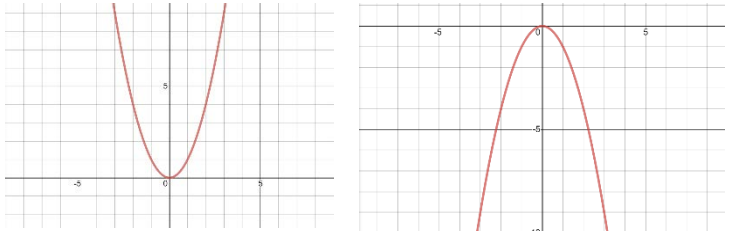
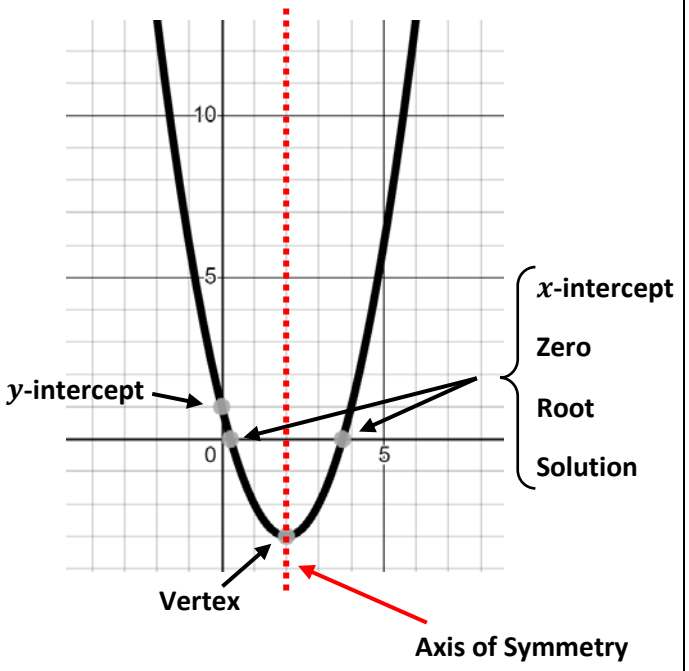
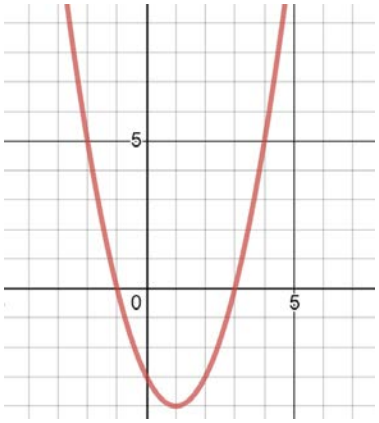
Quadratic Functions

Term	Definition (*related terms)	Example/Diagram/Picture
Quadratic Function	Function with a degree of 2 Standard form: $y = ax^2 + bx + c$	$f(x) = x^2 + 3x - 1$ $y = -2x^2 - 7$
Parabola	U-shaped graph of a quadratic function	
***Zero**	x-value(s) of the x-intercept(s)	
***Root**	x-value that makes an equation true	
***Solution**	x-value that makes an equation true	
***x-intercept**	Where the graph crosses the x-axis $y = 0$	
y-intercept	Where the graph crosses the y-axis $x = 0$	
Axis of Symmetry	Vertical line that divides a parabola in half x-value of the vertex	
Vertex	Minimum or maximum point of the parabola Written as a point (x, y)	

Quadratic Functions

***Factor**	Algebraic expression that evenly divides another Written as **two binomials** or **one monomial & one binomial** (for quadratic functions)	$f(x) = (x+2)(x-3)$ **Factor**
Lead Coefficient	The coefficient to the term with the highest degree • a in quadratic function (see above) Determines whether the graph opens upwards (+) or downwards (-) Indicates the stretch or shrink of the graph: $\lvert a\rvert > 1$ the graph stretches (gets taller) $0 < \lvert a\rvert < 1$ the graph shrinks (gets flatter)	$f(x) = 2x^2 + 3x + 1$ $\boldsymbol{a}$ a is **positive**, so the graph opens **up** $\lvert a\rvert > 1$, so the graph **stretches**
Constant	Numerical value (no variable) • c in a quadratic function (see above) Indicates the vertical shift of the graph/the y-intercept	$f(x) = x^2 + 3$ $\boldsymbol{c}$ The y-intercept is at $(0,3)$
Domain	Set of all x-values (inputs) that output a y-value Read the graph from Left to Right	 **Domain**: $x \in \mathbb{R}$ **Range**: $y \geq -4$
Range	Set of all y-values (outputs) Read the graph from Bottom to Top	

Polynomials & Factoring

Polynomials (expressions with multiple terms)

Concept	Process	Example
Addition	Combine like terms	$\mathbf{(2x^2 + 3x - 1) + (5x^2 + 2x + 7)} = 7x^2 + 5x + 6$
Subtraction	Distribute the negative first Combine like terms	$\mathbf{(x^2 - 3x + 2) - (2x^2 + x - 5)} = x^2 - 3x + 2 - 2x^2 - x + 5$ $= -x^2 - 4x + 7$
Multiplication (3 types)	Distribute and combine like terms • **(Monomial)*(Polynomial)** : distribute the monomial to each part of binomial • **(Binomial)*(Binomial)** : FOIL • **(Polynomial)*(Polynomial)** : distribute each part of the first ( ) to each part of the second ( )	$\mathbf{3x(2x - 1)} = 6x^2 - 3x$ $\mathbf{(x - 2)(2x + 3)} = 2x^2 + 3x - 4x - 6$ $= 2x^2 - x - 6$ $\mathbf{(x + 1)(x^2 - 2x - 3)} = x^3 - 2x^2 - 3x + x^2 - 2x - 3$ $= x^3 - x^2 - 5x - 3$
Division	Use exponent rules to simplify	$\frac{\mathbf{16x^6y^{-2}z}}{\mathbf{2xy^5z^2}} = \frac{8x^5}{y^7z}$

Factoring

Method	Process	Example
Greatest Common Factor (GCF)	1. Find the GCF of <u>all</u> terms in the polynomial 2. Divide the GCF out of all the terms • Format: $GCF * \left(\frac{polynomial}{GCF}\right)$	$\mathbf{2x^2 - 6x} = 2x(x - 3)$
Difference of Two Squares (DOTS)	Take the square root of the first <u>term</u> (a) and the second <u>term</u> (b) • Format: $(a + b)(a - b)$	$\mathbf{x^2 - 25} = (x + 5)(x - 5)$ $\mathbf{4x^2 - 81} = (2x + 9)(2x - 9)$
$\boldsymbol{a = 1}$	Find two factors that multiply to c and add to b • Format: $(x \pm p)(x \pm q)$ where p and q are factors	$\mathbf{x^2 + 5x + 6} = (x + 3)(x + 2)$ $\mathbf{x^2 - 7x - 8} = (x + 1)(x - 8)$
Slide-and-Divide ($\boldsymbol{a \neq 1}$)	1. Multiply a by c 2. Find factors that multiply to the <u>new</u> c and add to b. 3. Write as two binomials 4. Divide the second term of each binomial by a • If a fraction results, simplify (if applicable) and make the denominator the coefficient to the first term/variable)	$\mathbf{2x^2 - 5x - 3} = x^2 - 5x - 6$ $= (x + 1)(x - 6)$ $= \left(x + \frac{1}{2}\right)\left(x - \frac{6}{2}\right)$ $= (2x + 1)(x - 3)$