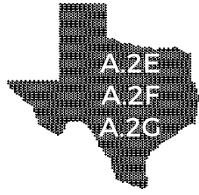


Equations of Parallel and Perpendicular Lines



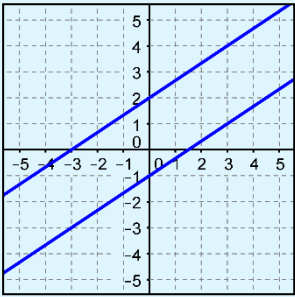
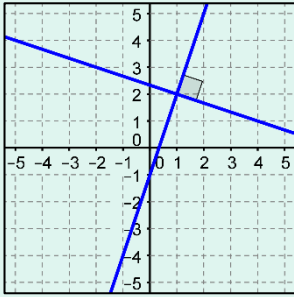
The student is expected to write the equation of a line that contains a given point and is parallel to a given line.

The student is expected to write the equation of a line that contains a given point and is perpendicular to a given line.

The student is expected to write an equation of a line that is parallel or perpendicular to the x - or y -axis and determine whether the slope of the line is zero or undefined.

i TELL ME MORE...

The slope of a line tells you the steepness of the graph. If two lines are parallel, then they never intersect and have the same steepness. If two lines are perpendicular, then they intersect at a right angle. The slopes of parallel and perpendicular lines have special relationships.

<p>Parallel Lines</p> <p>Parallel lines have the same slope. Because the slope, or steepness, of the lines is the same, they will never intersect. If a, b, and c are real numbers, then the lines y_1 and y_2 are parallel.</p> $y_1 = ax + b$ $y_2 = ax + c$ 	<p>Perpendicular Lines</p> <p>Perpendicular lines intersect at a right angle. Because of the coordinate relationships, the slopes of perpendicular lines are negative reciprocals of each other. If a, b, and c are real numbers, then the lines y_3 and y_4 are perpendicular.</p> $y_3 = ax + b$ $y_4 = -\frac{1}{a}x + c$ 
---	---

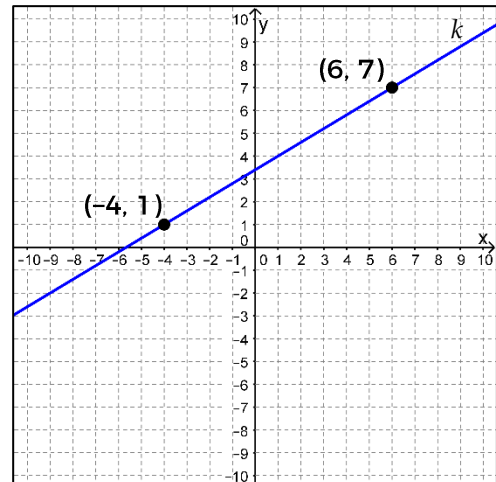
✓ EXAMPLES

Example 1: The graph of line k is shown. Write the equation, in slope-intercept form, of line j that is parallel to line k and has a y -intercept of $(0, -3)$.

Step 1: Determine the slope of line m using the slope formula and the two points given in the graph.

$$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{7 - 1}{6 - (-4)} = \frac{6}{10} = \frac{3}{5}$$

slope of line k : $m = \frac{3}{5}$



Equations of Parallel and Perpendicular Lines

Step 2: Since line j and line k are parallel, they have the same slopes.

$$\text{slope of line } j: m = \frac{3}{5}$$

Step 3: Use the slope of line j along with the y -coordinate of the given y -intercept to write the equation of line j in slope-intercept form.

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

$$y = mx + b$$

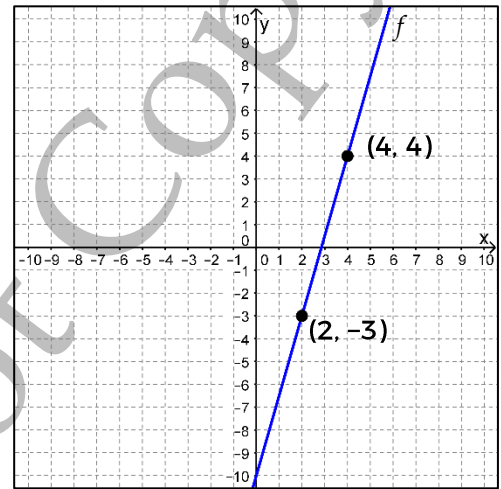
$$y = \frac{3}{5}x + (-3)$$

Example 2: The graph of line f is shown. Write the equation, in standard form, of line h that is perpendicular to line f and passes through the point $(1, 1)$.

Step 1: Determine the slope of line f using the slope formula and the two points given in the graph.

$$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{4 - (-3)}{4 - 2} = \frac{7}{2}$$

$$\text{slope of line } f: m = \frac{7}{2}$$



Step 2: Since line f and line h are perpendicular, they have slopes that are negative reciprocals of each other.

$$\text{Slope of line } h = -\frac{1}{\text{Slope of line } f} = -\frac{1}{\left(\frac{7}{2}\right)} = -\frac{2}{7}$$

$$\text{slope of line } h: m = -\frac{2}{7}$$

Step 3: Use the slope of line h along with the given point, $(1, 1)$, to write the equation of line h using point-slope form.

$$y - y_1 = m(x - x_1)$$

$$y - 1 = -\frac{2}{7}(x - 1)$$

$$y - 1 = -\frac{2}{7}(x - 1)$$

Step 4: Simplify the equation and write it in standard form.

$$y - 1 = -\frac{2}{7}(x - 1)$$

$$y - 1 = -\frac{2}{7}x + \frac{2}{7}$$

$$7y - 7 = -2x + 2$$

$$2x + 7y - 7 = 2$$

$$2x + 7y = 9$$

$$2x + 7y = 9$$

You Try It!

