M3U1D4

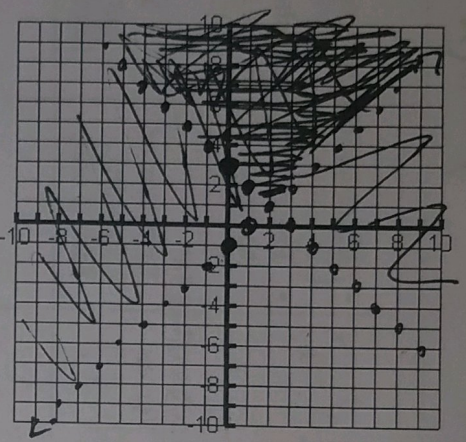
# GRAPHING SYSTEMS OF INEQUALITIES

**Example:**

$-x + y > -1$ $\quad y > x - 1$

$x + y > 3$ $\quad y > -x + 3$

Graph each inequality. First graph the boundary lines. Then decide which side of each boundary line contains solutions and whether the boundary line is included.



**More Examples**

$x + 2y \leq -1$

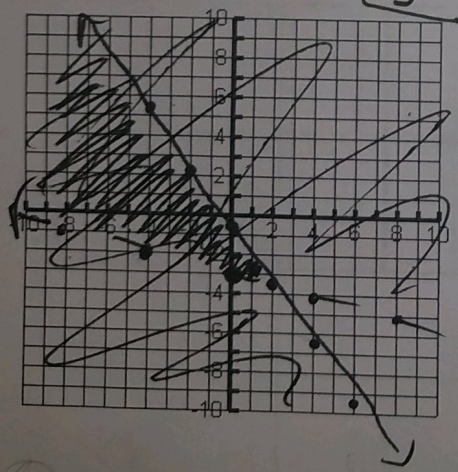
$x + 4y > -12$

$\frac{4y}{4} > \frac{-x}{4} - \frac{12}{4}$

$\frac{2y}{2} \leq \frac{-3x}{2} - \frac{1}{2}$

$y \leq -\frac{3}{2}x - \frac{1}{2}$

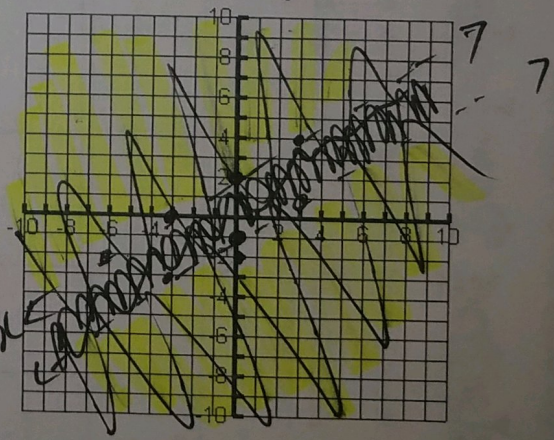
$y > -\frac{1}{4}x - 3$



$y > \frac{2}{3}x + 2$

$y < \frac{2}{3}x - 1$

→ no solution

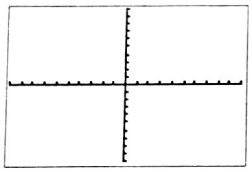
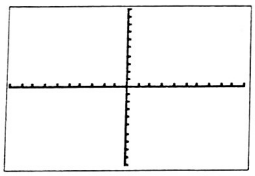
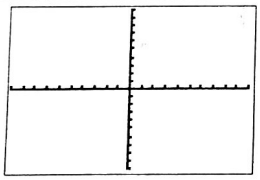


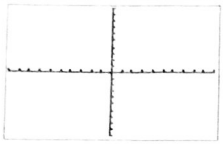
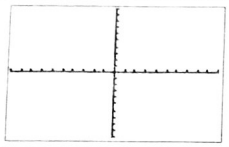
# Calculator Lab: Translating Parabolas

$$y = a(x - h)^2 + k$$

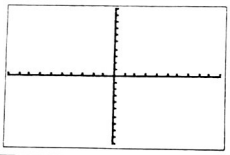
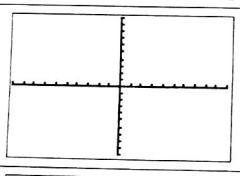
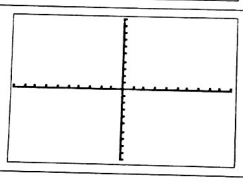
- Press Y= and make sure all Plots are off.
- Enter X^2 in Y1 make this graph bold (This is your parent graph)
- Enter the comparison equation in Y2
- Press ZOOM and select 6:Standard to view these graphs on the standard window.

