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5-1 Rate of Change and Slope

The diagram at the right shows a chair lift up a mountain.

1. What is the vertical and horizontal change for each section of the chair lift?

Section 1: vertical Δ 2 horizontal Δ 4

Section 2: vertical Δ 6 horizontal Δ 2

Section 3: vertical Δ 3 horizontal Δ 3

2. Now, find the ratio of the vertical change to the horizontal change for each section.

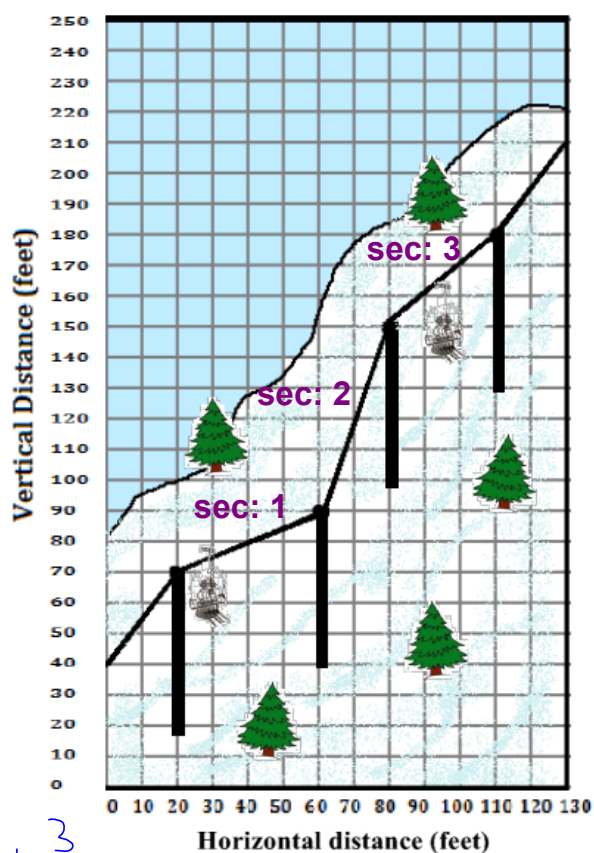
Ratio for section 1: $\frac{2}{4} = \frac{1}{2}$

Ratio for section 2: $\frac{6}{2} = 3$

Ratio for section 3: $\frac{3}{3} = 1$

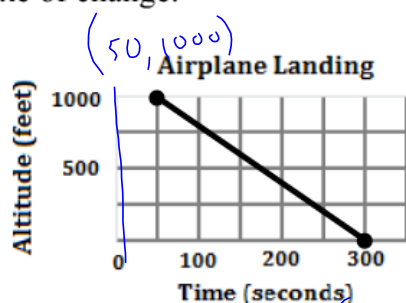
3. Now put the ratios in order from least steep to most steep. What do you notice? $\frac{1}{2}, 1, 3$

The larger the ratio, the steeper the line.



Example 1: Finding Rate of Change Using a Graph

The graph shows the altitude of an airplane as it comes in for a landing. Find the rate of change.



Step 1: **Find the vertical change.**

Step 2: **Find the horizontal change.**

Step 3: **Make a ratio. (rise over run)**

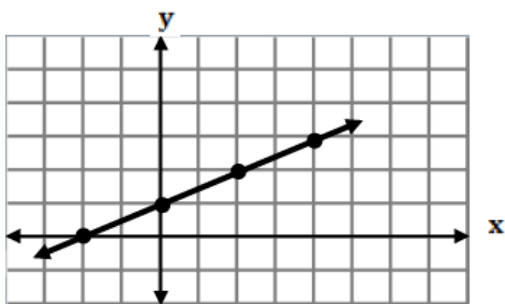
Step 4: **Reduce.**

$$\frac{\Delta \text{vert}}{\Delta \text{hor}} = \frac{-1000 \text{ ft}}{250 \text{ sec}} = -4 \text{ ft/sec}$$

