Day 12, Thursday March 5th

- Written HW 2 due today by 11:59pm
  (48 hour grace period)
- Exam 2 on Tuesday March 11th
  - 7.1 Ellipse
  - 7.2 Hyperbola
  - 7.3 Parabola
  - 2.3 Functions & Relations
  - 2.4 Linear Equation & Functions
  - 2.5 Applications of Linear functions

Practice Exam 2 posted in Aleks
score above 80% on Practice
2 extra points on exam

Email if you want to make up any homework
(7.1, ... , 2.5)
by Tuesday 10 am

Update Canvas w/ Aleks!

Practice: From last class notes:

3. **Temperature Conversion** $m = \frac{212-32}{100-0} = 1.8$

   The relationship between Celsius (C) and Fahrenheit (F) temperatures is linear. y intercept $(0, 32)$ $(100, 212)$

   Given that water freezes at $0°C$ $(32°F)$ and boils at $100°C$ $(212°F)$:

   (a) Develop a linear function $F(C)$ that converts Celsius temperatures to Fahrenheit. $F(C) = mC + b$ so $\boxed{F(C) = 1.8C + 32}$

   (b) Use your function to convert $25°C$ to Fahrenheit. $F(25) = 77$

   (c) At what temperature are the Celsius and Fahrenheit readings equal?

   $F(C) = C \Rightarrow C = 1.8C + 32$ solve for $C = -40$

4. **Depreciation of Equipment**

   A company purchases a piece of machinery for $80,000. The accountant estimates that after 10 years, the machine will have a salvage value of $20,000. Assuming the value depreciates linearly over time:

   (a) Create a linear function $V(t)$ that gives the value of the machinery after t years.

   (b) What will be the value of the machinery after 4 years? $V(4) = 56,000$

   (c) When will the machinery be worth half of its original value? $6.\overline{6}$

   (d) If the company sells the machinery when its value reaches $35,000, how long will they have owned it?

$(0, 80,000)$ $(10, 20,000)$

$t=0$ $V(t) = 80,000$

(x_1, y_1) (x_2, y_2)

$$\frac{20,000 - 80,000}{10 - 0} = \frac{-60000}{10} = -6000$$

$V(t) = mt + b$

$V(t) = -6000t + 80,000$

original value : 80,000

interested when value is : 40,000

$t = ?$

$\underbrace{V(t)} = -6000t + 80,000$

$40,000 = -6000t + 80,000$

35,000

$-40,000 = -6000t$

$\frac{-40,000}{-6000} = t$

$\boxed{t = 6.7 \text{ years}}$

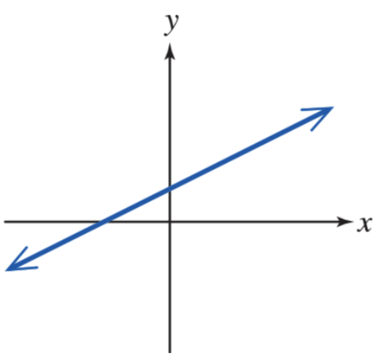
d) $t = 7.5$ years

Day 12 Notes
2.6 Transformations of Graphs

1. Graphs of basic functions

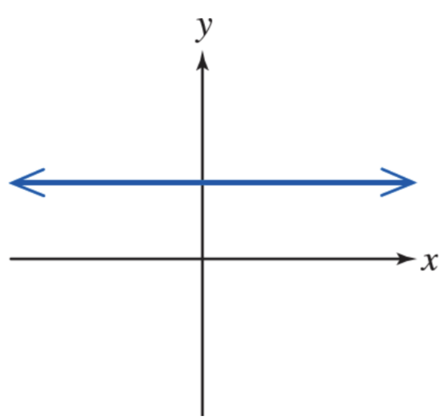
In addition to linear and constant functions we will learn to identify and work with other function such as:

