# Advanced Algebra Scope and Sequence 2013-14

## First Semester

<table>
<thead>
<tr>
<th>Unit Name</th>
<th>Sections in Book</th>
<th>0308 SLOs</th>
<th>0310 SLOs</th>
<th>Time (days)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unit 1: Review of Basic Concepts and Polynomials</td>
<td>R.2, R.3, R.4</td>
<td>8-5, 8-6, 8-7</td>
<td>10-1, 10-3</td>
<td>25</td>
</tr>
<tr>
<td>Unit 2: Rational and Radical Expressions</td>
<td>R.5, R.6, R.7</td>
<td>8-5, 8-10</td>
<td>10-1, 10-3, 10-6</td>
<td>33</td>
</tr>
<tr>
<td>Unit 3a: Linear Equations</td>
<td>1.1</td>
<td>8-1, 8-2</td>
<td>10-7</td>
<td>20</td>
</tr>
</tbody>
</table>

(includes exam and review days) **Total** 78

## Second Semester

<table>
<thead>
<tr>
<th>Unit Name</th>
<th>Sections in Book</th>
<th>0308 SLOs</th>
<th>0310 SLOs</th>
<th>Time (days)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unit 3b: Applications and Modeling with Linear Equations</td>
<td>1.2</td>
<td>8-1, 8-2</td>
<td>10-7</td>
<td>10 (of 30)</td>
</tr>
<tr>
<td>Unit 4: Quadratic Equations with Applications</td>
<td>1.3, 1.4, 1.5</td>
<td>8-8</td>
<td>10-1, 10-7</td>
<td>20</td>
</tr>
<tr>
<td>Unit 5: Other Equations and Inequalities with Applications</td>
<td>1.6, 1.7, 1.8</td>
<td>8-1</td>
<td>10-3, 10-4, 10-5, 10-7</td>
<td>20</td>
</tr>
<tr>
<td>Unit 6: Linear Functions</td>
<td>2.1, 2.3 - 2.8</td>
<td>8-3, 8-4</td>
<td>10-2, 10-6, 10-7</td>
<td>20</td>
</tr>
<tr>
<td>Unit 7: Polynomial and Rational Functions</td>
<td>3.1 - 3.5</td>
<td>8-10</td>
<td>10-7</td>
<td>15</td>
</tr>
<tr>
<td>Unit 8: Systems</td>
<td>5.1, 5.6</td>
<td>8-9</td>
<td>10-6, 10-7</td>
<td>7</td>
</tr>
<tr>
<td>Unit 9: Exponential and Logarithmic Functions (optional)</td>
<td>4.1, 4.2, 4.3</td>
<td></td>
<td>10-7</td>
<td>7</td>
</tr>
</tbody>
</table>

(includes exam and review days) **Total** 99
Unit 1: Review of Basic Concepts and Polynomials

Textbook Sections: R.2, R.3, R.4

Time Spent: 25 Days

Enduring Understandings:
The student understands that mathematics is a structure with rules and definitions that can be applied to solve problems.

The student understands the importance of the skills required to manipulate symbols in order to solve problems.

The student understands that expressions can be mathematically manipulated to create equivalent forms of the expression.

The student understands that polynomials can be written in a variety of ways and still be equivalent.

Vocabulary:
Natural numbers, whole numbers, integers, rational numbers, irrational numbers, real numbers, simplify, evaluate, base, power, exponent, monomial, binomial, trinomial, polynomial, degree, term, coefficient, constant, leading coefficient, factor

Student Learning Outcomes:
8-5 Simplify expressions using definitions and laws of integer exponents.
8-6 Add, subtract, multiply, and divide polynomials.
8-7 Factor polynomials.
10-1 Define, represent, and perform operations on real and complex numbers.
10-3 Recognize and use algebraic (field) properties, concepts, procedures (including factoring), and algorithms to combine, transform, and evaluate absolute value, polynomial, radical, and rational expressions.

The student will know...

- The characteristics of the number lines and the coordinate plane for all real numbers.
- Distinguish between the number sets (Natural, Whole, Integers, Rational, Irrational, Real).
- Properties of real numbers can be used to simplify expressions.

The student will be able to...

- Identify the set to which a given number belongs (Ex: π is an irrational number).
- Apply properties of real numbers and order of operations to evaluate and/or simplify expressions.
  ✓ Ex: \((-\frac{2}{9} + \frac{1}{4}) - \left[\frac{5}{18} - \left(\frac{1}{2}\right)\right]\)
  ✓ Ex: \(\frac{5q+2(1-p)^2}{r+3}\) when \(q = -3, r = 5\) and \(p = 2\)
  ✓ Ex: \(-\frac{1}{4}(20x + 8y - 32z)\)
  ✓ Ex: \(|-5y + x|\) when \(x = -4\) and \(y = 2\)
- Use exponent rules to simplify monomial expressions.
  ✓ Ex: \(n^6 \cdot n^4 \cdot n^0\)
  ✓ Ex: \(\left(\frac{3x^2y}{2x^{-1}y^3}\right)^2\)
- Simplify expressions, including +, −, ×, ÷.
  Ex: \(\frac{5}{p} + \frac{2}{p^2} + \frac{5}{p^3}\)
  Ex: \(m(5m - 2) + 9(5 - m)\)
- Factor polynomials of various types.
  ✓ GCF (Ex: \(28x^4y^2 + 7x^3y - 35x^4y^3\))
**Unit 2: Rational and Radical Expressions**

