GRAPH DYNA

Whatta Square

Parabolas
Quadratic Functions
Minimum Points
Graphing

Standards: Problem Solving, Communication, Reasoning, Connections, Algebra, and Functions

Materials: *CFX-9850G or CFX-9850Ga PLUS*

Calculator Menus: DYNA and GRAPH

One unique feature of the *CFX-9850G* and *CFX-9850Ga PLUS* is the dynamic graphing capabilities they possess. This power can be used to investigate how the graph of an equation is altered as one variable in that equation changes.

In this activity, you will use the Dynamic Graph (DYNA) Menu to investigate changes on a second degree equation of the form $Y1 = A(X+B)^2 + C$. The equation can be located by pressing F5 (B-IN) in the Dynamic Graph menu.

Enter the DYNA Menu and select $Y1 = A(X+B)^2 + C$ from the Built-In equations. Next set B and C at zero. Since A will be the **dynamic variable**, you do not have to set A to a specific value.

Set the Range of A to run between 2 and 6 with a pitch of 1 (which means the value of A starts with 2 and increases by increments of 1 until 6 is achieved. It will then recycle back down to 2 in steps of negative 1. The pitch dictates the size of the step between representations of the equation you will see. You now have the following conditions set in the Dynamic Grapher:

$Y1 = A(X+B)^2 + C$
B and C are set to zero
The values of A will change from 2 to 6 by increments of 1 giving

$Y1 = 2(X+0)^2 + 0$ $Y2 = 3(X+0)^2 + 0$

$Y3 = 4(X+0)^2 + 0$ $Y4 = 5(X+0)^2 + 0$

$Y5 = 6(X+0)^2 + 0$

For this example, select "Slow" for the speed and set the View-Window at INIT. Press F6 (DYNA) to draw the graphs and AC/ON key to stop the graph.

Describe the result of the selections you have made for this equation. **A.**

The five equations: $Y1 = 2(X+0)^2 + 0 = 2X^2$ $Y2 = 3(X+0)^2 + 0 = 3X^2$

$Y3 = 4(X+0)^2 + 0 = 4X^2$ $Y4 = 5(X+0)^2 + 0 = 5X^2$

$Y5 = 6(X+0)^2 + 0 = 6X^2$

Selecting a Built-In Dynamic Equation

In the DYNA Menu
Press F5 (B-IN)
Highlight equation.
Press EXE key

Setting Dynamic Range

In the DYNA Menu and equation is entered:
Press F4 (VAR)
F2 (RANG)
Start: -3
EXE key
End: 3
EXE key
pitch: 1
EXE key
EXIT key

Setting Dynamic Speed

In the DYNA Menu and equation is entered:
Press F4 (VAR)
F3 (SPEED)
Highlight Fast: >>
Press F1 (SEL)
EXT key

Stopping a Dynamic Graph

Press AC/ON key

Whatta Square

Changing the Dynamic Variable

In the DYNA Menu
Press F4 (VAR)
Highlight desired variable
Press F1 (SEL)
Note: A is the default Dynamic variable. Letters other than A must be re-selected each time the Dynamic Grapher is initiated.

Resizing the Graph Window

Press Shift key
F3 (V-WIN)
Highlight Xmin, Xmax , Ymin, or Ymax.
Enter desired value
EXE key
Repeat steps to alter min or max values for X or Y.

Determining a Minimum Point of a Graph

Graph the equation
Press F5 (G-SOLV)
F3 (MIN)

Setting the V-Window to the Initial Setting (INIT)

Press SHIFT key
F3 (V-Window)
F1 (INIT)
EXIT key

Deleting an Equation in the GRAPH Menu

Highlight the equation
Press F2 (DEL)
F1 (YES)

Exit the DYNA Menu and enter the GRAPH menu. Notice that the Dynamic Graph equation is still entered. Delete $Y1 = A(X+B)^2 + C$ Enter $Y1 = 2X^2$ Graph the equation.

Use F5 (G-SOLV) to find the minimum point of the graph. **B.**

Repeat the above process for at least two other of the $Y1 = AX^2$ equations. What is your conclusion about the minimum points on these equations? **C.**

Return to the DYNA Menu and reuse $Y1 = A(X+B)^2 + C$. Let B remain zero but change C to be a non-zero real number. Repeat the dynamic graphing for the same range, pitch, and speed. Simplify the equations if necessary and describe the minimum points of each of the graphs. **NOTE:** For the remaining graphs, you may need to re-size the View-Window. **D.**

Repeat the last paragraph but let C be a non-zero real number of the opposite sign from what you used initially. Simplify the equations if necessary and describe the minimum points of each of the graphs. **E.**

Return to the Dynamic Func: Y= screen. Let C be zero and change B to be a non-zero real number. Repeat the dynamic graphing for the same range, pitch, and speed. Simplify the equations if necessary and describe the minimum points of each of the graphs. **F.**

Repeat the last paragraph but let B be a non-zero real number of the opposite sign from what you used initially. Simplify the equations if necessary and describe the minimum points of each of the graphs. **G.**

Describe the graph when A is a negative real number? **H.**

Change the Range of A to -2 to -6 and graph. Was your response to H correct? **I.**

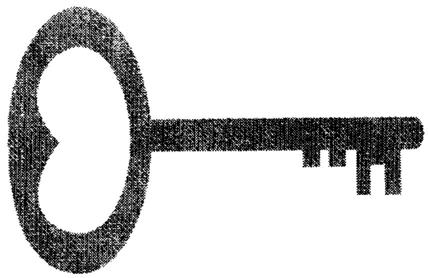
Does this happen for all negative values of A? Explain your answer. **J.**

Is it possible to find a minimum point for the equation $Y1 = A(X+B)^2 + C$ when A is negative? Why or why not? **K.**

Let the values of A, B, and C be non-zero real numbers in $Y1 = A(X+B)^2 + C$. Change between A, B, and C being the dynamic variable. What conclusion can be drawn? **L.**

The answer to L, coupled with the idea that a second degree equation is the basis for a process called "Completing the Square." By knowing how to complete a square, you have the ability to determine a multitude of information quickly about any second degree equation. Check it out!

Solution Key



Whatta Square

A. 4 different parabolas, each opening up. The width of the opening varies as the value of A changes between 2 and 6.
B. (0, 0) **C.** (0, 0) **D.** (0, C value) **E.** (0, C new value)
F. (-B value, 0) NOTE the X-coordinate could be positive if B was negative
G. (-B new value, 0) NOTE the X-coordinate could be positive if B was negative
H. - I. Answers will vary.
J. Yes. As X takes on any value, the negative A forces Y to be negative.
K. No. You find a maximum point for each curve.
L. The coordinates of the maximum or minimum will always be (-B, C).