1. Linear functions
$f(x) = mx + b$



Constant functions
$f(x) = b$

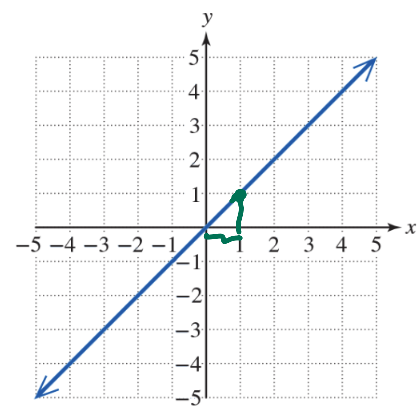
M= 0



2. Identity function: $f(x) = x$

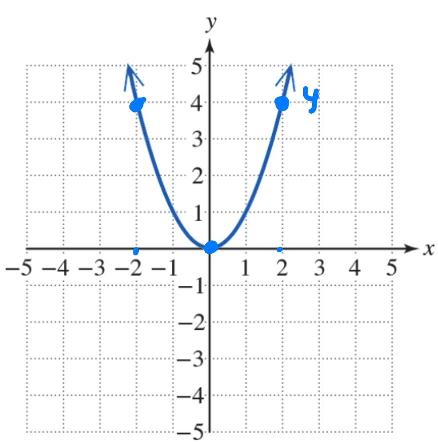
m=1
b=0

x	$f(x)$
−2	−2
−1	−1
0	0
1	1
2	2



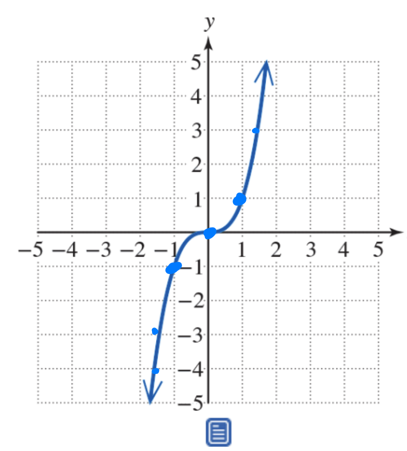
3. Quadratic function: $f(x) = x^2$ (graph is a parabola)

x	$f(x)$
−2	4
−1	1
0	0
1	1
2	4



4. Cube function: $f(x) = x^3$

x	$f(x)$
−2	−8
−1	−1
0	0
1	1
2	8

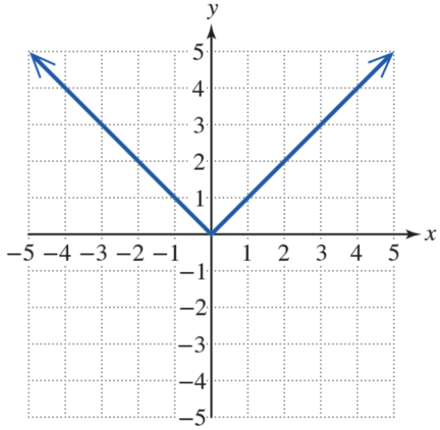


7. Absolute value function: $f(x) = |x|$

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

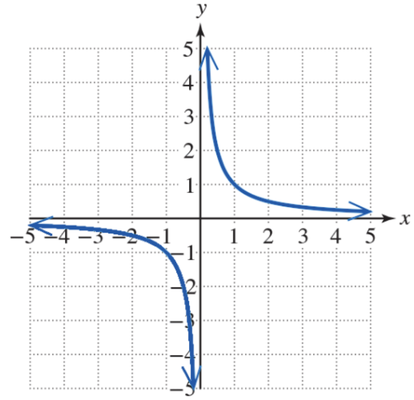
$f(x) = -|x+1| - 3$

x	$f(x)$
-2	2
-1	1
0	0
1	1
2	2



8. Reciprocal function: $f(x) = \dfrac{1}{x}$

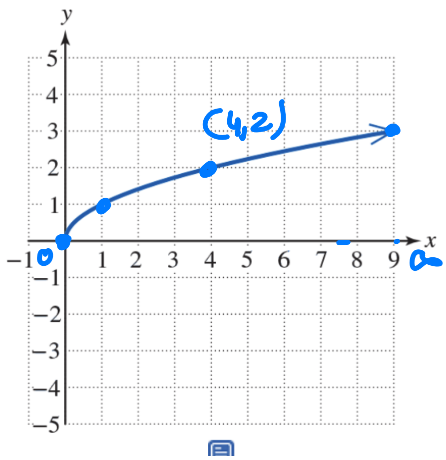
x	$f(x)$
-2	$-\frac{1}{2}$
-1	-1
$-\frac{1}{2}$	-2
$\frac{1}{2}$	2
1	1
2	$\frac{1}{2}$



