Patterns and Equations

This lesson looks at creating NEXT LEVEL equations for rules of input/output tables.

Input/output tables are also known as **Table of Values**.

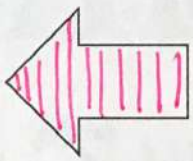
When asked to "write an equation" we should keep in mind a few things...

"write an equation"

An algebraic equation can either start as:

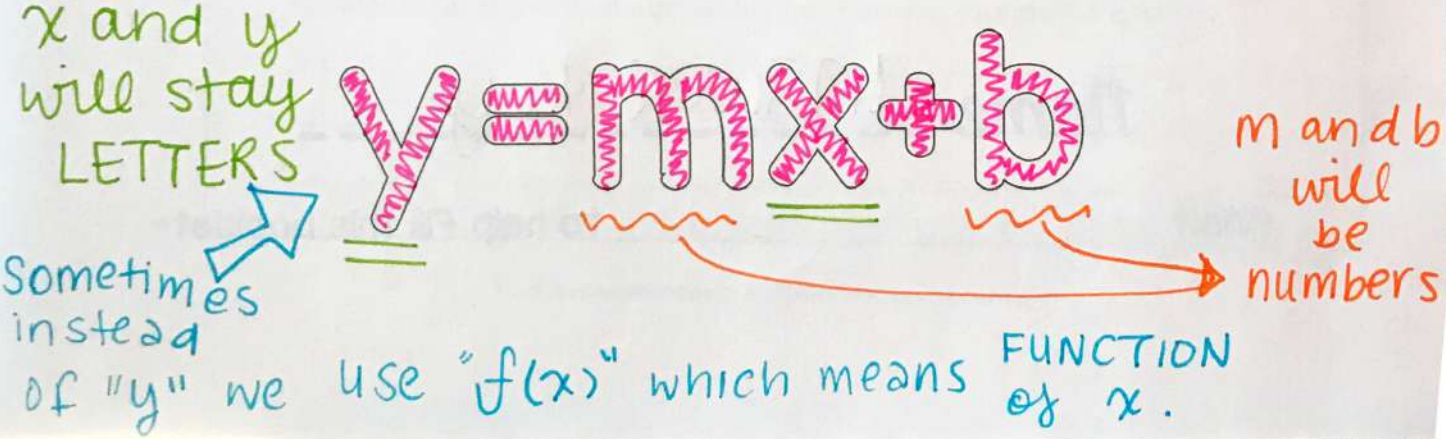
X= _____

Y=_____



we start with $y =$

Our linear relation equation will always follow the pattern:



y=mx+b

In your linear relation equation, "y" and "x" will always stay as variables (letters). You will have to find the numbers that "m" and "b" are...

Finding "m"

Your "m" will always be the pattern you find with your "y" values:

x	y	
2	20	
4	40	+20
6	60	+20
8	80	+20
10	100	+20
12	120	+20

$y = \boxed{20}x + b$

x	y	
5	8	
6	9	+1
7	10	+1
8	11	+1
9	12	
10	13	

$y = \boxed{+1}x + b$

x	y	
-2	11	
-1	21	+10
0	31	+10
1	41	
2	51	
3	61	

$y = \boxed{10}x + b$

★ Notice all patterns are going Down ↓

x	y	
-2	10	
-1	11	+1
0	12	+1
1	13	
2	14	
3	15	

$y = \boxed{1}x + b$

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

$y = \boxed{+2}x + b$

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

$y = \boxed{-1}x + b$

★ If there is No Pattern, it's NOT LINEAR!

y=mx+b

Finding "b"

Your "b" will always be what needs to be added / subtracted from "mx" to make the equation / rule work for ALL values.

*ALWAYS FIND "m" FIRST!

① PICK an (x,y) PAIR
② PLUG in to y=mx

x	y
2	20
4	40
6	60
8	80
10	100
12	120

$y = 10x + \boxed{0}$

$40 = 10(4)$
$40 = 40$ ✓

① PICK (x,y) PAIR
② PLUG in to y=mx

x	y
5	8
6	9
7	10
8	11
9	12
10	13

$y = 1x + \boxed{3}$

$10 = 1(7)$
$10 = 7 + 3$

③ See what you needed to Add!

$x = 0$
$y = 31$

x	y
-2	11
-1	21
0	31
1	41
2	51
3	61

$y = 10x + \boxed{31}$

$31 = 10(0) + \square$
$31 = 0$
+31

x	y
-2	10
-1	11
0	12
1	13
2	14
3	15

$y = 1x + \boxed{12}$

$y = 1x$
$12 = 1(0)$
$12 = 0$
+12

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

$y = 2x + \boxed{-3}$

$y = 2x$
$1 = 2(2)$
$1 = 4$
-3

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

$y = -1x + \boxed{1}$

$y = -1x$
$0 = -1(1)$
$0 = -1$
+1

Need HELP? Send me a message!

y=mx+b

Verifying your equation.

