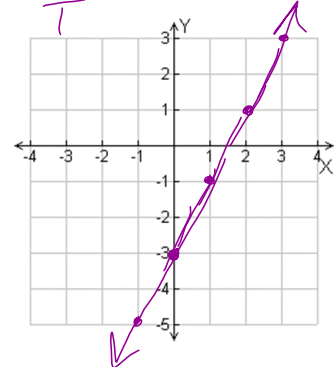
- Objectives:** 1. Write a linear equation in slope intercept form.
2. Graph a line using slope intercept form.

Graph the line given the slope and y-intercept.

Slope = $-\frac{2}{5}$; y intercept = 4



slope = 2, y-intercept = -3



Slope-Intercept Form of a Linear Equation

If a line has **slope m** and the **y-intercept is b** , then the line is described by the equation $y = mx + b$.

$y = mx + b$
slope \uparrow \uparrow *y-int*

Write the equation that describes the line in slope-intercept form.

slope = $\frac{1}{4}$; y-intercept = 4

$y = mx + b$
 $y = \frac{1}{4}x + 4$

slope = -9; y-intercept = $-\frac{5}{4}$

$y = mx + b$
 $y = -9x + \frac{-5}{4}$ or $y = -9x - \frac{5}{4}$

Same equation

slope = 1, y-intercept = 0

$y = 1x + 0$
 $y = 1x$
 $y = x$
} all correct

slope = -12, y-intercept = $-\frac{1}{2}$

$y = -12x + \frac{-1}{2}$
 $y = -12x - \frac{1}{2}$
} both correct

slope = 2; (3, 4) is on the line

$$y = mx + b$$

$$4 = 2(3) + b$$

$$4 = 6 + b$$

$$\frac{-6 - 6}{-2} = b$$

$$y = 2x - 2$$

slope = 8 and (-3, 1) is on the line

$$y = mx + b$$

$$1 = 8(-3) + b$$

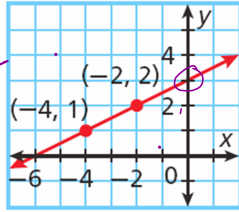
$$1 = -24 + b$$

$$\frac{+24 + 24}{25} = b$$

$$y = 8x + 25$$

$$y = mx + b$$

$$y = \frac{1}{2}x + 3$$

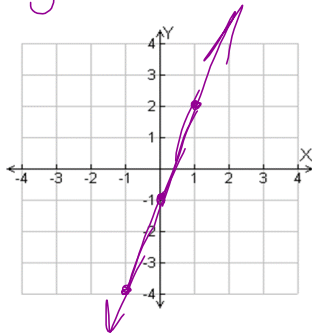


$$b = 3$$

$$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{2 - 1}{-2 - (-4)} = \frac{1}{2}$$

Write the equation in slope-intercept form. Then graph.

$$y = 3x - 1$$

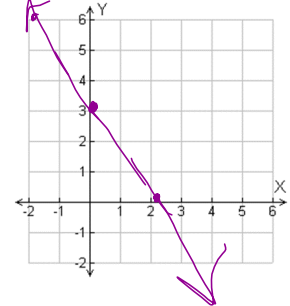


$$2y + 3x = 6$$
 ← Standard form

$$-3x -3x$$

$$\frac{2y}{2} = \frac{-3x + 6}{2}$$

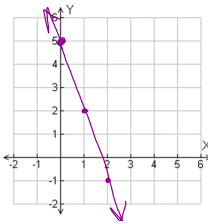
$$y = -\frac{3}{2}x + 3$$



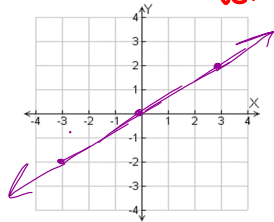
$$6x + 2y = 10$$

$$\frac{2y}{2} = \frac{-6x + 10}{2}$$

$$y = -3x + 5$$

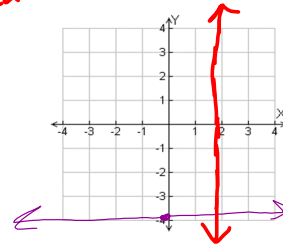


$$y = \frac{2}{3}x + 0$$



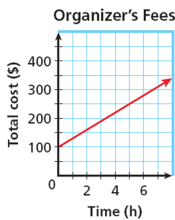
horizontal $y = -4$

Slope = 0



Vertical $x = 2$

A closet organizer charges a \$100 initial consultation fee plus \$30 per hour. The cost as a function of the number of hours worked is graphed below.