The table contains points that lie on the graph of a linear function.

x	-2	2	4	5
y	-8.5	-3.5	-1	0.25

What is the slope of the line represented?

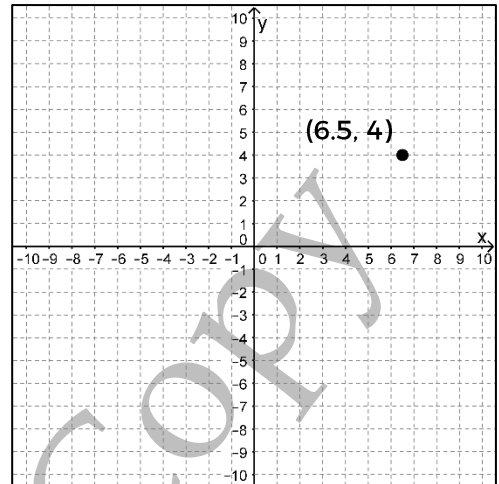
Line n is parallel to this line and passes through the point $(2, 5)$.

What is the slope of line n ? _____

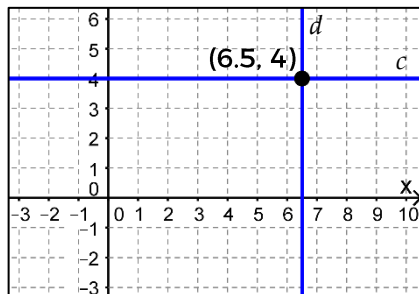
Write the equation of line n in slope-intercept form.

Equations of Parallel and Perpendicular Lines

Example 3: Thao is using computer software to design a quilt. She plots the point $(6.5, 4)$ and wants to draw line c that passes through the point and is parallel to the x -axis and line d that passes through the point and is perpendicular to the x -axis. Write the equation and determine the slope of both line c and line d .



Step 1: Draw line c through $(6.5, 4)$ that is parallel to the x -axis. Draw line d through $(6.5, 4)$ that is perpendicular to the x -axis.



Step 2: For line c , all of the y -values are 4, so write the equation of line c .
 $y = 4$

Step 3: For line d all of the x -values are 6.5, so write the equation of line d .
 $x = 6.5$

Step 4: Slope is the ratio of the vertical change to the horizontal change, $\frac{\Delta y}{\Delta x}$. Horizontal lines have a slope of 0 since Δy , the change in the vertical direction, is 0. Vertical lines have an undefined slope since Δx , the change in the horizontal direction, is 0 and the denominator of any fraction can never equal 0.

The slope of line c is 0 and the slope of line d is undefined.



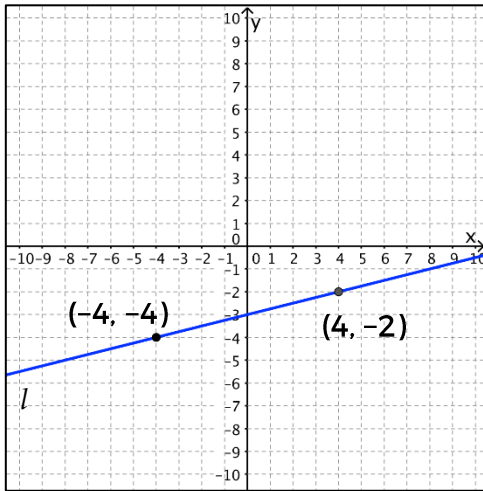
PRACTICE

Write the equations of each of the following lines. Identify the slope, if it exists.

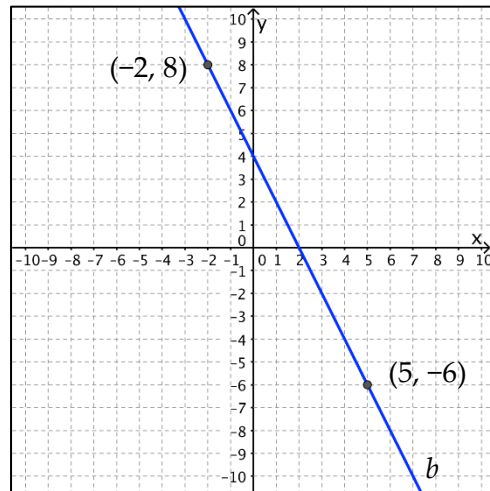
- Line k is parallel to the y -axis, perpendicular to the x -axis, and passes through the point $(-3, 6)$.
- Line r is parallel to the y -axis and contains the point $(4, -2)$.
- Line t is perpendicular to the y -axis and passes through point $(-3, 1.5)$.

Equations of Parallel and Perpendicular Lines

Use the graph of line l to answer questions 4-7.



Use the graph of line b to answer questions 8-10.



4. Write the equation, in slope-intercept form, of line m that is parallel to line l and has a y -intercept of $(0, 6)$.

5. Write the equation, in standard form, of line n that is perpendicular to line l and passes through the point $(3, -6)$.

6. Write the equation of line p that is parallel to the x -axis and passes through line l at point $(-4, -4)$.

7. Write the equation of line q that is perpendicular to the x -axis and passes through line l at point $(4, -2)$.

8. Which equation describes a line perpendicular to line b that has a y -intercept of $(0, -2)$?

A $y = 2x - 2$

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

C $y = -2x - 2$

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

9. Which equation describes a line parallel to line b that passes through the point $(4, 3)$?

F $y = -2x + 11$

G $y = 2x - 5$

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

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

10. What is the equation of line j that is perpendicular to the y -axis and passes through the y -intercept of line b ?

A $y = 0$

B $x = 4$

C $y = 4$

D $x = 0$