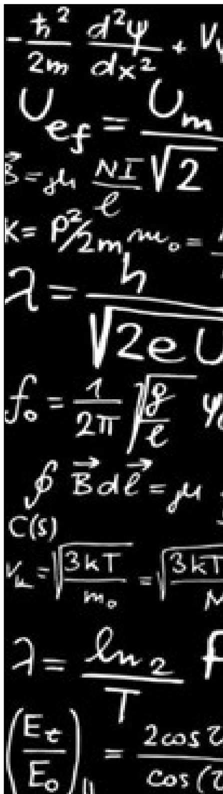


Unit #1 / Day #7

Transforming Parabolas

Objectives:

- Students will discover how the graph of a quadratic function (a parabola) changes based on changes to the graphing form of a quadratic equation.
- Students will be able to accurately predict what a parabola will look like based on any graphing form quadratic equation without making a table or a graph.

Unit 1 / Day 7

In Algebra I, you learned about slope and y-intercept; ideas that allow you to write equations and sketch graphs of any line. During this lesson, you will work on developing similar tools for parabolas.

PARABOLA LAB – PART ONE:

Graphing Form Equation: $y = a(x-h)^2 + k$

What happens to a parabola's graph when you change the numbers in the graphing form of the equation?

a. On graph paper, graph the equation $y = (x-2)^2$.
Be sure to plot accurate points on your graph.
Label this graph A.
Sketch and label the line of symmetry.

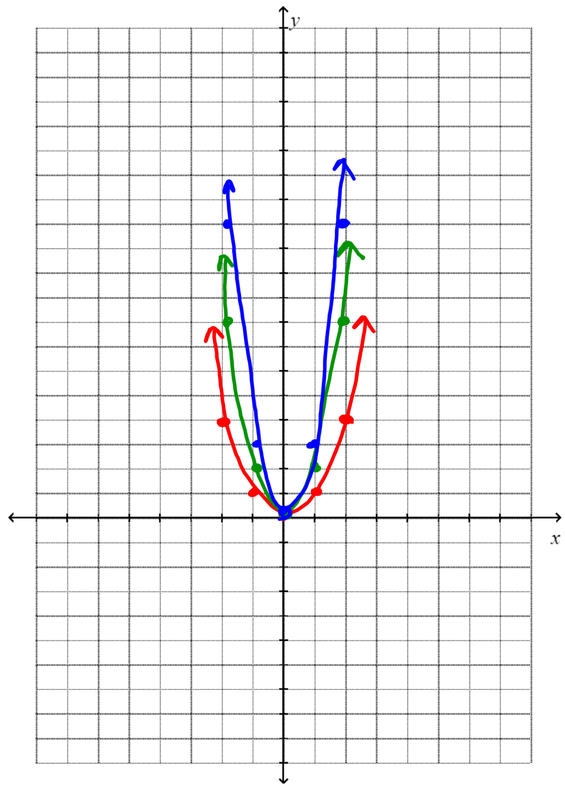
b. Use your graphing calculator to find equations and graphs for two different parabolas that open upward and also have a vertex at $(2,0)$. Accurately draw these two parabolas on your graph. Label them B and C. Write their equations below.

B: $y=2(x-2)^2$

C: $y=3(x-2)^2$

Line of Symmetry: $x=2$

Parabola Lab Pt. 1



Parabola Lab Pt. 1

PARABOLA LAB – PART TWO:
What happens to a parabola's graph when you change the numbers in the graphing form of the equation? $y = a(x-h)^2 + k$

c. Now use your graphing calculator to find equations and graphs for two different parabolas that **open downward** that have a vertex at $(2,0)$. Accurately draw them and label them **D** and **E**. Write their equations below.

D: $y = -2(x-2)^2$

E: $y = -3(x-2)^2$

Line of Symmetry: $x = 2$

d. How did you change the equations so the parabolas would open downward?

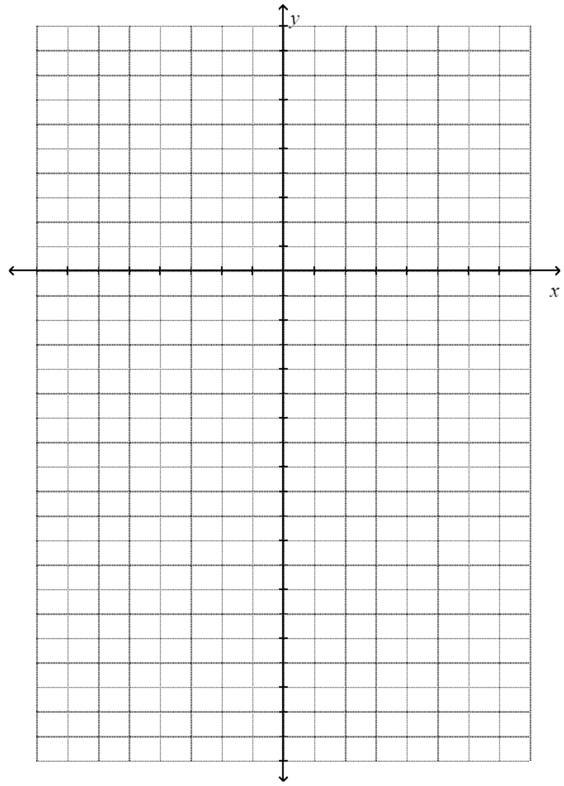
made "a" negative

e. Use your graphing calculator to find the equation of a parabola that opens downward with a vertex at $(-4,0)$.