a. Write an equation that represents the cost as a function of the number of hours:

$$y = 30x + 100$$

b. Identify the slope and y-intercept and describe their meanings.

$$\text{slope} = 30$$

$$y\text{-int} = 100$$

c. Find the cost if the organizer works 12 hrs.

$$y = 30x + 100$$

$$y = 30(12) + 100$$

$$y = 360 + 100$$

$$y = \$460$$

4.7 Point-Slope Form

Objectives: 1. Graph a line and write a linear equation using point-slope form.
2. Write a linear equation given two points.

Point-Slope Form of a Linear Equation

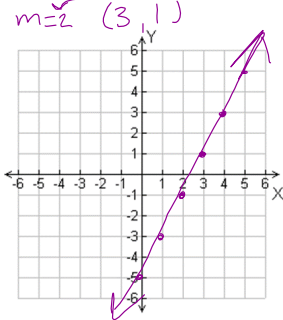
The line with slope m that contains the point (x_1, y_1) can be described by the equation $y - y_1 = m(x - x_1)$.

Write an equation in point slope form for the line with the given slope that contains the given point.

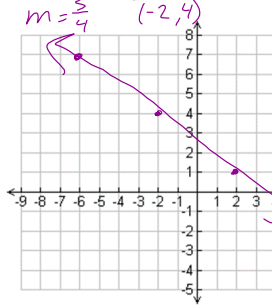
slope = $\frac{1}{6}$; (5, 1) slope = -4; (0, 3) slope = 1; (-1, -4) slope = 0; (3, -4)
 $y - 1 = \frac{1}{6}(x - 5)$ $y - 3 = -4(x - 0)$ $y - (-4) = 1(x - (-1))$ $y - (-4) = 0(x - 3)$
 $y - 1 = \frac{1}{6}(x - 5)$ $y - 3 = -4(x - 0)$ $y + 4 = 1(x + 1)$ $y + 4 = 0(x - 3)$

Graph the line described by the equation.

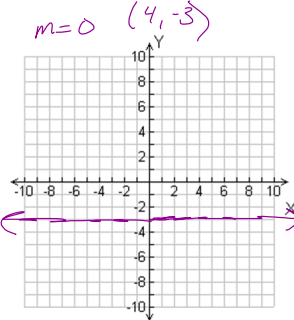
$y - 1 = 2(x - 3)$



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



$y + 3 = 0(x - 4)$



Write the equation that describes each line in slope-intercept form.

Slope = 3, (-1, 4) is on the line.

$y - 4 = 3(x + 1)$
 $y - 4 = 3x + 3$
 $y = 3x + 7$

Slope = -1; (0, 9)

$y - 9 = -1(x - 0)$
 $y - 9 = -1x + 0$
 $y = -x + 9$

x-intercept = $\frac{1}{4}$, y-intercept = 1

$\frac{1 - 0}{0 - \frac{1}{4}} = \frac{1}{-\frac{1}{4}} = 1 \cdot \frac{4}{1} = -4 = m$
 $y = -4x + 1$

Slope $\frac{1}{3}$ that contains (-3, 1).

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

x-intercept = 2, y-intercept = 2

$(2, 0)$ $(0, 2)$
 $\frac{2 - 0}{0 - 2} = \frac{2}{-2} = -1 = m$
 $y = -1x + 2$

Slope = $-\frac{1}{3}$; (3, -6)

$y + 6 = -\frac{1}{3}(x - 3)$
 $y + 6 = -\frac{1}{3}x + 1$
 $y = -\frac{1}{3}x - 5$

Write an equation in slope-intercept form for the line through the two points.

