Warm Up 9/10

1. Define function

   For every input there is only one output

2. Evaluate $f(0)$ and $f(2)$ for the following.

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

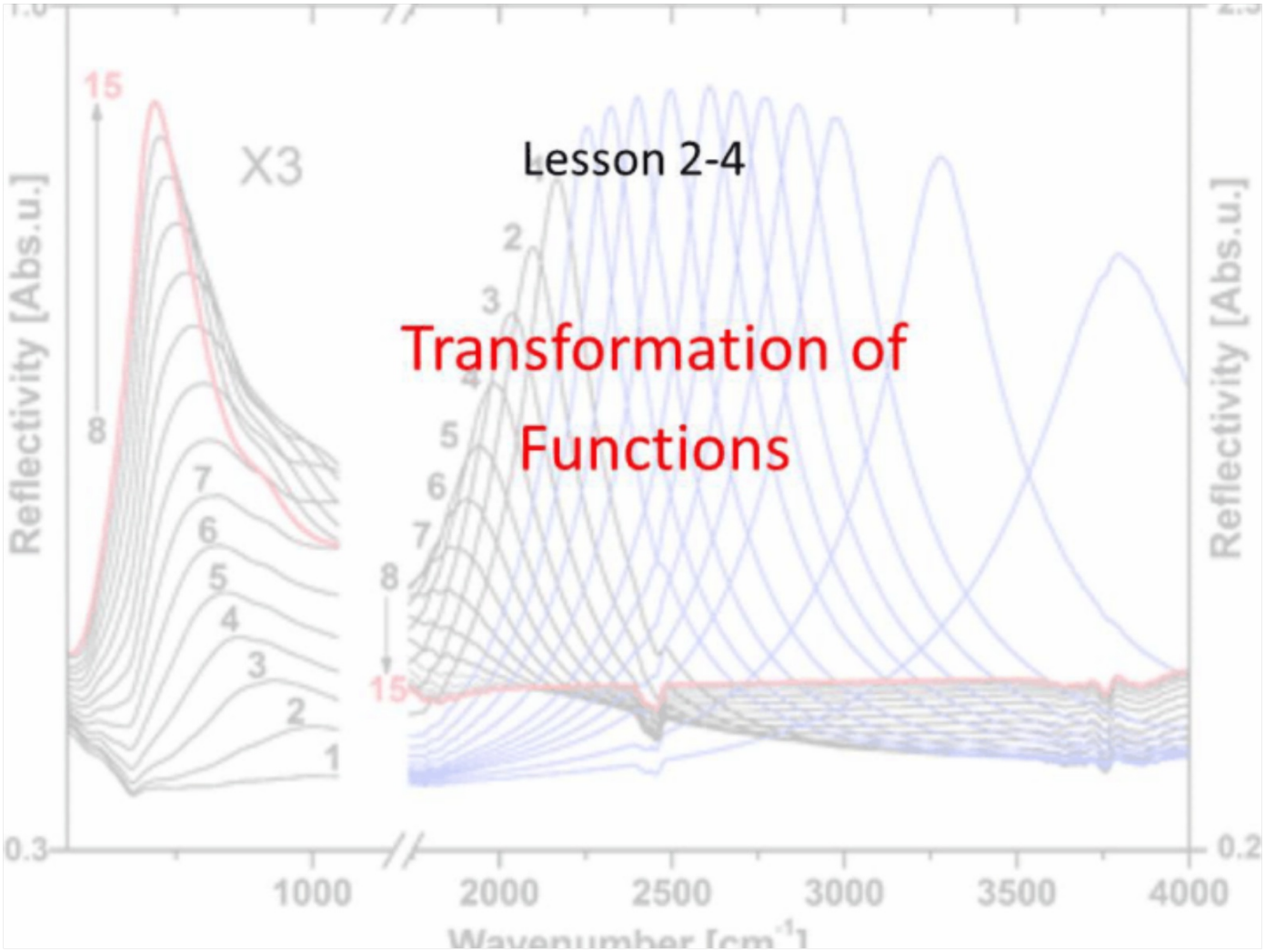
   $f(0) = 0$

   $f(2) = 4$

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

   $f(0) = -2$

   $f(2) = 2$


Lesson 2-4
Transformation of Functions
X3
15
8
7
6
5
4
3
2
1
Reflectivity [Abs.u.]
Reflectivity [Abs.u.]
0.3
0.2
1000
2000
2500
3000
3500
4000
Wavenumber [cm-1]

Objective

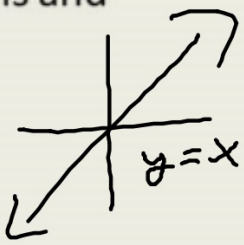
Students will...

