Recall: State the characteristics of \( y = -3(x-2)^2+4 \).

<table>
<thead>
<tr>
<th>Vertex</th>
<th>Domain</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direction of opening</td>
<td></td>
</tr>
<tr>
<td>Axis of symmetry</td>
<td></td>
</tr>
<tr>
<td>Range</td>
<td></td>
</tr>
</tbody>
</table>

What would the graph of \( y = (2x)^2 \) look like?

Using algebra, it simplifies to \( y = 2^2x^2 \) or \( y = 4x^2 \)... this horizontal change was simplified to look like a vertical stretch factor 4.

Let’s look at a table of values to see how \( x \) changed.

<table>
<thead>
<tr>
<th>( x )</th>
<th>( y = x^2 )</th>
<th>( x )</th>
<th>( y = (2x)^2 )</th>
<th>( y = 4x^2 )</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>1/2</td>
<td>4 ( (1/2)^2 = 1 )</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>4</td>
<td>1</td>
<td>4 ( 1^2 = 4 )</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>9</td>
<td>3/2</td>
<td>4 ( (3/2)^2 = 4 \left(\frac{9}{4}\right) = 9 )</td>
<td></td>
</tr>
</tbody>
</table>

Notice: to get the same \( y \)-values, \( x \) is \( \frac{1}{2} \) as much when there is a two in front of the \( x \).

Try \( y = \left(\frac{1}{3}x\right)^2 \)

<table>
<thead>
<tr>
<th>( x )</th>
<th>( y = x^2 )</th>
<th>( x )</th>
<th>( y = \left(\frac{1}{3}x\right)^2 )</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>4</td>
<td>6</td>
<td>4</td>
</tr>
<tr>
<td>3</td>
<td>9</td>
<td>9</td>
<td>9</td>
</tr>
</tbody>
</table>

Notice: to get the same \( y \)-values, \( x \) is \( \frac{1}{3} \) as much when there is a one-third in front of the \( x \).

In General: \( y = af(b(x-h)) + k \)

- \( a \) is: a reflection in the x-axis when \( a < 0 \);
  a vertical stretch when \( |a| > 1 \);
  a vertical compression when \( 0 < |a| < 1 \)
- \( b \) is: a reflection in the y-axis when \( b < 0 \);
  a horizontal stretch factor \( \frac{1}{b} \) when \( 0 < |b| < 1 \);
  a horizontal compression factor \( \frac{1}{b} \) when \( |b| > 1 \)

Horizontal is opposite to what it looks like…
When \( b = 3 \), it is a horizontal compression (divide by 3 or multiply by a third).
When \( b = \frac{1}{3} \), it is a horizontal stretch factor 3.

Applying the transformations you have learned to the Root Function.

- a:
  \( y = a f(x) \)  \hspace{1cm} or \hspace{1cm} \( y = a\sqrt{x} \)
- b:
  \( y = a f(bx) \)  \hspace{1cm} or \hspace{1cm} \( y = \) 
- h:
  \( y = a f(b(x-h)) \)  \hspace{1cm} or \hspace{1cm} \( y = \) 
- k:
  \( y = a f(b(x-h)) + k \)  \hspace{1cm} or \hspace{1cm} \( y = \) 

Describe the transformations to the Root function and apply them as necessary to graph the following equations. State the domain and range. ***Remember: When applying transformations, stretches and reflections must always be done before shifts.***

1. \( y = -\sqrt{2x} \)

2. \( f(x) = 3\sqrt{x} - 1 \)

3. \( y = -4 + \sqrt{3 - 3x} \)

4. \( g(x) = \sqrt{\frac{1}{2}(x + 4)} - 5 \)

State the domain and range for the following without graphing.

1. \( y = \frac{1}{\sqrt{4x + 2}} \) \quad 2. \( g(x) = 3 - \sqrt{x - 2} \) \quad 3. \( h(x) = \sqrt{3x - 6} \)

Applying the transformations you have learned to the \textbf{Reciprocal Function} \( f(x) = \frac{1}{x} \)

\[
\begin{align*}
a: & \quad y = a f(x) \quad \text{or} \quad y = \\
b: & \quad y = a f(bx) \quad \text{or} \quad y = \\
h: & \quad y = a f[b(x-h)] \quad \text{or} \quad y = \\
k: & \quad y = a f[b(x-h)] + k \quad \text{or} \quad y =
\end{align*}
\]
U3D7

Remember the graph of

\[ y = \frac{1}{x} \]

Describe the transformations to the Reciprocal function and apply them as necessary to graph the following equations. State the domain and range.

1. \( f(x) = \frac{3}{x-4} \)

2. \( g(x) = 3 - \frac{1}{2x} \)

State the domain and range for the following without graphing. (Remember: asymptotes only move with shifts (L/R, U/D))

1. \( y = \frac{1}{x+3} + 8 \)

2. \( f(x) = \frac{5}{x-9} - 11 \)

3. \( y = \frac{2}{5-3x} - 7 \)
The function given in each graph below is $f(x)$. Sketch the graph of the indicated new function. REMEMBER — Stretch and reflect FIRST, then slide LAST.

\[ y = \frac{3}{4} f(x) \]

\[ y = f\left(\frac{1}{2} x\right) \]

\[ y = f(2x) \]

\[ y = 2f(-x) \]

\[ y = 2f\left(-\frac{1}{2} x\right) \]

\[ y = -\frac{1}{2} f(-2x) \]