## Writing Linear Equations

$$
\text { slope }=\frac{\text { vertical change }}{\text { horizontal change }} \text { or } \frac{\text { rise }}{\text { run }}
$$

The steepness of the line is the ratio of rise to run, or vertical change to horizontal change, for this step. We call this ratio the slope of the line. Slope is also known as the rate of change.

## Line With Positive Slope

## 




Line With Negative Slope




## Zero slope

If the line is horizontal, the slope is zero.


## Undefined slope

If the line is vertical, the slope is undefined.

Positive Slope from a Table

| $x$ | 2 | 5 |
| :--- | :--- | :--- |
| $y$ | 2 | 4 |


| $\boldsymbol{x}$ | -6 | -4 | -2 | 0 | 2 | 4 |
| ---: | ---: | ---: | ---: | ---: | ---: | ---: |
| $\boldsymbol{y}$ | -10 | -7 | -4 | -1 | 2 | 5 |

Squeaky Clean Car Wash Charges

| Tlme (min) | 5 | 10 | 15 | 20 | 25 |
| :--- | :---: | :---: | :---: | :---: | :---: |
| Charge | $\$ 8$ | $\$ 13$ | $\$ 18$ | $\$ 23$ | $\$ 28$ |


| $\boldsymbol{x}$ | $\boldsymbol{y}$ |
| :--- | :--- |
| -4 | -4 |
| -2 | 0 |
| 0 | 4 |
| 2 | 8 |

## Negative Slope from a Table

| $x$ | 1 | 4 |
| :--- | :--- | :--- |
| $y$ | 4 | 2 |$\quad |$| $x$ | 1 | 2 | 3 | 4 | 5 | 6 |
| :--- | :--- | :--- | :--- | :--- | :--- | :--- |
| $y$ | 4.5 | 4.0 | 3.5 | 3.0 | 2.5 | 2.0 |


| $\boldsymbol{x}$ | $\boldsymbol{y}$ |
| :---: | :---: |
| 5 | 50 |
| 10 | 40 |
| 15 | 30 |
| 20 | 20 |


| $\boldsymbol{X}$ | $\boldsymbol{Y}$ |
| :---: | :---: |
| $\mathbf{4}$ | -10 |
| $\mathbf{5}$ | -13 |
| $\mathbf{6}$ | -16 |
| $\mathbf{7}$ | -19 |
| $\mathbf{8}$ | -22 |

Find the slope of each line that passes through each pair of points

1. $A(3,5)$ and $B(-2,10)$ 2. $A(2,-1)$ and $B(3,2)$
2. $C(-1,2)$ and $D(1,1)$
3. $J(-4,8), \quad K(-4,4)$
4. $P(5,-7), Q(-2,-7)$




The Ant and the Sugar
A scout ant discovers that sugar has been spilled on Karen's kitchen countertop. The ant marks a straight line trail from the sugar back to the hole in the wall where ants can crawl directly onto the countertop. The sugar is 8 feet from the hole in the wall. The graph and table below describe the movement of the Ant along a path that is a straight line.


1. How far did the ant travel in 20 seconds?
2. Does the graph represent the path that the ant took during the first 20 seconds?
3. What is the Ant's average speed for the time interval $0 \leq t \leq 10$. Include units.
4. What is the Ant's average speed for the time interval $10 \leq t \leq 20$. Include units.
5. Is the Ant's average speed increasing, decreasing, or constant.

A scout ant discovers that sugar has been spilled on Karen's kitchen countertop. The ant marks a straight line trail from the sugar back to the hole in the wall where ants can crawl directly onto the countertop. The sugar is 8 feet from the hole in the wall. The graph and table below describe the movement of the Ant along a path that is a straight line.


|  |  |
| :--- | :--- |
| $t$ | $d(t)$ |
| 0 | 0 |
| 4 | 5 |
| 6 | 5 |
| 10 | 8 |
| 14 | 8 |
| 16 | 4 |
| 18 | 0 |

1. What is the Ant's average speed for the time interval $0 \leq t \leq 18$. Include units.
2. What is the Ant's average speed for the time interval $0 \leq t \leq 5$. Include units.
3. What is the Ant's average speed for the time interval $0 \leq t \leq 10$. Include units.
4. What is the Ant's average speed for the time interval $6 \leq t \leq 8$. Include units.
5. What is the Ant's average speed for the time interval $6 \leq t \leq 14$. Include units.
6. What is the Ant's average speed for the time interval $14 \leq t \leq 18$. Include units.
7. According to the graph when was the Ant moving the fastest?
8. According to the graph when was the Ant moving the slowest?

