Algebra II Content Review Notes are designed by the High School Mathematics Steering Committee as a resource for students and parents. Each nine weeks’ Standards of Learning (SOLs) have been identified and a detailed explanation of the specific SOL is provided. Specific notes have also been included in this document to assist students in understanding the concepts. Sample problems allow the students to see step-by-step models for solving various types of problems. A “TRY IT” section has also been developed to provide students with the opportunity to solve similar problems and check their answers. Supplemental online information can be accessed by scanning QR codes throughout the document. These will take students to video tutorials and online resources. In addition, a self-assessment is available at the end of the document to allow students to check their readiness for the nine-weeks test. It is the Mathematics Instructors’ desire that students and parents will use this document as a tool toward the students’ success on the end-of-year assessment.

The document is a compilation of information found in the Virginia Department of Education (VDOE) Curriculum Framework, Enhanced Scope and Sequence, and Released Test items. In addition to VDOE information, Prentice Hall Textbook Series and resources have been used. Finally, information from various websites is included. The websites are listed with the information as it appears in the document.

Supplemental online information can be accessed by scanning QR codes throughout the document. These will take students to video tutorials and online resources. In addition, a self-assessment is available at the end of the document to allow students to check their readiness for the nine-weeks test.

The Algebra II Blueprint Summary Table is listed below as a snapshot of the reporting categories, the number of questions per reporting category, and the corresponding SOLs.

### Algebra II

**Test Blueprint Summary Table**

<table>
<thead>
<tr>
<th>Reporting Category</th>
<th>Algebra II SOL</th>
<th>Number of Items</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expressions and Operations</td>
<td>AII.1a-c</td>
<td>11</td>
</tr>
<tr>
<td></td>
<td>AII.2</td>
<td></td>
</tr>
<tr>
<td>Equations and Inequalities</td>
<td>AII.3a-d</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>AII.4</td>
<td></td>
</tr>
<tr>
<td>Functions and Statistics</td>
<td>AII.5</td>
<td>22</td>
</tr>
<tr>
<td></td>
<td>AII.6a-b</td>
<td></td>
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<tr>
<td></td>
<td>AII.7a-k</td>
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<tr>
<td></td>
<td>AII.8</td>
<td></td>
</tr>
<tr>
<td></td>
<td>AII.9</td>
<td></td>
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<td>AII.10</td>
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<td></td>
<td>AII.11a-c</td>
<td></td>
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<tr>
<td></td>
<td>AII.12</td>
<td></td>
</tr>
<tr>
<td>Number of Operational Items</td>
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<td>45</td>
</tr>
<tr>
<td>Number of Field-Test Items*</td>
<td></td>
<td>10</td>
</tr>
<tr>
<td>Total Number of Items on Test</td>
<td></td>
<td>55</td>
</tr>
</tbody>
</table>

*Field-test items are being tried out with students for potential use on subsequent tests and will not be used to compute students’ scores on the test.*
Algebra II Formula Sheet  
2016 Mathematics Standards of Learning

Geometric Formulas:

\[ A = \frac{1}{2}bh \quad p = 2l + 2w \quad a^2 + b^2 = c^2 \]

Quadratic Formula:

\[ x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} \]

where \( ax^2 + bx + c = 0 \) and \( a \neq 0 \)

Statistics Formulas:

Given:
- \( x \) represents an element of the data set,
- \( x_i \) represents the \( i \)th element of the data set,
- \( n \) represents the number of elements in the data set,
- \( \mu \) represents the mean of the data set,
- \( \sigma \) represents the standard deviation of the data set, and
- \( \sigma^2 \) represents the variance of the data set

z-score:

\[ z = \frac{x - \mu}{\sigma} \]

standard deviation:

\[ \sigma = \sqrt{\frac{\sum_{i=1}^{n} (x_i - \mu)^2}{n}} \]

variance (\( \sigma^2 \)):

\[ \sigma^2 = \frac{\sum_{i=1}^{n} (x_i - \mu)^2}{n} \]
The Quadratic Formula and the Discriminant

Sometimes you will need to solve a quadratic that cannot be factored. In that case you can use the quadratic formula:

\[ x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} \]

You just substitute the values for a, b, and c into the quadratic formula and simplify.

