

# Function Transformations of

$$y = a(bx \pm c) \pm d \text{ or } y = a \sin(bx \pm c) \pm d$$

1. If  $y = f(x)$ , then  $y = f(x) \pm d$

- If  $d > 0$  it's a **vertical translation up  $d$  units**
- If  $d < 0$  it's a **vertical translation down  $d$  units**

2. If  $y = f(x)$ , then  $y = f(x \pm c)$

- If  $c > 0$  it's a **horizontal translation left  $c$  units**
- If  $c < 0$  it's a **horizontal translation right  $c$  units**

3. If  $y = f(x)$ , then  $y = af(x)$

- If  $a < -1$  or  $a > 1$  (meaning it's a **whole number**)  
Then it's a **vertical stretch** by a factor of  $a$
- If  $a > -1$  or  $a < 1$  (meaning it's a **fraction**)  
Then it's a **vertical compression** by a factor of  $a$

multiply each y  
value by  $a$

4. If  $y = f(x)$ , then  $y = f(bx)$

- If  $b < -1$  or  $b > 1$  (meaning it's a **whole number**)  
Then **horizontal compression** by a factor of  $\frac{1}{b}$
- If  $b > -1$  or  $b < 1$  (meaning it's a **fraction**)  
Then **horizontal stretch** by a factor of the reciprocal of  $b$

multiply each  $x$   
by  $\frac{1}{b}$  or  
reciprocal

5. If  $y = f(x)$ , then  $y = -f(x)$ , then it's a **reflection across the x-axis**

6. If  $y = f(x)$ , then  $y = f(-x)$ , then it's a **reflection across the y-axis**