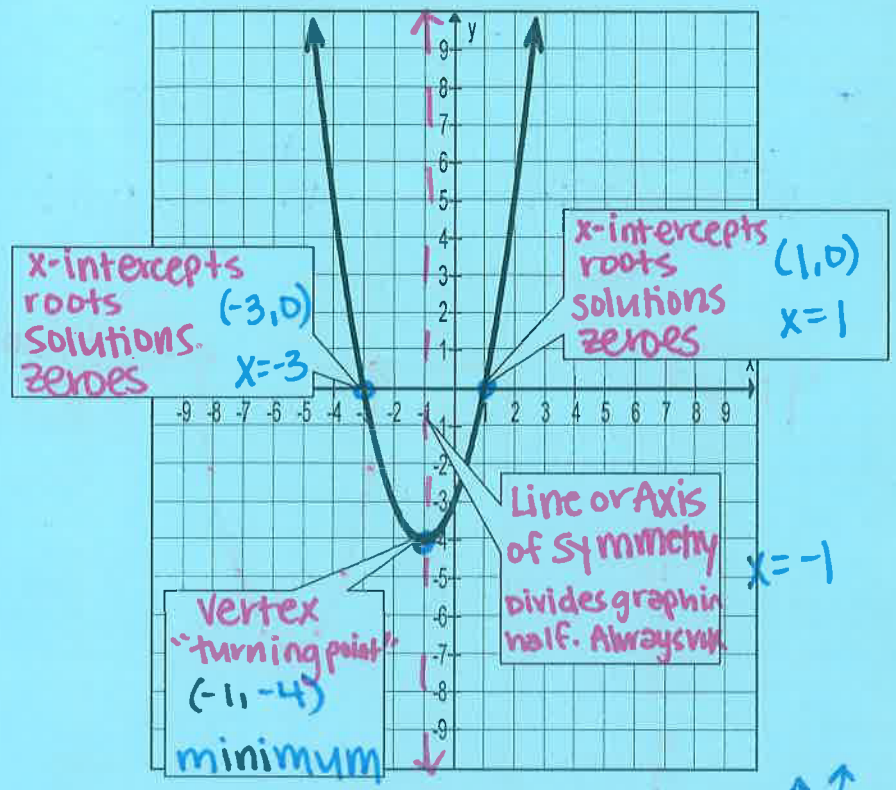
# Algebra I Unit 9

## Introduction to Quadratic FUNCTIONS

aka parabola

### Parts of a Quadratic

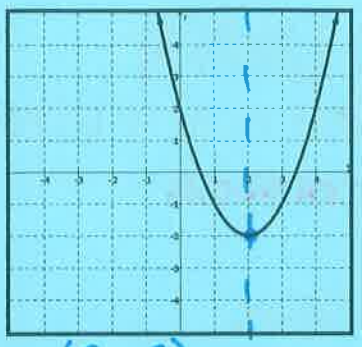



Concavity: describes if a parabola opens up (minimum) or opens down (maximum)

Domain: All the x-values

Range: All the y-values

1. $y = x^2 - 4x + 2$



Vertex: (2,-2)

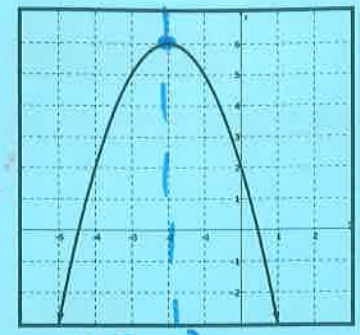
Line of Symmetry: x=2

Minimum or Maximum

Concavity: UP

Domain: ℝ Range: y≥-2

2. $y = -x^2 - 4x + 2$



Vertex: (-2,6)

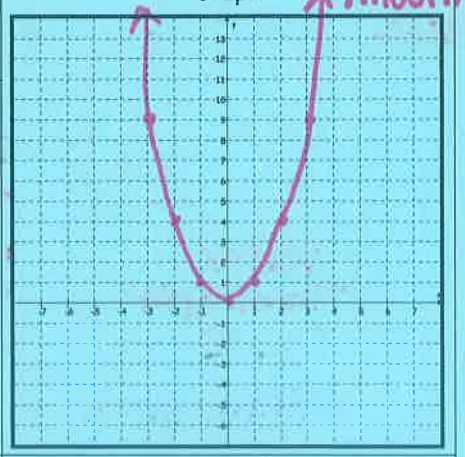
Line of Symmetry: x=-2

Minimum or Maximum

Concavity: down

Domain: ℝ Range: y≤6

## Quadratic Parent Function

| Equation | Graph |
|---|---|
| $y = x^2$ |  smooth curve |

Table

| $x$ | $y$ |
|---|---|
| -3 | 9 |
| -2 | 4 |
| -1 | 1 |
| 0 | 0 |
| 1 | 1 |
| 2 | 4 |
| 3 | 9 |

| | |
|---|---|
| DOMAIN ℝ (all real #s) | Vertex (0,0) |
| RANGE y≥0 | LINE OF SYMMETRY x=0 |
| Minimum or Maximum | |
| Concavity UP | ALWAYS x=#. |