(10, -3) and (5, -2)

$$\frac{-2+3}{5-10} = \frac{1}{-5} = m$$

$$y+2 = \frac{1}{5}(x-5)$$

$$y+2 = \frac{1}{5}x - 1$$

$$y = \frac{1}{5}x - 3$$

(2, -3) and (4, 1)

$$\frac{1+3}{4-2} = \frac{4}{2} = 2 = m$$

$$y-1 = 2(x-4)$$

$$y-1 = 2x-8$$

$$y = 2x-7$$

(2, 15) and (-4, -3)

$$\frac{-3-15}{-4-2} = \frac{-18}{-6} = 3 = m$$

$$y-15 = 3(x-2)$$

$$y-15 = 3x-6$$

$$y = 3x+9$$

(1, -2) and (3, 10)

$$\frac{10+2}{3-1} = \frac{12}{2} = 6 = m$$

$$y+2 = 6(x-1)$$

$$y+2 = 6x-6$$

$$y = 6x-8$$

The cost to stain a deck is a linear function of the deck's area. The cost to stain 100, 250, 400 square feet are shown in the table.

Write an equation in slope-intercept form that represents the function. Then find the cost to stain a deck whose area is 75 square feet.

$$\frac{337.5-150}{250-100} = \frac{187.5}{150} = 1.25 = \frac{5}{4}$$

$$y = \frac{5}{4}x + 25$$

$$y = \frac{5}{4}(25) + 25$$

$$y = 93.75 + 25$$

$$y = 118.75$$

$$y-150 = \frac{5}{4}(x-100)$$

$$y-150 = \frac{5}{4}x - 125$$

Area (ft ²)	Cost (\$)
100	150
250	337.50
400	525

At a newspaper the costs to place an ad for one week are shown.

Write an equation in slope-intercept form that represents this linear function. Then find the cost of an ad that is 21 lines long.

$$\frac{17.25-12.75}{5-3} = \frac{4.5}{2} = 2.25 = \frac{9}{4}$$

$$y = \frac{9}{4}x + 6$$

$$y-12.75 = \frac{9}{4}(x-3)$$

$$y-12.75 = \frac{9}{4}x - \frac{27}{4}$$

$$y = \frac{9}{4}(21) + 6$$

$$y - \frac{51}{4} = \frac{9}{4}x - \frac{27}{4}$$

$$y = 53.25$$

Lines	Cost (\$)
3	12.75
5	17.25
10	28.50

4.8 Line of Best Fit

Objectives: 1. Determine a line of best fit for a set of linear data.
2. Determine and interpret the correlation coefficient.

A line of best fit is the line that comes closest to all of the points in the data set, using a given process.

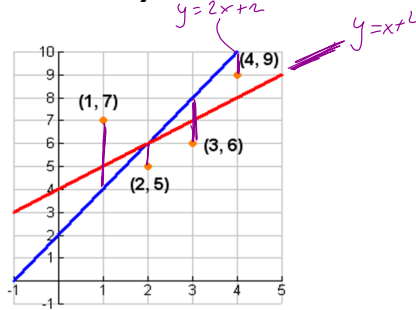
The residual is a number r , where $-1 \leq r \leq 1$, that describes how closely the points in a scatter plot cluster around a line of best fit.

Two lines of fit for this data are $y = 2x + 2$ and $y = x + 4$. Which line is a better fit?

X	1	2	3	4
Y	7	5	6	9

$y = x + 4$
 $(2)^2 + (-1)^2 + (-1)^2 + (1)^2$
 $4 + 1 + 1 + 1$
 7

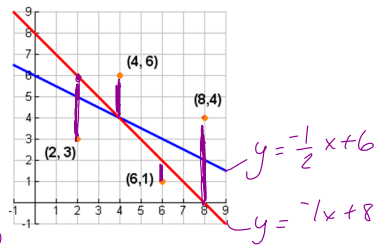
$y = 2x + 2$
 $(3)^2 + (1)^2 + (-2)^2 + (-1)^2$
 $9 + 1 + 4 + 1$
 15



Two lines of fit for this data are $y = -\frac{1}{2}x + 6$ and $y = -x + 8$. Which line is a better fit?

$y = -\frac{1}{2}x + 6$
 $(-2)^2 + (2)^2 + (-2)^2 + (2)^2$
 $4 + 4 + 4 + 4$
 16

$y = -x + 8$
 $(-3)^2 + (2)^2 + (-1)^2 + (4)^2$
 $9 + 4 + 1 + 16$
 30



The table shows populations and numbers of U.S. Representatives for several states in the year 2000.