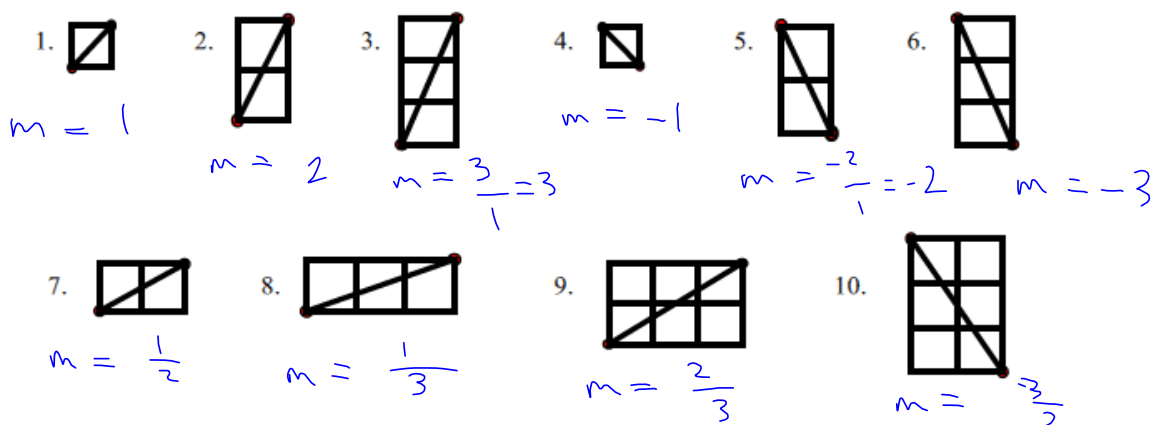
Explain what this rate of change means.

This means the plane is descending at 4 feet per second.

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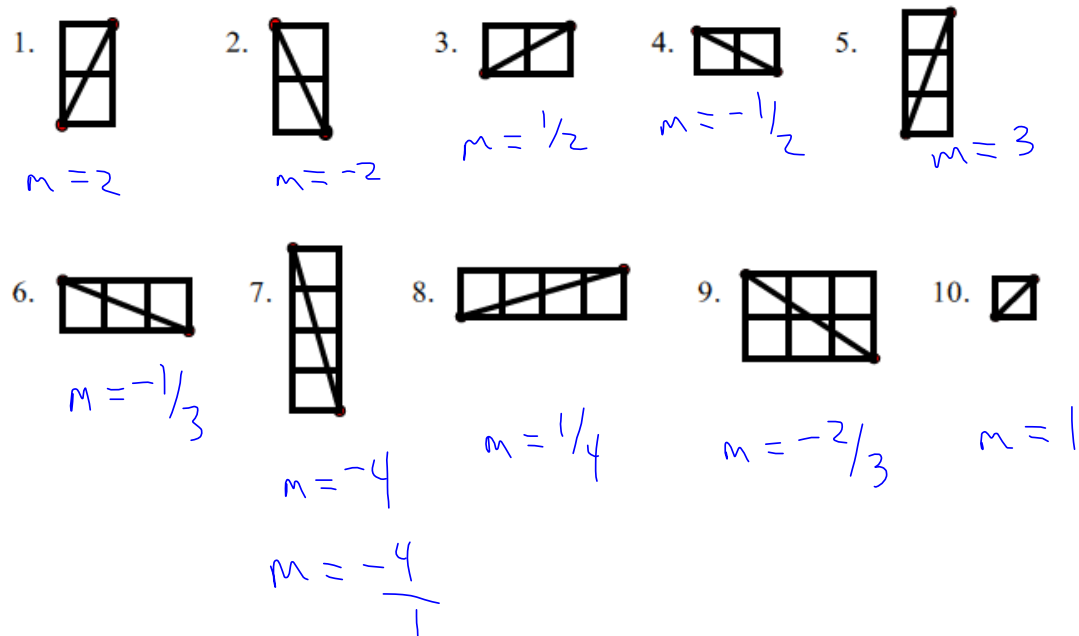
Example 2: Finding Slope Using a GraphStep 1: Locate 2 points on the line.(,) and (,)Step 2: Find rise and the run.Step 3: Make a ratio and reduce if needed.

A simple way to look at slopes:



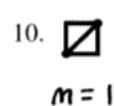
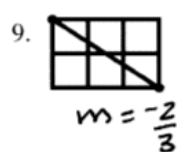
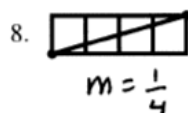
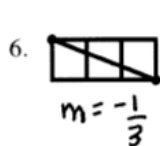
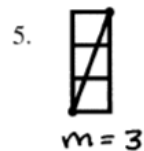
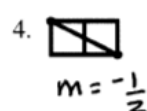
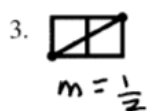
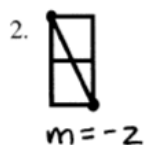
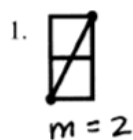
✓ Understanding Check:

Give the slope of each line



answers!

