Slope and Intercept 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 graph can be adjusted by varying the coefficients a, h, and k.

Example

Graph various quadratic equations and check the relation between the graphs and the values of coefficients of the equations.

1. Graph $y = x^2$ and $y = (x - 2)^2$.
2. Graph $y = x^2$ and $y = x^2 + 2$.
3. Graph $y = x^2$ and $y = 2x^2$.
4. Graph $y = x^2$ and $y = -2x^2$.

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	Display	Notes

1-1 Enter the equation $y = x^2$ for Y1.

| Y= | X/θ/T/n | X^2 |

```
Y1█X²
Y2=
Y3=
Y4=
Y5=
Y6=
```

1-2 Enter the equation $y = (x - 2)^2$ for Y2 using Sub feature.

▼	ALPHA	A	(	X/θ/T/n	—
ALPHA	H	)	X^2	+	ALPHA	K
2nd F	SUB	1	ENTER	2	ENTER
(	0	ENTER	)

```
Y1█X²
Y2█A(X-H)²+K
Y3=
Y4=
Y5=
Y6=
```

```
Y2=A(X-H)²+K    SUB:Y2
                A=1
                H=2
                K=0
```
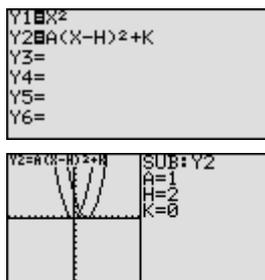
1-3 View both graphs.
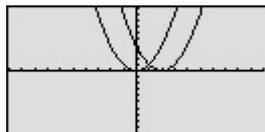
| GRAPH |

Notice that the addition of -2 within the quadratic operation moves the basic $y = x^2$ graph right two units (adding 2 moves it left two units) on the x-axis. This shows that placing an h (>0) within the standard form $y = a (x - h)^2 + k$ will move the basic graph right h units and placing an h (<0) will move it left h units on the x-axis.

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| *Step & Key Operation* | *Display* | *Notes* |

2-1 Change the equation in Y2 to $y = x^2 + 2$.

Y= ▼ **2nd F** **SUB** ▼ 0

ENTER 2 ENTER
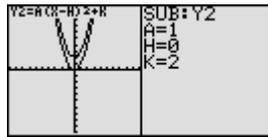
2-2 View both graphs.
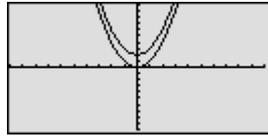
GRAPH

Notice that the addition of 2 moves the basic $y = x^2$ graph up two units and the addition of -2 moves the basic graph down two units on the y-axis. This demonstrates the fact that adding k (>0) within the standard form $y = a (x - h)^2 + k$ will move the basic graph up k units and placing k (<0) will move the basic graph down k units on the y-axis.

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3-1 Change the equation in Y2 to $y = 2x^2$.

Y= ▼ **2nd F** **SUB** 2 ENTER

▼ 0 ENTER
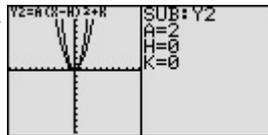
3-2 View both graphs.
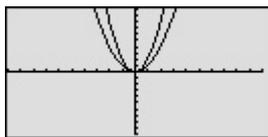
GRAPH

Notice that the multiplication of 2 pinches or closes the basic $y = x^2$ graph. This demonstrates the fact that multiplying an a (> 1) in the standard form $y = a (x - h)^2 + k$ will pinch or close the basic graph.

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4-1 Change the equation in Y2 to $y = -2x^2$.

Y= ▼ **2nd F** **SUB** (-) 2

ENTER

4-2 View both graphs.
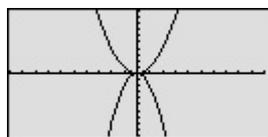
GRAPH

Notice that the multiplication of -2 pinches or closes the basic $y = x^2$ graph and flips it (reflects it) across the x-axis. This demonstrates the fact that multiplying an a (<-1) in the standard form $y = a (x - h)^2 + k$ will pinch or close the basic graph and flip it (reflect it) across the x-axis.

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The EL-9900 allows various quadratic equations to be graphed easily. Also the characteristics of quadratic equations can be visually shown through the relationship between the changes of coefficient values and their graphs, using the Substitution feature.

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