Math 2 **U2.1 Key Features of Quadratics** **Name:** _____

- **standard form of a quadratic function** → is in the form of $y = ax^2 + bx + c$
- **vertex form of a quadratic function** → is in the form of $y = a(x-h)^2 + k$ { vertex (h, k)

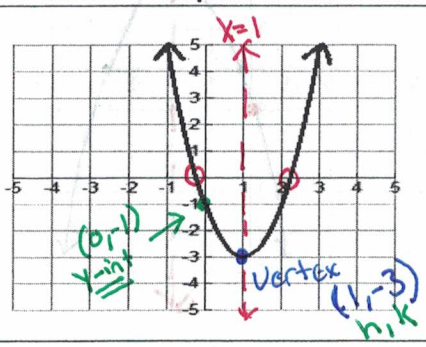
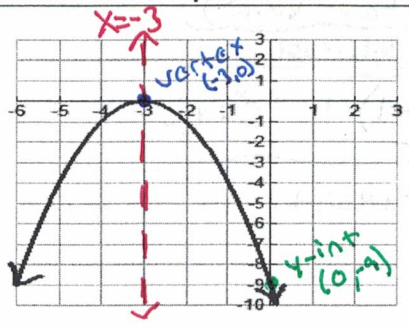
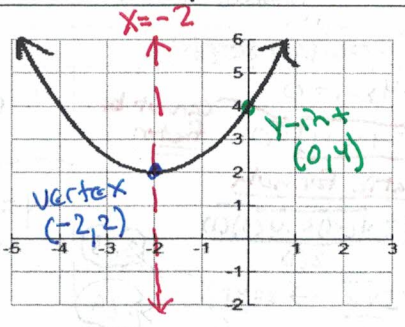
- **parabola** – the ∪ ∩ shape **curve** that a quadratic function creates when **graphed**
- **axis of symmetry ("aos")** – a(n) **invisible vertical line** that **DIVIDES the parabola** into **TWO pieces**, where the equation for the "aos" is $x = -b/2a$
- **vertex** – represents the **minimum OR maximum pt** and **is** (h, k) on the parabola
  - If "a" is **POSITIVE**, then the parabola will **open UP** and vertex will be a **minimum**
  - If "a" is **NEGATIVE**, then the parabola will **open DOWN** and vertex will be a **maximum**
  - The coordinates (h , k) of the vertex is.... h = $-b/2a$ and k => $k(h) = a(h)^2 + b(h) + c$ *FIND h, then plug into function to find k.*
- **x-intercept(s)** – represents the **place(s) that the parabola CROSSES/TOUCHES the x-axis**, where the **# of places touched/crossed on x-axis** = the **# of REAL ZEROS.**
  - zero(s) = the **x-coordinate of the x-int.**
  - factor(s) = the **opposite binomial of a zero.**

Ex: If a quadratic function has x-ints = (2 , 0) and (– 3 , 0), then zeros = **2, -3** and factors = **(x-2)(x+3)**
($x=2$ $x=-3$; $x-2=0$ $x+3=0$)

* General observations about parabolas in EITHER standard form or vertex form →

- If "a" is a **whole # > 1**, then the parabola is being **vertically stretched** Ex: $y = 3(x+1)^2 - 3$ → vertically stretched
- If "a" is a **Fractional #**, then the parabola is being **vertically compressed** Ex: $y = \frac{1}{2}(x-2)^2 + 4$ → vertically compressed
- If "a" is a **Negative #**, then the parabola is being **reflected about x-axis** Ex: $y = -(x+3)^2 + 1$ → reflected about x-axis

Example 1: From the given graph, complete each part about (some of) the graph's characteristics.

Example 1a	Example 1b	Example 1c
		
standard form: $y = 2x^2 - 4x - 1$ ($a=2$ $b=-4$ $c=-1$)	standard form: $y = -x^2 - 6x - 9$ ($a=-1$ $b=-6$ $c=-9$)	standard form: $y = \frac{1}{2}x^2 + 2x + 4$
vertex form: $y = 2(x-1)^2 - 3$ ($y = a(x-h)^2 + k$)	vertex form: $y = -1(x+3)^2$	vertex form: $y = \frac{1}{2}(x+2)^2 + 2$
graph is being **vertically stretched by 2**	graph is being **reflected about x-axis**	graph is being **vertically compressed by ½**
vertex = **(1, -3)** ; max or **(min)**	vertex = **(-3, 0)** ; **(max)** or min	vertex = **(-2, 2)** ; max or **(min)**
axis of symmetry: **x = 1**	axis of symmetry: **x = -3**	axis of symmetry: **x = -2**
# of real zero(s) = **2**	# of real zero(s) = **1**	# of real zero(s) = **0**
(b/c there are 2 x-ints)	(b/c it only touches x-axis once; it has a **multiplicity of 2**)	(b/c graph does not touch or cross x-axis; solutions are **Imaginary**)

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Graphing Quadratic Functions (By Hand)