✓ Understanding Check:
Give the slope of each line



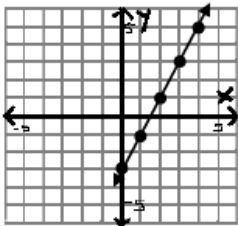
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✓ Understanding Check:
Find the slope of each line.

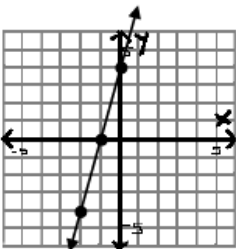
$m = -\frac{9}{3}$

1.

$m = 2$

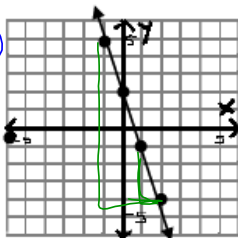


2.

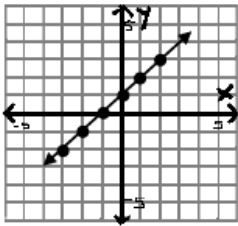


3.

$m = -3$

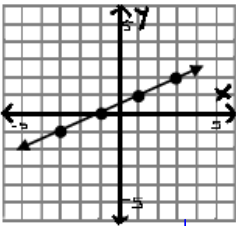


4.

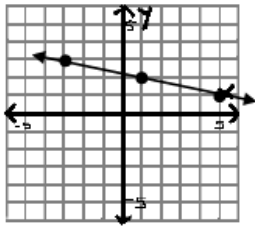


5.

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

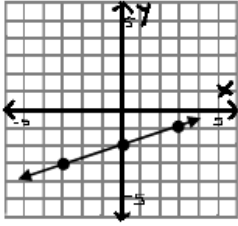


6.

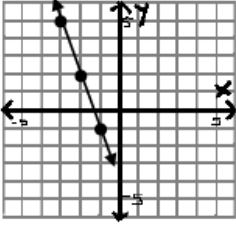


7.

$m = \frac{1}{3}$

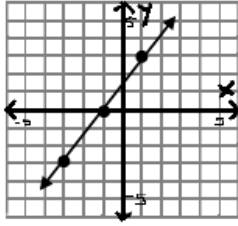


8.



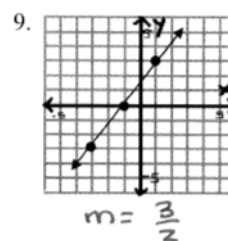
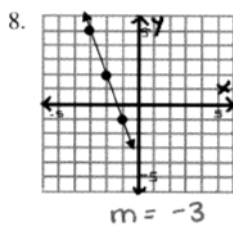
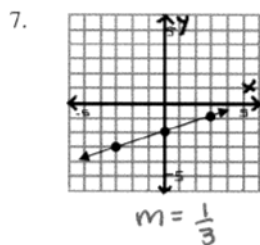
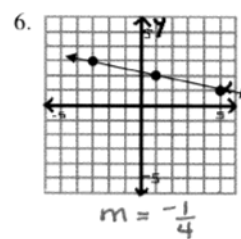
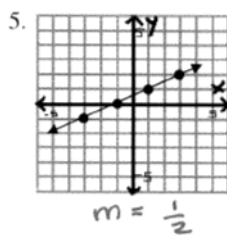
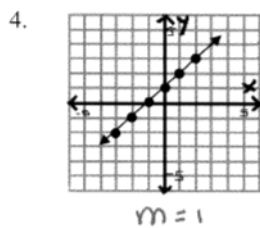
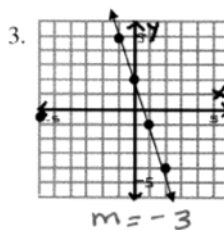
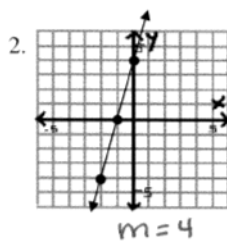
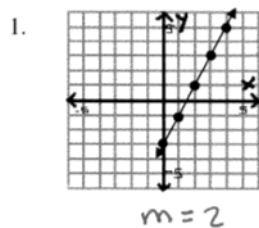
9.