**Textbook Sections:** R.5, R.6, R.7  
**Time Spent:** 33 Days

**Enduring Understandings:**
The student understands that expressions can be mathematically manipulated to create equivalent forms of the expression.
The student understands that concepts involving simple expressions (such as numerical fractions) can be applied to more complex expressions.
The student understands that there are rules that define how an expression can be mathematically manipulated, including rules involving exponents, rational expressions, and radicals.

**Vocabulary:**
rational expression, domain (of a rational expression), zero-factor Property, fundamental principle of fractions, least common denominator, complex fraction, negative exponent, rational exponent, product rule, quotient rule, power to a power, radical notation, radical sign, radicand, index, n<sup>th</sup> root, principal n<sup>th</sup> root, like radicals, unlike radicals

**Student Learning Outcomes:**
8-5  Simplify expressions using definitions and laws of integer exponents.  
8-10  Simplify, multiply and divide rational expressions.  
10-1  Define, represent, and perform operations on real and complex numbers.  
10-3  Recognize and use algebraic (field) properties, concepts, procedures (including factoring), and algorithms to combine, transform, and evaluate absolute value, polynomial, radical, and rational expressions.  
10-6  Model, interpret and justify mathematical ideas and concepts using multiple representations.

<table>
<thead>
<tr>
<th>The student will know...</th>
<th>The student will be able to...</th>
</tr>
</thead>
</table>
| • that there are some value(s) for which a rational expression may be undefined.  
  • the fundamental principle of fractions, \( \frac{ac}{bc} = \frac{a}{b} \) for \( b \neq 0, c \neq 0 \), and how to apply it.  
  • the properties of exponents, particularly as they apply to negative and rational exponents.  
  • that the properties of | • determine the domain over which a rational expression is defined.  
  ✓ Ex: the domain of \( \frac{(x + 6)(x + 4)}{(x + 2)(x + 4)} \) is \( \{x \mid x \neq -2, -4\} \)  
  • apply the fundamental principle of fractions to multiplication, division, addition, subtraction, and simplification of rational expressions and complex fractions.  
  ✓ Ex: \( \frac{2p^2 + 7p - 4}{5p^2 + 20p} \) |
exponents may be combined to simplify certain types of expressions.
• that complex fractions may be simplified, in some cases, from the standpoint of negative exponents.
• the product, quotient, and power rules for radicals, and how to use them, in combination if necessary, to simplify radical expressions.
• that radical notation and rational exponents of an expression are related.

✓ Ex: \[
\frac{x^2 - y^2}{x - y} \cdot \frac{x^2 - xy + y^2}{x^2 - 2xy + y^2}
\]

✓ Ex: \[
\frac{x^2 - y^2}{(x - y)^2} \div \frac{x^3 + y^3}{(x - y)^4}
\]

✓ Ex: \[
\frac{m - 4}{3m - 4} + \frac{3m + 2}{4 - 3m}
\]

✓ Ex: \[
\frac{3x}{x^2 + x - 12} \div \frac{x}{x^2 - 16}
\]

✓ Ex: \[
\frac{m - 1}{m^2 - 4} \quad \text{(increased the level of difficulty)}
\]

✓ Ex: \[
\frac{y + 3}{m + 2} \quad \text{(increased the level of difficulty)}
\]

• apply exponent rules to simplify expressions and solve problems, including those with rational and negative exponents.

✓ Ex: \[
\frac{25r^7 z^5}{10 r^9 z}
\]

✓ Ex: \[
\frac{\left(3x^2\right)^{-1} \left(3x^5\right)^{-2}}{\left(3^{-1} x^{-2}\right)^2}
\]

✓ Ex: \[-1296^{\frac{1}{3}}\]

✓ Ex: \[16^{\frac{3}{4}}\]

✓ Ex: \[
\frac{z^\frac{3}{2} z^{-\frac{5}{2}} z^{\frac{3}{6}}}{\left(z^{-\frac{1}{3}}\right)^3}
\]

✓ Ex: \[
\left(y - 2\right)^{\frac{3}{6}} + \left(y - 2\right)^{\frac{2}{6}}
\]

✓ Ex: \[
\frac{(x+y)^{-1}}{x^{-1} + y^{-1}}
\]

• convert between radical notation and the rational exponent form of an expression.