State	Population (millions)	Representatives
AL	4.5	7
AK	0.6	1
AZ	5.1	8
AR	2.7	4
CA	33.9	53
CO	4.3	7

A. Find an equation for a line of best fit.

$y - 7 = 1.56(x - 4.5)$ $y - 7 = 1.56x - 7.02$
 $y = 1.56x + .02$

B. Interpret the meaning of the slope and y-intercept. Slope: reps per million of population

($< \text{million}$)
y-int: Pop of 0 has .02 rep (1 rep)

C. Michigan had a population of approximately 10.0 million in 2000. Use your equation to predict Michigan's number of Representatives.

$y = 1.56(10) + .02$

$y = 15.6 + .02$

$y = 15.62$

16 reps.

The table shows the prices and the lengths in yards of several balls of yarn at Knit Mart.

X	Length (yd)	1680	100	153	99	109	109	176	100	1440	61
Y	Price (\$)	65.85	7.85	9.80	10.85	8.35	7.85	19.85	5.35	65.85	14.85

$$\frac{9.8 - 7.85}{153 - 100}$$

$$\frac{1.95}{53}$$

$$.04$$

a. Find an equation for a line of best fit.

$$y - 7.85 = .04(x - 100) \quad y - 7.85 = .04x - 4 + 7.85$$

$$y = .04x + 6.38$$

b. Interpret the meaning of the slope and y-intercept.

Slope: \$.04/yd price/yd y-int: Price added to each ball of yarn

c. Knit Mart also sells yarn in a 1000-yard ball. Use your equation to predict the cost of this yarn.

$$y = .04(1000) + 6.38$$

$$y = 40 + 6.38$$

$$46.38 = y$$

The table shows a relationship between points allowed and games won by a football team over eight seasons.

Year	Points Allowed	Games Won
1	285	3
2	310	4
3	301	3
4	186	6
5	146	7
6	159	7
7	170	5
8	190	6

Find an equation for a line of best fit. How well does the line represent the data?

$$y = -.02x + 9.91$$

$$r \approx -.91$$

Strong representation

L₁ x L₂ y

Kylie and Marcus designed a quiz to measure how much information adults retain after leaving school. The table below shows the quiz scores of several adults, matched with the number of years each person had been out of school. Find an equation for a line of best fit. How well does the line represent the data?

Time Out of School (yr)	1	1	1	2	2	3	5	7	10	10	14	25
Quiz Score	85	94	98	75	80	77	63	56	45	50	34	33

$$y = -2.74x + 84.32$$

$$r = -.88$$

Strong Negative $-1 \leq r \leq 1$

Malik is a contractor, installing windows for a builder. The table shows data for his first eight weeks on the job. The equation of the least-squares line for the data is $y \approx -10.36x + 53$, and $r \approx -0.88$.

Discuss correlation and causation for the data set.

Week	Average Time per Window (hr)	Net Profit per Hour (\$)
1	3.5	19
2	2.8	25
3	2.5	24
4	2.1	26
5	2.3	30
6	1.9	37
7	1.7	35
8	1.8	39

Strong negative

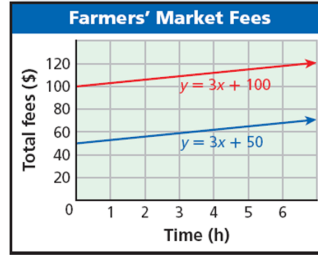
Less time per window means more profit.

4.9 Slopes Parallel and Perpendicular Lines

Objectives: 1. Identify and graph parallel and perpendicular lines.
2. Write equations to describe lines parallel or perpendicular to a given line.

To sell at a particular farmers' market for a year, there is a \$100 membership fee. Then you pay \$3 for each hour that you sell at the market. However, if you were a member the previous year, the membership fee is reduced to \$50.

- The red line shows the total cost if you are a new member.
- The blue line shows the total cost if you are a returning member



These lines are parallel lines.

Parallel Lines	
WORDS	Two different nonvertical lines are parallel if and only if they have the same slope. All different vertical lines are parallel.
GRAPH	

Identify which lines are parallel.