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



answers

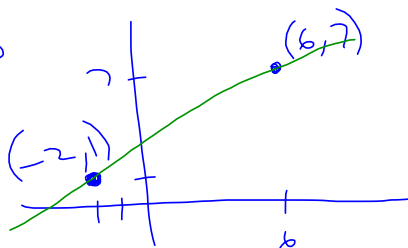
Understanding Check:
Find the slope of each line.



Example 3: Finding Slope Using Points

Can you find the slope two points without seeing the graph?

Find the slope of the line passing through $(-2, 1)$ and $(6, 7)$.



$$\frac{\Delta y}{\Delta x} = \frac{7 - 1}{6 - -2} = \frac{6}{8} = \frac{3}{4}$$

Step 1: **Subtract the y's.**

Step 2: **Subtract the x's.**

Step 3: **Make a ratio.**

Step 3: **Reduce if needed.**

$$m = \frac{y_2 - y_1}{x_2 - x_1}$$

Slope Formula

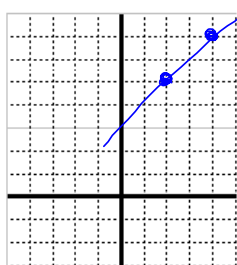
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$\text{Slope} = \frac{\text{vertical change}}{\text{horizontal change}} = \frac{\text{rise}}{\text{run}} = \frac{y_2 - y_1}{x_2 - x_1} = m$

Finding Slope From 2 Points Practice Activity

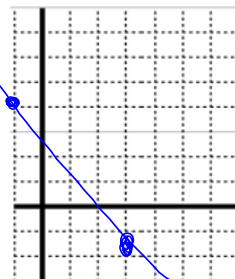
$x_1 \ y_1 \ x_2 \ y_2$
1. (2, 5) and (4, 7)

$$m = \frac{7-5}{4-2} = \frac{2}{2} = 1$$

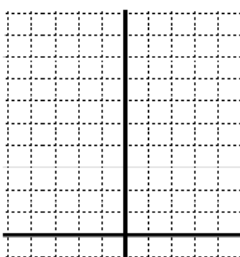


$x_1 \ y_1 \ x_2 \ y_2$
2. (-1, 4) and (3, -2)

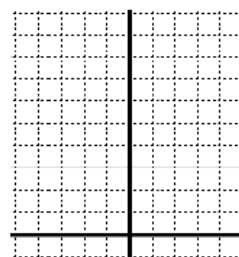
$$m = \frac{-2-4}{3-(-1)} = \frac{-6}{4} = -\frac{3}{2}$$



3. (,) and (,)

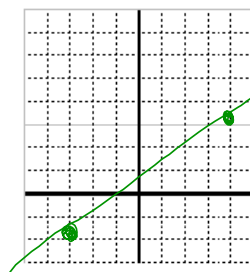


4. (,) and (,)



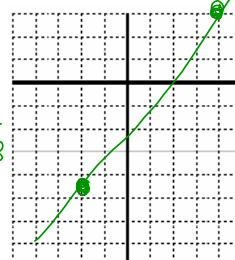
$x_1 \ y_1 \ x_2 \ y_2$
5. (-3, -2) and (4, 3)

$$m = \frac{3-(-2)}{4-(-3)} = \frac{5}{7}$$

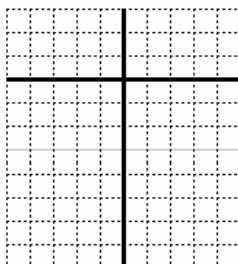


$x_2 \ y_2 \ x_1 \ y_1$
6. (-2, -5) and (4, 3)

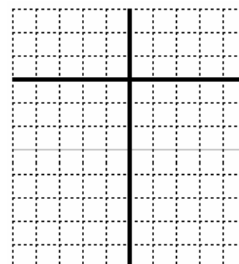
$$m = \frac{-5-3}{-2-4} = \frac{-8}{-6} = \frac{4}{3}$$



