

Transforming Quadratic Equations

We've learned how to identify transformations (RST rst) from an equation. Now, we'll learn to use given transformations to write quadratic equations. First, you have to know what RST & rst mean. Once you know that, you can plug those values into the equation:  $g(x) = RS(rsx + t)^2 + T$ .

| <b>Vertical (y) - Straight up</b>   | <b>Horizontal (x) - Liar, Liar</b>  |
|---|---|
| <b>R (-)</b> means<br>"Reflection over the $x$ -axis" (reflection down)<br><b>S (multiplication)</b> means<br>"Vertical Stretch" or "Vertical Compression"<br><b>T (addition)</b> means<br>"Translation up (+)" or "Translation down (-)" | <b>r (-)</b> means<br>"Reflection over the $y$ -axis" (reflection left)<br><b>s (multiplication)</b> means<br>"Horizontal Stretch" or<br>"Horizontal Compression"<br><i><b>"s" is a lie! If it says it's multiplying, it's really dividing—use the reciprocal!</b></i><br><b>t (addition)</b> means<br>"Translation right (+)" or "Translation left (-)"<br><i><b>"t" is a lie! If it says it's adding, it's really subtracting—change the <math>\pm</math> sign!</b></i> |

**EXAMPLE**

The parent function  $f(x) = x^2$  is **reflected over the  $x$ -axis, vertically stretched by a factor of 3, horizontally stretched by a factor of 2, translated right 7 units, and up 4 units** to create  $g$ . Use the description to write the quadratic function in vertex form.

The words "parent function  $f(x) = x^2$ " are there so we know it's a quadratic (uses an exponent of 2). The set up:

$$g(x) = RS(rsx + t)^2 + T$$

**reflected over the  $x$ -axis (down)  $\rightarrow$  R**  
**vertically stretched by a factor of 3  $\rightarrow$  S**  
**and up 4 units  $\rightarrow$  T**

**R: -**  
**S: 3**  
**T: +4**

**horizontally stretched by a factor of 2  $\rightarrow$  s**

**LIES!!!**

**translated right 7 units  $\rightarrow$  t**

**LIES!!!**

**r: none (+)**  
**s: LIE  $\rightarrow$  2**  
**TRUTH  $\rightarrow$   $\frac{1}{2}$**   
**t: LIE  $\rightarrow$  +7**  
**TRUTH  $\rightarrow$  -7**

$$g(x) = RS(rsx + t)^2 + T$$

$$g(x) = -3 \left( +\frac{1}{2}x + -7 \right)^2 + 4$$

$$g(x) = -3 \left( \frac{1}{2}x - 7 \right)^2 + 4$$

Now, it's your turn.

|  |  |           |           |  |  |                                       |           |  |  |                                       |   |           |           |           |  |  |                                       |           |  |  |                                       |
|--|--|-----------|-----------|--|--|---------------------------------------|-----------|--|--|---------------------------------------|---|-----------|-----------|-----------|--|--|---------------------------------------|-----------|--|--|---------------------------------------|
| <p>1. The parent function <math>f(x) = x^2</math> is reflected over the <math>y</math>-axis, vertically stretched by a factor of 2, translated down 5 units, and left 3 units to create <math>g</math>. Use the description to write the quadratic function in vertex form.</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 50%;"><b>R:</b></td> <td style="width: 50%;"><b>r:</b></td> </tr> <tr> <td><b>S:</b></td> <td><b>s: LIE <math>\rightarrow</math></b></td> </tr> <tr> <td></td> <td style="text-align: center;"><b>TRUTH <math>\rightarrow</math></b></td> </tr> <tr> <td><b>T:</b></td> <td><b>t: LIE <math>\rightarrow</math></b></td> </tr> <tr> <td></td> <td style="text-align: center;"><b>TRUTH <math>\rightarrow</math></b></td> </tr> </table> | <b>R:</b>                              | <b>r:</b> | <b>S:</b> | <b>s: LIE <math>\rightarrow</math></b> |  | <b>TRUTH <math>\rightarrow</math></b> | <b>T:</b> | <b>t: LIE <math>\rightarrow</math></b> |  | <b>TRUTH <math>\rightarrow</math></b> | <p>2. The parent function <math>f(x) = x^2</math> is horizontally compressed by a factor of <math>\frac{2}{3}</math>, translated right 6 units, and down 9 units to create <math>g</math>. Use the description to write the quadratic function in vertex form.</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 50%;"><b>R:</b></td> <td style="width: 50%;"><b>r:</b></td> </tr> <tr> <td><b>S:</b></td> <td><b>s: LIE <math>\rightarrow</math></b></td> </tr> <tr> <td></td> <td style="text-align: center;"><b>TRUTH <math>\rightarrow</math></b></td> </tr> <tr> <td><b>T:</b></td> <td><b>t: LIE <math>\rightarrow</math></b></td> </tr> <tr> <td></td> <td style="text-align: center;"><b>TRUTH <math>\rightarrow</math></b></td> </tr> </table> | <b>R:</b> | <b>r:</b> | <b>S:</b> | <b>s: LIE <math>\rightarrow</math></b> |  | <b>TRUTH <math>\rightarrow</math></b> | <b>T:</b> | <b>t: LIE <math>\rightarrow</math></b> |  | <b>TRUTH <math>\rightarrow</math></b> |
| <b>R:</b>  | <b>r:</b>                              |           |           |  |  |                                       |           |  |  |                                       |   |           |           |           |  |  |                                       |           |  |  |                                       |
| <b>S:</b>  | <b>s: LIE <math>\rightarrow</math></b> |           |           |  |  |                                       |           |  |  |                                       |   |           |           |           |  |  |                                       |           |  |  |                                       |
|  | <b>TRUTH <math>\rightarrow</math></b>  |           |           |  |  |                                       |           |  |  |                                       |   |           |           |           |  |  |                                       |           |  |  |                                       |
| <b>T:</b>  | <b>t: LIE <math>\rightarrow</math></b> |           |           |  |  |                                       |           |  |  |                                       |   |           |           |           |  |  |                                       |           |  |  |                                       |
|  | <b>TRUTH <math>\rightarrow</math></b>  |           |           |  |  |                                       |           |  |  |                                       |   |           |           |           |  |  |                                       |           |  |  |                                       |
| <b>R:</b>  | <b>r:</b>                              |           |           |  |  |                                       |           |  |  |                                       |   |           |           |           |  |  |                                       |           |  |  |                                       |
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| <b>T:</b>  | <b>t: LIE <math>\rightarrow</math></b> |           |           |  |  |                                       |           |  |  |                                       |   |           |           |           |  |  |                                       |           |  |  |                                       |
|  | <b>TRUTH <math>\rightarrow</math></b>  |           |           |  |  |                                       |           |  |  |                                       |   |           |           |           |  |  |                                       |           |  |  |                                       |

