Math-2
Lesson 3-1

## Equations of Lines

How can an equation "make" a line?

$$
y=x+1
$$

Fill in the rest of the table

| $x$ | rule | $f(x)$ |
| :---: | :---: | :---: |
| -4 | $-4+1$ | -3 |
| -3 | $-3+1$ | -2 |
| -2 | $-2+1$ | -1 |
| -1 | $-1+1$ | 0 |
| 0 | $0+1$ | 1 |
| 1 | $1+1$ | 2 |
| 2 | $2+1$ | 3 |
| 3 | $3+1$ | 4 |

Graph the
$x-y$ pairs

$y=x+1 \quad$ So far we've picked on "integer" values for ' $x$ '. We can also pick rational numbers between the integers.

Fill in the rest of the table

| $x$ | $y$ |
| :---: | :--- |
| -2.5 | -1.5 |
| -1.5 | -0.5 |
| -0.5 | 0.5 |
| 0.5 | 1.5 |
| 1.5 | 2.5 |
| 2.5 | 3.5 |

Graph the new $x-y$ pairs on the same graph.


$$
y=x+1
$$

## So far, we've used integers and \#'s halfway in between.

How many numbers are there between any 2 integers?.
What would happen to our graph if we used every possible value of ' $x$ ' as an input value into the function?

More and more points are plotted.


> Slope Intercept Form: An equation of the form $y=m x+b$. Where $m=$ slope and $b=y$ intercept.

Y-intercept: The y-coordinate of a point where the graph intersects the $y$-axis. The $x$-coordinate of the $y$-intercept will always equal zero. ( $0, \mathrm{y}$ )
$x$-intercept: The $x$-coordinate of a point where the graph intersects the $x$-axis. The $y$-coordinate of the $x$-intercept will always equal zero. ( $x, 0$ )

1. What are the coordinates [(x,y) pair] of the $x$-intercept?
2. What are the coordinates $[(x, y)$ pair] of the $y$-intercept?
3. What is the $y$-coordinate of the $x$-intercept?
4. What is the $x$-coordinate of the $y$-intercept?


Key Point


Standard form of a linear equation: An equation Of the form: $A x+B y=C . \quad$ Example: $3 x+4 y=12$

Graphing Standard form equations.


## Graph the lines.



$\begin{array}{ll}\text { Slope } & y=-2 x-1 \\ & y=m x+b\end{array}$

$$
m=-2 \quad m=-2
$$

$$
m=\frac{\text { rise }}{\text { run }}=\frac{-2}{1}
$$

What is the equation of the line?

$y=m x+b$
y-intercept: (0, -4)

$$
y=m x-4
$$

Rise $=+3$
Run $=1$
$m=\frac{\text { rise }}{\text { run }}=\frac{3}{1}$


$$
y=m x+b
$$

$y$-intercept: $(0,3)$

$$
y=m x+3
$$

Rise $=-2$
Run $=+1$

$$
m=\frac{\text { rise }}{\text { run }}=\frac{-2}{1}
$$

Find the equation of a that passes through 2 points.

## $(-2,3)$ and (4, -3)


negative slope!
Rise $=-6$
Run $=6$
$m=\frac{\text { rise }}{\text { run }}=\frac{-6}{6}=-1$
$y=(-1) x+b$

Pick either point and substitute for x and y in the equation:

$$
(3)=(-1)(-2)+b
$$

Solve for 'b' (the y-intercept)

$$
\begin{aligned}
& (3)=2+b \\
& -2-2 \\
& 1=b \\
& y=-x+1
\end{aligned}
$$

Find the equation of a that passes through 2 points.
$(3,-1)$ and $(-2,2)$

negative slope!

$$
\begin{aligned}
& \text { Rise }=-3 \\
& \text { Run }=5 \\
& m=\frac{\text { rise }}{\text { run }}=\frac{-3}{5} \\
& y=\frac{-3}{5} x+b
\end{aligned}
$$