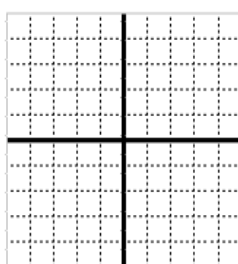
7. (,) and (,)



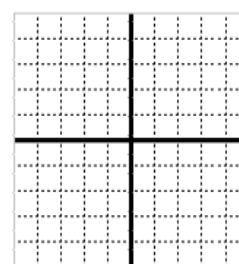
8. (,) and (,)



9. (,) and (,)



10. (,) and (,)

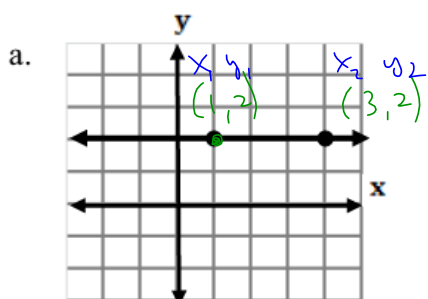


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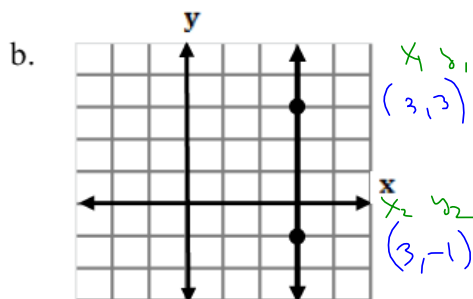
Example 4: Horizontal and Vertical Lines

Find the slope of each line.

$$m = \frac{y_2 - y_1}{x_2 - x_1}$$



$$m = \frac{2 - 2}{3 - 1} = \frac{0}{2} = 0$$



$$m = \frac{-1 - 3}{3 - 3} = \frac{-4}{0} \text{ undefined}$$

"no slope"

Find the slope of the line passing through each set of points:

* **same y values!**

a. (3, 4) and (-3, 4)

$$m = 0$$

* **same x values!**

b. (2, 3) and (2, -3)

m is undefined

* **same y values!**

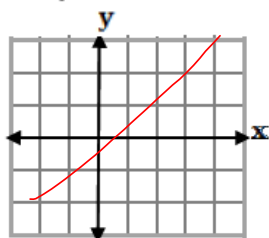
c. (5, -1) and (-3, -1)

$$m = 0$$

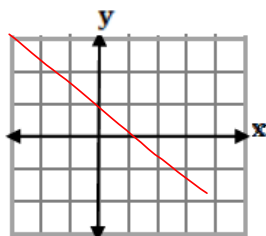
$$\frac{-1 + 1}{-3 - 5}$$



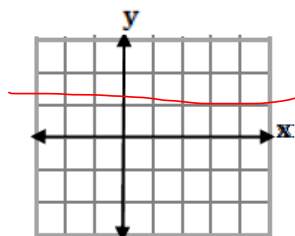
Slopes of Lines Summary



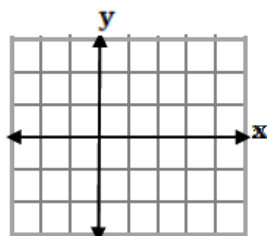
A line with positive slope
slants upward from
from left to right.



A line with negative slope
slants downward from
from left to right.



A line with a slope
of 0 is
horizontal



A line with a slope
of undef is
vertical

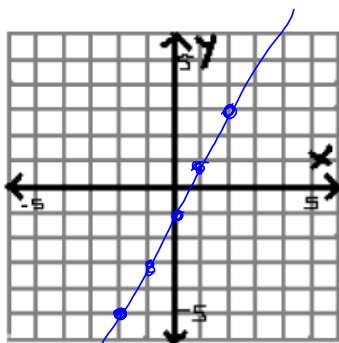
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5-2 Slope-Intercept Form