Using the table, find the average rate of change over the following intervals.

| $x$ | $f(x)$ |
| :---: | :---: |
| 0 | 5 |
| 1 | 1 |
| 2 | -3 |
| 3 | -7 |
| 4 | -11 |

a) from $x=0$ to $x=2$
b) from $x=1$ to $x=4$
c) from $x=3$ to $x=4$

Use the equations below to find the average rate of change on the given intervals

1. $\mathrm{y}=4 \mathrm{x}+3$
a) $\quad \mathrm{x}=0$ to $\mathrm{x}=2$
b) $x=1$ to $x=4$
c) $x=-5$ to $x=-1$
2. $y=\frac{-2}{3} x+1$
a) $x=0$ to $x=2$
b) $x=1$ to $x=4$
c) $x=-5$ to $x=-1$

## Finding the $y$-intercept of a line

The $y$-intercept is the $y$-coordinate of the point where a line crosses the $y$-axis, it's also the initial value when $x=0$.




Determining the $y$-intercept of a table
a.

| $\boldsymbol{x}$ | -6 | -4 | -2 | 0 | 2 | 4 |
| ---: | ---: | ---: | ---: | ---: | ---: | ---: |
| $\boldsymbol{y}$ | -10 | -7 | -4 | -1 | 2 | 5 |

b.

| $x$ | 1 | 2 | 3 | 4 | 5 | 6 |
| :--- | :--- | :--- | :--- | :--- | :--- | :--- |
| $y$ | 4.5 | 4.0 | 3.5 | 3.0 | 2.5 | 2.0 |

c.

| $\boldsymbol{x}$ | $\boldsymbol{y}$ |
| :--- | :--- |
| -4 | -4 |
| -2 | 0 |
| 0 | 4 |
| 2 | 8 |

Squeaky Clean Car Wash Charges

| Time (min) | 5 | 10 | 15 | 20 | 25 |
| :--- | :---: | :---: | :---: | :---: | :---: |
| Charge | $\$ 8$ | $\$ 13$ | $\$ 18$ | $\$ 23$ | $\$ 28$ |


| $\boldsymbol{x}$ | $\boldsymbol{y}$ |
| :---: | :---: |
| 5 | 50 |
| 10 | 40 |
| 15 | 30 |
| 20 | 20 |

## Example 3: Slope-Intercept Form of Linear Equations:

$\boldsymbol{y}=\boldsymbol{m} \boldsymbol{x}+\boldsymbol{b} \quad$ ( $m$ stands for slope and $b$ stands for $y$-intercept)

1. $y=4 x+7$
slope $\qquad$ $y$-intercept $\qquad$
2. $y=3 x-8$
slope $\qquad$ $y$-intercept $\qquad$
3. $y=6-7 x$
slope $\qquad$ $y$-intercept $\qquad$
4. $y=10 x$
slope $\qquad$ $y$-intercept $\qquad$
5. $y=12$
slope $\qquad$ $y$-intercept $\qquad$
6. Given slope of $\frac{2}{9}$ and the $y$-intercept is 3 .
7. Given slope of 0 and the $y$-intercept is 1 .
8. Given $m=-1$ and $b=-6$. $\qquad$
9. Given $m=-\frac{2}{3}$ and $b=5$.
10. Given $m=-4$ and the $y$-intercept is $(0,2)$.
11. Given slope of 0.4 and $b=0.6$

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Graph the linear equations: (Hint: identify the slope and $y$-intercept)

1. Graph: $y=\frac{1}{3} x-2$.

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

3. Graph: $y=-x+5$.

4. $y=3 x-1$


## Graphing Equations by Making Tables:

1. Erika is assigned to graph the line of the equation $y=2 x-3$.

Use Erika's equation to complete the table below for the given values of $x$.

| $x$ | $y$ |
| ---: | ---: |
| -1 |  |
| 1 |  |
| 3 |  |


2.