$y = \frac{5}{3}x - 2$; $y = x$; $y = \frac{5}{3}x + 4$; $y = x + 1$

$y = 2x + 2$; $y = 2x + 1$; $y = -4$; $x = 1$

Handwritten notes: $y = x$ and $y = x + 1$ are circled together. $y = 2x + 2$ and $y = 2x + 1$ are circled together. $y = -4$ is labeled "Horizontal" and $x = 1$ is labeled "Vertical".

$y = 2x - 3$; $y = -\frac{2}{3}x + 3$; $2x + 3y = 8$; $y + 1 = 3(x - 3)$

Handwritten work:

$$\begin{aligned} 2x + 3y &= 8 \\ -2x & \quad -2x \\ \hline 3y &= -2x + 8 \\ \frac{3y}{3} &= \frac{-2x}{3} + \frac{8}{3} \\ y &= -\frac{2}{3}x + \frac{8}{3} \end{aligned}$$

$$\begin{aligned} y + 1 &= 3(x - 3) \\ y + 1 &= 3x - 9 \\ -1 & \quad -1 \\ \hline y &= 3x - 10 \end{aligned}$$

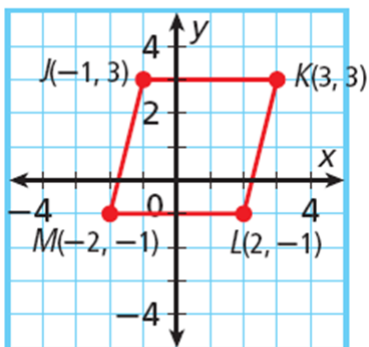
$y = \frac{3}{4}x + 8$; $-3x + 4y = 32$; $y = 3x$; $y - 1 = 3(x + 2)$

Handwritten work:

$$\begin{aligned} -3x + 4y &= 32 \\ +3x & \quad +3x \\ \hline 4y &= 3x + 32 \\ \frac{4y}{4} &= \frac{3x}{4} + \frac{32}{4} \\ y &= \frac{3}{4}x + 8 \end{aligned}$$

$$\begin{aligned} y - 1 &= 3(x + 2) \\ y - 1 &= 3x + 6 \\ +1 & \quad +1 \\ \hline y &= 3x + 7 \end{aligned}$$

Show that $JKLM$ is a parallelogram.



$$\overline{JK}: \frac{3-3}{3+1} = \frac{0}{4} = 0$$

$$\overline{LM}: \frac{-1+1}{2+2} = \frac{0}{4} = 0$$

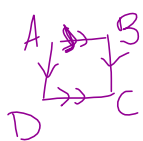
$$\overline{JM}: \frac{3+1}{-1+2} = \frac{4}{1} = 4$$

$$\overline{KL}: \frac{3+1}{3-2} = \frac{4}{1} = 4$$

} Parallel

} Parallel

Show that the points $A(0, 2)$, $B(4, 2)$, $C(1, -3)$, $D(-3, -3)$ are the vertices of a parallelogram.



$$\overline{AB}: \frac{2-2}{0-4} = \frac{0}{-4} = 0$$

$$\overline{CD}: \frac{-3+3}{1+3} = \frac{0}{4} = 0$$

$$\overline{AD}: \frac{2+3}{0+3} = \frac{5}{3}$$

$$\overline{BC}: \frac{-3-2}{1-4} = \frac{-5}{-3} = \frac{5}{3}$$

} Parallel

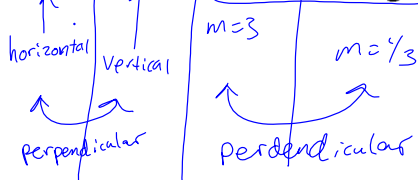
} Parallel

Perpendicular lines are lines that intersect to form right angles (90).

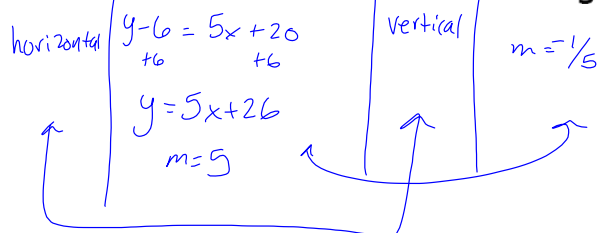
Perpendicular Lines	
WORDS	Two nonvertical lines are perpendicular if and only if the product of their slopes is -1 . Vertical lines are perpendicular to horizontal lines.
GRAPH	

Identify what lines are perpendicular:

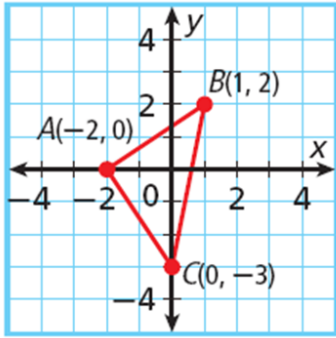
$y = 3$; $x = -2$; $y = 3x$; $y = -\frac{1}{3}(x - 4)$



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



Show that **ABC** is a right triangle.