**Example 1:** Solve \(5x^2 - 2x - 9 = 0\)

\[ a = 5 \quad b = -2 \quad c = -9 \quad \text{Plug these values into the quadratic formula} \]

\[ x = \frac{-(-2) \pm \sqrt{(-2)^2 - 4(5)(-9)}}{2(5)} \]

\[ x = \frac{2 \pm \sqrt{4 + 180}}{10} \]

\[ x = \frac{2 \pm \sqrt{184}}{10} \]

Your two solutions are \(x = \frac{2 + \sqrt{184}}{10}\) and \(x = \frac{2 - \sqrt{184}}{10}\).

In Example 7, the quadratic had two solutions, but a quadratic can also have only one solution or no solutions at all.

You can determine how many solutions a quadratic equation will have by calculating the discriminant \((b^2 - 4ac)\). This is the part that is located under the square root in the quadratic formula. If the discriminant is positive, the quadratic will have two real solutions. If the discriminant is zero, the quadratic will have one real solution. If the discriminant is negative, the quadratic will have no real solutions.
Example 2: Determine the number of solutions of $7x^2 - x = 12$

Start by getting one side equal to zero and write in standard form.

$7x^2 - x - 12 = 0$

Now, find the discriminant.

$a = 7$  $b = -1$  $c = -12$

$b^2 - 4ac = (-1)^2 - 4(7)(-12) = 1 + 336 = 337$

Because the discriminant is positive, this quadratic has two solutions.

TRY IT:  Quadratic Functions

1. Find the roots  $9x^2 + 48x + 64 = 0$
2. Determine the number of solutions  $4x^2 - 3x + 10 = 0$
3. Find the zeros  $x^2 - 5x = 14$
4. Find the solutions  $-2x^2 + 7 = -4x$

Completing the Square

The student will solve

b) quadratic equations over the set of complex numbers;

Completing the Square is one way to solve quadratic equations. When you complete the square, you will create a perfect square trinomial which can then be factored. In order to complete the square, you first need to transform the equation into the form $x^2 + bx = c$. This means that you will get all of the variable terms on one side, and the constant on the other. Also, be sure that the coefficient of the $x^2$ term is 1.

Next you will “complete the square” by adding $(\frac{b}{2})^2$ to each side of the equation.

Then, you can factor the trinomial. Take the square root of both sides and solve for $x$. 
Example 1: Solve by completing the square:  \( x^2 + 8 = 8x \)

\[
\begin{align*}
&x^2 + 8 = 8x \\
&-8 - 8 \\
&x^2 = 8x - 8 \\
&-8x - 8x \\
&x^2 - 8x = -8 \\
&x^2 - 8x + 16 = -8 + 16 \\
&(x - 4)^2 = 8 \\
&x - 4 = \pm\sqrt{8} \\
&x = 4 \pm 2\sqrt{2}
\end{align*}
\]

Transform the equation into the form \( x^2 + bx = c \).

Add \( (\frac{b}{2})^2 \) to both sides of the equation.

\[
b = -8 \text{ so } (\frac{-8}{2})^2 = 16
\]

Factor the left side, and simplify the right.

Take the square root of both sides.

Solve for x. Don’t forget to simplify your square root if you can!!

Scan this QR code to go to a video tutorial on completing the square.

Example 2: Solve by completing the square:  \( 3x^2 + 6x - 18 = 0 \)

\[
\begin{align*}
&3x^2 + 6x - 18 = 0 \\
&+18 + 18 \\
&3x^2 + 6x = 18 \\
&\div 3 \div 3 \\
&x^2 + 2x = 6 \\
&x^2 + 2x + 1 = 6 + 1 \\
&(x + 1)^2 = 7 \\
&x + 1 = \pm\sqrt{7} \\
&-1 - 1 \\
&x = -1 \pm \sqrt{7}
\end{align*}
\]

Transform the equation into the form \( x^2 + bx = c \).