✓ Ex: \[
(-32)^{\frac{3}{6}} = \left(\sqrt[6]{-32}\right)^4 = (-2)^4 = 16
\]

✓ Ex: \[
\sqrt[p^2 + q]{(p^2 + q)^{\frac{3}{2}}}
\]

• simplify radical expressions

✓ Ex: \[
\sqrt[9]{\frac{64}{\sqrt{729}}}
\]

✓ Ex: \[
\sqrt[6]{(-2)^6}
\]

✓ Ex: \[
\sqrt[3]{m} \cdot \sqrt[3]{m^2}
\]

✓ Ex: \[
2\sqrt{2}
\]
Unit 3: Linear Equations with Applications

**Textbook Sections:** 1.1, 1.2

**Time Spent:** 20+10 Days (split)

**Enduring Understandings:**
The student understands the basic terminology of linear equations and how to solve them.
The student understands that certain principles and methods can be applied to finding solutions to real-world problems.
The student understands that there are many practical real-world applications that can be modeled with linear equations.

**Vocabulary:**
equation, solution, root, solution set, equivalent equation, variable, linear equation, identity, conditional equation, contradiction, empty set, literal equation, independent variable, dependent variable, linear modeling

**Student Learning Outcomes:**

<table>
<thead>
<tr>
<th>The student will know...</th>
<th>The student will be able to...</th>
</tr>
</thead>
</table>
| • the basic terminology of equations and the definition of a linear equation in one variable. | • solve linear equations on one variable.  
  ✓ Ex: $3(2x - 4) = 7 - (x + 5)$ |
| • that there is a variety of methods than can be used to solve linear equations. | • remove fractions from an equation by multiplying both sides of the equation by the common denominator.  
  ✓ Ex: $\frac{1}{14}(3x - 2) = \frac{x + 10}{10}$ |
| • that the process of solving equations can be broken down into steps. | • Ex: $0.3(x + 2) - 0.5(x + 2) = -0.2x - 0.4$ |
| • that there are different types of linear equations. | • identify different types of linear equations (i.e. identities, conditional equations, contradictions).  
  ✓ Ex: $0 = 0$ (Identity)  
  ✓ Ex: $x = 3$ (Conditional)  
  ✓ Ex: $-3 = 7$ (Contradiction) |
• the addition and multiplication
  principles of equality.
• that linear equations can be
  used to model real-world
  situations.

• solve a literal equation for a specified variable.
  ✓ Ex: Solve $S = 2lw + 2wh + 2hl$ for $h$
• solve certain types of geometry, simple interest,
  motion, and mixture problems that can be modeled
  with linear equations.
  ✓ Ex: If the length of each side of a square is increased by 3 cm,
    the perimeter of the new square is 40 cm more than twice the
    length of each side of the original square. Find the dimensions of
    the original square.
  ✓ Ex: Latoya borrowed $5240 for new furniture. She will pay it off
    in 11 months at an annual simple interest rate of 4.5%. How
    much interest will she pay?
  ✓ Ex: Russ and Janet are running in the Strawberry Hill Fun Run.
    Russ runs at 7 mph and Janet runs at 5 mph. If they start at the
    same time, how long will it be before they are 1.5 miles apart?
  ✓ Ex: Marin needs 10% hydrochloric acid for a chemistry
    experiment. How much 5% acid should she mix with 60 mL of
    20% acid to get a 10% solution?
  ✓ Ex: Linda won $200,000 in a state lottery. She first paid income
    tax of 30% on her winnings. Of the rest, she invested some at
    1.5% and some at 4% earning $4,350 in interest per year. How
    much money did she invest at each rate?

Unit 4: Quadratic Equations with Applications
Textbook Sections: 1.3, 1.4, 1.5

Enduring Understandings:
The student understands that the number system used to solve problems can be
extended to include nonreal numbers (i.e. complex numbers).
The student understands the basic terminology of quadratic equations and how to solve
them.
The student understands that certain principles and methods can be applied to finding
solutions to real-world problems.
The student understands that there are many practical real-world applications that can
be modeled with quadratic equations.

Vocabulary:
imaginary unit, complex number, real number, pure imaginary, complex conjugate,
standard form $(a+bi)$, quadratic equation, second-degree equation, standard form
$(ax^2 + bx + c = 0)$, zero-factor property, double root, square root property, completing
the square, quadratic formula, cubic equation, discriminant, Pythagorean theorem

Student Learning Outcomes:
8-8 Solve quadratic equations using the factoring method.
10-1 Define, represent, and perform operations on real and complex numbers.
10-7 Connect and use multiple strands of mathematics in situations and problems, as well as
in the study of other disciplines.

