



# ALGEBRA I ACTIVITY 11: USING SYMMETRY TO FIND THE VERTEX OF A PARABOLA

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## ACTIVITY OVERVIEW:

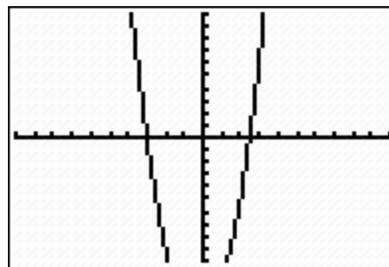
In this activity we will

- Enter the equation of a parabola in  $\boxed{Y=}$
- Use the table and home screen to explore symmetry in the parabola to find the vertex
- Evaluate the function of a value of  $x$  while tracing the graph

Consider the equation  $y = x^2 + x - 15$ . Press  $\boxed{Y=}$  and enter the equation as shown.

```
Plot1 Plot2 Plot3
Y1 X^2+X-15
Y2 =
Y3 =
Y4 =
Y5 =
Y6 =
Y7 =
```

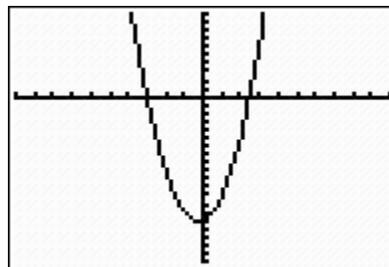
Press  $\boxed{\text{GRAPH}}$ . Take a moment to examine the graph. It would be helpful to be able to see the vertex.



Press  $\boxed{\text{WINDOW}}$  and adjust the window to show more space below the x-axis.

```
WINDOW
Xmin=-10
Xmax=10
Xscl=1
Ymin=-20
Ymax=10
Yscl=1
Xres=1
```

Press  $\boxed{\text{GRAPH}}$ . Approximately where is the vertex of the parabola? What do you notice about the shape of the parabola?



The symmetry of a parabola should mean that for every value of  $y$  that the parabola takes on, there are two values of  $x$  that are paired with it. Press  $\text{2nd|GRAPH}$ . Examine the table and notice that there are no repeated values of  $y$ . Try adjusting the table set up to view more values of  $x$ . Press  $\text{2nd|WINDOW}$  and set the “change in table” to 0.5 as shown here.

```
TABLE SETUP
TblStart=0
ΔTbl=.5
IndPnt: Auto Ask
Depend: Auto Ask
```

Press  $\text{2nd|GRAPH}$ . Now, as expected, each  $y$  value is associated with two  $x$  values. Choose a pair of  $x$  values that have the same  $y$  value.

X	Y1
-0.5	-15
0	-15
.5	-14
1	-12
1.5	-9
2	-5
2.5	0

X = -0.5

Press  $\text{2nd|MODE}$  to go to the home screen. Average the two  $x$ -values as shown.

```
(-.5+0)/2
-.25
```

Return to the table. Choose another pair of  $x$  values that have the same  $y$  value.

X	Y1
-4.5	21
-4	13
-3.5	6
-3	0
-2.5	-5
-2	-9
-1.5	-12

X = -3.5

Press  $\text{2nd|MODE}$  to go to the home screen. Average the two  $x$ -values. What do you notice about the two averages so far? What significance might this number have?

X	Y1
.5	-14
1	-12
1.5	-9
2	-5
2.5	0
3	6
3.5	13

X = 3

```
(-.5+0)/2
-.25
(3+ -3.5)/2
-.25
```

Using either factoring or the quadratic formula you should (or will) be able to find two x-values that have the y value of zero for many parabolas. Choose the two x-values that represent the zeros of this parabola using the table or another method.

X	Y <sub>1</sub>	
.5	-14	
1	-12	
1.5	-9	
2	-5	
<b>2.5</b>	0	
3	6	
3.5	13	

X=2.5

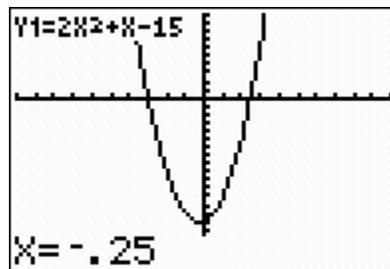
X	Y <sub>1</sub>	
<b>-3</b>	0	
-2.5	-5	
-2	-9	
-1.5	-12	
-1	-14	
-.5	-15	
0	-15	

X=-3

Return to the home screen. Average the two x-values. What do you notice about these three averages? What significance might this number have? Think about what it means to average two numbers on a number line. The average is the point **halfway** in between the numbers. If you fold the parabola and match up the symmetrical parts, what would be the point on the fold, or halfway in between?

$$\begin{aligned} (-.5+0)/2 &= -.25 \\ (3+ -3.5)/2 &= -.25 \\ (2.5+ -3)/2 &= -.25 \end{aligned}$$

To see what the significance of the value  $x = -0.25$ , examine the graph. Press **GRAPH**. Press **TRACE**. In "trace" mode, type  $(-)\square\square 25$ .



Press **ENTER**. What point on the parabola have you found?

Explore other parabolas.

