

## Equations of Lines

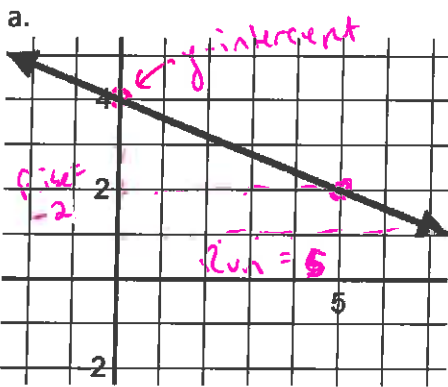
There are a variety of ways to represent the equation of a line – we will look at 2 common forms: “Slope – Intercept” form and “Point – Slope” form.

**Slope – Intercept Form of a Line:**  $y = mx + b$

1. What do the letters m and b represent in the slope-intercept equation?

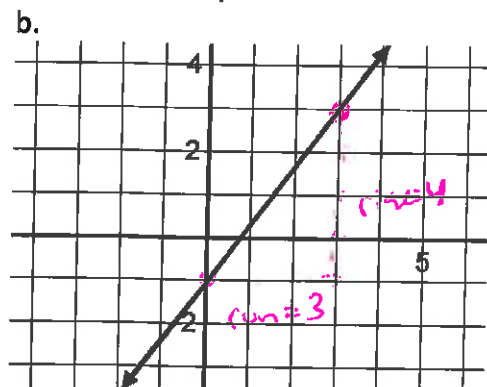
*m is the slope and b is the y-intercept.*

2. Identify the slope and the y-intercept for each line and use them to write the equation of the line.



Slope =  $-\frac{2}{5}$       y-int: (0, 4)

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



Slope =  $\frac{4}{3}$       y-int: -1

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

3. Does the line in part 2b pass through the point (10, 11)? Explain.

$$\begin{aligned} y &= \frac{4}{3}(10) - 1 \\ &= \frac{40}{3} - 1 \\ &= \frac{37}{3} \approx 12.3 \end{aligned}$$

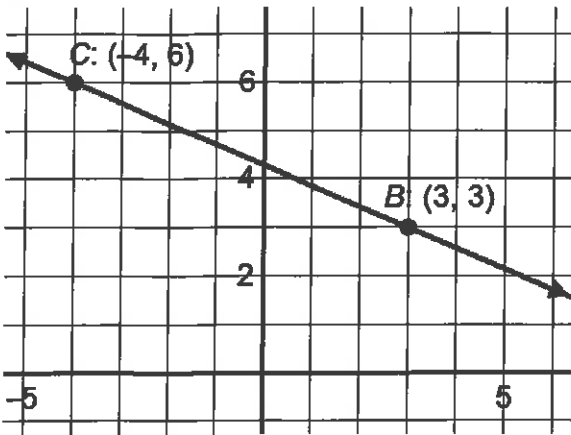
*when you plus  $x=10$  into the equation you get  $y=12.3$  not 11. So, the point (10, 11) is not on the line.*

4. Is the line  $y = \frac{-2}{5}x + 7$  parallel to the line in part 2a? Explain.

*the slope of the line  $y = \frac{-2}{5}x + 7$  is  $-\frac{2}{5}$ . the slope of the line in 2a is also  $-\frac{2}{5}$ .*

*so the lines are parallel because they have equal slopes.*

5.



a. Determine an equation for line CB (if possible).

$$m = \frac{6-3}{-4-3} = \frac{3}{-7}$$

$$y = -\frac{3}{7}x + \frac{30}{7}$$

$$y = -\frac{3}{7}x + b$$

$$6 = -\frac{3}{7}(-4) + b$$

$$6 = \frac{12}{7} + b$$

$$-\frac{12}{7} - \frac{12}{7}$$

$$b = \frac{30}{7}$$

b. Describe the difficulties you experienced in trying to find the equation of this line.

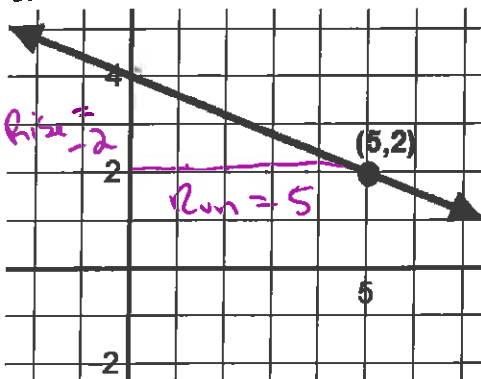
It was hard to find  $b$  because the line does not pass through a whole number on the  $y$ -axis.

In example 5, "Slope - Intercept" was difficult to use because the  $y$ -intercept was not easily found. "Point - Slope" form of line easily overcomes this difficulty.

**Point - Slope Form of a Line:**  $y - y_1 = m(x - x_1)$

where  $(x_1, y_1)$  is any point on the line.

6.



a. Use point-slope form and the indicated point to write the equation of the line:

$$m = -\frac{2}{5} \quad \text{point } (5, 2)$$

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

b. This is the same line as part 2a. How do you know that this equation is equivalent to the equation that you wrote in part 2a?

yes, when I simplify the equation by solving for  $y$ , I get the slope intercept form  $y = -\frac{2}{5}x + 4$ .

