Intro to Translation

Recall from 30SP $f(x) = x^2$

$f(x) = x^2 + d$ "d" shifts f(x) vertically up/down by d-units
+ d --> up
- d --> down

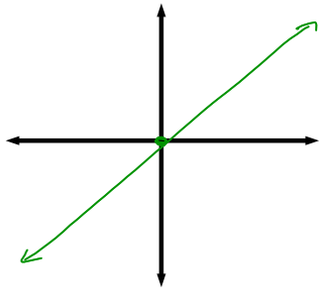
$f(x) = (x - c)^2$ "c" shifts f(x) horizontally left/right
(x - c) --> shifts right by c-units
(x + c) --> shifts left by c-units

$f(x) = ax^2$ "a" stretches or compresses f(x) vertically
a>1 vertical stretch occurs
0<a<1 vertical compress occurs

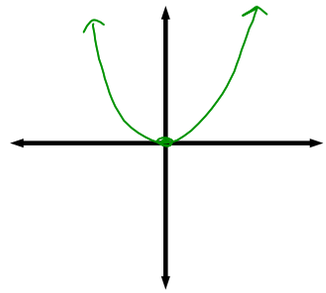
Together $\boxed{f(x) = a(x \pm c)^2 \pm d}$

Need to know some base graphs:

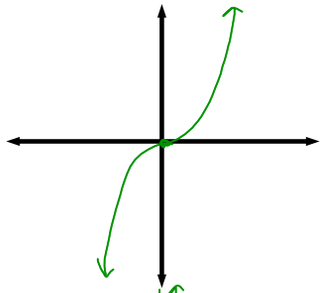
1) $y = x$
line



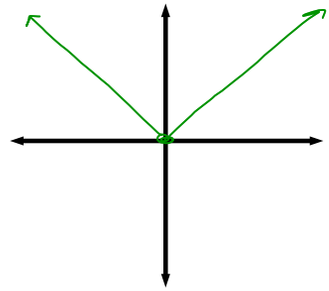
2) $y = x^2$
parabola
quadratic



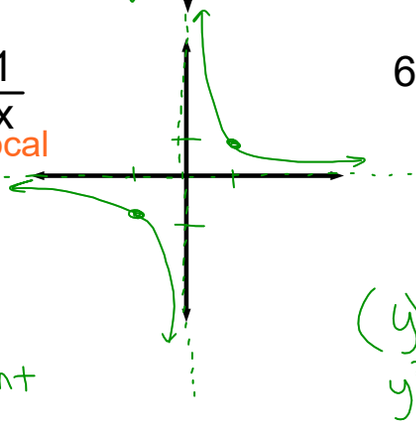
3) $y = x^3$
cubic



4) $y = |x|$
absolute value



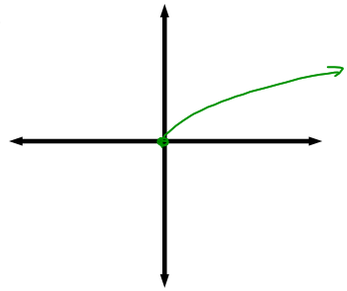
5) $y = \frac{1}{x}$
reciprocal



NPV
$x \neq 0$

(1, 1)
invariant
(-1, -1)

6) $y = \sqrt{x}$
radical

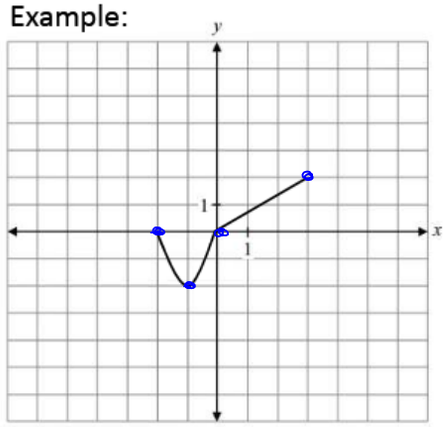


$(y)^2 = (\sqrt{x})^2$
$y^2 = x$

Transformations

Given a graph of a function y = f(x), we can find the graphs of related functions using transformations, reflections, stretches, and compressions.

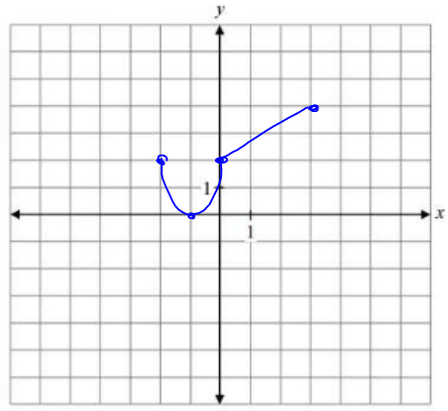
Example:



(-2, 0)
(-1, -2)
(0, 0)
(3, 2)

1) y = f(x) ± d

The graph of y = f(x) ± d consists of the graph of y = f(x) moved through a vertical translation of d units.



Example: y = f(x) + 2 up

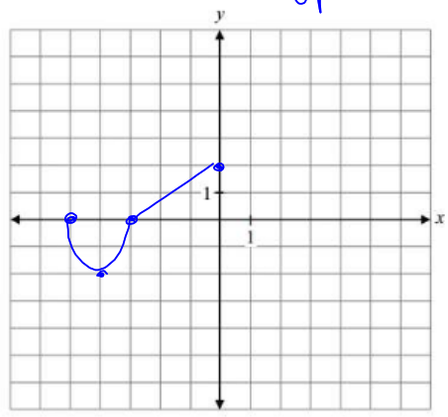
Note: **Same Sign** (x, y + 2)

(x, y) → (x, y ± d)

(-2, 0) → (-2, 2)
(-1, -2) → (-1, 0)
(0, 0) → (0, 2)
(3, 2) → (3, 4)

2) y = f(x ± c)

The graph of y = f(x ± c) consists of the graph of y = f(x) moved through a horizontal translation of c units.