5. Square root function: $f(x) = \sqrt[2]{x^1} = x^{\frac{1}{2}}$

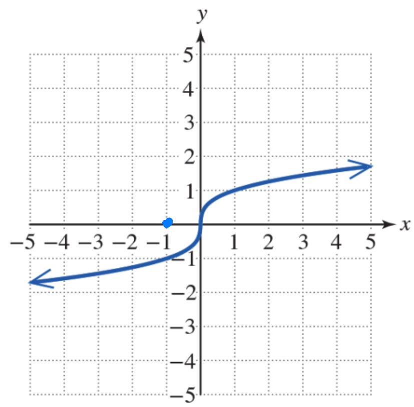
x	$f(x)$
0	0
1	1
4	2
9	3
16	4

$\sqrt{1} = 1$



6. Cube root function: $f(x) = \sqrt[3]{x^1} = x^{1/3}$

x	$f(x)$
-8	-2
-1	-1
0	0
1	1
8	2



$\sqrt[3]{-1} = -1$

$(-1)^3 = -1$

2. Transformations of functions

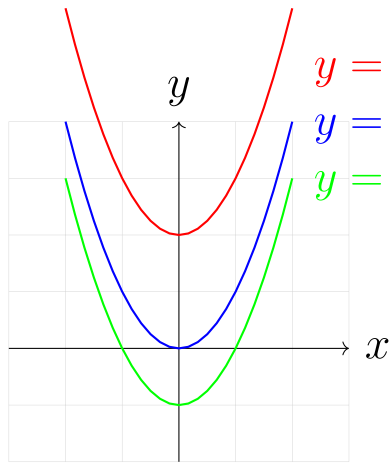
In this section, we'll discuss some ways to graph more complicated popular functions. For example, we will find a quick way to graph the function $f(x) = -(x+2)^2 + 5$ just by knowing that this graph is the graph of x^2 (which we call the **parent** or **basic** function) transformed in some way. These transformation can be rigid or non-rigid.
A **rigid transformation** changes the location of the function in a coordinate plane, but leaves the size and shape of the graph unchanged.
A **non-rigid transformation** changes the size and/or shape of the graph.

1 Shifting

Vertical Shifting (UP or Down)

For any function $f(x)$, adding or subtracting a constant k shifts the graph:

- $f(x) + k$ shifts the graph up k units
- $f(x) - k$ shifts the graph down k units

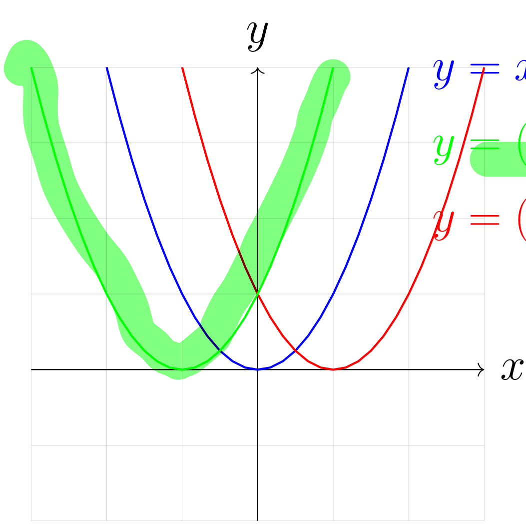


Horizontal Shifting(LEFT or RIGHT)

For any function $f(x)$, replacing x with $(x \pm h)$ shifts the graph:

- $f(x - h)$ shifts the graph right h units
- $f(x + h)$ shifts the graph left h units

Note: The shift is in the opposite direction of the sign inside the parentheses!