## Standard Form a, b, c are #s!

$$y = ax^2 + bx + c$$

Put the following equations in Standard Form (solve for y=)

1. $3x^2 + y = -5x + 4$

$-3x^2 \quad -3x^2$

$\boxed{y = -3x^2 - 5x + 4}$

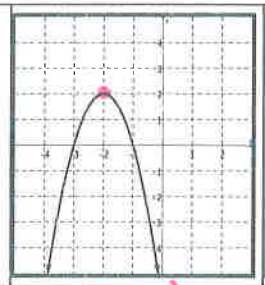
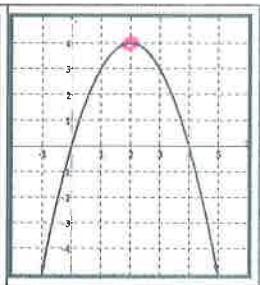
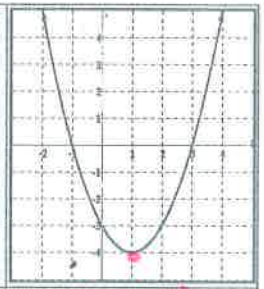
2. $-x^2 + 3 = 7x - y$

$-7x \quad -7x$

$\frac{-x^2}{-1} - \frac{7x}{-1} + \frac{3}{-1} = \frac{-1y}{-1}$

$\boxed{x^2 + 7x - 3 = y}$

## Line of Symmetry Exploration

| | | | |
|---|---|---|---|
| Graph |  |  |  |
| Vertex | (-2,2) | (2,4) | (1,-4) |
| Line of Symmetry | $x =$ -2 | x=2 | x=1 |
| Function | $y = -2x^2 - 8x - 6$ | $y = -1x^2 + 4x$ | $y = x^2 - 2x - 3$ |
| $a$ | -2 | a=-1 | a=1 |
| $b$ | -8 | b=4 | b=-2 |
| $\frac{b}{2a}$ | $\frac{-(-8)}{2(-2)} = \frac{8}{-4} = -2$ | $\frac{-4}{2(-1)} = \frac{-4}{-2} = 2$ | $\frac{-(-2)}{2(1)} = \frac{2}{2} = 1$ |

Equation of the Line of Symmetry: $x = \frac{-b}{2a}$

**Find the Axis of Symmetry of each of the following parabolas.**

1) $y = 2x^2 + 12x - 7$

a=2 b=12 c=-7

$x = \frac{-12}{2(2)} = \frac{-12}{4}$

$\boxed{x=-3}$

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

a=1 NOT in Standard!

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

a=1 b=4 c=-8

$x = \frac{-4}{2(1)} = -2$

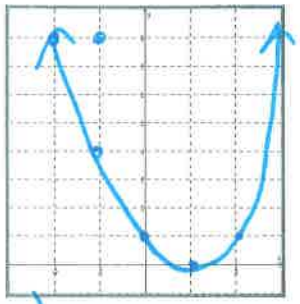
$\boxed{x=-2}$

use your graphing calculator! Y=
• at least 3 pts → connect w/ a smooth curve.

## Graphing Quadratic Functions

1. $y = x^2 - 2x + 1$

| x | y |
|---|---|
| -2 | 9 |
| -1 | 4 |
| 0 | 1 |
| 1 | 0 |
| 2 | 1 |



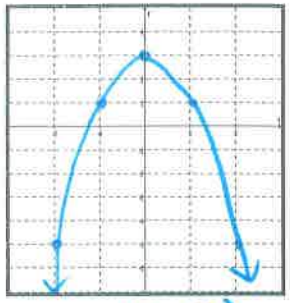
Vertex: (1, 0)

Line of Symmetry: X = 1

Domain: $\mathbb{R}$

Range: $y \geq 0$

2. $y = -2x^2 + 3$



Vertex: (0, 3)

Line of Symmetry: X = 0

Domain: $\mathbb{R}$

Range: $y \leq 3$

## Finding the coordinates of the vertex using a calculator

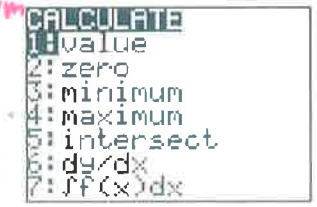
**Steps:**
1. Enter equation into y=
2. Press GRAPH
   Is it a min or a max?
3. Press 2nd TRACE
4. Choose 3:minimum or 4:maximum
5. Follow the instructions
   - scroll to the vertex
   - go a little left ENTER
   - go a little right ENTER
   - back to vertex ENTER