- Be able to understand the basic idea of transformation of functions.
- Explore and apply the properties of vertical and horizontal shifts.

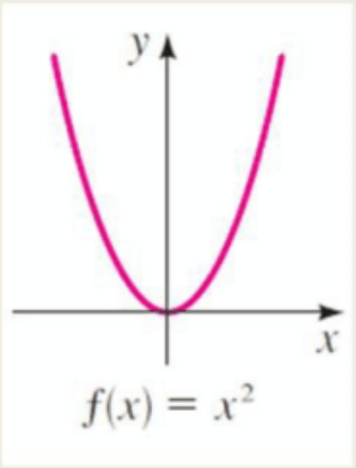
"Parent" Functions

We have seen and studied some of the standard functions and their graphs. For example.

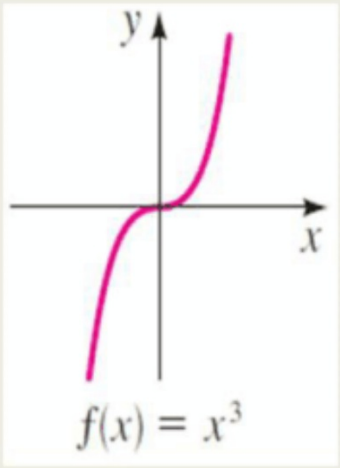
$\frac{1}{2}(x+3.65)^2 - \pi$



$f(x) = x^2$



$f(x) = x^3$

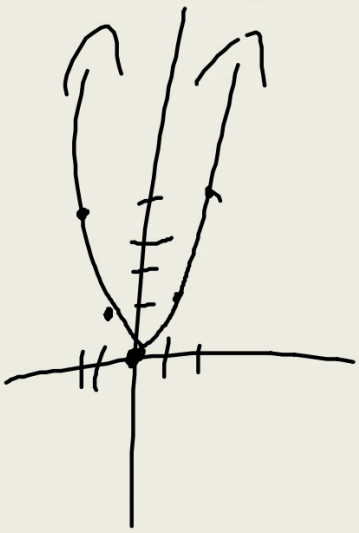


Transformation of Functions

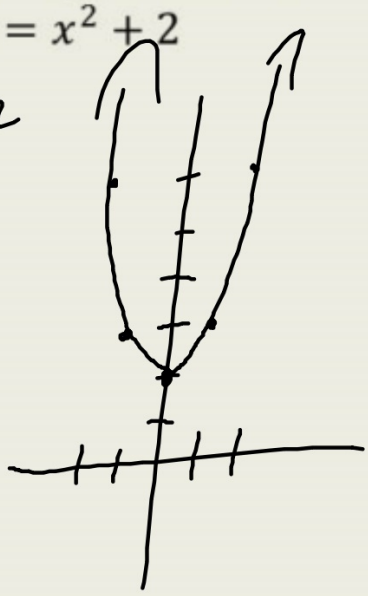
$g(x) = x^2 + 2 = f(x) + 2$

Now, consider our problem from the warm up. Let's go ahead and compare the two functions: $f(x) = x^2$ and $g(x) = x^2 + 2$

x	x^2
−2	4
−1	1
0	0
1	1
2	4



x	x^2+2
−2	6
−1	3
0	2
1	3
2	6



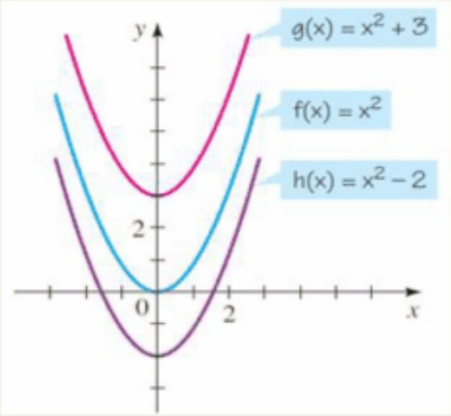
Transformation: Vertical Shift

As observed, the difference between $f(x)$ and $g(x)$ was that $g(x)$ was simply $f(x)$ vertically **shifted up 2 units**. This can be generalized by the following:

$y = f(x) \pm c$ shifts the graph of $y = f(x)$ upward(+) or downward(-) c units, for $c > 0$.