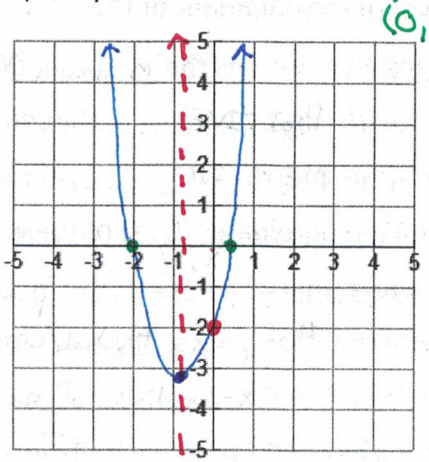
- In order to graph a quadratic equation, we will NEED to obtain the following information:

1.) axis of symmetry ($x = -b/2a$) 2.) vertex (max or min point) ((h,k)) 3.) factors/zeros (x-intercepts) (set = to 0 and solve) 4.) y-intercept ("value of C", let $x=0$ and solve for y)

Example 2: Find the required information, then graph the quadratic function.

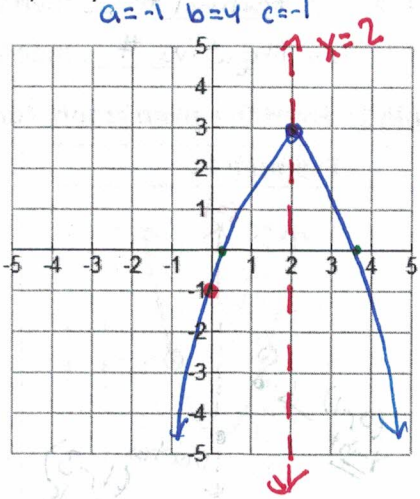
a.) $y = 2x^2 + 3x - 2$ $a=2$ $b=3$ $c=-2$ ← y-intercept $(0,-2)$

axis of symmetry ("aos")	vertex (max or min?)
$x = \frac{-b}{2a}$ → this is also "h" $x = \frac{-(3)}{2(2)}$ $x = -3/4$ or $-.75$	The "aos" is h! → $k = a(h)^2 + b(h) + c$ $k = 2(-.75)^2 + 3(-.75) - 2$ $k = -3.125$ Vertex $(-.75, -3.125)$
factor(s) / zero(s)	**y-intercept**
$2x^2+3x-2=0$ $(2x^2-1x)(4x-2)$ $x(2x-1)+2(2x-1)$ $(x+2)(2x-1)=0$ FACTORS $x+2=0$ $2x+1=0$ $x=-2$ $x=1/2$ ZEROS	y-int = $(0,-2)$ To find y-intercept let $x=0$. $y = 2(0)^2+3(0)-2$ $y=-2$



b.) $y = -x^2 + 4x - 1$ $a=-1$ $b=4$ $c=-1$

axis of symmetry ("aos")	vertex (max or min?)
$x = \frac{-b}{2a}$ $x = \frac{-(4)}{2(-1)}$ $x=2$ Remember, "x" is "h".	$k = -(2)^2+4(2)-1$ $k = -4+8-1$ $k=3$ Vertex $(2,3)$
factor(s) / zero(s)	**y-intercept**
$-x^2+4x-1=0$ $-1[x^2-4x+1]=0$ cannot be factor Quadratic Formula $x = \frac{4 \pm \sqrt{(-4)^2-4(1)(1)}}{2(1)}$ $x = \frac{4 \pm \sqrt{12}}{2} \rightarrow x = \frac{4 \pm 2\sqrt{3}}{2}$ 3.73 .29	$(0,-1)$ "C" = y-int $y = -(0)^2+4(0)-1$ $y=-1$



Example 3: Use the given information to write a quadratic function in standard form. $y = ax^2+bx+c$

a.) Has zeros of 2 and $-\frac{1}{3}$ and is being vertically stretched by 3

$a=3$ (vert. stretch)

$x=2$ $x=-\frac{1}{3}$ (zeros)

$x-2=0$ $3x=-1$ → $(x-2)(3x+1)$ FACTORS

$3x+1=0$

$y = 3(x-2)(3x+1)$ FACTORED FORM

$y=(3x-6)(3x+1)$ Box or Foil

$y=9x^2+3x-18x-6$

$y=9x^2-15x-6$ STANDARD FORM

b.) Has only a zero of -6 (multiplicity of 2) and is being vertically compressed by $\frac{1}{2}$ and reflected about x-axis $a=-1/2$

$x=-6$ $x=-6$

$(x+6)(x+6)$

$(x+6)^2$

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

DO NOT DISTRIBUTE THE $-\frac{1}{2}$

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

$y = -\frac{1}{2}(x^2+12x+36)$

$y = -\frac{1}{2}x^2-6x-18$

c.) Has a vertex of $(-3, 5)$ and is being vertically stretched by 2.

$a=2$ vertex $(-3,5)$ (h,k)

$y = 2(x+3)^2+5$ VERTEX FORM

$y = 2[(x+3)(x+3)]+5$ Box or FOIL

$y = 2(x^2+6x+9)+5$

$y = 2x^2+12x+18+5$

$y = 2x^2+12x+23$