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

Minimum or Maximum

Vertex: (3, 2)

Line of Symmetry: X = 3




2. $y = x^2 + 6x + 4$

Minimum or Maximum

Vertex: (-3, -5)

Line of Symmetry: X = -3

3. $f(x) = -\frac{1}{2}x^2 - 2x + 1$

Minimum or Maximum

Vertex: (-2, 3)

Line of Symmetry: X = -2



## Multiple Representations

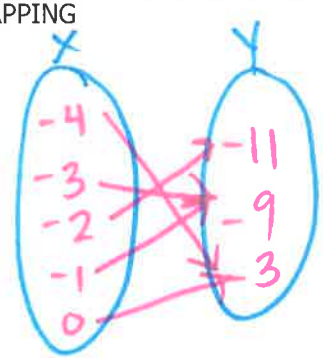
1. $y = 2x^2 + 8x - 3$

TABLE

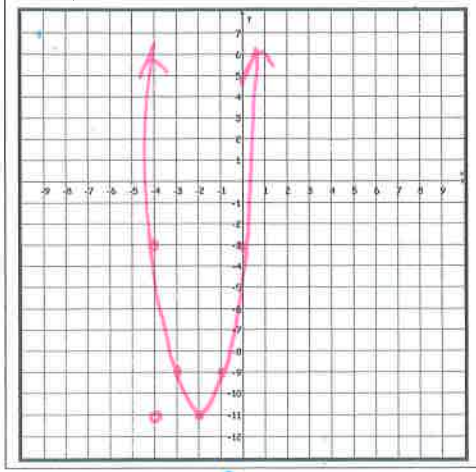
| x | y |
|---|---|
| -4 | -3 |
| -3 | -9 |
| -2 | -11 |
| -1 | -9 |
| 0 | -3 |

Yes this is a function

MAPPING




GRAPH



Domain

All Real #s

Range

$y \geq -11$

2. $y + x^2 = -2x - 3$

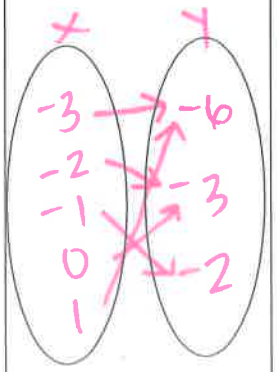
solve for y=

$y = -x^2 - 2x - 3$

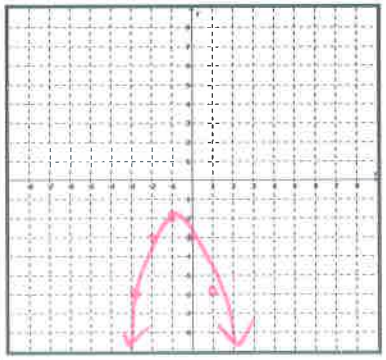
TABLE

| x | y |
|---|---|
| -3 | -6 |
| -2 | -3 |
| -1 | -2 |
| 0 | -3 |
| 1 | -6 |

MAPPING




GRAPH



no exponent

# Linear VS Quadratic

squared

## From EQUATIONS

1. $y = 3x + 4$

Linear

2. $f(x) = 5x^2 - 6x + 3$

Quadratic

3. $f(x) = 4 - x$

Linear

4. $y = 7 - 3x^2$

Quadratic

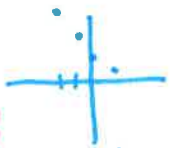
## From TABLES/DATA SETS

5. LINEAR

| x | y |
|---|---|
| -2 | 10 |
| -1 | 7 |
| 0 | 4 |
| 1 | 1 |

+1 +1 +1

-3 -3 -3

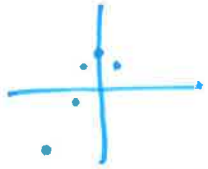


LOOKS like a line!

m = slope = $\frac{\text{RISE}}{\text{RUN}} = \frac{-3}{1}$

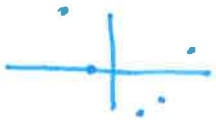
6. Quadratic

| x | y |
|---|---|
| -3 | -12 |
| -2 | -2 |
| -1 | 4 |
| 0 | 6 |
| 1 | 4 |



Not a line repeats!

7. $\{(-3,14),(-1,0),(2,-6),(3,-4),(5,6)\}$



Not a line!
Quadratic

## Writing Equations of Quadratic Data

If you know your data is quadratic...

