

## 2.4 Transformations of Graphs

Review: General Graphs:

Quadratic:  $y = x^2$

Square Root Graphs:  $y = \sqrt{x}$

Absolute Value Graphs:  $y = |x|$

Cubic Graphs:  $y = x^3$

Reciprocal Graphs:  $y = \frac{1}{x}$

### **Transformations:**

Given the function  $y = f(x)$

#### Translations:

Horizontal translation:  $y = f(x - c)$

$c > 0$  is right

$c < 0$  is left

Vertical translation:  $y = f(x) + d$

$d > 0$  is up

$d < 0$  is down

**Example:** Given point  $(1, 2)$  is in  $y = f(x)$ . What is the new point after:

a.)  $y = f(x + 3)$

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

c.)  $y = f(x) + 4$

d.)  $y = f(x) - 1$

#### Compressions & Expansions

Horizontal:  $y = f(bx)$

$|b| > 1$  is **compression**

$|b| < 1$  is **expansion**

Vertical:  $y = af(x)$

$|a| > 1$  is expansion

$|a| < 1$  is compression

**Example:** Given point (1, 2) is in  $y = f(x)$ . What is the new point after:

a.)  $y = 3f(x)$

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

c.)  $y = f\left(\frac{3}{4}x\right)$

d.)  $y = f(3x)$

Reflections:

Vertical:  $y = af(x)$

$a < 0$  (across x-axis)

Horizontal:  $y = f(bx)$

$b < 0$  (across y-axis)

**Example:** Given point (1, 2) is in  $y = f(x)$ . What is the new point after:

a.)  $y = -f(x)$

b.)  $y = f(-x)$

**General Examples:**

1. Given:  $y = \sqrt{x}$ , write the equation after:

a.) Translation up 5, right 2

b.) Horizontal Compression by a factor of 2 (or to a factor of  $\frac{1}{2}$ )

c.) Reflection across the x-axis

2. Given:  $y = -x^2$  write the equation after:

a.) Translation down 3, left 2

b.) Vertical Expansion by a factor of 3

c.) Reflection across the y-axis

**Absolute Value Functions:**

The domain remains the same, the range becomes positive or stays positive.

**Reciprocal Function**

Domain remains the same, take the reciprocal of the range:

**Example:** Given point  $(-1, -2)$  is in  $y = f(x)$ . What is the new point after:

a.)  $y = |f(x)|$

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