Divide by 3 to get the coefficient of \( x^2 \) to 1. Remember that you are dividing all terms by 3!

Add \( (\frac{b}{2})^2 \) to both sides of the equation.

\[
b = 2 \text{ so } (\frac{2}{2})^2 = 1
\]

Factor the left side, and simplify the right.

Take the square root of both sides.

Solve for x. Don’t forget to simplify your square root if you can!!
**Complex Numbers**

**AII.2** The student will perform operations on complex numbers and express the results in simplest form using patterns of the powers of $i$.

**AII.3** The student will solve
   a) absolute value linear equations and inequalities;
   b) quadratic equations over the set of complex numbers;

The complex numbers are made up of the real numbers and the imaginary numbers.

### Complex Numbers $(a + bi)$

<table>
<thead>
<tr>
<th>Real Numbers $(a + 0i)$</th>
<th>Imaginary Numbers $(a + bi, b \neq 0)$</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pure Imaginary Numbers $(0 + bi, b \neq 0)$</td>
</tr>
</tbody>
</table>

The imaginary number, $i$, is the same as $\sqrt{-1}$, therefore $i^2 = -1$

**Example 1:** Simplify $\sqrt{-8}$

We can start by pulling $i$ out to factor the negative out from under the radical.

$$i \cdot \sqrt{8}$$

Now simplify the radical by pulling out any perfect square factors (i.e. 4).

$$i \cdot \sqrt{4} \cdot \sqrt{2}$$

$$2i \sqrt{2}$$

You can also perform operations on complex numbers. Remember that if you get an $i^2$ term that it can be replaced with $-1$.

**Example 2:** Simplify $(3 - 3i) - (-4 + 5i)$

Don’t forget to distribute the negative!!

And then combine like terms!

$3 - 3i + 4 - 5i$

$7 - 8i$
Example 3: Simplify \((3 - 3i)(-4 + 5i)\)  
\[-12 + 15i + 12i - 15i^2\]  
\[-12 + 27i - 15i^2\]  
\[-12 + 27i - 15(-1)\]  
\[-12 + 27i + 15\]  
\[3 + 27i\]

You can FOIL this!  
Combine like terms  
Replace \(i^2\) with -1  
Simplify

Number pairs that are of the form \(a + bi\) and \(a - bi\) are called complex conjugates.  
When you multiply complex conjugates, the product is a real number. This can be used to simplify quotients of complex numbers.

Example 4: Simplify \((9 - 5i)(9 + 5i)\)  
\[81 + 45i - 45i - 25i^2\]  
\[81 - 25i^2\]  
\[81 - 25(-1)\]  
\[81 + 25\]  
\[106\]

Notice that the \(i\) terms cancel  
Replace \(i^2\) with -1

Example 5: Find the quotient by using the complex conjugate.

\[\frac{8 - 16i}{4i}\]  
Multiply the numerator and denominator by \(-4i\)

\[\frac{8 - 16i}{4i} \cdot \frac{-4i}{-4i}\]  
\[\frac{-32i + 64i^2}{-16i^2}\]  
Replace \(i^2\) with -1

\[\frac{-32i + 64(-1)}{-16(-1)}\]  
\[\frac{-64 - 32i}{16}\]  
\[\frac{-64 - 32i}{16}\]  
\[= -4 - 2i\]  
Simplify!
Try It: Complex Numbers

Simplify

1. $\sqrt{-32x}$

2. $(6 - 4i) + (2 - 3i) - (6 - 6i)$

3. $-5i(4 + 3i)$

4. $(2 + i)(3 - 2i)$

5. $\frac{6 - 10i}{-2i}$

6. $\frac{4 + 7i}{1 - 3i}$
Polynomial Functions

All.4 The student will solve systems of linear-quadratic and quadratic-quadratic equations, algebraically and graphically.