**Part 1: Changing "a"**

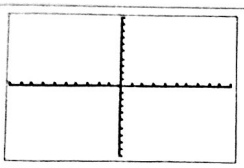
| Equation | Graph | Vertex | Direction of Opening (circle one) | Max or Min (circle one) | How is it different than the parent? | What is a? |
|---|---|---|---|---|---|---|
| $y = x^2$ |  | (0,0) | (Up) Down | Max (Min) | **PARENT** | 1 |
| $y = 4x^2$ |  | (0,0) | (Up) Down | Max (Min) | skinnier | 4 |
| $y = 0.25x^2$ |  | (0,0) | (Up) Down | Max (Min) | wider | 0.25 |

| | | | | | | |
|---|---|---|---|---|---|---|
| $y = -2x^2$ |  | (0,0) | Up (Down) | (Max) Min | flipped skinnier | -2 |
| $y = -0.5x^2$ |  | (0,0) | Up (Down) | (Max) Min | flipped wider | -0.5 |

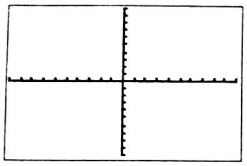
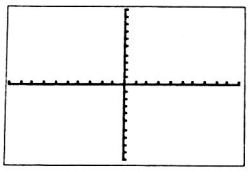
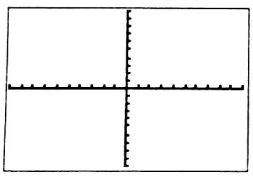
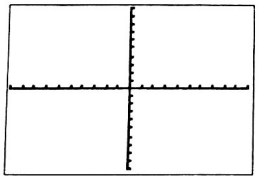
**Part 2: Changing "k"**

| Equation | Graph | Vertex | Direction of Opening (circle one) | Max or Min (circle one) | How is it different than the parent? | What is k? |
|---|---|---|---|---|---|---|
| $y = x^2+4$ |  | (0,4) | (Up) Down | Max (Min) | up 4 | 4 |
| $y = x^2+9$ |  | (0,9) | (Up) Down | Max (Min) | up 9 | 9 |
| $y = x^2 - 4$ |  | (0,-4) | (Up) Down | Max (Min) | down 4 | -4 |

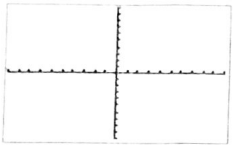
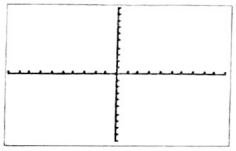
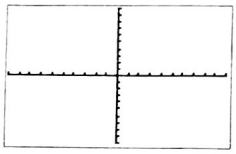
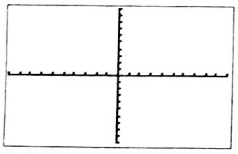
(2)

| | | | | | | |
|---|---|---|---|---|---|---|
| $y = x^2 - 9$ |  | (0,-9) | (Up) Down | Max (Min) | down 9 | -9 |

**Part 3: Changing "h"**

| Equation | Graph | Vertex | Direction of Opening (circle one) | Max or Min (circle one) | How is it different than the parent? | What is h? |
|---|---|---|---|---|---|---|
| $y = (x-2)^2$ |  | ~~(2,0)~~ (2,0) | (Up) Down | Max (Min) | right 2 | 2 |
| $y = (x-8)^2$ |  | (8,0) | (Up) Down | Max (Min) | right 8 | 8 |
| $y = (x+3)^2$ |  | (-3,0) | (Up) Down | Max (Min) | left 3 | -3 |
| $y = (x+1)^2$ |  | (-1,0) | (Up) Down | Max (Min) | left 1 | -1 |

**Part 4: Putti[illegible]l together**

| Equation | Graph | Vertex | Direction of Opening (circle one) | Max or Min (circle one) | How is it different than the parent? |
|---|---|---|---|---|---|
| $y = (x-2)^2+4$ |  | (2, 4) | (Up) Down | Max (Min) | right 2 up 4 |
| $y = 5(x+1)^2+9$ |  | (-1, 9) | (Up) Down | Max (Min) | skinny by 5 left 1 up 9 |
| $y = 0.5(x-3)^2 - 4$ |  | (3, -4) | (Up) Down | Max (Min) | wider by ½ right 3 down 4 |
| $y = -1(x+4)^2 - 5$ |  | (-4, -5) | Up (Down) | (Max) Min | flipped left 4 down 5 |