|   |  |           |           |                          |           |                          |   |           |           |           |                          |           |                          |
|---|--|-----------|-----------|--------------------------|-----------|--------------------------|---|-----------|-----------|-----------|--------------------------|-----------|--------------------------|
| <p>3. The parent function <math>f(x) = x^2</math> is reflected over the <math>x</math>-axis, vertically compressed by a factor of <math>\frac{5}{6}</math>, and translated up 2 units to create <math>g</math>. Use the description to write the quadratic function in vertex form.</p> <table border="1" data-bbox="142 310 797 646"> <tbody> <tr> <td><b>R:</b></td> <td><b>r:</b></td> </tr> <tr> <td><b>S:</b></td> <td><b>s:</b> LIE→<br/>TRUTH→</td> </tr> <tr> <td><b>T:</b></td> <td><b>t:</b> LIE→<br/>TRUTH→</td> </tr> </tbody> </table> | <b>R:</b>  | <b>r:</b> | <b>S:</b> | <b>s:</b> LIE→<br>TRUTH→ | <b>T:</b> | <b>t:</b> LIE→<br>TRUTH→ | <p>4. The parent function <math>f(x) = x^2</math> is reflected over the <math>x</math>-axis, horizontally stretched by a factor of <math>\frac{7}{2}</math>, translated left 8 units, and down 2 units to create <math>g</math>. Use the description to write the quadratic function in vertex form.</p> <table border="1" data-bbox="824 310 1479 646"> <tbody> <tr> <td><b>R:</b></td> <td><b>r:</b></td> </tr> <tr> <td><b>S:</b></td> <td><b>s:</b> LIE→<br/>TRUTH→</td> </tr> <tr> <td><b>T:</b></td> <td><b>t:</b> LIE→<br/>TRUTH→</td> </tr> </tbody> </table> | <b>R:</b> | <b>r:</b> | <b>S:</b> | <b>s:</b> LIE→<br>TRUTH→ | <b>T:</b> | <b>t:</b> LIE→<br>TRUTH→ |
| <b>R:</b>   | <b>r:</b>  |           |           |                          |           |                          |   |           |           |           |                          |           |                          |
| <b>S:</b>   | <b>s:</b> LIE→<br>TRUTH→   |           |           |                          |           |                          |   |           |           |           |                          |           |                          |
| <b>T:</b>   | <b>t:</b> LIE→<br>TRUTH→   |           |           |                          |           |                          |   |           |           |           |                          |           |                          |
| <b>R:</b>   | <b>r:</b>  |           |           |                          |           |                          |   |           |           |           |                          |           |                          |
| <b>S:</b>   | <b>s:</b> LIE→<br>TRUTH→   |           |           |                          |           |                          |   |           |           |           |                          |           |                          |
| <b>T:</b>   | <b>t:</b> LIE→<br>TRUTH→   |           |           |                          |           |                          |   |           |           |           |                          |           |                          |
| <p>5. The parent function <math>f(x) = x^2</math> is reflected over the <math>y</math>-axis, vertically stretched by a factor of 2, and horizontally stretched by a factor of 3 to create <math>g</math>. Use the description to write the quadratic function in vertex form.</p>   | <p>6. The parent function <math>f(x) = x^2</math> is reflected over the <math>x</math>-axis, horizontally compressed by a factor of <math>\frac{1}{4}</math>, and translated down 1 unit to create <math>g</math>. Use the description to write the quadratic function in vertex form.</p> |           |           |                          |           |                          |   |           |           |           |                          |           |                          |
| <p>7. The parent function <math>f(x) = x^2</math> is vertically stretched by a factor of <math>\frac{3}{2}</math>, horizontally compressed by a factor of <math>\frac{2}{5}</math>, and translated down 3 units to create <math>g</math>. Use the description to write the quadratic function in vertex form.</p>   | <p>8. The parent function <math>f(x) = x^2</math> is reflected over the <math>x</math>-axis, horizontally stretched by a factor of <math>\frac{6}{5}</math>, and translated left 6 units to create <math>g</math>. Use the description to write the quadratic function in vertex form.</p> |           |           |                          |           |                          |   |           |           |           |                          |           |                          |
| <p>9. The parent function <math>f(x) = x^2</math> is reflected over the <math>y</math>-axis, horizontally stretched by a factor of 6, and translated right 2 units to create <math>g</math>. Use the description to write the quadratic function in vertex form.</p>  | <p>10. The parent function <math>f(x) = x^2</math> is vertically stretched by a factor of 5, and translated right 2 units to create <math>g</math>. Use the description to write the quadratic function in vertex form.</p>  |           |           |                          |           |                          |   |           |           |           |                          |           |                          |