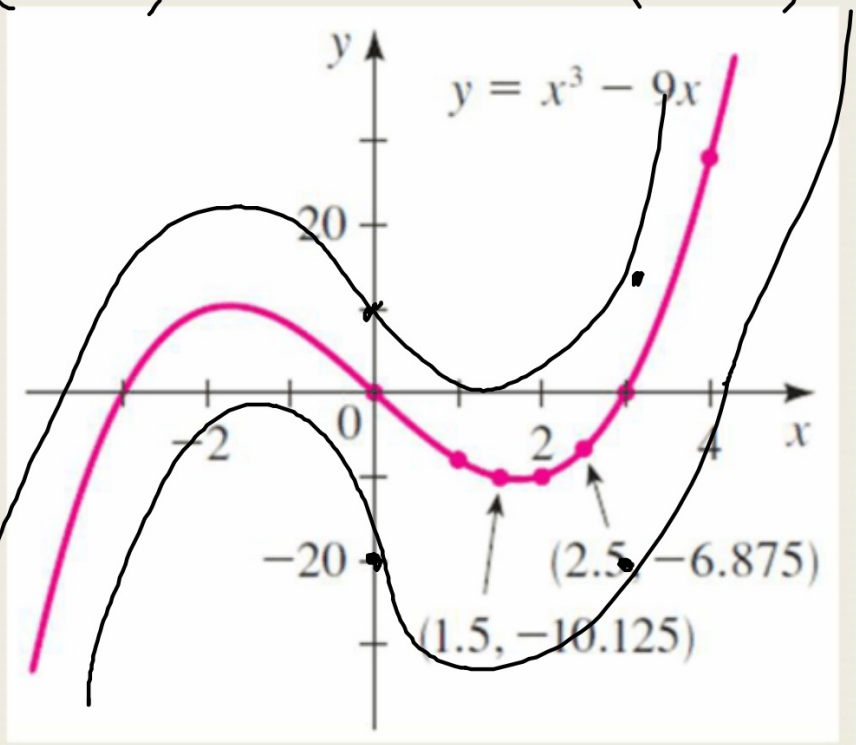
Ex. Use the graph of $f(x) = x^2$ to sketch the graph of,

$g(x) = x^2 + 3$ and $h(x) = x^2 - 2$



Example

Use the graph of $f(x) = x^3 - 9x$ shown below to sketch the graph of $g(x) = x^3 - 9x + 10$ and $h(x) = x^3 - 9x - 20$



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

Transformation: Horizontal Shift

Similar to vertical shift, we also have a **horizontal shift**. Let's compare the three functions: $f(x) = x^2$, $g(x) = (x+2)^2$, $h(x) = (x-1)^2$

