Warm Up 9/12

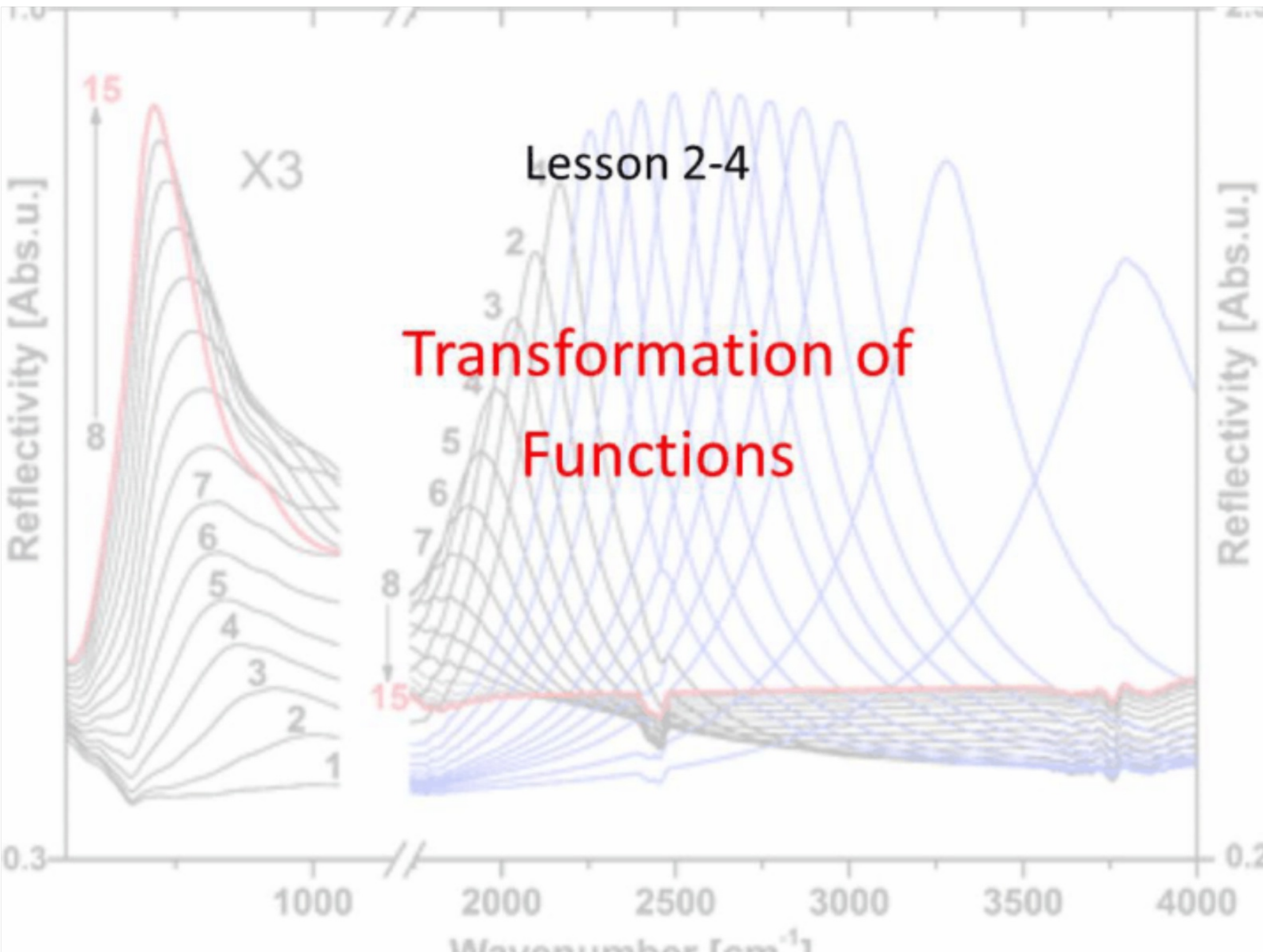
Determine whether f is even, odd, or neither.

a. $f(x) = 2x^5 - 3x^2 + 2$

b. $f(x) = \frac{1}{x+2}$

Lesson 2-4

Transformation of Functions



Objective

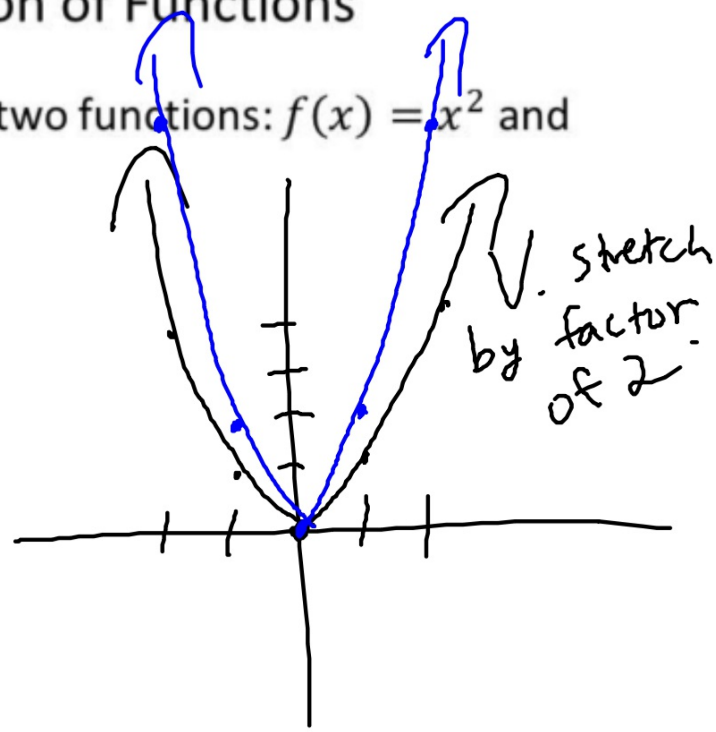
Students will…

- Be able to apply the properties of <u>stretch and compression</u> in graphing various functions.
- Be able to determine the scale factor of the stretch or compression.

Transformation of Functions

Let's go ahead and compare the two functions: $f(x) = x^2$ and $g(x) = 2(x^2)$.

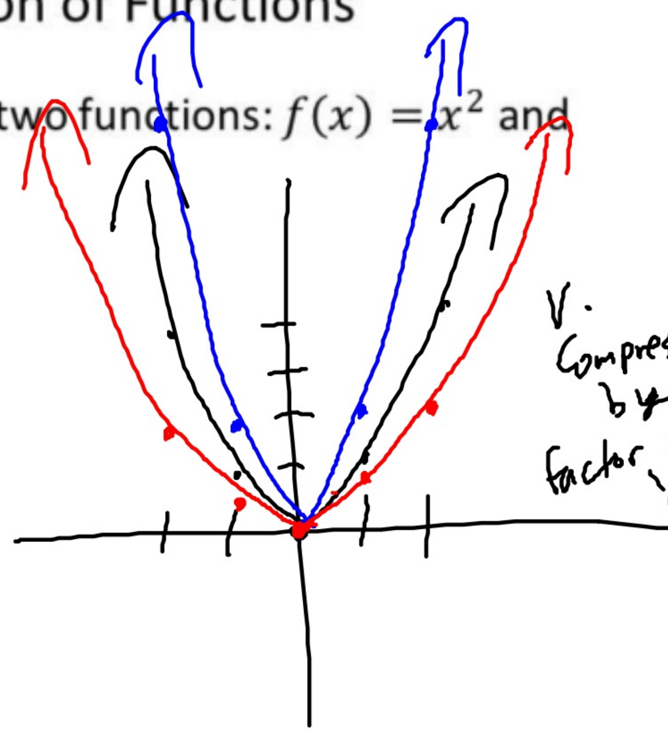
x^2	$2x^2$
$(-2, 4)$	$(-2, 8)$
$(-1, 1)$	$(-1, 2)$
$(0, 0)$	$(0, 0)$
$(1, 1)$	$(1, 2)$
$(2, 4)$	$(2, 8)$



Transformation of Functions

Let's go ahead and compare the two functions: $f(x) = x^2$ and $g(x) = \frac{1}{2}x^2$

x^2	$\frac{1}{2}x^2$
$(-2, 4)$	$(-2, 2)$
$(-1, 1)$	$(-1, \frac{1}{2})$
$(0, 0)$	$(0, 0)$
$(1, 1)$	$(1, \frac{1}{2})$
$(2, 4)$	$(2, 2)$



V. Compression by factor of 1/2

Transformation: Stretch and Compression

As observed, the transformation that took place was a vertical **stretch or a compression** by a certain **scale factor**. This can be generalized by the following:

For $y = cf(x)$

If $c > 1$, stretch the graph of $y = f(x)$ vertically by a factor of c.