The student will know… | The student will be able to…
---|---
• the definition and
  characteristics of the
  imaginary unit and complex
  numbers.
• that a quadratic equation may
  rewrite an expression with a negative radicand using
  the imaginary unit
  ✓ Ex: $\sqrt{-16} = 4i$
• perform operations $(+, -, \times, \div)$ on complex numbers,
  including using a complex conjugate for division and/or
have up to 2 solutions.
- the definition of a quadratic equation.
- the zero-factor property and how to apply it.
- the square root property and how to apply it.
- that there are various methods of solving a quadratic equation, including: factoring, taking the square root, completing the square, and the quadratic formula.
- the significance of the discriminant in a quadratic equation.
- that there are real-world applications problems that can be modeled with quadratic equations.

simplification.
✓ Ex: \( \frac{\sqrt{-48}}{\sqrt{24}} \)
✓ Ex: \( -8 + \frac{\sqrt{-128}}{4} \)
✓ Ex: \( (12 - 5i) - (8 - 3i) \)
✓ Ex: \( (6 + 5i)(6 - 5i) \)
✓ Ex: \( \frac{3 + 2i}{5 - i} \)

- simplify powers of \( i \).
  ✓ Ex: \( i^{40} \)

- solve quadratic equations using various methods (zero-factor property, square root property, completing the square, quadratic formula).
  ✓ Ex: \( 6x^2 + 7x = 3 \)
  \( 6x^2 + 7x - 3 = 0 \)
  \( (3x - 1)(2x + 3) = 0 \) etc.
  ✓ Ex: \( x^2 = -25 \)
  \( \sqrt{x^2} = \sqrt{-25} \)
  \( x = \pm 5i \)
  ✓ Ex: \( x^2 - 4x - 14 = 0 \)
  \( x^2 - 4x + 4 = 14 + 4 \)
  \( (x - 2)^2 = 18 \) etc.
  ✓ Ex:
  \( -6x^2 = 3x + 3 \)
  \( -6x^2 - 3x - 3 = 0 \)
  \( x = \frac{3 \pm \sqrt{(-3)^2 - 4(-6)(-3)}}{2(-6)} \) etc.

- solve cubic equations.
  ✓ Ex: \( x^3 + 8 = 0 \)

- solve literal quadratic equations for a specified variable.
  ✓ Ex: \( rt^2 - st = k \) \((r \neq 0)\) Solve for \( t \).

- identify the discriminant of a quadratic equation and use it to identify the type of solutions for that equation.
  ✓ Ex: \( 5x^2 + 2x - 4 = 0 \) has a discriminant of \( 2^2 - 4(5)(-4) = 84 \) so the equation has 2 irrational solutions.

- solve application problems modeled by quadratic equations (area and volume, Pythagorean theorem, height of a projectile).
  ✓ Ex: The difference of the squares of two positive consecutive odd integers is 32. Find the integers.
  ✓ Ex: The length of each side of a square is 3 in. more than the length of each side of a smaller square. The sum of the areas of the squares is 149 in\(^2\). Find the lengths of the sides of the two squares.
  ✓ Ex: Tanner and Sheldon received walkie talkies for Christmas. If
they leave from the same point at the same time, Tanner walking north at 2.5 mph and Sheldon walking east at 3 mph, how long will they be able to talk to each other if the range of the walkie talkies is 4 mi.? Round your answer to the nearest minute.

Ex: An astronaut on the moon throws a baseball upward. The astronaut is 6 ft, 6 in. tall, and the initial velocity of the ball is 30 ft per second. The height $s$ of the ball in feet is given by the equation $s = -2.7t^2 + 30t + 6.5$ where $t$ is the number of seconds after the ball was thrown.

a) After how many seconds is the ball 12 ft above the moon’s surface?
b) How many seconds will it take for the ball to return to the surface?

---

**Unit 5: Other Equations and Inequalities with Applications**

**Textbook Sections: 1.6, 1.7, 1.8**

<table>
<thead>
<tr>
<th>Enduring Understandings:</th>
</tr>
</thead>
<tbody>
<tr>
<td>The student understands how to use identity properties to solve equations and inequalities, including: square root, cube root, and rational equations and inequalities. The student understands that strategies used to solve basic linear equations can be applied to more complex equations.</td>
</tr>
<tr>
<td>The student understands the basic terminology of radical equations and inequalities and how to solve them.</td>
</tr>
<tr>
<td>The student understands the basic terminology of rational equations and inequalities and how to solve them.</td>
</tr>
<tr>
<td>The student understands the basic terminology of inequalities and how to solve them.</td>
</tr>
<tr>
<td>The student understands that certain principles and methods can be applied to finding solutions to real-world problems.</td>
</tr>
<tr>
<td>The student understands that there are many practical real-world applications that can be modeled with inequalities.</td>
</tr>
</tbody>
</table>

**Vocabulary:**
- rational equation
- linear inequality
- interval notation
- open interval
- closed interval
- quadratic inequality
- rational inequality
- absolute value equation
- absolute value inequality
- union
- intersection

**Student Learning Outcomes:**

| 8-1 | Solve linear equations and inequalities in one variable and compound inequalities in one variable. |
| 10-3 | Recognize and use algebraic (field) properties, concepts, procedures (including factoring), and algorithms to combine, transform, and evaluate absolute value, polynomial, radical, and rational expressions. |
| 10-4 | Identify and solve absolute value, polynomial, radical, and rational equations. |
| 10-5 | Identify and solve absolute value and linear inequalities. |
| 10-7 | Connect and use multiple strands of mathematics in situations and problems, as well as in the study of other disciplines. |

**The student will know...**
- that some solutions to rational and radical equations may not be valid.
- there are real-world situations

**The student will be able to...**
- solve rational equations and determine if the solutions are valid.
that can be modeled with rational or radical equations.
  • the concepts and terminology of inequalities and their solution sets.
  • there are various methods for solving linear, three-part, quadratic, absolute value, and rational inequalities.
  • that the solution to an inequality can be expressed in various ways, including set-builder notation and interval notation.
  • that the solution set for an inequality will often contain an infinite number of solutions.
  • the definition and properties of absolute value expressions.