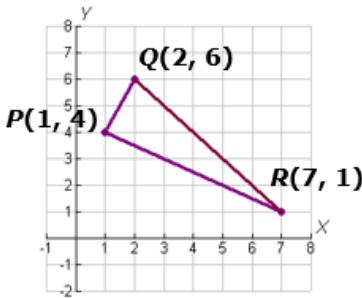
$$\overline{AB} : \frac{2-0}{1+2} = \frac{2}{3}$$

$$\overline{BC} : \frac{-3-2}{0-1} = \frac{-5}{-1} = 5$$

$$\overline{AC} : \frac{-3-0}{0+2} = \frac{-3}{2}$$

Perpendicular

Show that **P(1, 4), Q(2, 6), and R(7, 1)** are the vertices of a right triangle.



Complete on
Your own

Write an equation in slope-intercept form for the line that passes through **(4, 10)** and is parallel to the line described by **$y = 3x + 8$** .

$$m = 3$$

$$y - 10 = 3(x - 4)$$

$$y - 10 = 3x - 12$$

$$+10 \quad +10$$

$$y = 3x - 2$$

Write an equation in slope-intercept form for the line that passes through **(2, -1)** and is perpendicular to the line described by **$y = 2x - 5$** .

$$*m = -\frac{1}{2}$$

$$y + 1 = -\frac{1}{2}(x - 2)$$

$$y + 1 = -\frac{1}{2}x + 1$$

$$-1 \quad -1$$

$$y = -\frac{1}{2}x + 0$$

$$m = 2$$

Write an equation in slope-intercept form for the line that passes through **(5, 7)** and is parallel to the line described by **$y = \frac{4}{5}x - 6$** .

Complete on

Write an equation in slope-intercept form for the line that passes through **(-5, 3)** and is perpendicular to the line described by **$y = 5x$** .

Your own

4.10A Transforming Linear Functions

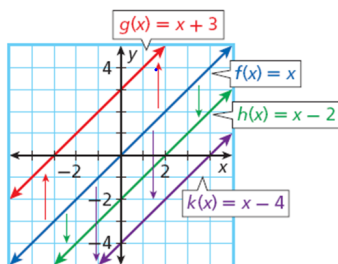
Objective: 1. Describe how changing slope and y-intercept affect the graph of a linear function.

A family of functions is a set of functions whose graphs have basic characteristics in common. For example, all linear functions form a family because all of their graphs are the same basic shape.

A parent function is the most basic function in a family. For linear functions, the parent function is $f(x) = x$. $y = x$

The graphs of all other linear functions are *transformations* of the graph of the parent function, $f(x) = x$. A transformation is a change in position or size of a figure.

There are three types of transformations— translation, rotation, and reflections.



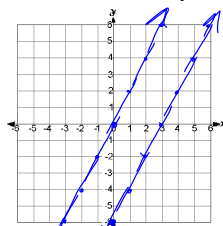
Vertical Translation of a Linear Function

When the y-intercept b is changed in the function $f(x) = mx + b$, the graph is translated vertically.

- If b increases, the graph is translated up.
- If b decreases, the graph is translated down.

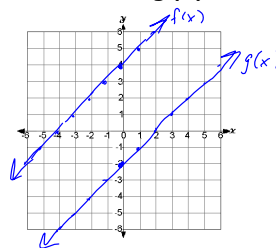
Graph the functions. Then describe the transformation from the graph of $f(x)$ to the graph of $g(x)$.

