

# Translations and Dilations

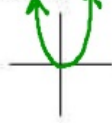
$$y = af(x - c) + d$$

**Using your calculator graph each function.** You must memorize these "Parent" graphs

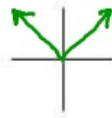
a)  $f(x) = x$



b)  $f(x) = x^2$



d)  $f(x) = |x|$



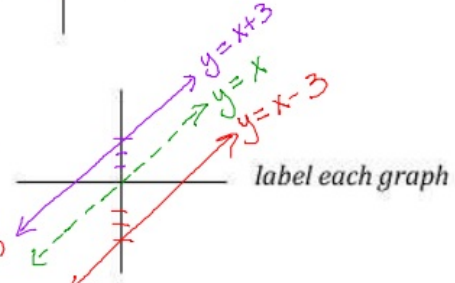
## Part I - Vertical Translation (Outside): $y = f(x) + d$

A.  $f(x) = x$

Graph  $y_1 = x$

Graph  $y_2 = x + 3$

change  $y_2$  to  $y_2 = x - 3$

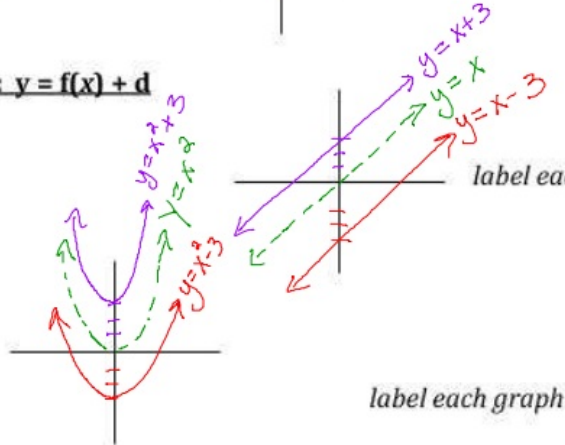


B.  $f(x) = x^2$

Graph  $y_1 = x^2$

Graph  $y_2 = x^2 + 3$

change  $y_2$  to  $y_2 = x^2 - 3$



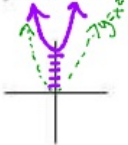
Given  $y = f(x) + d$ , explain how  $d$  changed the graphs.  $d$  translates the graph vertically ( $\uparrow \downarrow$ )

Explain what happens when  $d$  is added vs. subtracted from  $f(x)$ .

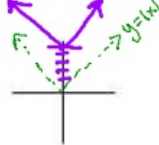
When  $d$  is added, then  $f(x)$  moves up.  
When  $d$  is subtracted then  $f(x)$  moves down.

Graph the functions *without a calculator* (first draw the parent graph using dotted lines)

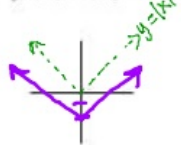
1)  $f(x) = x^2 + 5$



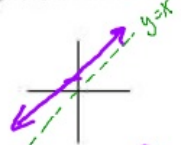
2)  $f(x) = |x| + 5$



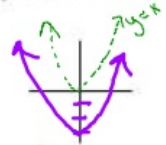
3)  $f(x) = |x| - 2$



4)  $f(x) = x + 1$



5)  $f(x) = x^2 - 3$



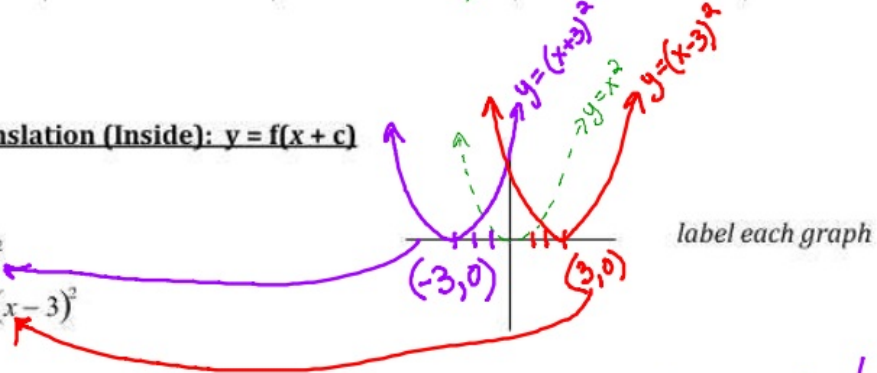
## Part II - Horizontal Translation (Inside): $y = f(x + c)$