✓ Ex: \(6 = \frac{7}{2x - 3} + \frac{3}{(2x - 3)^2}\)

• solve radical equations and determine if the solutions are valid.
  ✓ Ex: \(\sqrt{2x} - x + 4 = 0\)
  ✓ Ex: \(\sqrt{x} + \sqrt{x - 16} = 8\)

• solve inequalities and state the solution in interval notation.
  ✓ Ex: \(-3x + 5 > -7\)
  ✓ Ex: \(4 - 3x \leq 7 + 2x\)
  ✓ Ex: \(-2 < 5 + 3x < 20\)
  ✓ Ex: \(\frac{5}{x + 4} \geq 1\)

• use absolute value to describe distances.
  ✓ Ex: “\(k\) is less than 5 units from 8” becomes \(|k - 8| < 5\)

• solve absolute value equations and inequalities and state the solution set in interval notation using union and intersection of sets as necessary.
  ✓ Ex: \(|\frac{3}{2x - 1}| = 4\)
  ✓ Ex: \(|2x + 1| < 7\)
  ✓ Ex: \(|3x - 4| \geq 2\)

Unit 6: Linear Functions

Textbook Sections: 2.1, 2.3 - 2.8 Time Spent: 20 Days

Enduring Understandings:
The student understands the concept of slope as a rate of change and can apply it to purely mathematical and real-world situations.
The student understands the definition of a function as a relation and can represent a function in various ways, including graphical, tabular, verbal, and symbolic.
The student understands the attributes of functions, including domain, range, continuity, and increasing/decreasing and can make connections of these attributes between various representations.
The student understands the relationship between the algebraic and geometric representations of a circle and parts of a circle.
The student understands that the graphs of parent functions have characteristics such as continuity and symmetry which set them apart from other functions.
The student understands that functions can be combined through performing operations (+, -, x, ÷) or by composition.

Vocabulary:
ordered pair, rectangular coordinate system, distance formula, midpoint formula, x-axis, y-axis, Cartesian coordinate system, coordinate plan, quadrants, coordinates, graph, x-intercept, y-intercept, circle, center-radius form, general form, relation, function, domain, range, function notation, increasing function, decreasing function,
constant function, linear function, standard form, slope, point-slope form, parallel, perpendicular, horizontal, vertical, continuous function, identity, square, square root, cube, cube root, greatest integer function, expansion, compression, reflection, symmetry, even function, odd function, odd function, translations, composite function

**Student Learning Outcomes:**

8-3 Sketch graphs of linear relations and determine a linear equation in two variables given pertinent information.
8-4 Find the slope and x- and y-intercepts of a linear relation.
10-2 Recognize, understand, and analyze features of a function.
10-6 Model, interpret and justify mathematical ideas and concepts using multiple representations.
10-7 Connect and use multiple strands of mathematics in situations and problems, as well as in the study of other disciplines.

<table>
<thead>
<tr>
<th>The student will know...</th>
<th>The student will be able to...</th>
</tr>
</thead>
<tbody>
<tr>
<td>• the distance and midpoint formulas.</td>
<td>• calculate the distance between two points.</td>
</tr>
</tbody>
</table>
| • that an ordered pair is a solution of an equation if its values make the equation true when substituted in for the variables. | ✓ Given \( P(-5, -7); Q(-13, 1) \),
\[
PQ = \sqrt{(-13 - (-5))^2 + (1 - (-7))^2} = 8\sqrt{2}
\]
| • the definition of a relation. | ✓ Ex: Given \( P\left(-\sqrt{7}, 8\sqrt{3}\right) \) and \( Q\left(5\sqrt{7}, -\sqrt{3}\right) \), find \( PQ \).
| • that a function is a particular kind of relation. | • state the domain and range for a function. |
| • how to interpret functional notation. | ✓ Ex: \( y = \sqrt{7} - 2x \)
| • the concept of slope in a linear function. | • determine if three given points can be the vertices of a right triangle. |
| • a linear function can be written in different forms. | ✓ Ex: Are \((-6, 4), (0, -2)\) and \((-10, 8)\) vertices of a right triangle?
| • that the domain of a function represents the independent \((x)\) values and the range represents the dependent \((y)\) values of the function. | ✓ Ex: Given midpoint \( M(5, 8) \) and endpoint \((13, 10)\), find the coordinates of the other endpoint.
| • the unique equations for a vertical line \((x=a)\) and a horizontal line \((y=b)\) through a point \((a, b)\). | • determine if a given relation is a function. |
| • that transforming the graph of a parent function will create infinitely many new functions. | ✓ Ex: \( x + y < 3 \)
| • the definition and characteristics of even and odd functions. | ✓ Ex: \( y = \frac{-7}{x-5} \)
| • a linear function can be written in different forms. | • identify the domain and range and intervals of increasing and decreasing of a function. |
| • the concept of continuity. | ✓ Ex: \( y = \frac{5}{x-1} \)
| • functions can be added, subtracted, multiplied, or divided to create a new function. | • find the values of functions. |

