Vertically Shifting the Graph Upward:

\[ y = f(x) + c \]
Shift graph upward \( c \) units. \((c > 0)\)

Example: \( f(x) = x^2 + 1 \)
and \( f(x) = x^2 + 5 \)

Vertically Shifting the Graph Downward:

\[ y = f(x) - c \]
Shift graph downward \( c \) units. \((c > 0)\)

Example: \( f(x) = x^2 - 1 \)
and \( f(x) = x^2 - 5 \)

Horizontally Shifting the Graph to the Right:

\[ y = f(x - c) \]
Shift graph to the right \( c \) units. \((c > 0)\)

Example: \( f(x) = (x - 1)^2 \)
and \( f(x) = (x - 5)^2 \)

Horizontally Shifting the Graph to the Left:

\[ y = f(x + c) \]
Shift graph to the left \( c \) units. \((c > 0)\)

Example: \( f(x) = (x + 1)^2 \)
and \( f(x) = (x + 5)^2 \)
The following is to help you understand part 5 of the homework:

- **a)** \( f(x + 3) \)
  - Left 3 units

- **b)** \( f(x) + 3 \)
  - Up 3 units

- **c)** \( f(x + 3) + 1 \)
  - Left 3 units, up 1 unit

The following is to help you understand part 6 of the homework:

### Vertically Stretching:

\[ y = c \cdot f(x) \]

\( (c > 1) \)

**Example:** Using \( y = x^2 \) and \( x = 2 \) then: \( y = 4 \).

If \( y = c \cdot f(x) \) where \( c = 2 \), then:

\[ y = 2x^2 = 2(2)^2 = 8 \]

\( f(x) \) is stretched from \( y = 4 \) to \( y = 8 \)

*Vertically Stretched by a factor of 2*

### Vertically Compressing:

\[ y = c \cdot f(x) \]

\( (0 < c < 1) \)

**Example:** Using \( y = x^2 \) and \( x = 2 \) then: \( y = 4 \).

If \( y = c \cdot f(x) \) where \( c = 0.5 \), then:

\[ y = 0.5x^2 = 0.5(2)^2 = 2 \]

\( f(x) \) is compressed from \( y = 4 \) to \( y = 2 \)

*Vertically Compressed by a factor of \( 1/0.5 = 2 \)*