

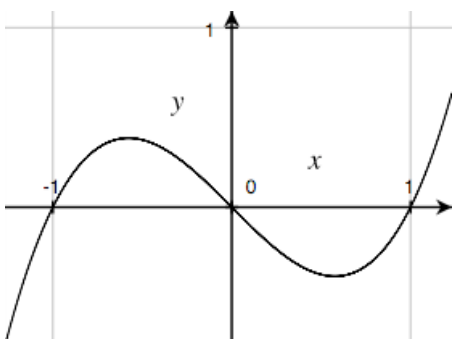
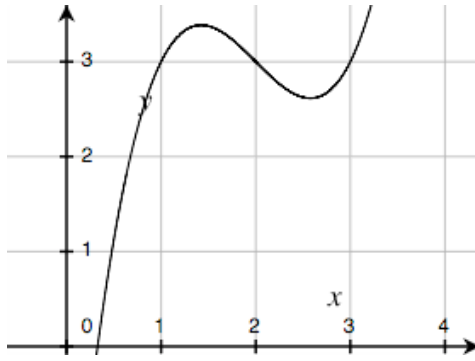
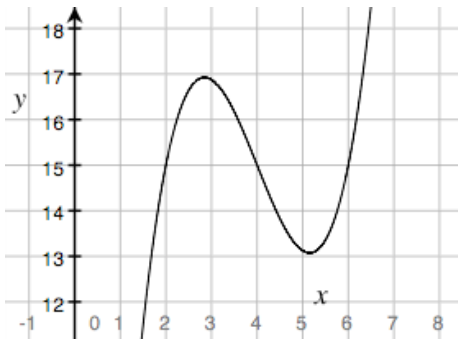
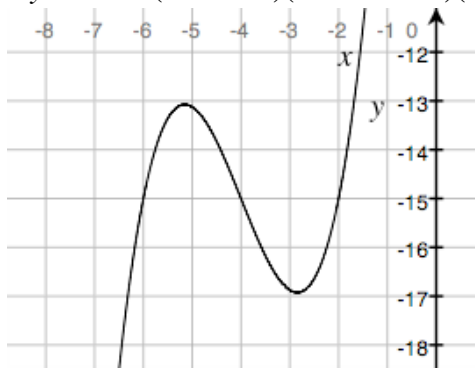
## Essence of Basic Transformations

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**Note:**  $v$  represents one variable. In two dimensions,  $v$  could be  $x$  or  $y$ .

To	Replace $v$ -values in all points by	Replace all parent relation's $v$ -variables by
translate $c$ units in $v$ direction	$v + c$	$v - c$
dilate by $c$ in $v$ direction	$cv$	$v/c$ ; $0 < c < 1$ shrinks, $1 < c$ stretches*
reflect in $v = 0$	$-v$	$-v$
reflect in origin	reflect in $v = 0$ for all $v$	
reflect in $y = x$	$(x, y) \rightarrow (y, x)$ in relation and all points. (Do this to get inverses. E.g., $y = e^x \rightarrow x = e^y \Leftrightarrow y = \ln x$ .)	
rotate $+90^\circ$	$(x, y) \rightarrow (-y, x)$ in relation and all points. (If $m$ is slope, then for lines: $l_1 \perp l_2 \Leftrightarrow m_2 = -1/m_1$ )	

Examples:

<p>1. Parent, <math>y = x(x+1)(x-1)</math>:</p> 	<p>2. Translate up 3, right 2 (translation vector: <math>\langle 2, 3 \rangle</math>), <math>y - 3 = (x - 2)(x - 2 + 1)(x - 2 - 1)</math>:</p> 
<p>3. Stretch vertically 5 units and horizontally 2, <math>y/5 - 3 = (x/2 - 2)(x/2 - 2 + 1)(x/2 - 2 - 1)</math></p> 	<p>4. Reflect in origin (note axes scales): <math>-y/5 - 3 = (-x/2 - 2)(-x/2 - 2 + 1)(-x/2 - 2 - 1)</math></p> 

\* Some texts treat stretching in  $x$  and  $y$  directions differently. In Blitzer, Precalculus, 2nd Ed,  $y = f(x) \rightarrow y = c_y f(c_x x)$ , where in the  $x$  direction  $0 < c_x < 1$  stretches and  $1 < c_x$  shrinks.