All.6 For absolute value, square root, cube root, rational, polynomial, exponential, and logarithmic functions, the student will
a) recognize the general shape of function families; and
b) use knowledge of transformations to convert between equations and the corresponding graphs of functions.

All.7 The student will investigate and analyze linear, quadratic, absolute value, square root, cube root, rational, polynomial, exponential, and logarithmic function families algebraically and graphically. Key concepts include
b) intervals in which a function is increasing or decreasing;
h) end behavior;

All.8 The student will investigate and describe the relationships among solutions of an equation, zeros of a function, x-intercepts of a graph, and factors of a polynomial expression.

Systems of Equations
The solution to a system of equations is the place or places where two equations intersect. These two equations can be linear, quadratic, or a combination of both. Systems of two linear equations can have no solutions, one solution, or infinitely many solutions.

<table>
<thead>
<tr>
<th>No Solutions</th>
<th>One Solution</th>
<th>Infinitely Many Solutions</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1.png" alt="Graph" /></td>
<td><img src="image2.png" alt="Graph" /></td>
<td><img src="image3.png" alt="Graph" /></td>
</tr>
<tr>
<td>Two lines that are parallel. These lines have the same slope, but different y-intercepts. They will never intersect. Therefore, there is no solution.</td>
<td>Two lines that intersect. These lines have different slopes, which causes them to intersect in one place. Therefore, there is one solution. In this example, the solution is (2, 3).</td>
<td>Two lines that are the same. These lines have the same slope and the same y-intercept. This means they are the same line and will share all points. Therefore, there are infinitely many solutions.</td>
</tr>
</tbody>
</table>
Systems of one linear and one quadratic equation can have no solutions, one solution, or two solutions.

<table>
<thead>
<tr>
<th>No Solutions</th>
<th>One Solution</th>
<th>Two Solutions</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1.png" alt="Graph" /></td>
<td><img src="image2.png" alt="Graph" /></td>
<td><img src="image3.png" alt="Graph" /></td>
</tr>
<tr>
<td>Because these two graphs never intersect, this system of equations has no solution.</td>
<td>The line and the parabola share one common point. This system of equations has one solution.</td>
<td>The line intersects the parabola in two places. This system of equations has two solutions.</td>
</tr>
</tbody>
</table>

Systems of equations can be solved graphically or algebraically. To solve a system graphically, you will graph both equations and determine the intersection points. This can be verified on your calculator.
Example 1: Solve this system of equations by graphing.

\[ y = x^2 + 5x - 4 \]
\[ y = x - 4 \]

First graph both equations in your calculator.

You can see that the line crosses the parabola in two places which means this system will have two solutions!

We will use the Calculate: Intersection function of your calculator to determine the ordered pairs.

Scan this QR code to go to a video tutorial on solving systems of linear and quadratic equations.

Next, push the \( \text{2ND} \) button, then the \( \text{TRACE} \) button. This will take you to the \( \text{CALCULATE} \) menu.

You will select 5: intersect

Your calculator will ask you “First curve?” Scroll your cursor near the first intersection point and push Enter.

The two graphs intersect at the point (-4, -8).

The two graphs intersect at another point as well. Repeat the above procedure to find the other intersection point.

The solution to this system of equations is \((-4, -8)\) and \((0, -4)\).
To solve a system of equations algebraically, you will use the substitution method. We will solve the same system that we just solved graphically, algebraically now.

**Example 1:** Solve this system of equations algebraically.

\[
\begin{align*}
y &= x^2 + 5x - 4 \\
y &= x - 4
\end{align*}
\]

The substitution property states that you can substitute two equal quantities in an equation. In our system of equations, we can substitute \((x - 4)\) for \(y\) from the second equation, into the first equation. This substitution will give us:

\[
\begin{align*}
x - 4 &= x^2 + 5x - 4 \\
-x + 4 &= -x + 4 \\
0 &= x^2 + 4x \\
0 &= x(x + 4) \\
y &= 0 - 4 = -4 \\
y &= -4
\end{align*}
\]

Move terms so that one side of the equation is equal to 0, then factor to solve! You can now see that \(x = 0\) or \(x = -4\). Plug these two solutions into one of the original equations to find the corresponding \(y\)-values. This will give you your ordered pairs.