A.  $f(x) = x^2$

Graph  $y_1 = x^2$

Graph  $y_2 = (x + 3)^2$

change  $y_2$  to  $y_2 = (x - 3)^2$



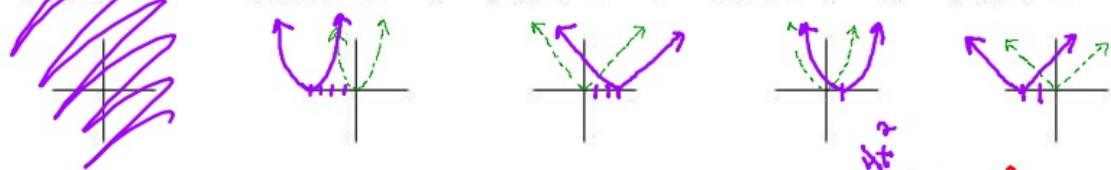
Given  $y = f(x - c)$ , explain how  $c$  changed the graphs. Translates the graph horizontally ( $\leftarrow \rightarrow$ )

Explain the difference between the graphs of  $y = f(x - c)$  and  $y = f(x + c)$ .

right left

Graph the functions *without* a calculator (first draw the parent graph using dotted lines)

- 1)  $f(x) = x + 2$     2)  $f(x) = (x + 4)^2$     3)  $f(x) = |x - 3|$     4)  $f(x) = (x - 1)^2$     5)  $f(x) = |x + 2|$



**Part III - Dilations:  $y = af(x)$**

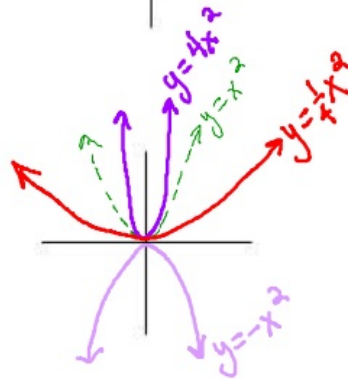
A.  $f(x) = x^2$

Graph  $y_1 = x^2$

Graph  $y_2 = 4x^2$

change  $y_2$  to  $y_2 = \frac{1}{4}x^2$

change  $y_2$  to  $y_2 = -x^2$

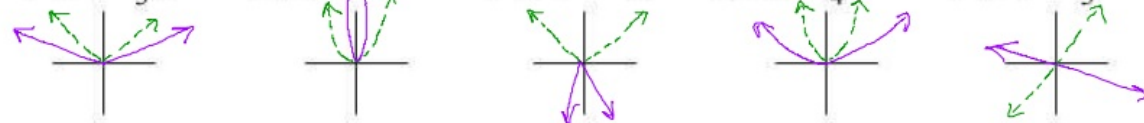


Given  $y = af(x)$ , explain how  $a$  changed the graphs. Explain the difference between the graphs when

- $a > 1$      $0 < a < 1$      $a$  has a negative sign
- Stretch    Shrink    reflection
- steep / narrow    wide / fatter

Graph the functions *without* a calculator (first draw the parent graph using dotted lines)

- 1)  $f(x) = \frac{1}{3}|x|$     2)  $f(x) = 4x^2$     3)  $f(x) = -5|x|$     4)  $f(x) = \frac{1}{4}x^2$     5)  $f(x) = -\frac{1}{3}x$



**Part IV - All Together:  $y = af(x - c) + d$**

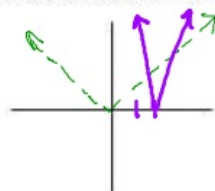
How do each of the variables change the graph of  $f(x)$ ?

- a stretch/shrink and/or reflection
- c horizontal shift (left or right)
- d vertical shift (up or down)

**List the transformations and sketch each graph.** Draw each of the parent graphs with dotted lines.

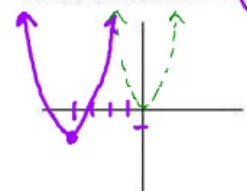
1.  $f(x) = 3|x - 2|$

3 stretch/shrink/normal  
reflection: yes no  
Horizontal Shift: 2 L R  
Vertical Shift: 0 U D



2.  $f(x) = (x + 4)^2 - 1$

stretch/shrink/normal  
reflection: yes no  
Horizontal Shift: 4 L R  
Vertical Shift: 1 U D



3.  $f(x) = -\frac{1}{5}x + 3$

stretch/shrink/normal  
reflection: yes no  
Horizontal Shift: 0 L R  
Vertical Shift: 3 U D