x	$(x+2)^2$
-4	4
-3	1
-2	0
-1	1
0	4

x	x^2
-2	4
-1	1
0	0
1	1
2	4

x	$(x-1)^2$
-1	4
0	1
1	0
2	1
3	4

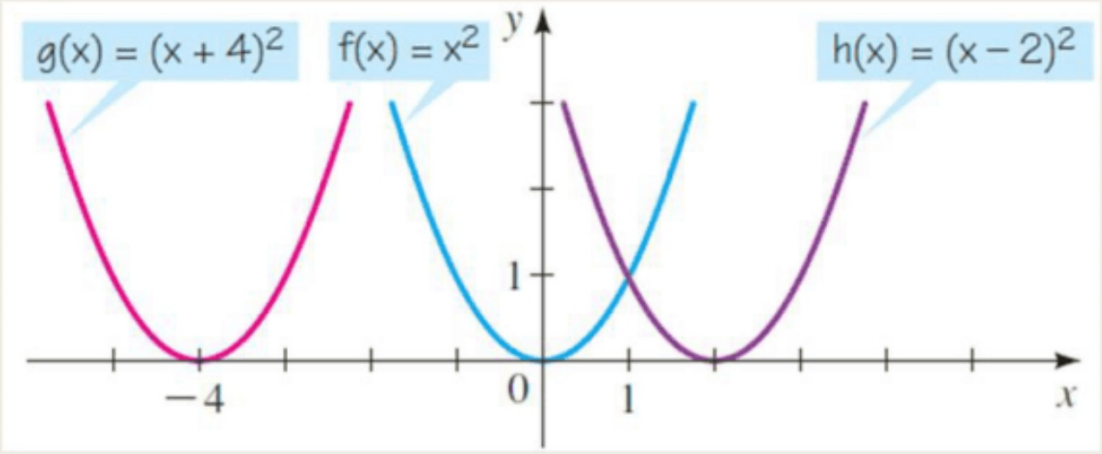
Transformation: Horizontal Shift

So the horizontal shift can also be generalized.

$y = f(x \pm c)$ shifts the graph of $y = f(x)$ to the ~~right~~ left (+) or ~~left~~ right (-) c units, for $c > 0$. Note the **opposite** signs!

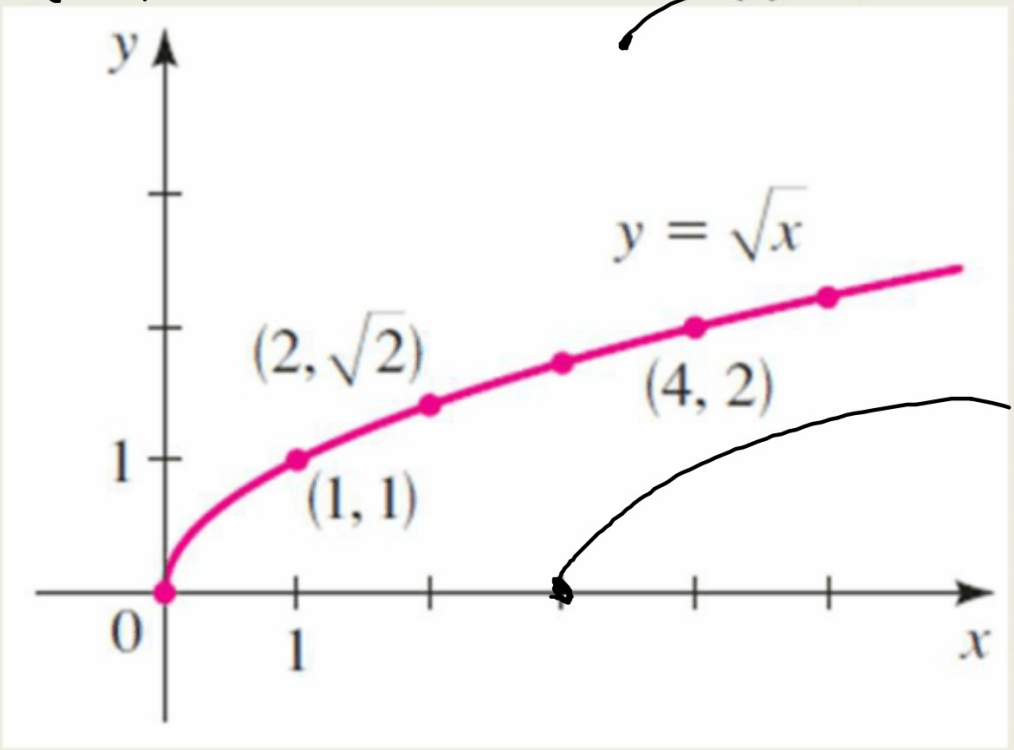
Ex. Use the graph of $f(x) = x^2$ to sketch the graph of,

$g(x) = (x + 4)^2$ and $h(x) = (x - 2)^2$



Example

Use the graph of $f(x) = \sqrt{x}$ shown below to sketch the graph of $g(x) = \sqrt{x-3}$ and $h(x) = \sqrt{x-3} + 4$



Examples

Describe the shift of the function: $g(x) = (x + 11)^2 - 2$ from its "parent" function, $f(x) = x^2$

left 11, down 2

Describe the shift of the function $h(x) = (x - 6)^5 + 1$ from its "parent" function, $f(x) = x^5$

right 6, up 1

Describe the shift of the function $p(x) = \sqrt{x + 5} - 4$ from its "parent" function, $f(x) = \sqrt{x}$

left 5, down 4

Homework 9/10

TB pg. 190 #1-3, 7, 11, 13, 19 (a, b, d), 27, 28, 33, 37, 39