Linear → $y = mx^1 + b$

## Introduction to Quadratics

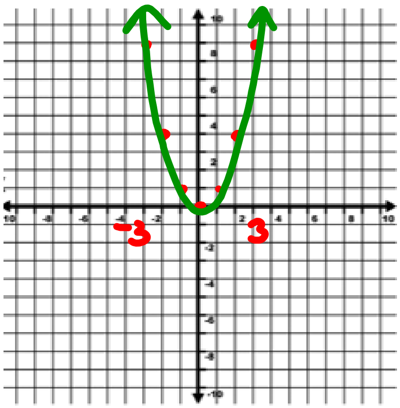
A quadratic function is a function that has an "$x^2$" term in it somewhere.

**Determine whether each function is linear or quadratic.**

a. Y = 3x − 5 b. Y = 3x(x + 5) c. Y = (x − 2)(x + 4) d. Y = 6x − 5 + 2x

| a | b | c | d |
|---|---|---|---|
| Linear | $3x^2+15x$ Quadratic | $x^2+2x-8$ Quadratic | $y=8x-5$ Linear |

Quadratic Functions ($y = x^2$...) when graphed are parabola **"U" shaped graphs**



**Parent Function**

$\mathbf{y = x^2}$

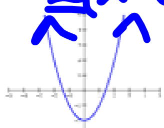
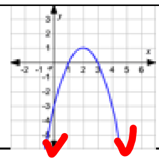
| x | $y = x^2$ | y |
|---|---|---|
| -2 | $=(-2)^2$ | 4 |
| -1 | $(-1)^2$ | 1 |
| 0 | $(0)^2$ | 0 |
| 1 | $(1)^2$ | 1 |
| 2 | $(2)^2$ | 4 |

(-2, 4)
(-1, 1)
(0, 0)
(1, 1)
(2, 4)

****Two Major Forms of a Quadratic****

***Standard***: $y = ax^2 + bx + c$ | ***Vertex***: $y = a(x - h)^2 + k$

$y = 5x^2 + 3x + 8$ | $y = -2(x-3)^2 + 1$

| | | |
|---|---|---|
| If "a" is positive or a > 0 (+) | The graph opens up |  |
| If "a" is negative or a < 0 (−) | The graph opens down |  |

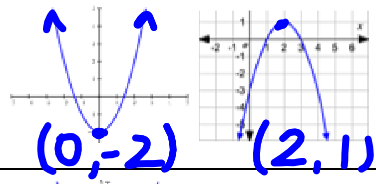
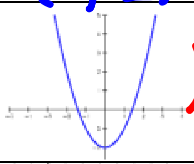
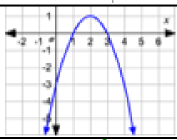
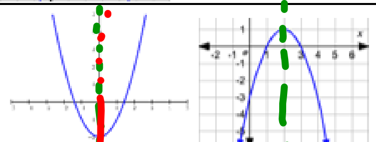
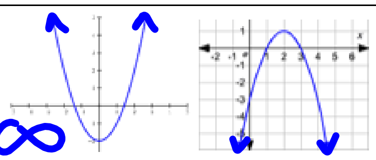
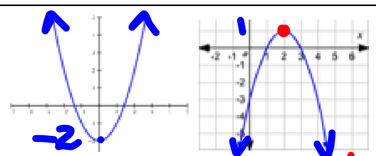
Which direction would each quadratic open?

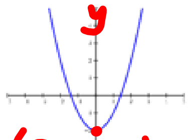
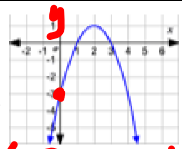
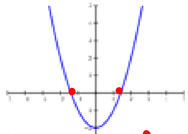
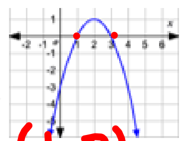
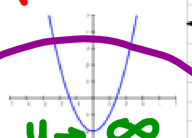
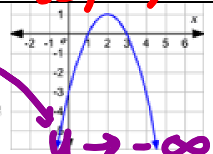
**Example 1:** $y = 2x^2 - x - 7$ up

**Example 2:** $y = -(x + 5)^2 - 9$ down

**Example 3:** $y = 3(x - 1)^2 + 4$ up

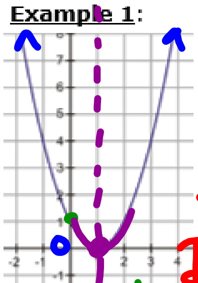
**Example 4:** $y = -6x^2 + 7$ down

| Characteristic | Definition | Example |
|---|---|---|
| Extrema<br>max/min | The lowest or the highest point on the parabola<br>**For a quadratic, this point will be the _vertex_ |  (0,-2) (2,1) |
| minimum | The lowest point/y-value on the parabola |  y=-2 |
| maximum | The highest point/y-value on the parabola |  y=1 |
| Axis of Symmetry<br>AOS | The ***vertical line*** that divides the parabola into mirror images and goes through the vertex. dotted<br>***When describing the AOS always use the _x_-value of the vertex written in an equation, x = # |  x=0 x=2 |
| Domain | All possible values of x<br>ℝ<br>$-\infty < x < +\infty$ |  |
| Range | All possible values of y |  -2<br>$y \geq -2$ $y \leq 1$ |

| | | |
|---|---|---|
| y-intercept | Where the graph crosses the y-axis, written (0, y)<br>***If you do not see one on the graph, plug in 0 for x into the equation |  <br>(0,-2) (0,-3) |
| x-intercept(s) | Where the graph crosses the x-axis, written (x, 0)<br>***You might have 0, 1, or, 2 points of intersection.<br>***Other names are roots, solutions and zeros |  <br>(-1.2,0) (1.2,0) (1,0) (3,0) |
| End Behavior | The direction each end approaches as the x-values approach positive and negative infinity.<br>$x \to -\infty$<br>$x \to \infty$ |  <br>$y \to \infty$ $y \to -\infty$<br>$y \to \infty$ $y \to -\infty$ |

Describe the characteristics of the following graphs:

**Example 1:**



ℝ ℝ

Vertex: (1,0) Axis of Symmetry: $x = 1$

Extrema: min Max/Min Value: $y = 0$

Domain: ℝ Range: $y \geq 0$

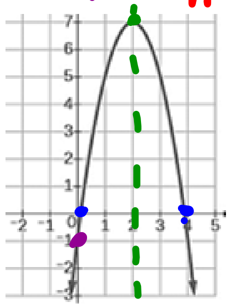
a $>0$ up Y-Intercept: (0,1)

X-Intercepts: (1,0) Zeros: $x = 1$

End Behavior: As $x \to -\infty$, $y \to +\infty$

As $x \to \infty$, $y \to +\infty$

**Example 2:**



Vertex: (2,7) Axis of Symmetry: $x = 2$

Extrema: max Max/Min Value: $y = 7$

Domain: ℝ Range: $y \leq 7$

a $<0$ Y-Intercept: (0,-1)

X-Intercepts: (0.1,0) (3.9,0) Zeros: $x = 0.1, 3.9$

End Behavior: As $x \to -\infty$, $y \to -\infty$

As $x \to \infty$, $y \to -\infty$