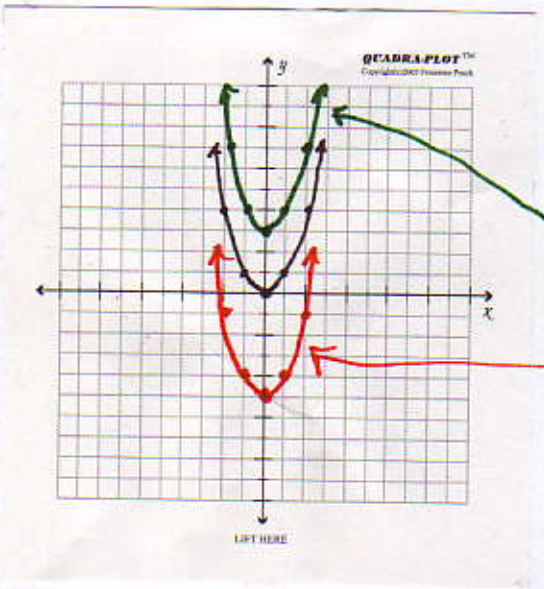
SEC 3.4 TRANSFORMATIONS OF FUNCTIONS

1. VERTICAL SHIFTS

A) SHIFT UP $y = f(x) + c$ IF $c > 0$

B) SHIFT DOWN $y = f(x) - c$ IF $c > 0$



$f(x) = x^2$

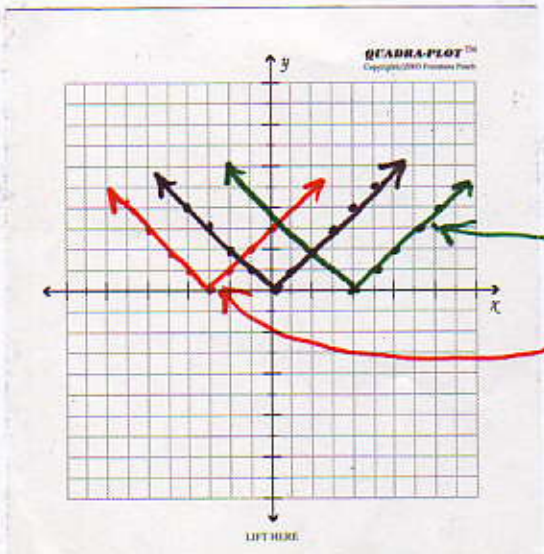
SHIFT UP $f(x) = x^2 + 3$

SHIFT DOWN $f(x) = x^2 - 5$

2. HORIZONTAL SHIFTS

A) SHIFT RIGHT $y = f(x - c)$ IF $c > 0$

B) SHIFT LEFT $y = f(x + c)$ IF $c > 0$



$f(x) = |x|$

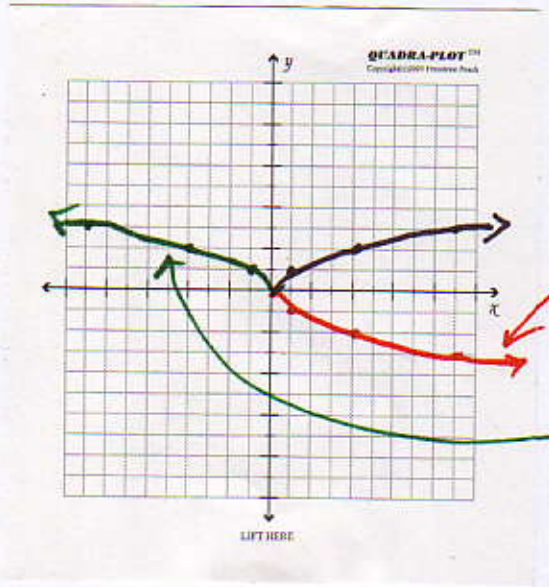
SHIFT RIGHT $f(x) = |x - 4|$

SHIFT LEFT $f(x) = |x + 3|$

3. REFLECTIONS

A) ABOUT x-AXIS $y = -f(x)$

B) ABOUT y-AXIS $y = f(-x)$



$f(x) = \sqrt{x}$

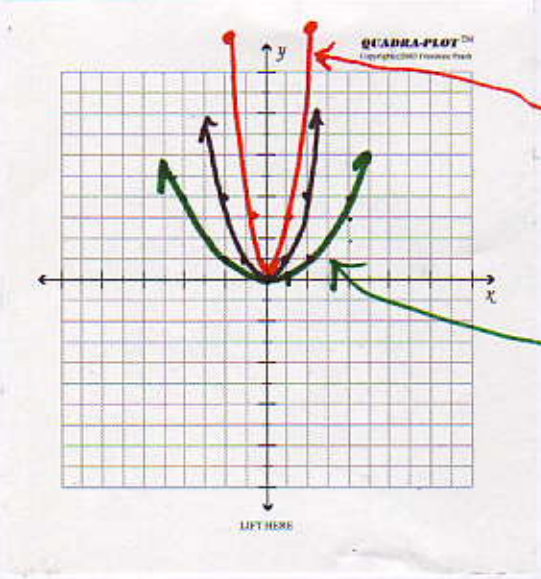
ABOUT x-AXIS $f(x) = -\sqrt{x}$

ABOUT y-AXIS $f(x) = \sqrt{-x}$

4. VERTICAL STRETCH OR SHRINK

A) VERTICAL STRETCH BY A FACTOR OF c $y = c\,f(x)$ $c > 1$

B) VERTICAL SHRINK (COMPRESSION) BY A FACTOR OF c $y = c\,f(x)$ $0 < c < 1$ FRACTION



