

Lesson 3 Stretches/Compressions

Stretches/Compressions change the shape of the graph but do not change the orientation of the graph.

Graphs of the form $y = af(x)$ such as:

- $y = 2f(x)$ vertical stretch by a factor of 2
- $y = f(x)$ parent shape
- $y = \frac{1}{2}f(x)$ vertical compression by a factor of $\frac{1}{2}$

Vertical Stretches/Compressions and Reflections

$y = af(x)$ is the image graph of $y = f(x)$ after a vertical stretch/compression or reflection.

Note: Point (x, y) becomes point (x, ay)

- When $a > 1$, there is a vertical stretch by a factor of a
- When $0 < a < 1$ there is a vertical compression by a factor of a
- When $a < 0$, there is a reflection in the x -axis as well as a stretch or compression

Graphs of the form $y = f(bx)$

- $y = f(2x)$ horizontal compression by a factor of 2
 - $y = f(x)$ parent shape
 - $y = f\left(\frac{1}{2}x\right)$ horizontal stretch by a factor of 2
- } stretch by a factor of $\frac{1}{b}$
} horizontal stretch by a factor of $\frac{1}{b}$

* divide x -coordinates by b

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Horizontal Stretches/Compressions and Reflections

$y = f(bx)$ is the image graph of $y = f(x)$ after a horizontal stretch, compression or reflection.

Note: Point (x, y) becomes point $(\frac{x}{b}, y)$

- When $b > 1$, there is a horizontal compression
- When $0 < b < 1$, there is a horizontal stretch
- When $b < 0$, there is a reflection in the y -axis as well as the stretch or compression

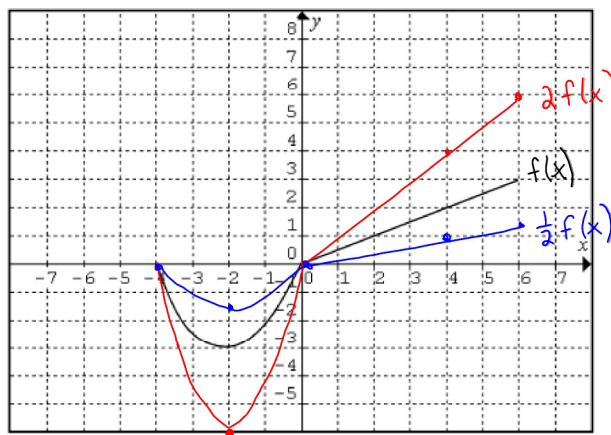
Ex. 1) Sketch

a) $2f(x)$

mult
y-coords
by 2

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

mult y-coords
by $\frac{1}{2}$
(divide by 2)



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Pre-Calculus 12 Enriched Transformations

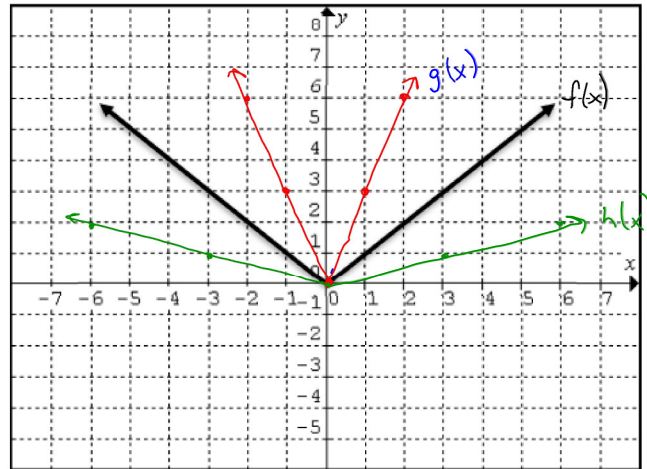
Ex. 2) Given $f(x) = |x|$, sketch

a) $g(x) = f(3x)$

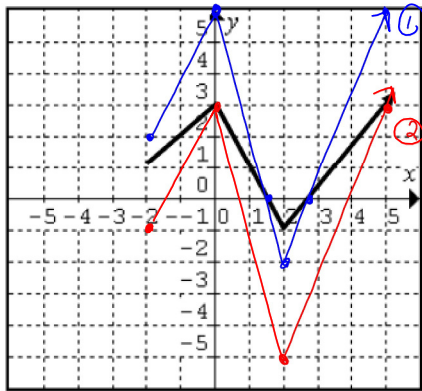
horizontal compression
by a factor of 3
(horizontal stretch by a
factor of $\frac{1}{3}$)
* divide x values by 3

b) $h(x) = f(\frac{1}{3}x)$

horizontal stretch by
a factor of 3
* divide x values by $\frac{1}{3}$
(same as multiplying by 3)



Ex. 3) Sketch $g(x) = 2f(x) - 3$



① $g(x) = 2f(x)$

② $g(x) = 2f(x) - 3$

Order is important!!

① Stretches/
Compressions
and/or
reflections

② Translations

Ex. 4) Given the function $f(x) = 2x - 1$, determine the equation of:

a) $y = 2f(x)$

$$y = 2(2x - 1)$$

$$y = 4x - 2$$

b) $y = f(3x)$

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

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

or $y = 6x - 1$

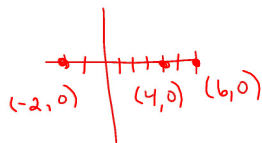
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Pre-Calculus 12 Enriched Transformations

Ex. 5) The x -intercepts of the graph $f(x)$ are $-2, 4,$ and 6 . Determine the x -intercepts after the following transformations.

a) $y = \frac{1}{2}f(x)$ *affects y-coords*

b) $y = f(-2x)$ *affects x-coords*



$-2, 4, 6$

$1, -2, -3$

∴ divide by (-2)

Ex. 6) Determine the equation of $g(x)$ after the following transformations of $f(x)$.

- a horizontal stretch by a factor of 2 $b = \frac{1}{2}$
- a vertical compression by a factor of $\frac{1}{3}$ $a = \frac{1}{3}$
- a reflection in the x -axis $a = -\frac{1}{3}$

$$y = af(bx)$$

$$g(x) = -\frac{1}{3} f\left(\frac{1}{2}x\right)$$