Pick either point and substitute for x and y in the equation:

$$
\text { (3) }=\frac{-3}{5}(-1)+b
$$

Solve for 'b' (the y-intercept)

$$
\begin{array}{lc}
3=\frac{3}{5}+b & 12=5 b \\
{ }^{*} 5{ }^{*} 5 & \div 5 \quad 12 / 5=b \\
15=5\left(\frac{3}{5}+b\right) & y=\frac{-3}{5} x+\frac{12}{5} \\
15=3+5 b & \\
-3-3 & \text { Do not give the slope or } y- \\
\text { intercept in decimal form. }
\end{array}
$$

What is the slope and $y$-intercept of the following equation?

$$
\begin{aligned}
2 x-3 y=6 & \text { Convert the following equation } \\
+3 y+3 y & \text { to "slope intercept form" }
\end{aligned}
$$

$$
2 x=3 y+6
$$

$$
-6-6
$$

Slope: 2/3 y-int: (0, -2)

$$
2 x-6=3 y
$$

$$
\div 3 \div 3
$$

2

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

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

Re-write slope intercept form as standard form

$$
\begin{array}{cc}
y=2 x+2 & \text { Slope-intercept } \rightarrow \text { standard form } \\
-2 x \quad-2 x & y-4=2(x-1) \\
-2 x+y=2 & y-4=2 x-2 \\
& -2 x \quad-2 x \\
y=\frac{2}{3} x-1 & -2 x+y-4=-2 \\
& +4 \quad+4 \\
& -2 x+y=2
\end{array}
$$

What is the name of this form of equation? $y=2 x+2$ Slope intercept form

$$
y=m x+b
$$

How can you recognize this form? (4 things)
$Y$ is a function of $x$ ( $y$ is all by itself)
There are no parentheses
There are two variables
The exponents of the variables are one.

What is the name of this form of equation? $2 x+3 y=6$
Standard form
$a x+b y=c$
How can you recognize this form? (4 things)

Constant value is all by itself
There are no parentheses
There are two variables
The exponents of the variables are one.

## Parallel lines do not intersect each other.

Which line is parallel to the line: $y=1$ ?

Is the red line parallel?
Is the green line parallel?
Is the yellow line parallel?
Is the orange line parallel?
Is the black line parallel? yes


How can you tell if the graphed lines are parallel?
Does the y-intercept help to make lines parallel? no

## Parallel $\rightarrow$ same slope $\quad y=m x+b$

Write the equation of a line that is parallel to the line $y=2 x+1$ and passes through the point $(0,4)$
Slope $=2$
$y$-intercept $=4$
$y=2 x+4$

Write the equation of a line that is parallel to the line $y=3 x-4$ and passes through the point $(3,8)$

$$
\begin{aligned}
& \text { Slope }=3 \quad y \text {-intercept }=? ? \quad y=3 x+b \\
& (8)=3(3)+b \quad 8=9+b \quad b=-1 \quad y=3 x-1
\end{aligned}
$$

## slopes of perpendicular lines are

1. reciprocals of each other.
2. opposite signs (+/-) of each other. Is the slope positive or negative?

Negative slope


What two things do we know about the slopes of perpendicular lines?

The slopes are reciprocals of each other.
The slopes have opposite signs of each other.
The slopes of perpendicular lines are negative reciprocals of each other.

What is the slope a line that is perpendicular to each of the following?

$$
\begin{gathered}
y=2 x+1 \\
y=-\frac{3}{2} x-4
\end{gathered}
$$

$$
y=\frac{5}{9} x+2
$$

$$
y=-\frac{1}{6} x-7
$$

Find the slope intercept form of a line that is perpendicular to the line:

$$
y=2 x-6 \text { and passes through the point }(0,1)
$$

Find the slope intercept form of a line that is perpendicular to the line:

$$
y=\frac{1}{5} x-8 \quad \text { and passes through the point }(5,2)
$$

