Shifting a Graph of Quadratic Equations

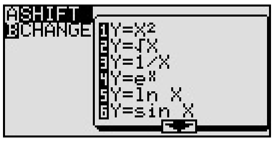
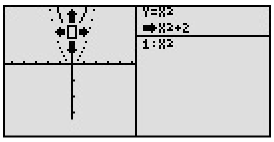
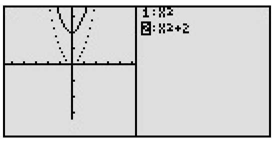
A quadratic equation of y in terms of x can be expressed by the standard form $y = a(x - h)^2 + k$, where a is the coefficient of the second degree term ($y = ax^2 + bx + c$) and (h, k) is the vertex of the parabola formed by the quadratic equation. An equation where the largest exponent on the independent variable x is 2 is considered a quadratic equation. In graphing quadratic equations on the calculator, let the x-variable be represented by the horizontal axis and let y be represented by the vertical axis. The relation of an equation and its graph can be seen by moving the graph and checking the coefficients of the equation.

Example

Move or pinch a graph of quadratic equation $y = x^2$ to verify the relation between the coefficients of the equation and the graph.

1. Shift the graph $y = x^2$ upward by 2.
2. Shift the graph $y = x^2$ to the right by 3.
3. Pinch the slope of the graph $y = x^2$.

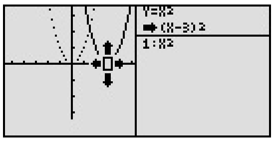
Before Starting There may be differences in the results of calculations and graph plotting depending on the setting. Return all settings to the default value and delete all data.

Step & Key Operation (When using EL-9650/9600c) *Use either pen touch or cursor to operate.	Display (When using EL-9650/9600c)	Notes
1-1 Access Shift feature and select the equation $y = x^2$. [2nd F] [SHIFT/CHANGE] [A]* [1]*		
1-2 Move the graph $y = x^2$ upward by 2. [▲] [▲] [ENTER]*		
1-3 Save the new graph and observe the changes in the graph and the equation. [ENTER] [ALPHA] [▶] [▼]		Notice that upward movement of the basic $y = x^2$ graph by 2 units in the direction of the y-axis means addition of 2 to the y-intercept. This demonstrates that upward movement of the graph by k units means adding a k (>0) in the standard form $y = a(x - h)^2 + k$.

Step & Key Operation	***Display***	***Notes***
(When using EL-9650/9600c) *Use either pen touch or cursor to operate.	(When using EL-9650/9600c)	

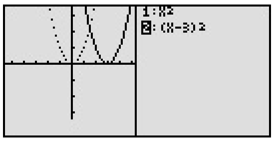
2-1 Move the graph $y = x^2$ to the right by 3.

CL ▶ (three times) ENTER*



2-2 Save the new graph and observe the changes in the graph and the equation

ENTER ALPHA ▶ ▼

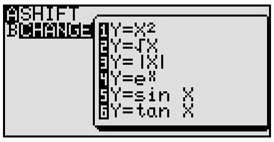


Notice that movement of the basic $y = x^2$ graph to the right by 3 units in the direction of the x-axis is equivalent to the addition of 3 to the x-intercept. This demonstrates that movement of the graph to the right means adding an h (>0) in the standard form $y = a(x - h)^2 + k$ and movement to the left means subtracting an h (<0).

3-1 Access Change feature and select the equation $y = x^2$.

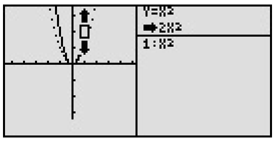
2nd F SHIFT/CHANGE B*

1*



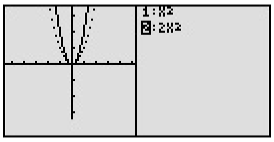
3-2 Pinch the slope of the graph.

▲ ENTER



3-3 Save the new graph and observe the changes in the graph and the equation.

ENTER ALPHA ▶ ▼



Notice that pinching or closing the basic $y = x^2$ graph is equivalent to increasing an a (>1) within the standard form $y = a(x - h)^2 + k$ and broadening the graph is equivalent to decreasing an a (<1).

The Shift/Change feature of the EL-9650/9600c/9450/9400 allows visual understanding of how graph changes affect the form of quadratic equations.