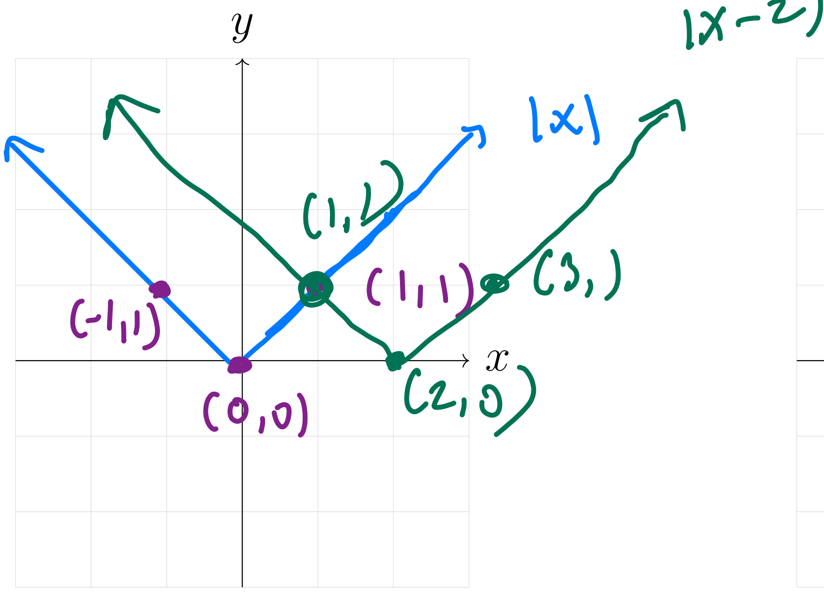


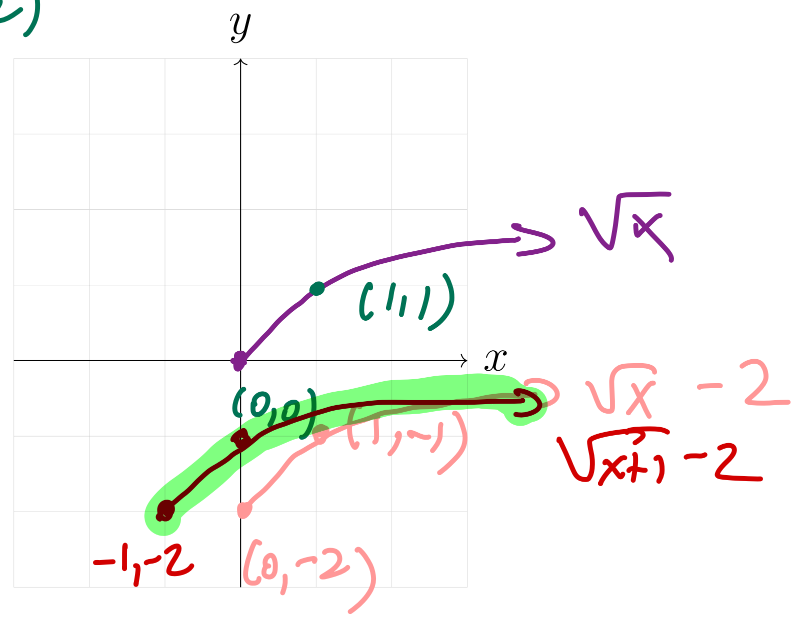
Example 1. Describe the transformation and sketch the graph of each function:

1. $f(x) = |x-2|$
2. $f(x) = \sqrt{x+1} - 2$

$\left.\right\}$ parent function $|x|$

$\rightarrow$ parent function $\sqrt{x}$ $\left.\right\}$ down 2 units, left 1 unit