**TRY IT:** *Polynomial Functions*

1. How many solutions does this system have? \(y = 7x - 8\) and \(y = 3x^2 - 2x + 4\)

2. Solve the system using either method. \(y = 2x + 1\) and \(y = x^2 - 4x + 9\)

3. Solve the system by graphing, round your answers to the nearest hundredth.

\[
\begin{align*}
y &= x^2 + 2x - 7 \quad \text{and} \quad y = -2x^2 + 4x + 3
\end{align*}
\]
## Polynomials Graphs

<table>
<thead>
<tr>
<th>Degree</th>
<th>0</th>
<th>1</th>
<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name</td>
<td>Constant</td>
<td>Linear</td>
<td>Quadratic</td>
</tr>
<tr>
<td>Polynomial Example</td>
<td>$y = -2$</td>
<td>$y = x + 3$</td>
<td>$y = \frac{1}{2}x^2 + 3x$</td>
</tr>
<tr>
<td>Graph Example</td>
<td><img src="image1.png" alt="Graph Example" /></td>
<td><img src="image2.png" alt="Graph Example" /></td>
<td><img src="image3.png" alt="Graph Example" /></td>
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</table>

<table>
<thead>
<tr>
<th>Degree</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name</td>
<td>Cubic</td>
<td>Quartic</td>
<td>Quintic</td>
</tr>
<tr>
<td>Polynomial Example</td>
<td>$y = \frac{1}{4}x^3 - 2$</td>
<td>$y = x^4 - 3x^3 + 2x^2 + 2$</td>
<td>$y = -x^5 + x$ (<em>note: graph does not match equation</em>)</td>
</tr>
<tr>
<td>Graph Example</td>
<td><img src="image4.png" alt="Graph Example" /></td>
<td><img src="image5.png" alt="Graph Example" /></td>
<td><img src="image6.png" alt="Graph Example" /></td>
</tr>
</tbody>
</table>

### End Behavior:
This describes what the graph does on each end. It is usually described as either going up or down.

As an example, this graph is going down to the left and up to the right.

This can be expressed as:

$$f(x) \to -\infty \text{ as } x \to -\infty$$

$$f(x) \to \infty \text{ as } x \to \infty$$

### Relative Minimum and Maximum:
This describes any ‘peaks’ or ‘valleys’ in your graph.

### Absolute Minimum and Maximum:
This describes the lowest and highest points on the graph.
You may be asked to state where the graph is increasing or decreasing. You will do this in interval notation, reading the graph from left to right.

This graph is decreasing over the intervals: \((-\infty, A) \cup (B, C)\)

This graph is increasing over the intervals: \((A, B) \cup (C, \infty)\)

The zeros of a graph refer to places on the graph where \(y = 0\). These will be your x-intercepts. This graph appears to have 3 zeros at approximately \(-2.3, 0, and 1.3\).

Domain and Range refer to all of the x-values (domain) and y-values (range) that a graph will have if you extend the ends as far as they will go. When determining the domain, think about the x-axis, and when thinking about range consider the y-axis.
In the graph pictured below, even though the graph is traveling to the right and left very slowly, along the \( x \)-axis, it will ultimately cross all \( x \)-coordinates from \(-\infty\) to \(\infty\). Thus the domain of this graph would be \((-\infty, \infty)\).

The range of this graph refers to all of the \( y \)-values that this graph will ultimately touch. This graph is coming down from the left and going up to the right which means that it has an absolute minimum point, on this graph. That point is A. This graph will never have a \( y \)-value smaller than the \( y \)-value at point A (which is approximately \(-5.1\)). Thus, the range of this graph is \([-5.1, \infty)\). This means that the range does include \(-5.1\) because that is where point A is, and continues all the way up to infinity.

**TRY IT: Polynomial Functions**

4. For the polynomial function shown below state the:

    a) end behavior
    b) the intervals where it is increasing and decreasing
    c) the relative and absolute minimums and maximums
    d) zeros
    e) domain and range
Composition and Inverse Functions

All.7 The student will investigate and analyze linear, quadratic, absolute value, square root, cube root, rational, polynomial, exponential, and logarithmic function families algebraically and graphically. Key concepts include

j) inverse of a function; and
k) composition of functions algebraically and graphically.

Function Operations

<table>
<thead>
<tr>
<th>Operation</th>
<th>Expression</th>
</tr>
</thead>
<tbody>
<tr>
<td>Addition</td>
<td>((f + g)(x) = f(x) + g(x))</td>
</tr>
<tr>
<td>Subtraction</td>
<td>((f - g)(x) = f(x) - g(x))</td>
</tr>
<tr>
<td>Multiplication</td>
<td>((f \cdot g)(x) = f(x) \cdot g(x))</td>
</tr>
<tr>
<td>Division</td>
<td>(\left(\frac{f}{g}\right)(x) = \frac{f(x)}{g(x)} \quad g(x) \neq 0)</td>
</tr>
</tbody>
</table>

Example 1: Let \(f(x) = x^2 - 3x\) and \(g(x) = 2x^2 - 5\).

Find \((f + g)(x)\) and \((f - g)(x)\). State the domain of each.

\[
(f + g)(x) = f(x) + g(x) = x^2 - 3x + (2x^2 - 5) \\
x^2 - 3x + 2x^2 - 5 = 3x^2 - 3x - 5
\]

Because the domain of both original functions is all real numbers, the domain of the sum is also all real numbers, \((-\infty, \infty)\).

\[
(f - g)(x) = f(x) - g(x) = x^2 - 3x - (2x^2 - 5) \\
x^2 - 3x - 2x^2 + 5 = -x^2 - 3x + 5
\]

Because the domain of both original functions is all real numbers, the domain of the difference is also all real numbers, \((-\infty, \infty)\).
Example 2: Let \( f(x) = x - 2 \) and \( g(x) = x^2 - 4 \).

Find \((f \cdot g)(x)\) and \(\left(\frac{f}{g}\right)(x)\). State the domain of each.

\[
(f \cdot g)(x) = f(x) \cdot g(x) = (x - 2)(x^2 - 4) = x^3 - 2x^2 - 4x + 8
\]

Because the domain of both original functions is all real numbers, the domain of the product is also all real numbers, \((-\infty, \infty)\).

Example 2: continued

\[
\left(\frac{f}{g}\right)(x) = \frac{f(x)}{g(x)} = \frac{x - 2}{x^2 - 4}
\]

Factor the denominator to see if you can simplify!

\[
\frac{x - 2}{(x + 2)(x - 2)} = \frac{x - 2}{x^2 - 4} \text{ divide to make 1!}
\]

\[
\frac{1}{x + 2}
\]

Because any value that would make the denominator 0 is not in the domain of this function, we need to determine these values before stating the domain.

\[
x^2 - 4 = 0 \quad \Rightarrow \quad (x + 2)(x - 2) = 0 \quad \Rightarrow \quad x = 2, -2
\]

The values of 2 and -2 would make the denominator equal to 0. Therefore, those values are not in the domain. The domain is \((-\infty, -2) \cup (-2, 2) \cup (2, \infty)\).

Composition Functions

\[
(g \circ f)(x) = g(f(x))
\]

First, you will evaluate \( f(x) \). Then, you will substitute that value in for \( x \) in \( g(x) \).
**Example 3:** Let \( f(x) = x + 7 \) and \( g(x) = 3x^2 - 1 \).

Find \((f \circ g)(1)\) and \((g \circ f)(1)\).

\[
(f \circ g)(1) = f(g(1)) \\
g(1) = 3(1)^2 - 1 = 3 \cdot 1 - 1 = 3 - 1 = 2 \\
f(2) = 2 + 7 = 9
\]

\[
(g \circ f)(1) = g(f(1)) \\
f(1) = 1 + 7 = 8 \\
g(8) = 3(8)^2 - 1 = 3 \cdot 64 - 1 = 192 - 1 = 191
\]

**Inverse Functions**

If an original function has \((x, y)\) as an ordered pair, this function’s inverse will have \((y, x)\) as an ordered pair.

Thus to find the inverse of a function, you simply switch the \(x\) and \(y\). A function’s inverse is often written as \(f^{-1}(x)\).

**Example 4:** What is the inverse of the relation listed below?

<table>
<thead>
<tr>
<th>x</th>
<th>f(x)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>11</td>
</tr>
<tr>
<td>5</td>
<td>23</td>
</tr>
<tr>
<td>7</td>
<td>74</td>
</tr>
</tbody>
</table>

The inverse can be found by switching the \(x\) and \(y\) terms.

<table>
<thead>
<tr>
<th>Inverse</th>
<th>x</th>
<th>f(x)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>11</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>23</td>
<td>5</td>
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<td></td>
<td>74</td>
<td>7</td>
</tr>
</tbody>
</table>

**Example 5:** Given \( f(x) = x^2 - 5 \) find \( f^{-1}(x) \).

In order to find the inverse, switch the \(x\) and \(y\) terms, and then transform the function for \(y\).

\[
y = x^2 - 5 \\
x = y^2 - 5 \\
+5 \quad +5 \\
x + 5 = y^2 \\
\pm \sqrt{x + 5} = y
\]
TRY IT: Composition and Inverse Functions

Given \( f(x) = x - 4 \) \( g(x) = x^2 \) \( h(x) = x^2 - x - 12 \)

1. Find \((f + h)(x)\)

2. Find \((h - g)(x)\)

3. Find \((f \cdot g)(x)\)

4. Find \(\left(\frac{h}{f}\right)(x)\)

5. Find \((h \circ f)(4)\)

6. Find \((g \circ h)(3)\)

7. Find \(f^{-1}(x)\) and \(g^{-1}(x)\)
Answers to the *Try It* problems:

**Quadratic Functions**

1. \( x = -\frac{8}{3} \)
2. Zero
3. \( x = -2, 7 \)
4. \( x \approx -1.121, 3.121 \)

**Complex Numbers**

1. \( 4i\sqrt{2x} \)
2. \( 2 - i \)
3. \( 15 - 20i \)
4. \( 8 - i \)
5. \( 5 + 3i \)
6. \( \frac{-17 + 19i}{10} \)

**Polynomial Functions**

1. no solution
2. \((2, 5)\) and \((4, 9)\)
3. \((-1.52, -7.73)\) and \((2.19, 2.17)\)
4. a. \( f(x) \to -\infty \) as \( x \to -\infty \)
   \[ f(x) \to -\infty \] as \( x \to \infty \)
   b. Increasing \((-\infty, -2.7)\) \(\cup\) \((0.3, 2.6)\)
   Decreasing \((-2.7, 0.3)\) \(\cup\) \((2.6, \infty)\)
   c. Relative max: \(6\) when \( x = -2.7 \)
      0.67 when \( x = 2.6 \)
   Absolute max: \(6\) when \( x = -2.7 \)
   Relative min: \(-2.7\) when \( x = 0.3 \)
   Absolute min: Does not exist
   d. \(-4, -1, 2, 3\)
   e. \( D: (-\infty, \infty) \quad R: (-\infty, 6] \)

**Composition and Inverse Functions**

1. \( x^2 - 16 \)
2. \(-x - 12 \)
3. \( x^3 - 4x^2 \)
4. \( x + 3 \)
5. \(-12 \)
6. 36
7. \( f^{-1}(x) = x + 4 \)
   \[ g^{-1}(x) = \pm\sqrt{x} \]