- **Write an equation of a parabola that moves $y = x^2$ up 2 units, right 6 units, and opens down.**

$$y = -(x-6)^2 + 2$$

- **Write an equation of a parabola that moves $y = x^2$ down 7 units, left 5 units, opens up, and is wider.**

$$y = \frac{1}{2}(x+5)^2 + 7$$

G

## Unit 1 Day 4 ~ Absolute Value Functions

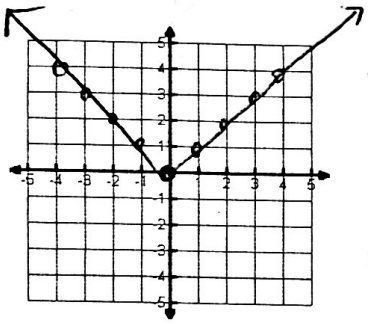
Absolute value variable equations are written as: Parabolas $y = a(x-h)^2 + k$

- $f(x) = |mx + b| + c$ $y = a|x-h| + k$
- Graph looks like a right side up or upside down V
  - Opens up if the coefficient in front of the absolute value symbols is positive.

    $f(x) = 4|x + 2| + 3$ opens up Parent $y = |x|$
  - Opens down if the coefficient in front of the absolute value symbols is negative.

    $f(x) = -4|x + 2| + 3$ opens down
- The vertex of the graph will be ↗ the values h and k You can use your calculator to find it!!

Let's start with $f(x) = |x|$ and graph the equation. This is called the parent function.



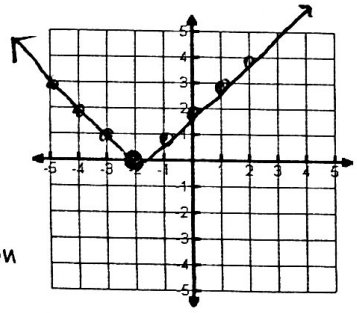
What's the vertex? (0,0)

Does it open up or down? up

Domain: $(-\infty, \infty)$ Range: $[0, \infty)$

calculator → Math → NuM → #1 absl

You try $f(x) = |x + 2|$. How is it different from the parent graph? left 2



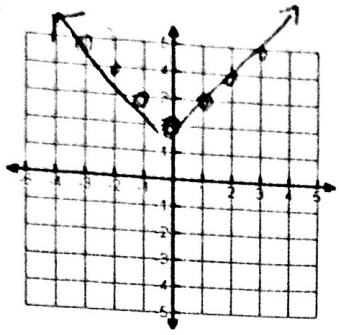
What's the vertex? (-2,0)

Does it open up or down? up

Domain: $(-\infty, \infty)$ Range: $[0, \infty)$

Now

$f(x) = |x| + 2$. How is it different from the parent graph? up 2



What's the vertex? (0, 2)

Does it open up or down? up

Domain: $(-\infty, \infty)$ Range: $[2, \infty)$

**Vertical Transformations:**

A constant added outside the absolute value symbol shifts the graph UP that many units.

$f(x) = |x| + 5$ moves the parent graph up 5

A constant subtracted outside the absolute value symbol shifts the graph DOWN that many units.

$f(x) = |x| - 3$ moves the parent graph down 3

**Horizontal Transformations:**

A constant added inside the absolute value symbols shifts the graph LEFT horizontally.

$f(x) = |x + 2|$ moves the parent graph left 2

A constant subtracted inside the absolute value symbols shifts the graph RIGHT horizontally.

$f(x) = |x - 2|$ moves the parent graph right 2

**Reflection over the x-axis:**

If you have a negative in front of the absolute value, the graph will be reflected, or flip, over the x-axis.

$f(x) = -|x|$ moves the parent graph flipped over x axis.

**Vertical Stretch/Compression:**

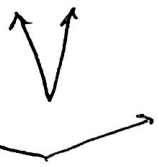
$C \cdot f(x)$, where $C$ is a real number $> 0$ skinny wide $y = a|x-h| + k$

If $C > 1$, then $f(x)$ has a vertical stretch (skinny) by a factor of $C$ units.

If $0 < C < 1$, then $f(x)$ has a vertical compression (wide) by a factor of $C$ units.

$f(x) = 2|x|$ How does this compare to the parent? skinny by 2

$f(x) = 0.5|x|$ How does this compare to the parent? wider by 0.5



Quick Recap:

**In what way would the graph of $y = |x|$ move according to the following equations? Be specific.**

1. $y = 4|x+3| - 5$ Stretch by 4 left 3 down 5

2. $y = -|x-2| + 7$ right 2 flip up 7

**Application:**

A rainstorm begins as a drizzle, builds up to a heavy rain, and then drops back to a drizzle. The rate r (in inches per hour) at which it rains is given by the functionand t represents time in hours.

Graph the function.

How long does it rain?

When does it rain the hardest?

What is the rate of the rain after 30 minutes?