- ✓ If you have found the equation (or are given the equation) you need to be able to check that it is correct.
- ✓ Each PAIR of values (x,y) must work with the equation.

For each table of values below, fill in the table (follow the "y" pattern), and check to see if the given equation is correct. If it is wrong, give the proper equation.

Example:

Boxes Sold x	Profit y
10	5.00
11	5.50
12	6.00
13	6.50
14	7.00
15	7.50

+0.5

$y = 0.5x + 5$

① Pick an (x,y) pair
So $x=10$ when $y=5$

② Plug into Equation
$y=0.5x+5$
$(5)=0.5(10)+5$
$5=5+5$
$5=10$ NOPE

③ Find PROPER Equation:
$m=+0.5$ ✓
$(5)=0.5(10)+b$
$5=5+b$
$0=b$
$\therefore y=+0.5x$

Number of Tickets x	Cost y
1	6
2	12
3	18
4	24
5	30
6	36

+6

$y = 6x + 1$

① $x=5$ when $y=30$

② $y=6x+1$
$(30)=6(5)+1$
$30=30+1$
$30=31$ NOPE

③ $m=+6$ ✓
$y=6x+b$
$(30)=6(5)+b$
$30=30+b$
$0=b$
$\therefore y=6x$

x	y
-2	-2
-1	0
0	2
1	4
2	6

$y = 2x + 2$ ✓

① Pick (x,y)
$x=1$ when $y=4$

② Plug In
$y = 2x + 2$
$(4) = 2(1) + 2$
$4 = 2 + 2$
$4 = 4$ ✓

③ Double Check other (x,y) pairs
$x = 2$ when $y = 6$
$y = 2x + 2$
$6 = 2(2) + 2$
$6 = 4 + 2$
$6 = 6$ ✓

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

+3

$y = 3x + 1$

① $x=1$ when $y=2$

② $y = 3x + 1$
$(2) = 3(1) + 1$
$2 = 3 + 1$
$2 = 4$ NOPE!

③ $m = 3$ ✓
$y = 3x + b$
$2 = 3(1) + b$
$2 = 3 + b$
$-1 = b$

$y = 3x - 1$

x	y
-2	-21
-1	-11
0	-1
1	9
2	19

10

10

$y = 9x - 1$

① $x=2$
$y=19$

② $y = 9x - 1$
$19 = 9(2) - 1$
$19 = 18 - 1$
$19 = 17$ NOPE!

③ $m = 10$
$y = 10x + b$
$(19) = 10(2) + b$
$19 = 20 + b$
$-1 = b$

$y = 10x - 1$

Remember, that a **LINEAR EQUATION** is an equation that makes a line.

One way to identify a linear equation, is that the exponent of the "x" is always ONE. $x^1 = x$

For an equation to be LINEAR, it does not necessarily need to be in the form $y = mb + b$

For example, the following ARE all linear equations:

$y = x + 3$ ✓	$y = 43x$ ✓	$y + 19 = \frac{1}{2}x$ ✓	$\frac{y}{90} = -x$ ✓

The following are NOT (their "x" exponents are not ONE)

$y = x^{2} + 3$	$y = 43x^{4}$	$y + 19 = \frac{1}{2}x^{3}$	$y = -x^{5} + 90$

Write whether the following equations are LINEAR or NON-LINEAR:

1) $5y = 7x + 6$

LINEAR

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

NON-LINEAR

3) $y = \frac{x}{9} - 12$

LINEAR

4) $2x^2 - y = 11$

NON-LINEAR

5) $9x^4 - y = 13$

NON-LINEAR

6) $y = -5(x + 7)$

LINEAR.

Recognizing Patterns and Creating Equations

Consider the following pattern:

Make a table of values for the figure number (x) and the number of toothpicks (y)

x	y	
1	3	
2	5	+2
3	7	+2
4	9	+2
5	11	

So $m = 2$

PICK (x,y) PAIR TO FIND "b"...

$x = 1$ when $y = 3$

$y = 2x + b$

$3 = 2(1) + b$

$3 = 2 + b$

$1 = b$

Write an equation for this pattern in the form $y = mx + b$

$y = 2x + 1$

How many toothpicks will there be in figure 45?

If $x = 45$

$y = 2x + 1$

$y = 2(45) + 1$

$y = 90 + 1$

$y = 91$

Which figure will have 17 toothpicks?

If $y = 17$

$y = 2x + 1$

$17 = 2x + 1$

$-1 \quad -1$

$16 = 2x$

$\frac{16}{2} = \frac{2x}{2}$

$8 = x$

Solve with your Algebra Skills