\[
\begin{align*}
&\{(5, 1), (3, 2), (4, 9), (7, 8)\} \\
&\{(4, 0), (-1, 6), (0, 8)\}
\end{align*}
\]
function.
- the concept of composition of functions.
- the graphs and characteristics of the following parent functions:
  - identity \( y = x \)
  - square \( y = x^2 \)
  - square root \( y = \sqrt{x} \)
  - cube \( y = x^3 \)
  - absolute value \( y = |x| \)
  - inverse \( y = \frac{1}{x} \)
  - inverse squared \( y = \frac{1}{x^2} \)
  - greatest integer \( y = \lfloor x \rfloor \)

✓ Ex: Find \( f(-1) \) for

- write a linear function in various forms (i.e. slope-intercept, point-slope, standard) and convert between the forms.
  - Ex: Write the function \( y - 3 = \frac{1}{2}(x + 4) \) in slope-intercept form and in standard form.

- recognize graphs of basic functions and identify discontinuities, if they exist.
- represent intervals of increasing and decreasing in a function.
  - Ex: Identify the intervals of increasing and decreasing for the function shown.

- graph functions by hand and on a graphing calculator.
  - Ex: through \((-1, 3)\) with slope \( \frac{3}{2} \)
  - Ex: through \((-\frac{1}{2}, 4)\), \( m = 0 \)

- find the slope of a linear function.
  - Ex: through \((2, -1)\) and \((-3, -3)\)
  - Ex: vertical line through \((4, -7)\)
  - Ex: \(4x + 3y = 12\)
- write the equation of a line in standard and slope-intercept form.
  - Ex: through \((-2, -3)\) and slope is \(-\frac{3}{4}\)
  - Ex: through \((-1, 3)\) and \((3, 4)\)
  - Ex: slope is 5 and \( y \)-intercept is 15
  - Ex: vertical line through \((-6, 4)\)
  - Ex: horizontal line through \((-7, 4)\)
  - Ex: through \((-1, 4)\) and parallel to \( x + 3y = 5 \)
  - Ex: through \((-5, 6)\) and perpendicular to \( x = -2 \)
  - Ex: find \( k \) so that the line through \((4, -1)\) and \((k, 2)\) is perpendicular to the line \(2y - 5x = 1\)

- apply linear functions to real-life situations.
  - Ex: The pressure \( p \) of water on a diver’s body is a linear function of the diver’s depth, \( x \). At the water’s surface, the pressure is 1 atmosphere. At a depth of 100 ft, the pressure is about 3.92 atmospheres. Find the linear function that relates \( p \) to \( x \) and compute the pressure at a depth of 10 fathoms (60 ft).
  - Ex: See p. 258, #53 in textbook

- determine the slope and \( y \)-intercept of each line.
  - Ex: \( x + 2y = -4 \)

- graph piece-wise functions with domain restrictions.
<table>
<thead>
<tr>
<th>(optional)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>✓ Ex: ( f(x) = \begin{cases} 2x &amp; \text{if } -5 \leq x &lt; -1 \ -2 &amp; \text{if } -1 \leq x &lt; 0 \ x^2 - 2 &amp; \text{if } 0 \leq x \leq 2 \end{cases} )</td>
<td></td>
</tr>
<tr>
<td>• write a piece-wise function given a graph. (optional)</td>
<td></td>
</tr>
<tr>
<td>✓ Ex:</td>
<td></td>
</tr>
<tr>
<td>• transform the graphs of functions, including translations, reflections, and dilations and write the equations of transformed graphs.</td>
<td></td>
</tr>
<tr>
<td>✓ Ex: Graph and describe the transformations on the parent function for the following:</td>
<td></td>
</tr>
<tr>
<td>- ( f(x) = (-2x)^2 )</td>
<td></td>
</tr>
<tr>
<td>- ( f(x) = -3(x - 2)^2 + 1 )</td>
<td></td>
</tr>
<tr>
<td>- Compare the graph of ( y = g(x) ) to ( y = g(-x) ), ( y = g(x - 2) ), and ( y = g(x) + 2 ).</td>
<td></td>
</tr>
<tr>
<td>• determine symmetry of functions.</td>
<td></td>
</tr>
<tr>
<td>✓ Ex: Describe the symmetry of each of the following:</td>
<td></td>
</tr>
<tr>
<td>- ( y = x^2 + 4 )</td>
<td></td>
</tr>
<tr>
<td>- ( y =</td>
<td>x</td>
</tr>
<tr>
<td>- ( 2x - y = 6 )</td>
<td></td>
</tr>
<tr>
<td>- ( x^2 + y^2 = 25 )</td>
<td></td>
</tr>
<tr>
<td>• determine algebraically whether a function is even, odd, or neither.</td>
<td></td>
</tr>
<tr>
<td>✓ Ex: ( g(x) = x^5 + 2x^3 - 3x )</td>
<td></td>
</tr>
<tr>
<td>✓ Ex: ( 2x^2 - 3 )</td>
<td></td>
</tr>
<tr>
<td>✓ Ex: ( x^2 + 6x + 9 )</td>
<td></td>
</tr>
<tr>
<td>• perform operations on functions and the composition of functions.</td>
<td></td>
</tr>
<tr>
<td>✓ Ex: For the functions ( f(x) = \sqrt{x - 2} ) and ( g(x) = 2x ), find the following:</td>
<td></td>
</tr>
<tr>
<td>- ( (f \circ g)x ) and its domain</td>
<td></td>
</tr>
<tr>
<td>- ( (g \circ f)x ) and its domain</td>
<td></td>
</tr>
</tbody>
</table>