Equation for the parabola: $y = -(x+4)^2$

Equation for the line of symmetry: $x = -4$

Parabola Lab Pt. 2



Parabola Lab Pt. 2

PARABOLA LAB – PART THREE:
What happens to a parabola's graph when you change the numbers in the graphing form of the equation? $y = a(x-h)^2 + k$

f. Choose a new point on the x-axis and find at least three equations of parabolas that touch the x-axis only at that point. Write their equations below.

x-intercept: (5 , 0)

F: $y = (x-5)^2$

G: $y = 2(x-5)^2$

H: $y = 3(x-5)^2$

Line of Symmetry: $x = 5$

Parabola Lab Pt. 3

PARABOLA LAB – PART FOUR:
Work with your team to determine all of the ways you can change the graph of a parabola by changing its equation. Be prepared to share your ideas with the class. Graph the parabola $y = x^2$ in Y1 of your calculator. Leave this parabola there as you investigate other equations and graphs.

a. Find a way to change the equation $y = x^2$ to make a parabola that ***stretches vertically*** (gets narrower). This parabola should have the same vertex and orientation as $y = x^2$. Write down all the equations you tried.

$y = 2x^2$

b. Find a way to change the equation $y = x^2$ to make a parabola that ***compresses vertically*** (gets wider). This parabola should have the same vertex and orientation as $y = x^2$. Write down all the equations you tried.

$y = \frac{1}{2}x^2$

c. Find a way to change the equation to make $y = x^2$ *open downward.*

$y = -x^2$

d. Find a way to change the equation to make the $y = x^2$ parabola *move 5 units down.*

$y = x^2 - 5$

e. Find a way to change the equation to make the $y = x^2$ parabola *move 5 units up.*

$y = x^2 + 5$

f. Find a way to change the equation to make the $y = x^2$ parabola *move 3 units to the right.*

$y = (x-3)^2$

g. Find a way to change the equation to make the $y = x^2$ parabola *move 3 units to the left.*

$y = (x+3)^2$

h. Find a way to change the equation to make the $y = x^2$ parabola *vertically compressed by half, opens down, moves six units up, and moves two units left.*

$y = -\frac{1}{2}(x+2)^2 + 6$

Where is the vertex of your new parabola?

$(-2, 6)$

Parabola Lab Pt. 4

i. **Create your own:** Write an equation for the parabola that could be shifted or stretched in any direction by any amount.

$y = -4(x+2)^2 - 8$

State what the stretches and shifts are for your equation.

opens down

left 2
down 8 } vertex = $(-2, -8)$

vertical stretch by 4

Parabola Lab Pt. 4

WHAT DID YOU LEARN?

PARABOLA TRANSFORMATION SUMMARY

$$y = a(x-h)^2 + k$$

How does "a" affect the graph?

a = pos, opens up

a = neg, opens down

$|a| > 1$: vertical stretch (narrower)

$0 < |a| < 1$ (fraction): vertical compression (wider)

How does "h" affect the graph?

$y = a(x-h)^2 + k$

left/right

moves backwards

+h → left

−h → right

How does "k" affect the graph?

$y = a(x-h)^2 + k$

up/down

moves normally

+k → up

−k → down

Summary

$y = \cancel{-}\frac{1}{3}(x\cancel{-1})^2 \cancel{-4}$

vertex

(1, −4)

↓ 4

opens down

→ 1

V. comp. by 1/3

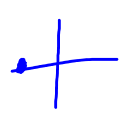
$y = \cancel{2}x^2 \cancel{+5}$

↑ 5

V. stretch by 2

opens up

(0, 5)



$y = -\cancel{.75}(x\cancel{+7})^2$

← 7

vert. comp by .75

opens down

(−7, 0)

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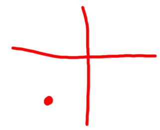
$y = 3(x \cancel{+4})^2 \cancel{-7}$

opens up

left 4 $(-4, -7)$



down 7

v. stretch by 3

$y = -\cancel{\frac{2}{3}}(x+2)^2 + \cancel{12}$

v. comp by $\frac{2}{3}$

up 12 $(-2, 12)$

opens down

left 2

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④ $\left(\frac{64}{49}\right)^{-\frac{3}{2}}$

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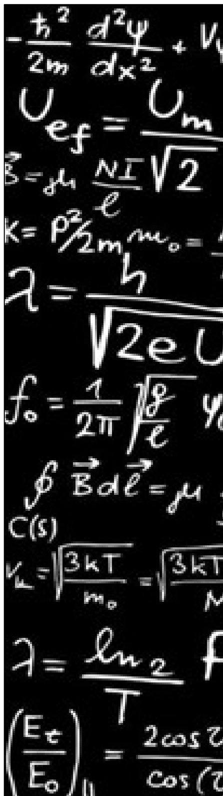

Homework:

Unit #1 Day #7 worksheets

Homework