$f(x) = x^2$

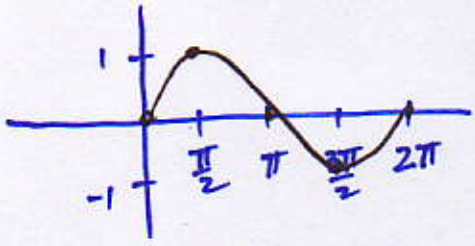
VERTICAL STRETCH $f(x) = 3x^2$

VERTICAL SHRINK $f(x) = \frac{1}{4}x^2$

5. HORIZONTAL STRETCH OR SHRINK

A) HORIZONTAL SHRINK (COMPRESSION) $y = f(cx)$ IF $c > 1$
BY A FACTOR OF $1/c$

B) HORIZONTAL STRETCH $y = f(cx)$ IF $0 < c < 1$ (FRACTION)
BY A FACTOR OF $1/c$

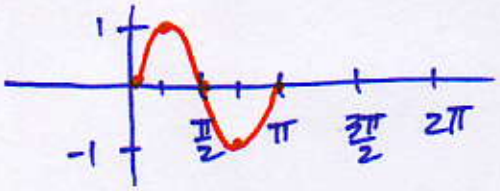


$f(x) = \sin x$

HORIZONTAL SHRINK

$f(x) = \sin 2x$

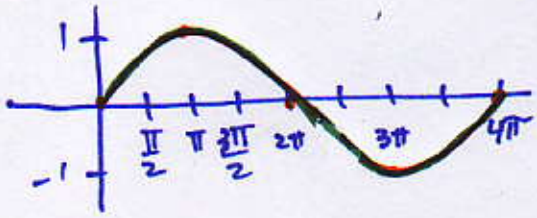
(HALF THE DISTANCE)



HORIZONTAL STRETCH

$f(x) = \sin \frac{1}{2}x$

(TWICE THE LENGTH)



6. ODD AND EVEN FUNCTIONS

A) ODD: SUBSTITUTE $(-x)$ IN FOR EVERY "x" IN THE FUNCTION. IF EVERY TERM IS EXACTLY OPPOSITE THE ORIGINAL FUNCTION, IT IS ODD.

OPPOSITE ⇒ ODD

(SYMMETRY ABOUT ORIGIN)

B) EVEN: SUBSTITUTE $(-x)$ INTO THE FUNCTION FOR "x", IF IT IS EXACTLY LIKE THE ORIGINAL, IT IS EVEN.

EXACTLY ⇒ EVEN

(SYMMETRY ABOUT y-AXIS)