**Unit 7: Polynomial and Rational Functions**  
**Textbook Sections: 3.1 - 3.5**  
**Time Spent: 15 Days**

**Enduring Understandings:**  
The student understands the basic terminology and characteristics of polynomial functions and how to apply them.  
The student understands the basic terminology and characteristics of rational functions and how to apply them.
**Vocabulary:**
- polynomial function
- leading coefficient
- zero (of a function)
- quadratic function
- parabola
- axis
- vertex
- synthetic division
- remainder theorem
- factor theorem
- rational zeros theorem
- fundamental theorem of algebra
- multiplicity of the zero
- conjugate zeros theorem
- turning point
- end behavior
- reciprocal function
- asymptotes (vertical and horizontal)
- discontinuous
- rational function

**Student Learning Outcomes:**

8-10 Simplify, multiply and divide rational expressions.
10-7 Connect and use multiple strands of mathematics in situations and problems, as well as in the study of other disciplines.

<table>
<thead>
<tr>
<th>The student will know...</th>
<th>The student will be able to...</th>
</tr>
</thead>
</table>
| - the definition and characteristics of a polynomial function. | - graph and state the vertex, axis, domain, and range of a quadratic function.  
  ✓ Ex: \( f(x) = -\frac{1}{2}(x + 1)^2 - 3 \) |
| - that linear and quadratic functions are polynomial functions. | - write the equation of a quadratic function from its graph.  
  ✓ Ex: |
| - the division algorithm. | - transform the general form of a quadratic function to the vertex (graphing) form using completing the square.  
  ✓ Ex: \( f(x) = 2x^2 - 4x + 5 \) |
| - that synthetic division is a shortcut for long division of polynomials. | |
| - the remainder theorem. | |
| - the definition and characteristics of a rational function. | |
| - some relationships between quantities can be expressed as a variation. | |
| - the definition and characteristics of a polynomial function. | |
| - that linear and quadratic functions are polynomial functions. | |
| - the division algorithm. | |
| - that synthetic division is a shortcut for long division of polynomials. | |
| - the remainder theorem. | |
| - the definition and characteristics of a rational function. | |
| - some relationships between quantities can be expressed as a variation. | |

✓ Ex: See p. 317, #62 in textbook
- divide polynomials using long division or synthetic division. (no complex roots)  
  ✓ Ex: Given \( f(x) = 3x^4 + 2x^3 - 5x + 10 \), determine if \( k = -\frac{4}{3} \) is a zero of the function.
- find the real zeros of polynomial function. (no complex)  
  ✓ Ex: \( f(x) = (7x - 2)^3(x^2 + 9)^2 \)
- use the factor theorem to factor polynomials.  
  ✓ Ex: Factor \( f(x) = 2x^3 - 5x^2 - x + 6 \)
- identify the characteristics of the graph of a polynomial function, including zeros, turning points, and end behavior.  
  ✓ Ex: \( f(x) = x^4 + 3x^3 - 3x^2 - 11x - 6 \)
- graph and analyze the function \( f(x) = ax^n \) where \( n \in \{\text{natural numbers}\} \), and its transformations
\[ f(x) = \frac{1}{x} \] and \[ f(x) = \frac{1}{x^2} \] and their transformations.

- \[ \text{Ex: } g(x) = \frac{-1}{(x + 5)^2} + 4 \]
- identify the characteristics of the graph of a rational function, \[ f(x) = \frac{P(x)}{Q(x)} \] where \( P(x) \) and \( Q(x) \) are polynomial functions: including intercepts, asymptotes (vertical and horizontal), removable discontinuities, and end behavior.
  - \[ \text{Ex: } f(x) = \frac{x^2 - 2x - 3}{2x^2 - x - 10} \]
- identify a variation problem and set up an equation to represent the situation, including direct variation, inverse variation, joint variation, and combined variation.
  - \[ \text{Ex: } \text{Simple interest varies jointly as principal and time. If $1000 left in an account for 2 years earned $110, find the amount of interest earned by $5000 for 5 years.} \]

### Unit 8: Systems

**Textbook Sections:** 5.1  
**Time Spent:** 7 Days

**Enduring Understandings:**
The student understands that linear systems can be solved by different methods to achieve the same solution.
The student understands that there are many practical real-world applications that can be modeled with systems of equations and inequalities.