$f(x) = 2x$ and $g(x) = 2x - 6$



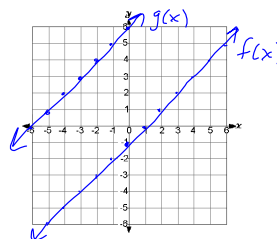
translation down 6 units

$f(x) = x + 4$ and $g(x) = x - 2$

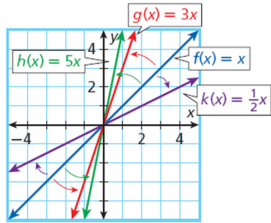


translation down 6 units

$f(x) = x - 1$ and $g(x) = x + 6$



translation up 7 units

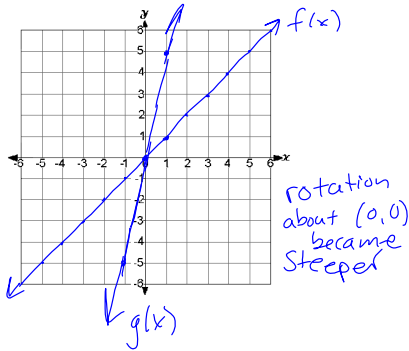


Rotation of a Linear Function

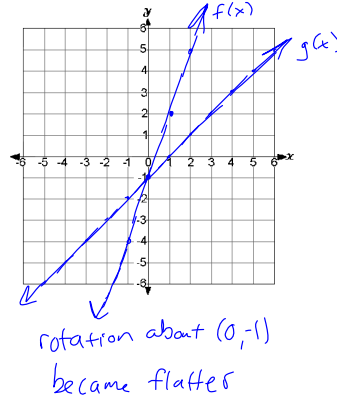
When the slope m is changed in the function $f(x) = mx + b$ it causes a rotation of the graph about the point $(0, b)$, which changes the line's steepness.

Graph the functions. Then describe the transformation from the graph of $f(x)$ to the graph of $g(x)$.

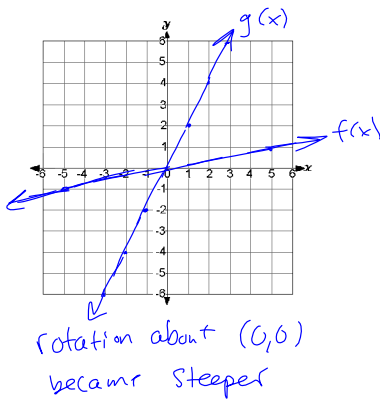
$f(x) = x$ and $g(x) = 5x$



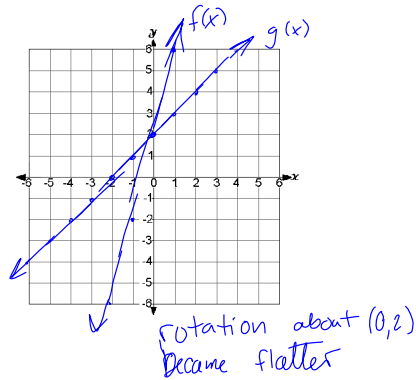
$f(x) = 3x - 1$ and $g(x) = x - 1$



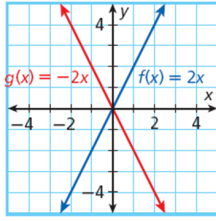
$f(x) = \frac{1}{5}x$ and $g(x) = 2x$



$f(x) = 4x + 2$ and $g(x) = x + 2$



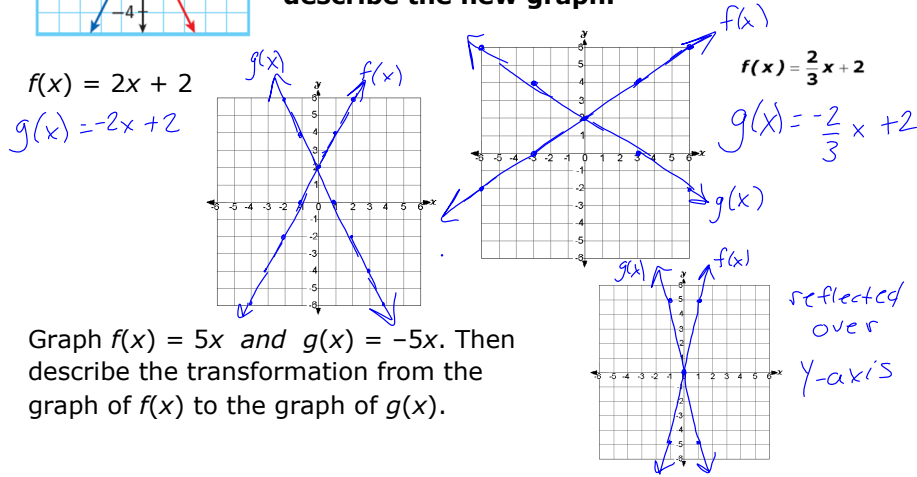
4.10B Transforming Linear Functions



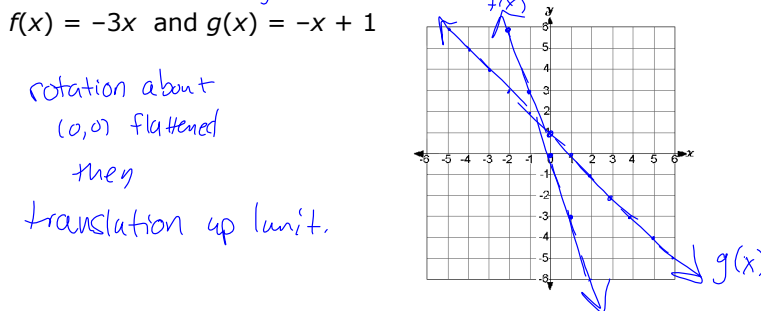
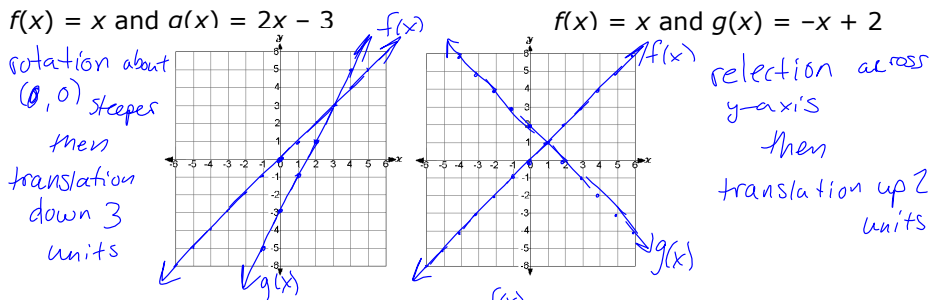
Reflection of a Linear Function

When the slope m is multiplied by -1 in $f(x) = mx + b$, the graph is reflected across the y -axis.

Graph the function. Then reflect the graph of $f(x)$ across the y -axis. Write a function $g(x)$ to describe the new graph.



Graph the functions. Then describe the transformations from the graph of $f(x)$ to the graph of $g(x)$.



A florist charges \$25 for a vase plus \$4.50 for each flower. The total charge for the vase and flowers is given by the function $f(x) = 4.5x + 25$. How will the graph change if the vase's cost is raised to \$35? if the charge per flower is lowered to \$3.00?

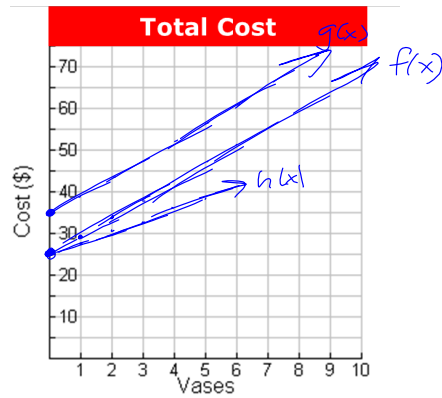
$$f(x) = 4.5x + 25$$

$$g(x) = 4.5x + 35$$

$$h(x) = 3x + 25$$

$f(x) \rightarrow g(x)$ = translation
up 10 units

$f(x) \rightarrow h(x)$ = rotation (0,25)
flatter



A trophy company charges \$175 for a trophy plus \$0.20 per letter for engraving. The total charge is given $f(x) = 0.2x + 175$. the graph of this function is shown in blue.

How will the graph be affected if the charge per letter is lowered to \$0.15?

$$g(x) = .15x + 175 \quad \text{rotation (0,175) flatter}$$

How will the graph change if the trophy's cost is raised to \$180?

$$h(x) = .2x + 180$$

translation
up 5 units

