

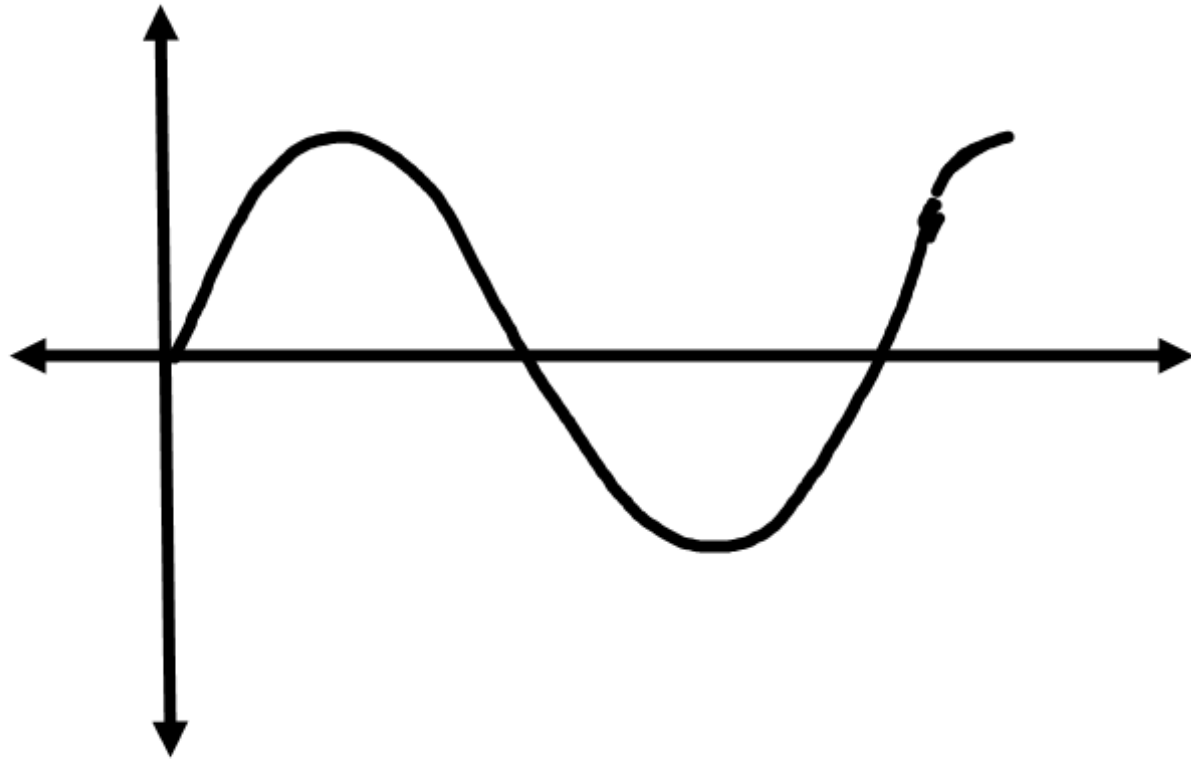
2.7 Vertical Stretch

by a factor of a $a > 1$

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

$$y = 3x^2 \quad 3 > 1$$

Narrow



Vertical Compression by
a factor of a

$$0 < a < 1$$

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

$$y = \frac{1}{4} x^2$$

Vertical compression by a
factor of $\frac{1}{4}$

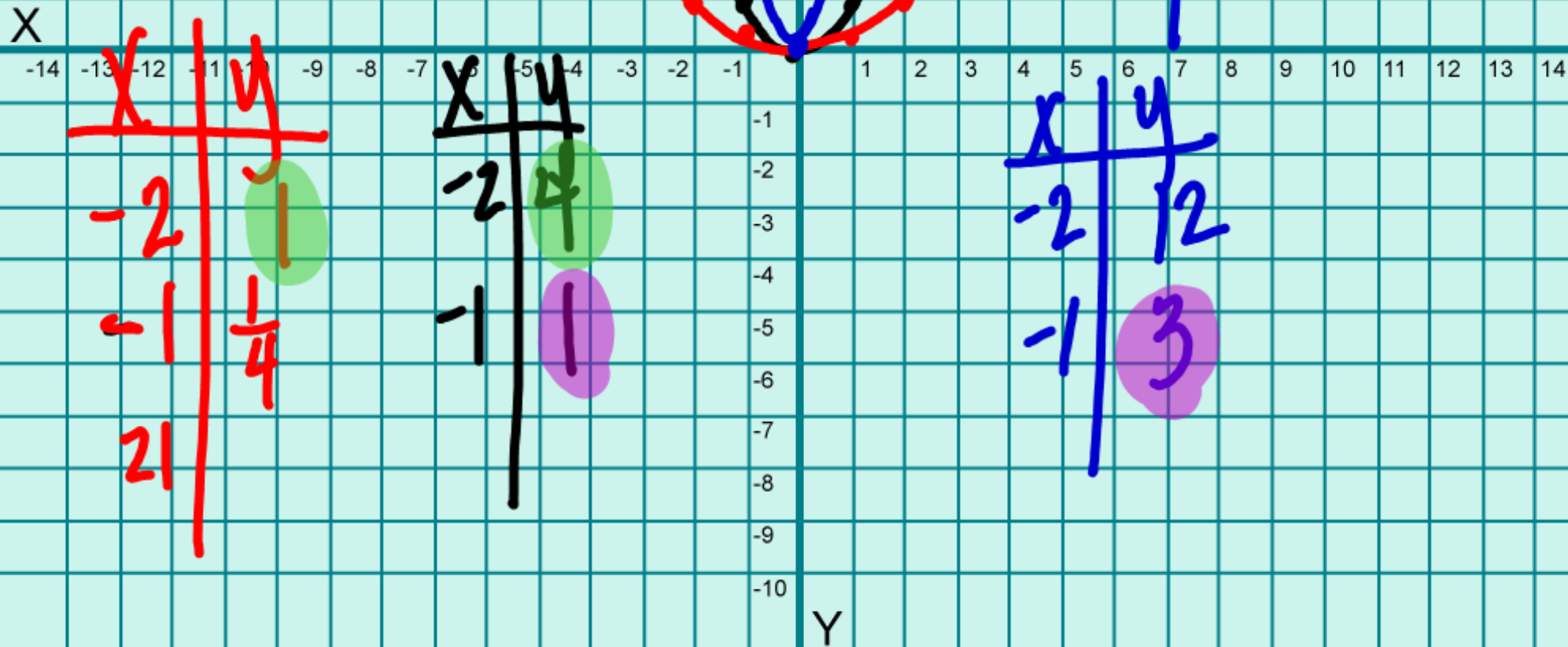
Wide

$$y = \frac{1}{8} x^2$$

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

$$y = \frac{1}{4}x^2$$

$$y = 3x^2$$



Horizontal Stretch
by a factor of $\frac{1}{b}$

$$0 < b < 1$$

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

$$f(x) = |x|$$

$$y = f(bx)$$

$$\frac{1}{2}$$

$$y = \left(\frac{1}{2}x\right)^2$$

$$y = \left|\frac{1}{2}x\right|$$

Horizontal Stretch by a factor
of $\frac{1}{2}$ Wide

Horizontal Compression
by a factor of $\frac{1}{b}$

$$b > 1$$

$$y = f(bx)$$

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

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

Horizontal Compression by