Press STAT ENTER

| L1 | L2 |
|---|---|
| x's | y's |

STAT → 5: QuadReg ENTER

Write your equation!

1. Find the equation of the parabola that passes through the points (-5, -43.75), (1, 30.65), and (2, 79.1)

$y = 5.15x^2 + 33x - 7.5$

2. Find the equation that best represents the data in the table.

| x | y |
|---|---|
| 0 | 0 |
| 17.5 | 7 |
| 32.5 | 9 |
| 47.5 | 7 |
| 65 | 0 |

$y = -.01x^2 + .55x - .01$

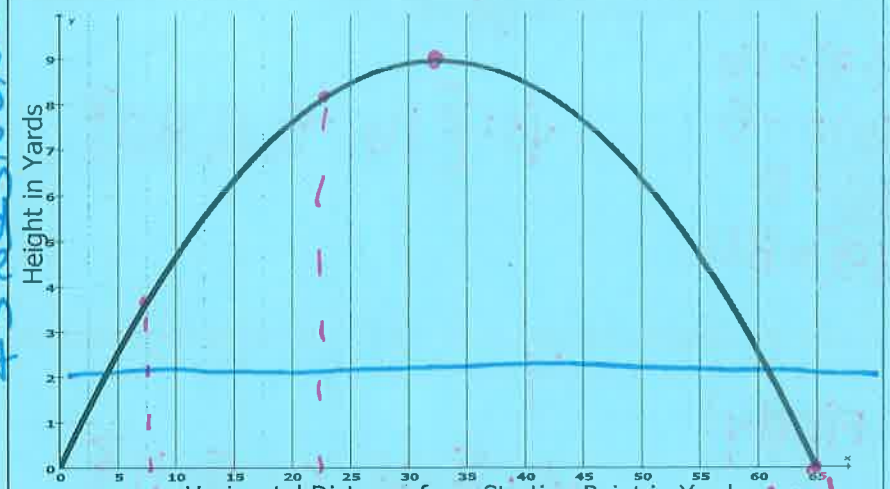
Round to 2 decimals



## Applications

1. The graph below represents the relationship between the height (in yards) and the horizontal distance (in yards) of a soccer ball after being kicked.

4 yards




ind.

Find the following values:

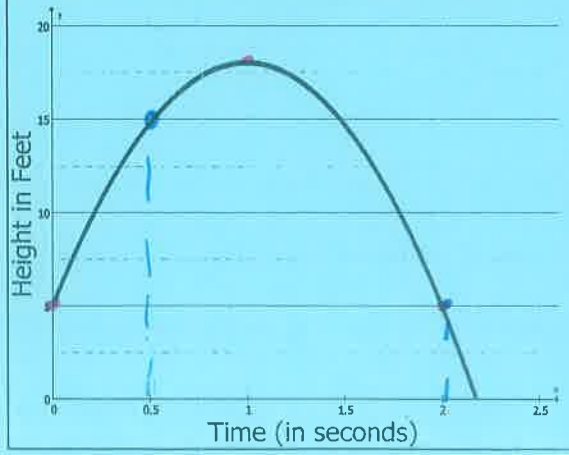
f(7.5) = ~3.5 yards (x=7.5) f(22.5) = ~8 yds

When $f(x) = 2$, find the value of $x$. (y=2) x=3.75 AND x=61.25

What is the maximum height of the ball? 9 yards

When does the ball touch the ground? 65 feet away

2. During a basketball game, a shot was taken from midcourt and the basket was made. The equation $h(t) = -13t^2 + 26t + 5$ describes the height (in feet) of the ball t seconds after it was thrown.




Find h(0.5) = 15ft

Find h(2) = 5ft

Approximately when is the ball 5 feet in the air? 0 sec & 2 sec

How high did the ball go in the air? ~18 ft

LABEL, Plug in values!

x = independent

y = dependent

## Evaluating Quadratic Functions

1. Given the quadratic function $f(x) = 3x^2 + 2x - 5$ find the dependent variables when the independent ~~y~~ variables are {-3, 0, 1, 5}

Look @ table

$f(-3) = 16$

$f(0) = -5$

$f(1) = 0$

$f(5) = 80$

y's: {16, -5, 0, 80}

2. Given the quadratic function $f(x) = -5x^2 + 2x + 6$ find the independent variables when the dependent ~~x~~ y variables are {-82, 6, -109, -577}.

Find y!

x's: {-4, 0, 5, 11}

3. Given the quadratic equation $f(x) = 2x^2 - 3x + 1$, find

f(-32)

f(1)

f(3)

f(44)

{2145, 0, 10, 3741}