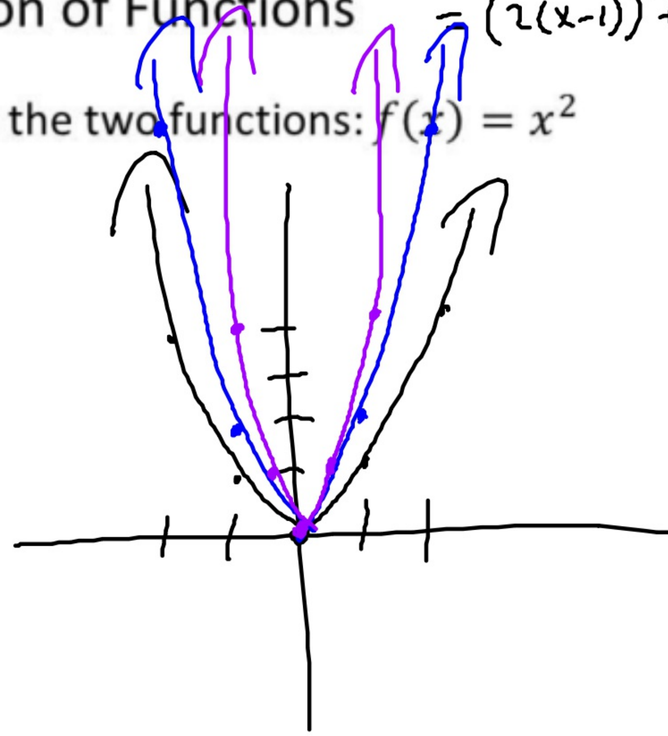
If $0 < c < 1$, compress the graph of $y = f(x)$ vertically by a factor of c.

Transformation of Functions

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

Now let's go ahead and compare the two functions: $f(x) = x^2$ and $g(x) = (2x)^2 = 4x^2$

x^2	$(2x)^2$
$(-2, 4)$	$(-1, 4)$
$(-1, 1)$	$(-\frac{1}{2}, 1)$
$(0, 0)$	$(0, 0)$
$(1, 1)$	$(\frac{1}{2}, 1)$
$(2, 4)$	$(1, 4)$



Transformation of Functions

Now let's go ahead and compare the two functions: $f(x) = x^2$ and $g(x) = \left(\frac{1}{2}x\right)^2$

Transformation: Stretch and Compression

As observed, the transformation that took place was a horizontal **stretch or a compression** by a certain **scale factor**. This can be generalized by the following:

For $y = f(cx)$

If $c > 1$, compress the graph of $y = f(x)$ horizontally by a factor of $\frac{1}{c}$

If $0 < c < 1$, stretch the graph of $y = f(x)$ horizontally by a factor of $\frac{1}{c}$

Note the **opposite relationship** of the scale factor between vertical and horizontal stretch/compression.

Examples

Determine whether the function has a vertical or a horizontal stretch/compression, and determine its scale factor.

a. $f(x) = 3x^2$

Vertical stretch by 3

b. $f(x) = \left(\frac{1}{2}x\right)^3$

horiz. stretch by 2.

c. $h(x) = \frac{3}{4}(x-1)^{19}$

V. C by $3/4$

d. $p(x) = \sqrt{3x}$

H.C by $1/3$.

e. $f(x) = \frac{5}{4}|x|$

Vertical stretch by $5/4$

f. $q(x) = \frac{8}{5}\sqrt[6]{x-1}$

V. stretch by $8/5$.

g. $u(x) = \frac{10}{11}(x-990)^5$

V. comp by $\frac{10}{11}$

h. $t(x) = 3\sqrt{\frac{7}{6}(x+5)}$

V. stretch by 3

H. comp. by $6/7$.

Examples

For the function given function f, write the equation for the final transformed graph, based on the description of the transformation done.

$f(x) = \sqrt[3]{x}$; shift 3 units to the left, stretch vertically by a factor of 5, and reflect in the x-axis.

$$g(x) = -5\sqrt[3]{x+3}$$

Examples

Explain how the graph of g is obtained from the graph of f.

$f(x) = |x|\ ,\ g(x) = 3|x| + 1$

v. stretch by 3, up 1.

$f(x) = |x|\ ,\ g(x) = -|x + 1|$

left 1, reflect vertically

Homework 9/12

Transformation WKSHT