1.5: More on Slope

Two lines with the same slope and different y-intercepts are parallel.
Ex. $y = 2x + 5$ and $y = 2x - 1$

Two lines whose slopes are opposite-signed reciprocals are perpendicular.
Ex. $y = \frac{1}{3}x + 5$ and $y = -3x$

Write the equation of a line which passes through $(4, 1)$ and is parallel to the line $y = 2x$.

$m = 2$

Write the equation of a line which passes through $(4, 1)$ and is perpendicular to the line $y = 2x$.

$m = -\frac{1}{2}$
Write the equation of a line which is parallel to the x-axis and passes through the point (4, 5).

$$m = 0$$

Vertical line: $$x = a$$

Write the equation of a line which is perpendicular to the x-axis and passes through the point (4, 5).

Write the equation of a line which is parallel to the line $$2x - 3y = 9$$ and passes through the point (6, -5).

$$m = \frac{3}{2}$$

Write the equation of a line which is perpendicular to the line $$5x + 4y = 20$$ and passes through the point (0, -2).
Write the equation of a line which passes through \((3, 5)\) and is **parallel** to a line with x-intercept 4 and y-intercept -4.

\[
m = 1 \\
y - 5 = 1(x - 3) \\
y = x + 2
\]

Write the equation of a line which passes through \((3, 5)\) and is **perpendicular** to a line with x-intercept 4 and y-intercept -4.

\[
m = -1 \\
y - 5 = -1(x - 3) \\
y = -x + 8
\]
Slope as a Rate of Change

To determine the rate of change, or average rate of change, between two points, we simply calculate the slope of the line between the points.

Ex. Use the graph on page 201 (shown below) to find the average rate of change in the number of active-duty gay service members discharged from the military from

a) 1997 to 1998.

\[ \frac{y_2 - y_1}{x_2 - x_1} = \frac{163}{1} = 163 \text{ more servicemembers per year} \]

b) 2002 to 2006.

\[ \frac{612 - 900}{2006 - 2002} = -\frac{288}{4} = -72 \]

72 fewer servicemembers per year
Find the average rate of change of the function \( f(x) = 5x - 7 \) from \( x_1 = 1 \) to \( x_2 = 4 \).

\[
\frac{13 - (-2)}{4 - 1} = \frac{15}{3} = 5
\]

\[f(1) = 5(1) - 7 = -2\]
\[f(4) = 5(4) - 7 = 13\]

Find the average rate of change of the function \( f(x) = x^2 - 4x + 5 \) from \( x_1 = 2 \) to \( x_2 = 5 \).

\[
\frac{10 - 1}{5 - 2} = \frac{9}{3} = 3
\]

\[f(2) = 2^2 - 4(2) + 5 = 4 - 8 + 5 = 1\]
\[f(5) = 5^2 - 4(5) + 5 = 25 - 20 + 5 = 10\]

Find the average rate of change of the function \( f(x) = x^3 + 7 \) from \( x_1 = -3 \) to \( x_2 = 2 \).

\[
\frac{15 - (-20)}{2 - (-3)} = \frac{35}{5} = 7
\]

\[f(-3) = (-3)^3 + 7 = -27 + 7 = -20\]
\[f(2) = 2^3 + 7 = 8 + 7 = 15\]
Write a linear function in slope-intercept form which models the given description. Each function should model the percentage as a function of the number of years after 1980.

\[ f(x) = mx + b \]

1) In the year 1980, 35% of the residents of a particular town had cable TV. Since then, the percentage has increased at an average rate of about 5 per year.

\[ f(x) = 5x + 35 \]

\[ m = 5; \quad b = 35 \]

2) In the year 1980, 70% of the residents of a particular town regularly attended church. Since then, the percentage has decreased at an average rate of approximately 1.8 per year.

\[ f(x) = -1.8x + 70 \]

\[ m = -1.8; \quad b = 70 \]