Graph the following linear equations by making a table of values for each:

a. $y = 2x - 1$

x	y
-2	-5
-1	-3
0	-1
1	1
2	3

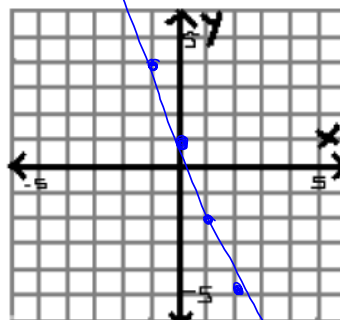


What is the slope of this line? 2

Where does this graph cross the y-axis? (0, -1)

b. $y = -3x + 1$

x	y
-2	7
-1	4
0	1
1	-2
2	-5



What is the slope of this line? -3

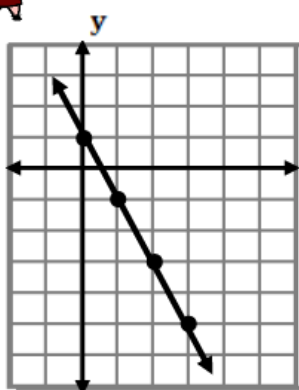
Where does this graph cross the y-axis? (0, 1)

Compare the slope of each line to its equation. Do you notice any patterns?

The slope is the same as the coefficient of x.

Compare the point where each graph crosses the y-axis to its equation. Do you notice any patterns?

The y-intercept is the same as the constant in the rule.

**Vocabulary:**

The slope of a line is its rate of change from left to right and is referred to as M .

The slope of the given graph is -2 .

The y -intercept of a line is the point at which the line crosses the y -axis and is referred to as b .

The y -intercept of the given graph is $(0, 1)$ or $b = 1$.

The slope intercept form of a linear equation is:

$$y = mx + b$$

So, the slope intercept form of the line above is:

$$y = -2x + 1$$

slope

y -int

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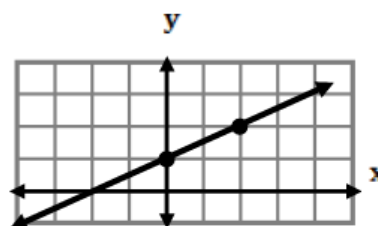
 y -int**Example 1: Writing an Equation from a Graph**

Find the equation of the line using points (0, 1) and (2, 2).

Step 1: Find the slope (m).

Step 2: Find the y-intercept (b).

Step 3: Write the $y=mx+b$ form of the line.



$$m = \frac{1}{2} \quad b = 1$$

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

✓ Understanding Check:

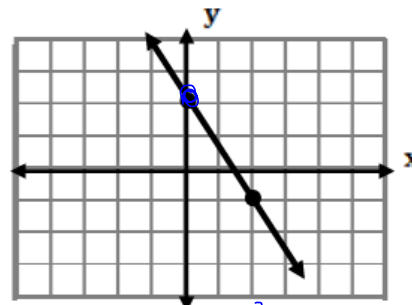
Which equation models the linear function shown in the graph?

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

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

C. $y = 2x - \frac{3}{2}$

D. $y = 2x - \frac{2}{3}$



$$m = -\frac{3}{2} \quad b = 2$$

Example 2: Identifying the Slope and y-intercept

What are the slope and
y-intercept of $y = 3x - 5$?

slope = $m = 3$

y-int. = $b = -5$

What are the slope and
y-intercept of $y = -4x + 6$?

slope = $m = -4$

y-int. = $b = 6$

Understanding Check:

Find the slope and y-intercept of each of the following lines:

a. $y = -2x + 5$

$m = -2$

$b = (0, 5)$

b. $y = 4x - 6$

$m = 4$

$b = (0, -6)$

c. $y = x + 2$

$m = 1$

$b = (0, 2)$

d. $y = -x - 4$

$m = -1$

$b = (0, -4)$

e. $y = 2x - 5$

$m = 2$

$b = (0, -5)$

$b = -5$

f. $y = \frac{7}{6}x - \frac{3}{4}$

$m = \frac{7}{6}$

$b = (0, -\frac{3}{4})$

$b = -\frac{3}{4}$

g. $y = 3x$

$m = 3$

$b = (0, 0)$

$b = 0$

*h. $y = 4$

$m = 0$

$b = (0, 4)$

$b = 4$

Understanding Check:

Find the slope and y-intercept of each of the following lines:

a. $y = -2x + 5$

$m = -2$

$b = (0, 5)$

b. $y = 4x - 6$

$m = 4$

$b = (0, -6)$

c. $y = x + 2$

$m = 1$

$b = (0, 2)$

d. $y = -x - 4$

$m = -1$

$b = (0, -4)$

e. $y = 2x - 5$

$m = 2$

$b = (0, -5)$

f. $y = \frac{7}{6}x - \frac{3}{4}$

$m = \frac{7}{6}$

$b = (0, -\frac{3}{4})$

g. $y = 3x$

$m = 3$

$b = (0, 0)$

h. $y = 4$

$m = 0$

$b = (0, 4)$

Example 3: Writing an Equation

Write an equation of the line with slope $=\frac{3}{8}$ and y-intercept 6.