Ken used the function rule below to create a number pattern.

$$
y=2 x+2
$$

Complete the table below using Ken's function rule.

| $x$ | $y$ |
| :---: | :---: |
| -4 |  |
| -2 |  |
| 0 |  |
| 1 |  |
| 3 |  |



## Writing Linear Equations

Use the graph to determine the linear equation.

3.

2.

4.


Use the table to determine the linear equation in slope-intercept form.
1.

| $x$ | $y$ |
| :---: | :---: |
| -6 | -8 |
| -2 | 0 |
| 2 | 8 |


| $x$ | $y$ |
| :---: | :---: |
| -2 | -7 |
| -1 | -3 |
| 0 | 1 |
| 1 | 5 |

## Writing Equations based on a point and slope:

Use the information provided to determine the linear equation in slope-intercept form.

1. Given $m=-\frac{1}{4}$ and the point $(-4,2)$.

2. Given $m=\frac{3}{2}$ and the point $(-2,0)$.

3. Given $m=2$ and the point $(-4,-5)$.


## Writing Equations based on 2 points:

1. Graph a line that goes through the following 2 points, $(-3,2),(3,-2)$ and write the equation.

2. Graph a line that goes through the following 2 points, $(-4,-5),(-3,-3)$ and write the equation.


Finding Equations in point slope and slope intercept form Given 2 Points:
Use the information below to write a linear equation.
A. $(5,3) \&(4,5)$
B. $(6,-4) \&(-3,5)$

Use the information below to write a linear equation.
A. $(2,7) \&(1,-4)$
B. $(6,-3) \&(-2,-3)$

Graph each pair of lines on the same coordinate plane. Make sure you list the slope of each line.

1. $y=\frac{-1}{3} x-2$ and $y=\frac{-1}{3} x-4$
2. $y=\frac{1}{4} x-2$ and $y=\frac{1}{4} x+1$
3. $y=x+2$ and $y=x-5$



4. $y=\frac{-1}{3} x-2$ and $y=3 x-4 \quad$ 2. Graph $y=\frac{1}{4} x-2$ and $y=-4 x+1$
5. $y=-x+2$ and $y=x-5$




Write in point-slope form the equation of the line that is parallel to the given line and passes through the given point. Your final answer should be in slope-intercept form.

1. $y=x+5,(-1,-1)$
2. $y=-3 x+1,(2,4)$
$\qquad$
$\mathrm{m}=$
$m=$ $\qquad$
3. $y=\frac{1}{4} x-6,(3,3)$
$\mathrm{m}=$ $\qquad$
point $\qquad$ point $\qquad$ point $\qquad$
point-slope: $\qquad$ point-slope: $\qquad$ point-slope: $\qquad$

Write in point-slope form the equation of the line that is perpendicular to the given line and passes through the given point. Your final answer should be in slope-intercept form.

1. $y=2 x+5,(-1,-1)$
2. $y=-3 x+1,(2,4)$
3. $y=\frac{1}{4} x-6,(3,3)$
$\mathrm{m}=$ $\qquad$
$\mathrm{m}=$ $\qquad$
$\mathrm{m}=$ $\qquad$
point $\qquad$ point $\qquad$ point $\qquad$
point-slope: $\qquad$ point-slope: $\qquad$ point-slope: $\qquad$

Write in point-slope form the equation of the line that is parallel to the given line and passes through the given point. Your final answer should be in slope-intercept form.

1. $2 x+y=4,(-1,-1)$
2. $-3 x+2 y=6,(2,4)$
3. $5 x-2 y=10,(3,3)$
$\mathrm{m}=$ $\qquad$ $\mathrm{m}=$ $\qquad$
point $\qquad$ point $\qquad$ point $\qquad$
$\qquad$ point-slope: $\qquad$ point-slope: $\qquad$

Write in point-slope form the equation of the line that is perpendicular to the given line and passes through the given point. Your final answer should be in slope-intercept form.

1. $2 x+y=4,(-1,-1)$
2. $-3 x+2 y=6,(2,4)$
3. $5 x-2 y=10,(3,3)$
$\mathrm{m}=$ $\qquad$ $\mathrm{m}=$ $\qquad$ $\mathrm{m}=$ $\qquad$
point $\qquad$ point $\qquad$ point $\qquad$
point-slope: $\qquad$ point-slope: $\qquad$ point-slope: $\qquad$