a factor of $\frac{1}{2}$

Narrow

Reflection

Across the x-axis

$$y = -f(x)$$

$$f(x) = 2x$$

$$y = 2x$$

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

$$-4^2$$

$$-16$$

$$y = -x^2$$

$$f(x) = |x|$$

$$y = -|x|$$

$$f(x) = x^2 + 3x + 4$$

$$y = -x^2 - 3x - 4$$

$$y = -(x^2 + 3x + 4)$$

Reflection

Same

$$f(x) = \sqrt{x}$$

$$y = -\sqrt{x}$$

Reflection
across the
X-axis

X

-14 -13 -12 -11 -10 -9 -8 -7 -6 -5 -4 -3 -2 -1 1 2 3 4 5 6 7 8 9 10 11 12 13 14

10
9
8
7
6
5
4
3
2
1

(x, y)

$(1, 4)$



$(x, -y)$

$(1, -4)$



-1
-2
-3
-4
-5
-6
-7
-8
-9
-10

Y

Reflection across the
y-axis

$$y = f(-x)$$

$$y = x^2$$

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

$$y = |x|$$

$$y = |-x|$$

$$y = \sqrt{x}$$

$$y = \sqrt{-x}$$

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

$$y = -3(x+2)^2 - 7$$

Reflection across the x-axis

Vertical stretch by a factor of 3

Horizontal translation 2 units left

Vertical translation 7 units down

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