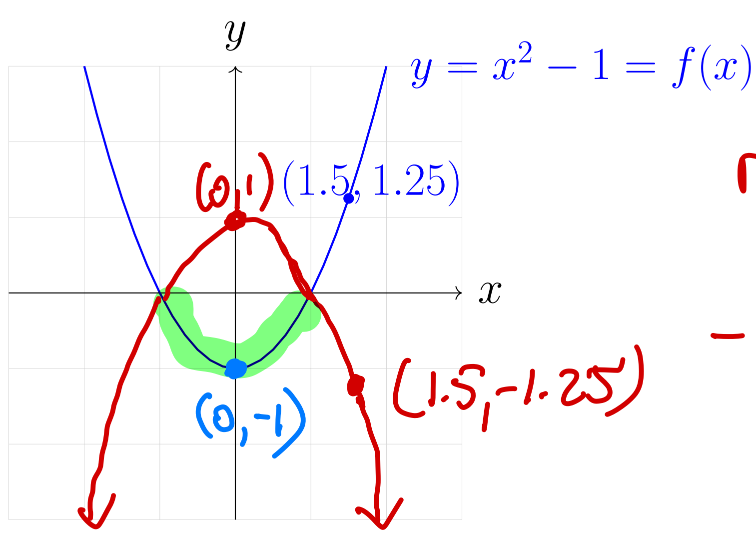


2 Reflecting

Reflecting over x-axis

For any function $f(x)$, multiplying by -1 reflects the graph over the x-axis:

- $y = -f(x)$ reflects the graph of $y = f(x)$ over the x-axis
- Each point (x, y) becomes $(x, -y)$



reflected over x axis

$-(x^2-1)$

Reflection over the y-axis

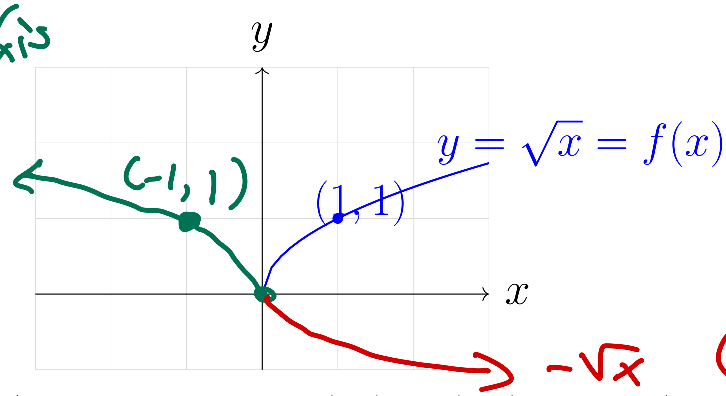
For any function $f(x)$, replacing x with $-x$ reflects the graph over the y-axis:

- $y = f(-x)$ reflects the graph of $y = f(x)$ over the y-axis
- Each point (x, y) becomes $(-x, y)$

$-\sqrt{x}$

reflection over y axis

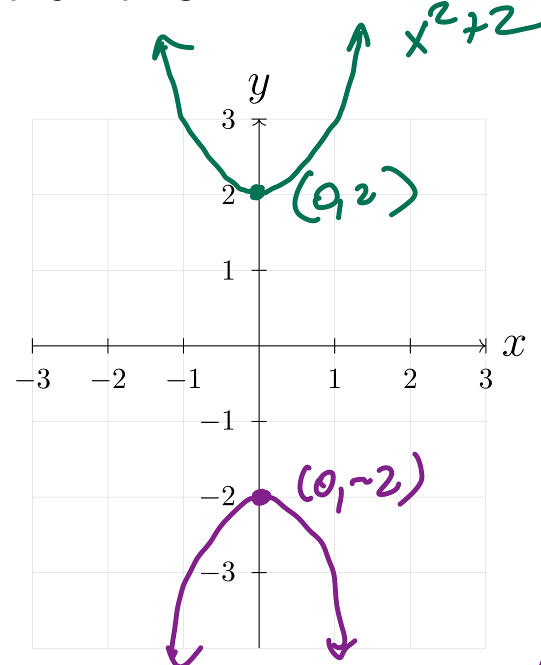
$\sqrt{-x}$



(reflection x axis)

