

# Transformations

1. Up  $c$  units :  $f(x) + c$

2. Down  $c$  units :  $f(x) - c$

3. Right  $c$  units :  $f(x - c)$

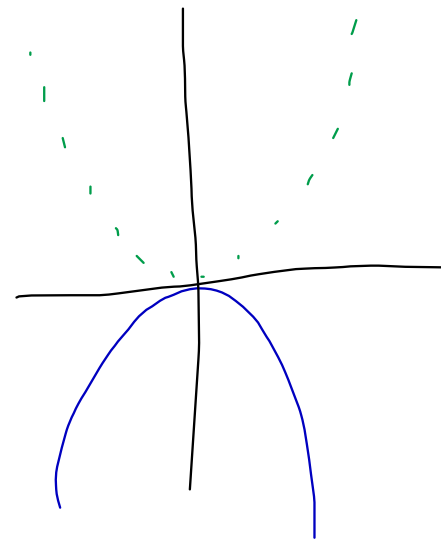
4. Left  $c$  units :  $f(x + c)$

5. Reflect across :  $-f(x)$   
x axis

6. Reflect across :  $f(-x)$   
y axis

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

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



7. Vertical Stretch :  $c f(x)$ ,  $c > 1$

8. Vertical Shrink :  $c f(x)$ ,  $0 < c < 1$

9. Horizontal Stretch :  $f(cx)$ ,  $0 < c < 1$

10. Horizontal Shrink :  $f(cx)$ ,  $c > 1$

# Best Form for Transformations:

$$f(x) = -a \left[ -b(x \pm c) \right] \pm d$$

$-f(x)$

vert stretch  
or  
shrink  
 $c f(x)$

$f(-x)$

horizontal  
stretch  
or  
shrink  
 $f(-x)$

Left/right  
 $f(x \pm c)$

up/down  
 $f(x) \pm c$

1. Down 4

2. Left 5

3. Horizontal Shrink (9)

4. Reflect across y

5. Vert Stretch (7)

Use  $f(x) = |x|$

$$f(x) =$$

$$7 \left| -9(x+5) \right| - 4$$

Diagram illustrating the construction of the function  $f(x) = 7 \left| -9(x+5) \right| - 4$  from the parent function  $f(x) = |x|$  using transformations:

- $f(x) \rightarrow -f(x)$  (Reflection across the y-axis)
- $f(x) \rightarrow cf(x)$  (Vertical stretch by 7)
- $f(x) \rightarrow f(cx)$  (Horizontal shrink by 9)
- $f(x) \rightarrow f(-x)$  (Reflection across the y-axis)
- $f(x) \rightarrow f(x) + c$  (Vertical shift down by 4)

✓ 1. Up 2

✓ 2. Right 5

✓ 3. Vert str (3)

✓ 4. Ref across x

Use  $f(x) = x^3$

$$f(x) = -3 \left( (x-5) \right)^3 + 2$$

Hw. Pg 107

# 55-71 odd

ID the transformations

$$107 \quad 55. \quad 3 + 2(x-4)^2 = 2[(x-4)^2] + 3$$

$$= \frac{\pm \#}{2} \left[ \pm \# (x \pm \#) \right] \pm \#$$

Vert stretch.

Up 3

Right 4

$$f(x) = x^4$$

$$f(x) = \sqrt{x}$$

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

$$2\sqrt{(x-4)}$$

$$2|(x-4)|$$

57.  $x^3 + 7$       up 7       $f(x) = x^3$

59.  $(x-1)^3 + 2$       up 2  
Right 1

61.  $3(x-2)^3$       Right 2  
Vert stretch

$[3(x-2)]^3$

63.  $-|x| - 2$       Ref across  $x$   
Down 2

65.  $-|x+4|+8$       up 8  
Ref across x,  
Left 4.

67.  $-2|x-1|$       Ref across x  
Right 1  
Vert stretch

69.  $\sqrt{x-9}$       Right 9

71.  $\sqrt{7-x}-2$       Down 2

$$\sqrt{7-x} - 2$$

Down 2

Right ?

$$\sqrt{-(x-7)} - 2$$

Ref across y.

Trick!

- before x term without parentheses requires parentheses to be added!

$$(8-x) = (-(-7-x))$$

Write a function formula that includes transformations

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

1. Left 3

2. Up 5

3. Vert shrink ( $\frac{1}{5}$ )

4. Ref y

5. Hor stretch ( $\frac{2}{3}$ )

$$f(x) =$$

$$f(x) = \sqrt[3]{x}$$

1. Down 7

2. Left 2

3. Ref x

4. Vert stretch (3)

[ ( ) ]

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

1. Right 6

2. Hor shrink  
(4)

3. Up 7