Example: y = f(x + 3) c left

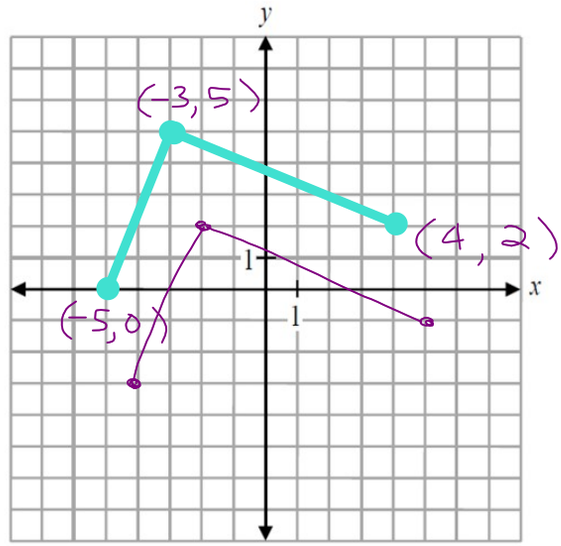
Note: **Opposite Sign** (x - 3, y)

(x, y) → (x ± c, y)

(-2, 0) → (-5, 0)
(-1, -2) → (-4, -2)
(0, 0) → (-3, 0)
(3, 2) → (0, 2)

ex. Given the graph of f(x),
Sketch the graph of
$y = f(x - 1) - 3$
c d
right down

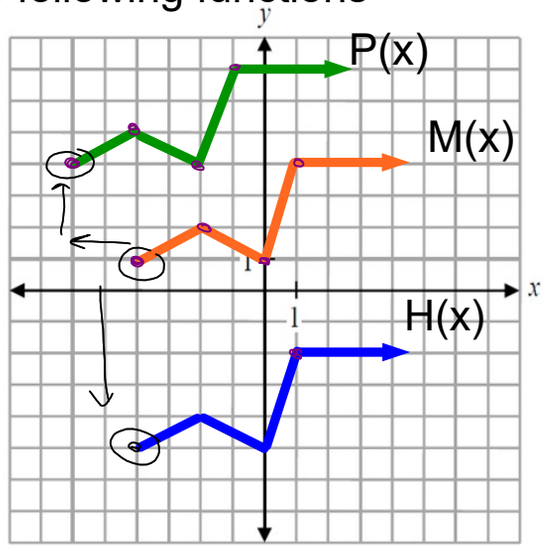
$(x,y) \rightarrow (x+1, y-3)$
$(-5,0) \rightarrow (-4,-3)$
$(-3,5) \rightarrow (-2,2)$
$(4,2) \rightarrow (5,-1)$



ex. State the equation for the following functions in relation to M(x)
a) P(x)
b) H(x)

a) $P(x) = M(x+2) + 3$

b) $H(x) = M(x) - 6$



ex. Describe the following in words:

a) $y = (x + 1)^2 - 4$
c d
moves left 1 space
and down 4 spaces

b) $f(x) = (x - 3)^2 + 6$
shifted 3 units right
and 6 units up

#8 $y + 3 = f(x+2)$
$y = f(x+2) - 3$
c d

p. 168
1, 2, 4–10,
12–16

Domain and Range:

Domain – x-values

Range – y-vales

If given just points that are not connected by a line → list them as a set.

Ex. {(1,-1), (4, 2), (4, 0)}

D: {1, 4}

R: {-1, 0, 2}

Set Notation:

D: $\{x|\quad\}$ • point is included use ≤ or ≥ ○ point is not included use < or >

R: $\{y|\quad\}$

If all values use x∈R or y∈R

∈ belongs to or is an element of ↑ all real numbers

Interval Notation:

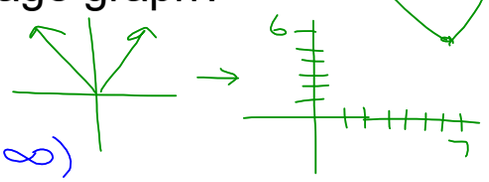
• point is included Use [ ] ○ point is not included use ( )

If all values use $(-\infty, \infty)$

$y = f(x)$

ex. The graph of y = |x| is translated 7 units right and 6 units up. What is the equation of the image graph?

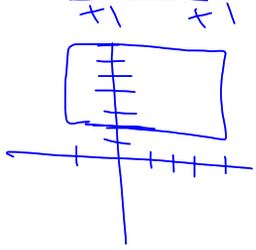
$y = |x - 7| + 6$



D: $\{x \mid x \in \mathbb{R}\}$ $(-\infty, \infty)$

R: $\{y \mid y \geq 6\}$ $[6, \infty)$

ex. The function y = f(x) has the domain $-1 \leq x \leq 4$ and range $2 \leq y \leq 7$. What are the domain and range of y = f(x - 5) + 1?



D: $\{x \mid 4 \leq x \leq 9\}$

$[4, 9]$

R: $\{y \mid 3 \leq y \leq 8\}$

$[3, 8]$