Example 2. Find the equation and sketch the graph of each reflection:

1. Reflect $y = x^2 + 2$ over the x-axis



$f(x)$

$-f(x)$ reflection over x

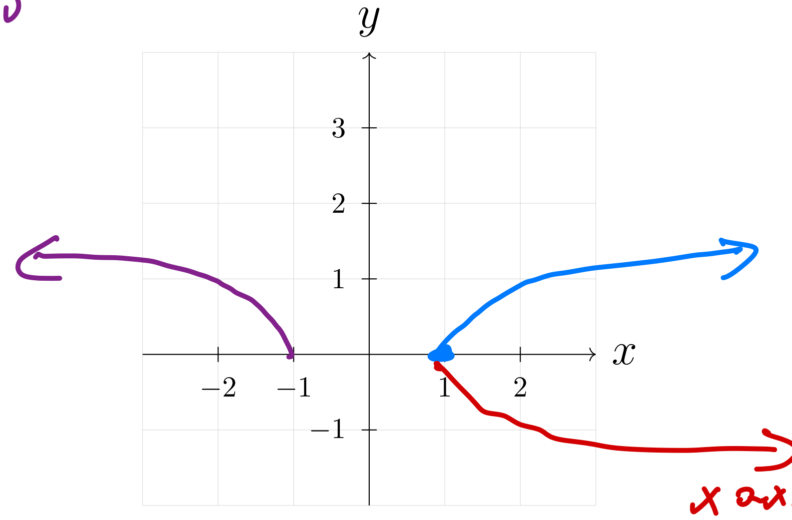
$-(x^2+2) = -x^2-2$

2. Reflect $y = \sqrt{x-1}$ over the y-axis → equation :

right one unit

f(x) graph

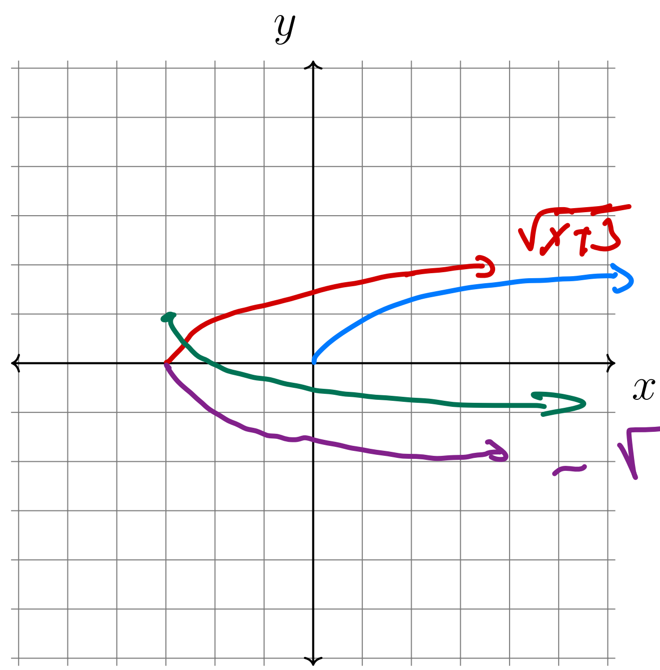
$\sqrt{-x-1}$



x axis ref : $-\sqrt{x-1}$

$\sqrt{x-1}$

Practice: Graph the parent function $\sqrt{x}$ and the function
$f(x) = -\sqrt{x+3} + 1$.
Where are the points [illegible] on the graph of $\sqrt{x}$ transformed to on the graph of $-\sqrt{x+3} + 1$?



$\sqrt{x+3}$

$\sqrt{x}$

$-\sqrt{x+3}+1$

$-\sqrt{x+3}$

parent function : $\sqrt{x}$

shift left 3 units : $\sqrt{x+3}$

reflect over x axis : $-\sqrt{x+3}$

up 1 unit : $-\sqrt{x+3} + 1$