**Vocabulary:**
linear systems, independent, dependent, inconsistent

**Student Learning Outcomes:**
8-9  
Solve systems of linear equations in two variables, including applications.
10-6  
Model, interpret and justify mathematical ideas and concepts using multiple representations.
10-7  
Connect and use multiple strands of mathematics in situations and problems, as well as in the study of other disciplines.

<table>
<thead>
<tr>
<th>The student will know...</th>
<th>The student will be able to...</th>
</tr>
</thead>
<tbody>
<tr>
<td>- the definition and characteristics of systems of equations.</td>
<td>- solve systems of linear equations by a variety of methods: substitution method, elimination method, or matrices.</td>
</tr>
</tbody>
</table>
| - that some real-life situations can be represented by a system of equations. | - Ex: Solve by substitution \[ 3x + 2y = 11 \]  
  \[ -x + y = 3 \] |
| - A system of linear equations in two variables can have 0, 1, or infinitely many solutions. | - Ex: Solve by elimination \[ 6x + 7y + 2 = 0 \]  
  \[ 7x - 6y - 26 = 0 \] |
| - Different methods of solving systems can be most efficient depending on the format of | - Ex: Solve by elimination \[ \frac{2x - 1}{3} + \frac{y + 2}{4} = 4 \]  
  \[ \frac{x + 3}{2} - \frac{x - y}{3} = 3 \] |
the system given.

✓ Ex: A system of linear equations in two variables given in standard form may be easiest to solve by the elimination method.

✓ Ex: $8 - 3y + 6z = -2$
$4x + 9y + 4z = 18$
$12x - 3y + 8z = -2$

- determine is a system is one of the following:
  - inconsistent (with no solution)
  - independent (with one solution)
  - dependent (with infinitely many solutions)

- solve linear inequalities
  - $y > 4$
  - $x \leq 5$
  - $y < 2x - 1$
  - $y > -3x + 5$

Unit 9: Exponential and Logarithmic Functions (optional)

Textbook Sections: 4.1, 4.2, 4.3

Time Spent: 7 Days

Enduring Understandings:
The student understands the basic terminology and characteristics of exponential functions and how to apply them.
The student understands the basic terminology and characteristics of logarithmic functions and how to apply them.
The student understands the inverse relationship between exponential and logarithmic functions and the concept of one-to-one correspondence.
The student understands the equivalence relationship between exponential and logarithmic expressions and can utilize this relationship to solve problems.

Vocabulary:
inverse operation, one-to-one function, horizontal line test, inverse function, exponential function, compound interest, $e$, compounding continuously, logarithm, base, argument, logarithmic function, properties of logarithms

Student Learning Outcomes:

10–7 Connect and use multiple strands of mathematics in situations and problems, as well as in the study of other disciplines.

<table>
<thead>
<tr>
<th>The student will know...</th>
<th>The student will be able to...</th>
</tr>
</thead>
<tbody>
<tr>
<td>- the definition of the inverse of a function.</td>
<td>- determine if a function is one-to-one by using the horizontal line test and/or algebraically.</td>
</tr>
<tr>
<td>- that an exponent can have a real irrational value</td>
<td>- determine if two given functions are inverses of each other.</td>
</tr>
</tbody>
</table>
| - the definition and characteristics of an exponential function. | ✓ Ex: $f(x) = -4x + 2$ and $g(x) = -\frac{1}{4}x - 2$
| - the number $e$ and its value in application problems. | ✓ Ex: $f(x) = x^2 + 3$; $D: [0, \infty)$ and $g(x) = \sqrt{x - 3}$, $D: [3, \infty)$ |
| - the definition and characteristics of a logarithmic function. | - determine the inverse of a function and if the inverse is a function. |
| - the properties of logarithms | ✓ Ex: Given $f(x) = \sqrt{6 + x}$, for $x \geq -6$
| | ✓ Ex: $y = -x^2 + 2$
| | - graph and analyze exponential functions $f(x) = a^x$, $a > 0$. |
| | - graph and analyze exponential function transformations. |
✓ Ex: $f(x) = -2^{3x+6} + 5$

- use the properties of exponents to solve exponential equations.
  ✓ Ex: $(\sqrt[3]{2})^{x+4} = 4^x$
  ✓ Ex: $\frac{2^x}{3} = 4$

- use exponential functions to calculate values involving compound interest, including continuously compounded interest. (optional)
  ✓ Ex: $A = P\left(1 + \frac{r}{n}\right)^{nt}$
  ✓ Ex: $A = Pe^{rt}$

- identify the logarithmic function as the inverse of a given exponential function and vice versa.
- apply properties of logarithms evaluate and/or simplify expressions and solve equations.
  ✓ Ex: Simplify $\log_b (2y + 5) - 2\log_b (y + 3)$
  ✓ Ex: Solve $\log_a x = \frac{7}{2}$