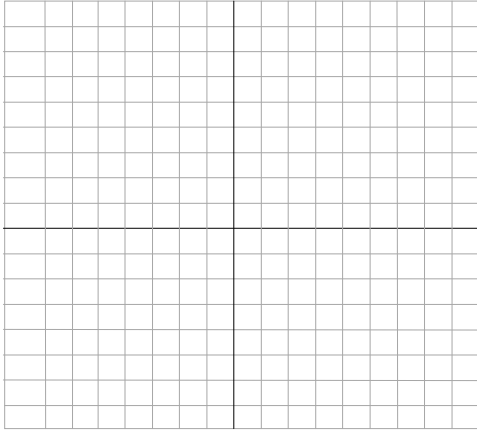


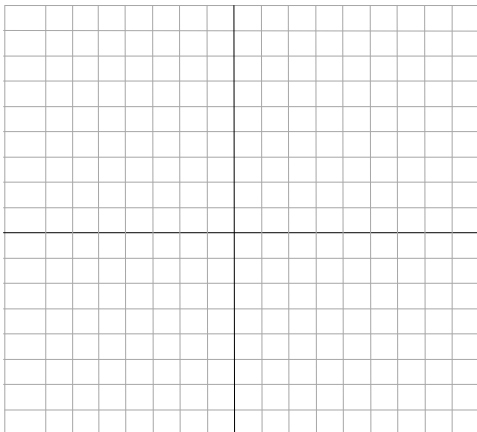
Using transformations to graph.

(1) On the axes below, graph $y = x^2$, $y = x^2 - 4$, and $y = x^2 + 2$



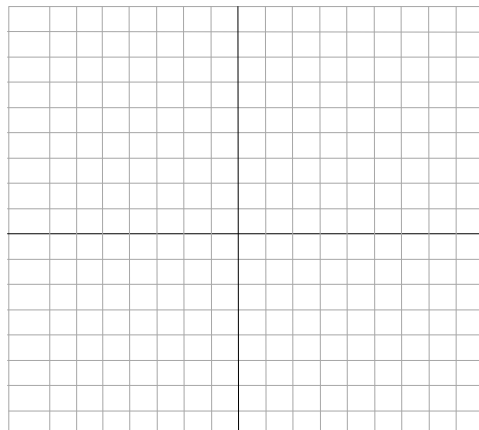
GENERALIZATION: VERTICAL SHIFT - For $c > 0$, to graph $f(x) + c$, shift the graph of $f(x)$ UP c units,
 $f(x) - c$, shift the graph of $f(x)$ DOWN c units.

(2) On the axes below, graph $y = x^2$, $y = (x-2)^2$, and $y = (x+3)^2$.

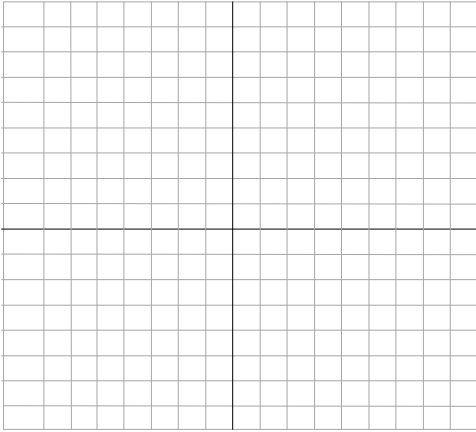


GENERALIZATION: HORIZONTAL SHIFT - For $c > 0$, to graph $f(x+c)$, shift the graph of $f(x)$ LEFT c units,
 $f(x-c)$, shift the graph of $f(x)$ RIGHT c units.

Example: Combining horizontal and vertical shifts.

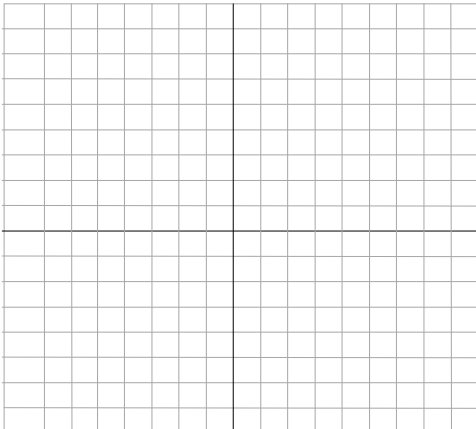


(3) Graph $y = \sqrt{x}$, $y = -\sqrt{x}$, $y = \sqrt{-x}$



GENERALIZATION: REFLECTION -To graph
- $f(x)$, reflect the graph of $f(x)$ in the x axis,
 $f(-x)$, reflect the graph of $f(x)$ in the y axis.

(4) Graph $y = x^2$, $y = 3x^2$, and $y = \frac{1}{2}x^2$.



GENERALIZATION: VERTICAL STRETCH/SHRINK -
 $cf(x)$ where $c > 1$, vertically stretch the graph of $f(x)$,
 $cf(x)$ where $0 < c < 1$, vertically shrink or compress the graph of $f(x)$.

Example:

