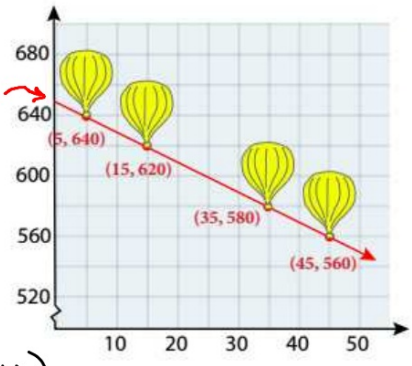
Name _____

5-4 Point-Slope Form

OBJECTIVE: I can write and graph linear equations using point-slope form

Warm-Up

The red line shows the altitude of a hot-air balloon during its linear descent. What is an equation of the line in slope-intercept form? (Hint: What is the altitude of the balloon when it starts its descent at x = 0 ?)



① Find the slope (5, 640) (15, 620)
x_1 y_1 x_2 y_2

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

$$m = \frac{620 - 640}{15 - 5}$$

$$m = \frac{-20}{10}$$

$$\boxed{m = -2}$$

slope

② Find the y-intercept (5, 640)

$$y = mx + b$$

$$(640) = -2(5) + b$$

$$640 = -10 + b$$

$+10 \quad +10$

$$\boxed{650 = b}$$

y-intercept

③ Write the equation

$$y = -2x + 650$$

m b

Essential Understanding

Essential Understanding You can use the slope of a line and any point on the line to write and graph an equation of the line. Any two equations for the same line are equivalent.

Key Concept:

Definition

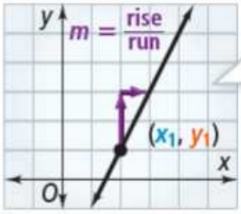
The **point-slope form** of an equation of a nonvertical line with slope m and through point (x_1, y_1) is $y - y_1 = m(x - x_1)$.

Symbols

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

↑ y-coordinate ↑ slope ↑ x-coordinate

Graph



When you use $y - y_1 = m(x - x_1)$, (x_1, y_1) represents a *specific* point and (x, y) represents *any* point.

Example #1 Writing an Equation in Point-Slope Form

Here's Why It Works Given a point (x_1, y_1) on a line and the line's slope m, you can use the definition of slope to derive point-slope form.

$\frac{y_2 - y_1}{x_2 - x_1} = m$	Use the definition of slope.
$\frac{y - y_1}{x - x_1} = m$	Let (x, y) be any point on the line. Substitute (x, y) for (x_2, y_2).
$\frac{y - y_1}{x - x_1} \cdot (x - x_1) = m(x - x_1)$	Multiply each side by $(x - x_1)$.
$y - y_1 = m(x - x_1)$	Simplify the left side of the equation.

A line passes through (3, 6) and has slope 5. What is an equation of the line?

x_1 y_1 m

$$y - y_1 = m(x - x_1)$$
$$y - y_1 = m(x - 3) \quad \leftarrow \text{Insert } x_1$$
$$y - 6 = m(x - 3) \quad \leftarrow \text{Insert } y_1$$
$$y - 6 = 5(x - 3) \quad \leftarrow \text{Insert slope } (m)$$

Your Turn to Work it Out

1. A line passes through $(8, -4)$ and has slope $\frac{2}{3}$. What is an equation in point-slope form of the line?

x_1 y_1 m

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

$$y - (-4) = \frac{2}{3}(x - 8)$$

$$\updownarrow$$

$$y + 4 = \frac{2}{3}(x - 8)$$

Example #2 Graphing Using Point-Slope Form

What is the graph of the equation $y - 1 = \frac{2}{3}(x - 2)$?

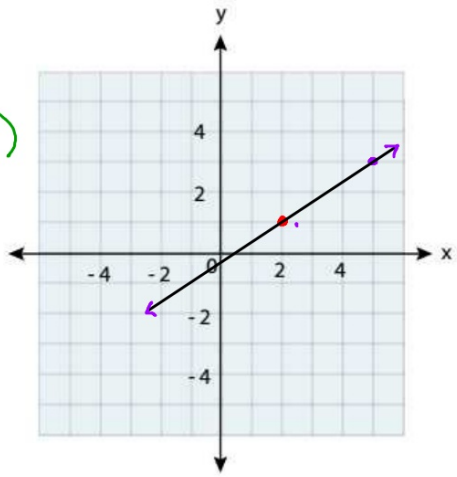
$x_1 = 2$

$y_1 = 1$

Negative (Values of points are +)

Negative

$(2, 1)$ this is your starting point



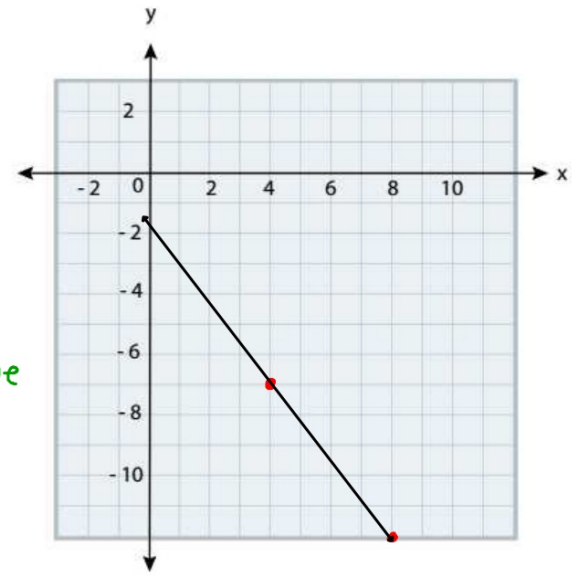
Your Turn to Work it Out

2. What is the graph of the equation $y + 7 = -\frac{4}{5}(x - 4)$?

$x_1 = 4$

$y_1 = -7$

+ ↗ ↓ −7

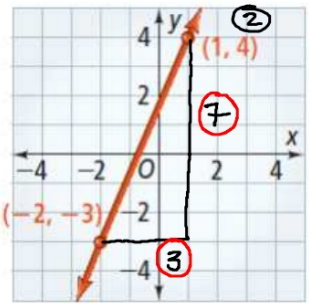


Hint

Keep the template in mind.
If y_1 or x_1 are positive, the negative value is the one you use.

Example #3 Using Two Points to Write an Equation

What is an equation of the line at the right?



Hint

If graph is given, use it to see the slope

Find the slope m

$$m = \frac{7}{3}$$

$(-2, -3)$

① $y - y_1 = m(x - x_1)$

$y - y_1 = \frac{7}{3}(x - x_1)$

$y - (-3) = \frac{7}{3}(x - (-2))$

$y + 3 = \frac{7}{3}(x + 2)$

$(1, 4)$

② $y - y_1 = m(x - x_1)$

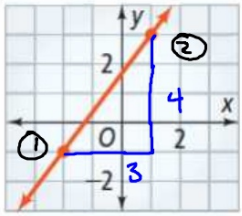
$y - y_1 = \frac{7}{3}(x - x_1)$

$y - 4 = \frac{7}{3}(x - 1)$

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

Your Turn to Work it Out

3. Write an equation of the line from the graph at right.



Point 1
$(-2, -1)$

$m = \frac{4}{3}$

Point 2
$(1, 3)$

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

$y - (-1) = \frac{4}{3}(x - (-2))$

$y + 1 = \frac{4}{3}(x + 2)$

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

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

You can use any point that lies on the graph as they too would be correct equations.