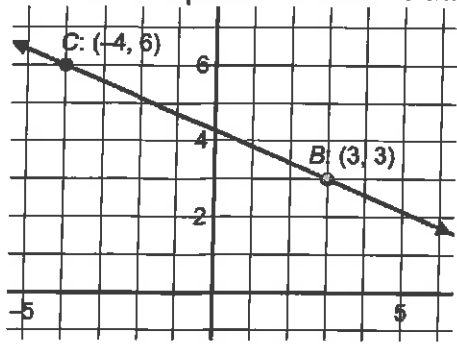
$$y - 2 = -\frac{2}{5}(x - 5)$$

$$y - 2 = -\frac{2}{5}x + \frac{10}{5}$$

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

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

7. Find the equation of the line through the points C(-4, 6) and B(3, 3).



$$m = \frac{6-3}{-4-3} = \frac{3}{-7}$$

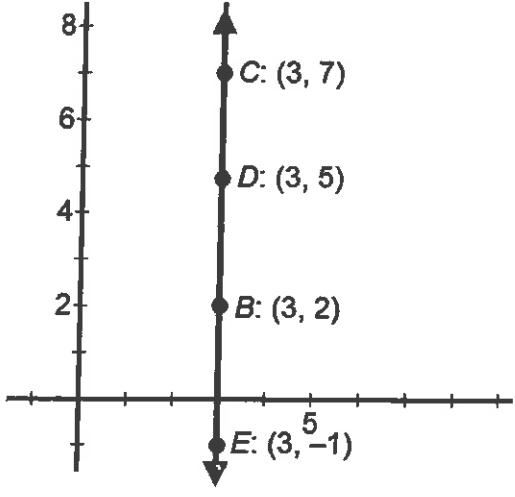
point (-4, 6)

$$y - 6 = -\frac{3}{7}(x + 4)$$

point slope form. I can stop here, unless I am asked to put it into slope intercept form.

**Horizontal & Vertical Lines:**

8.



a. What is the slope of this Vertical line?

the line has no slope. because the run = 0 and when you do  $\frac{\text{rise}}{\text{run}}$  you can't divide by zero.

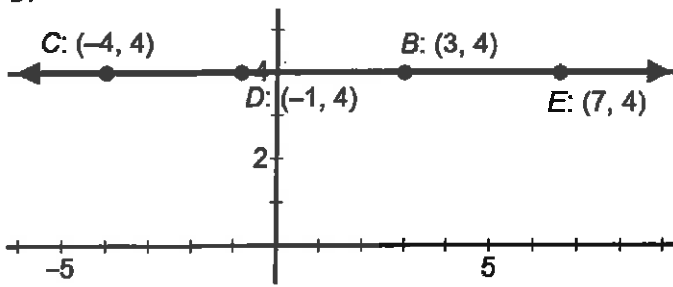
b. Why can neither Slope-Intercept nor Point-Slope be used to write the equation of a vertical line?

Both forms require the use of the slope of the line, but if there is no slope, then you can't use them.

c. Since all the points on this vertical line have an x-coordinate of 3, the equation of the line is given as  $x = 3$ . Suppose you want the equation of a vertical line through the point (-5, 8). What would it be?

the equation of a vertical line through (-5, 8) would be  $x = -5$ . Since any point on the line would have an x-coord. of -5.

9.



a. What is the slope of this Horizontal line?

The rise is zero, so  $\frac{\text{rise}}{\text{run}} = \frac{0}{\text{run}}$

will be zero.

So, the slope is zero.

b. Since every point on this horizontal line has a y-coordinate of 4, the equation is given as  $y = 4$ .

Suppose you want the equation of a horizontal line through the point  $(-5, 8)$ . What would it be?

a horizontal line through the point  $(-5, 8)$  would be  $y = 8$ . because every point on the line has a y-coord. of 8.

### Parallel & Perpendicular Lines

10. Determine if the lines are parallel, perpendicular, or neither and explain why.

a.  $y = 6x - 7$   
 $y = 6x + 1$

parallel, the slopes of both lines is  $\frac{6}{1}$ .

b.  $2x - y = 8$   
 $x + 2y = 10$

$2y = -x + 10$   
 $y = -\frac{1}{2}x + \frac{10}{2}$   
 $m = -\frac{1}{2}$

$-y = -2x + 8$   
 $y = \frac{2}{1}x - 8$   
 $m = \frac{2}{1}$

these lines are perpendicular because their slopes are negative reciprocals.

c.  $3x + 2y = 4$   
 $5x + 3y = 9$

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

$3y = -5x + 9$   
 $y = -\frac{5}{3}x + \frac{9}{3}$   
 $m = -\frac{5}{3}$

these are neither.

d.  $x = 8$   
 $y = -3$

vertical line      horizontal line.

Vertical and horizontal lines are always perpendicular.

11. What is the equation of the line that passes through the point  $(8, -2)$  and is perpendicular to the line

$y = 2x + 3$

$\hookrightarrow m = \frac{2}{1}$

Slope of  $\perp$  line =  $-\frac{1}{2}$

point  $(8, -2)$

equation:  $y - y_1 = m(x - x_1)$   
 $y + 2 = -\frac{1}{2}(x - 8)$  ← point slope form.

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

$y = -\frac{1}{2}x + 2$  ← slope intercept form.