Lesson 5: Parallel and Perpendicular Lines

Objective: Write the equation of a line given a line parallel or perpendicular.

Students will be able to:

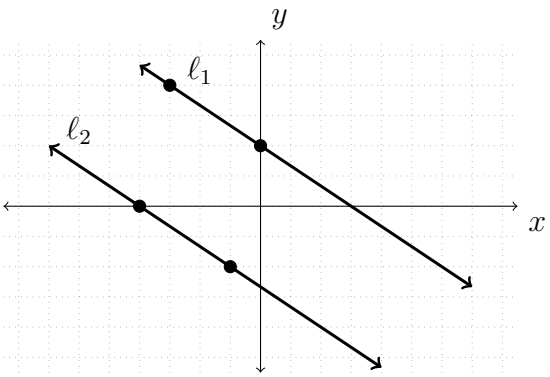
- Find a perpendicular slope, given a slope or linear equation.
- Find a parallel slope, given a slope or linear equation.
- Find the equation of a line parallel or perpendicular to a given linear equation.

Prerequisite Knowledge:

- Identify the slope of a line.
- Work with the slope-intercept form of a line.
- Work with the point-slope form of a line.

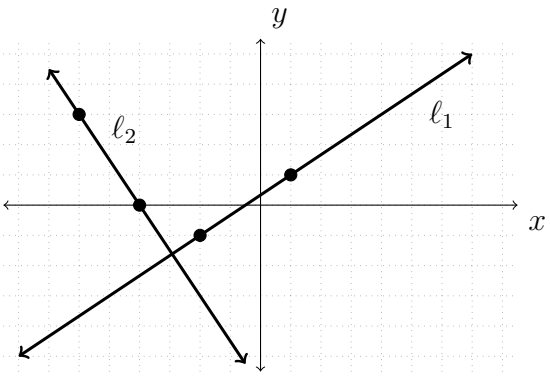
Lesson:

I - Motivating Example(s):



This graph shows two parallel lines.

The slope (rise over run) of each line is "down 2, right 3," or $m_1 = m_2 = -\frac{2}{3}$.



This graph shows two perpendicular lines.

The slope (rise over run) of the more gradual line is "up 2, right 3," or $m_1 = \frac{2}{3}$.

The slope of the steeper line is "down 3, right 2," or $m_2 = -\frac{3}{2}$.

As the first graph illustrates, **parallel lines** have the **same slope**, $m_1 = m_2$.

On the other hand, the second graph shows us that **perpendicular lines** have **negative reciprocal slopes**, $m_2 = -\frac{1}{m_1}$ (and so, $m_1 \cdot m_2 = -1$).

We can use these properties to make conclusions about whether two lines are parallel, perpendicular, or neither.

II - Demo/Discussion Problems:

1. Find the equation of the line through (6,-9) perpendicular to the line $y = -\frac{3}{5}x + 4$.
2. Find the equation of a line through (4,-5) and parallel to the line $2x - 3y = 6$.
3. Find the equation of the line through (3,4) and perpendicular to the line $x = -2$.

III - Practice Problems:

Find the slope of a line parallel to each given line.

1) $y = 2x + 4$
2) $y = -\frac{2}{3}x + 5$
3) $y = 4x - 5$
4) $y = -\frac{10}{3}x - 5$
5) $x - y = 4$
6) $6x - 5y = 20$
7) $7x + y = -2$
8) $3x + 4y = -8$

Find the slope of a line perpendicular to each given line.

9) $x = 3$
10) $y = -\frac{1}{2}x - 1$
11) $y = -\frac{1}{3}x$
12) $y = \frac{4}{5}x$
13) $x - 3y = -6$
14) $3x - y = -3$
15) $x + 2y = 8$
16) $8x - 3y = -9$

Write the point-slope form of the equation of the line described.

17) through $(2, 5)$, parallel to $x = 0$
18) through $(5, 2)$, parallel to $y = \frac{7}{5}x + 4$
19) through $(3, 4)$, parallel to $y = \frac{9}{2}x - 5$
20) through $(1, -1)$, parallel to $y = -\frac{3}{4}x + 3$
21) through $(2, 3)$, parallel to $y = \frac{7}{5}x + 4$
22) through $(-1, 3)$, parallel to $y = -3x - 1$
23) through $(4, 2)$, parallel to $x = 0$
24) through $(1, 4)$, parallel to y $= \frac{7}{5}x + 2$
25) through $(1, -5)$, perpendicular to $-x + y = 1$
26) through $(1, -2)$, perpendicular to $-x + 2y = 2$
27) through $(5, 2)$, perpendicular to $5x + y = -3$
28) through $(1, 3)$, perpendicular to $-x + y = 1$
29) through $(4, 2)$, perpendicular to $-4x + y = 0$
30) through $(-3, -5)$, perpendicular to $3x + 7y = 0$
31) through $(2, -2)$, perpendicular to $3y - x = 0$
32) through $(-2, 5)$, perpendicular to $y - 2x = 0$

Write the slope-intercept form of the equation of the line described.

33) through $(4, -3)$, parallel to $y = -2x$
34) through $(-5, 2)$, parallel to $y = \frac{3}{5}x$
35) through $(-3, 1)$, parallel to $y = -\frac{4}{3}x - 1$
36) through $(-4, 0)$, parallel to $y = -\frac{5}{4}x + 4$
37) through $(-4, -1)$, parallel to $y = -\frac{1}{2}x + 1$
38) through $(2, 3)$, parallel to $y = \frac{5}{2}x - 1$
39) through $(-2, -1)$, parallel to $y = -\frac{1}{2}x - 2$
40) through $(-5, -4)$, parallel to $y = \frac{3}{5}x - 2$
41) through $(4, 3)$, perpendicular to $x + y = -1$
42) through $(-3, -5)$, perpendicular to $x + 2y = -4$
43) through $(5, 2)$, perpendicular to $x = 0$
44) through $(5, -1)$, perpendicular to $-5x + 2y = 10$
45) through $(-2, 5)$, perpendicular to $-x + y = -2$
46) through $(2, -3)$, perpendicular to $-2x + 5y = -10$
47) through $(4, -3)$, perpendicular to $-x + 2y = -6$
48) through $(-4, 1)$, perpendicular to $4x + 3y = -9$