$$y = \frac{3}{8}x + 6$$

✓ Understanding Check:

Write an equation of the line with:

a. slope $=\frac{2}{5}$ and y-intercept (0, -1)

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

b. slope = -2 and y-intercept (0, 4)

$$y = -2x + 4$$

c. slope = 6 and y-intercept (0, -8)

$$y = 6x - 8$$

d. slope = -1 and y-intercept (0, 2)

$$y = -1x + 2$$

✓ Understanding Check:

Write an equation of the line with:

a. slope $=\frac{2}{5}$ and y-intercept (0, -1)

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

b. slope = -2 and y-intercept (0, 4)

$$y = -2x + 4$$

c. slope = 6 and y-intercept (0, -8)

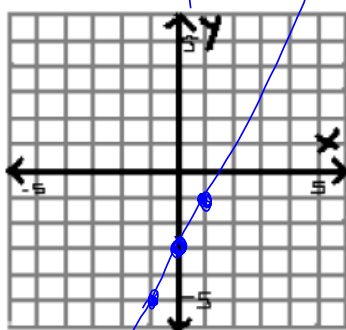
$$y = 6x - 8$$

d. slope = -1 and y-intercept (0, 2)

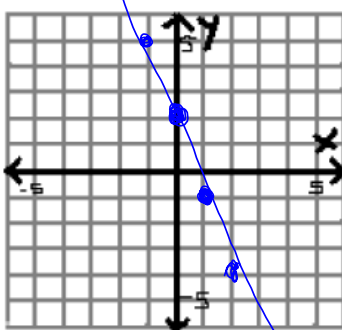
$$y = -x + 2$$

Example 4: Graphing Equations from the Slope-Intercept Form of the LineStep 1: Locate and plot the y-int.Step 2: Write slope as a ratioStep 3: count the slope to the rightStep 4: , then lefta. Graph $y = 2x - 3$

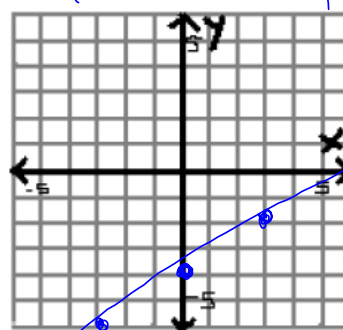
$$m = 2 = \frac{2}{1} \quad b = -3$$

b. Graph $y = -3x + 2$

$$m = -3 \quad b = 2$$

c. Graph $y = \frac{2}{3}x - 4$

$$m = \frac{2}{3} \quad b = -4$$

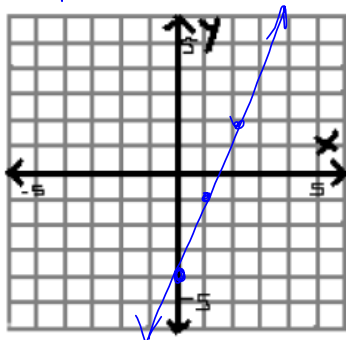
Important Reminder!

✓ Understanding Check:

Graph each equation using the slope and y-intercept. (Show all steps on each graph)

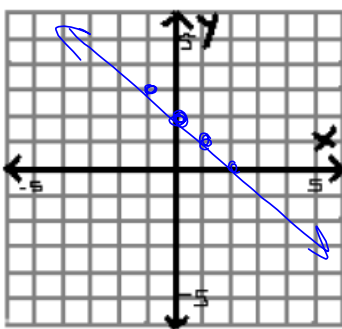
a. $y = 3x - 4$

$m = 3$ $b = -4$



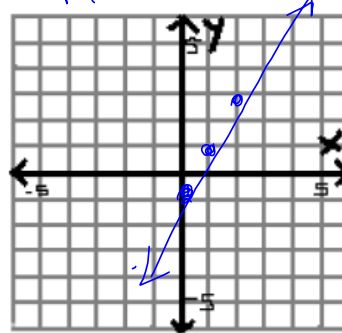
b. $y = -x + 2$

$m = -1$ $b = 2$

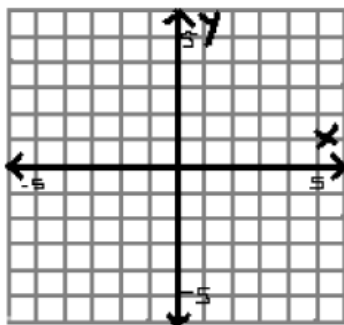


c. $y = 2x - 1$

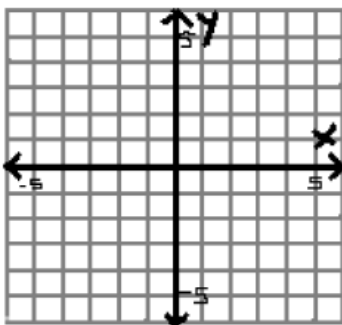
$m = 2$ $b = -1$



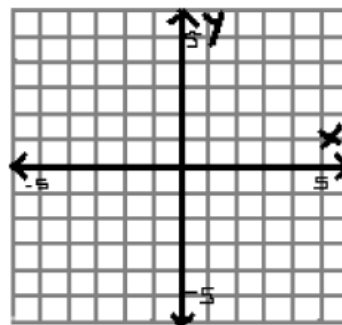
d. $y = x - 3$



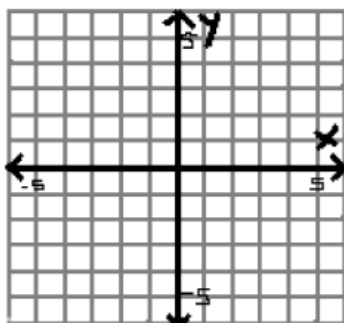
e. $y = -x + 5$



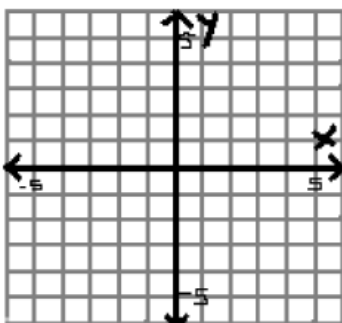
f. $y = -3x + 2$



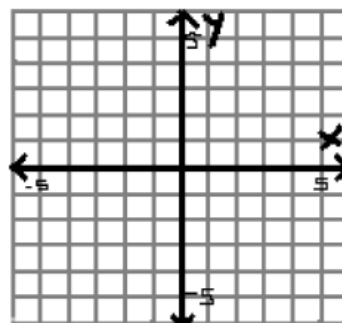
g. $y = \frac{3}{4}x - 2$



h. $y = -x - 5$



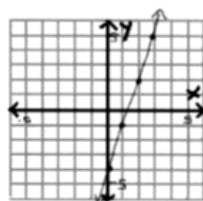
i. $y = \frac{1}{2}x + 1$



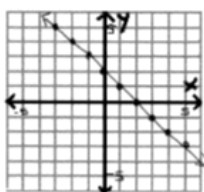
✓ Understanding Check:

Graph each equation using the slope and y-intercept. (Show all steps on each graph)

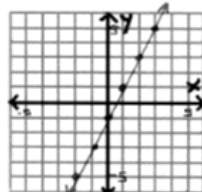
a. $y = 3x - 4$



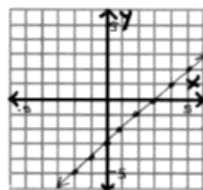
b. $y = -x + 2$



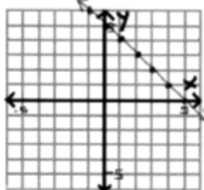
c. $y = 2x - 1$



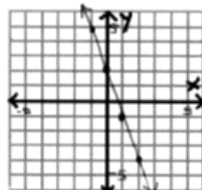
d. $y = x - 3$



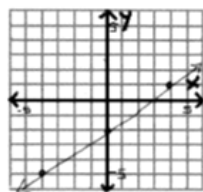
e. $y = -x + 5$



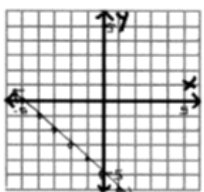
f. $y = -3x + 2$



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



h. $y = -x - 5$



i. $y = \frac{1}{2}x + 1$

