## Big Picture – Algebra is Solving Equations with Variables*

<table>
<thead>
<tr>
<th>1 Variable</th>
<th>2 Variables</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Linear Equations</strong></td>
<td>$x - 2 = 0$</td>
</tr>
<tr>
<td>Solution: 1 Point</td>
<td>MA090</td>
</tr>
<tr>
<td>$y = x - 2$</td>
<td>Page 2</td>
</tr>
<tr>
<td><strong>Linear Inequalities</strong></td>
<td>$x - 2 &lt; 0$</td>
</tr>
<tr>
<td>Solution: Ray</td>
<td>Page 2</td>
</tr>
<tr>
<td><strong>Systems of Linear Equations</strong></td>
<td>$\begin{cases} x = 7 \ y = -5 \end{cases}$</td>
</tr>
<tr>
<td>Solution: 1 point, infinite points or no points</td>
<td>Page 7</td>
</tr>
<tr>
<td><strong>Quadratic Equations</strong></td>
<td>$x^2 + 5x + 6 = 0$</td>
</tr>
<tr>
<td>Solution: Usually 2 points</td>
<td>Page 15</td>
</tr>
<tr>
<td><strong>Higher Degree Polynomial Equations</strong> (cubic, quartic, etc.)</td>
<td>$x^3 + 5x^2 + 6x = 0$</td>
</tr>
<tr>
<td>Solution: Usually $x$ points, where $x$ is the highest exponent</td>
<td>Page 15</td>
</tr>
<tr>
<td><strong>Rational Equations</strong></td>
<td>$\frac{x^2 - 1}{x + 1} = 1$</td>
</tr>
<tr>
<td>Solution: Usually simplifies to a linear or quadratic equation</td>
<td>Page 20</td>
</tr>
</tbody>
</table>

*To determine the equation type, simplify the equation. Occasionally all variables “cancel out”.
- If the resulting equation is true (e.g. $5 = 5$), then all real numbers are solutions.
- If the resulting equation is false (e.g. $5 = 4$), then there are no solutions.

## Find It Fast

- Number Lines & Interval Notation .................. 2
- Linear Inequalities with 1 Variable .............. 2
- The Cartesian Plane .................................. 3
- Graphing Lines ....................................... 3
- Line Basics............................................ 4
- Finding the Equation of a Line ..................... 5
- Systems of Linear Equations ....................... 6
- Solving Systems of Linear Equations ............. 7
- Solving Word Problems............................... 8
- Polynomial Definitions ................................ 9
- Polynomial Operations.............................. 9
- Factor Out the GCF .................................. 10
- Factor 4 Term Expressions ......................... 11
- Factor Trinomials: Leading Coefficient of 1 ... 11
- Factor Any Trinomial ................................. 12
- Easy to Factor Polynomial Types .................. 13
- Factor Any Polynomial .............................. 13
- Quadratic Methods ................................. 14
- Solve Any 1 Variable Equation .................... 15
- Graph Quadratic Equations in 2 Variables ...... 16
- Exponents & Powers .............................. 17
- Scientific Notation ................................. 17
- Roots ............................................... 18
- Rational Expressions ............................... 19
- Solving Rational Equations ....................... 20
- Formulas ........................................... 21
- Dictionary of Terms ............................... 21
### Number Lines & Interval Notation

<table>
<thead>
<tr>
<th><strong>Number Lines</strong></th>
<th><strong>Interval Notation</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>○ ( ) – If the point is not included</td>
<td>▪ 1st graph the answers on a number line, then write the interval notation by following your shading from left to right</td>
</tr>
<tr>
<td>● [ ] – If the point is included</td>
<td>▪ Always written: 1) Left enclosure symbol, 2) <strong>smallest number</strong>, 3) <strong>comma</strong>, 4) <strong>largest number</strong>, 5) right enclosure symbol</td>
</tr>
<tr>
<td>– Shade areas where infinite points are included</td>
<td>▪ Enclosure symbols</td>
</tr>
<tr>
<td>( ) – Does not include the point</td>
<td>( ) – Does not include the point</td>
</tr>
<tr>
<td>[ ] – Includes the point</td>
<td>[ ] – Includes the point</td>
</tr>
<tr>
<td>Infinity can never be reached, so the enclosure symbol which surrounds it is an open parenthesis</td>
<td>Infinity can never be reached, so the enclosure symbol which surrounds it is an open parenthesis</td>
</tr>
</tbody>
</table>

**Ex. 1**

- **x = 1** "x is equal to 1" 
- **x ≠ 1** "x is not equal to 1" 
- **x < 1** "x is less than 1" 
- **x ≤ 1** "x is less than or equal to 1" 
- **x > 1** "x is greater than 1" 
- **x ≥ 1** "x is greater than or equal to 1"

**Linear Inequalities with 1 Variable**

<table>
<thead>
<tr>
<th><strong>Standard Form</strong></th>
<th><strong>Solution</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>( ax + b &lt; c ) ( ax + b \leq c ) ( ax + b &gt; c ) ( ax + b \geq c ) ( &gt; 2x + 4 &gt; 10 )</td>
<td>( x &gt; 3 )</td>
</tr>
</tbody>
</table>

**Multiplication Property of Inequality**

- When both sides of an inequality are multiplied or divided by a negative number, the direction of the inequality symbol must be reversed to form an equivalent inequality.

**Solving**

1. Same as **Solving an Equation with 1 Variable** (**MA090**), except when both sides are multiplied or divided by a negative number

   - **Ex 4 ≤ −2x**
   - \( 4 \geq \frac{-2x}{-2} \)
   - \( -2 \geq x \)
   - \( x \leq -2 \)

2. Checking
   - Plug solution(s) into the original equation. Should get a true inequality.
   - Plug a number which is not a solution into the original equation. Shouldn’t get a true inequality

   - \( x \leq -2 \)
   - \( x \geq -3 \)
   - \( x \geq 2 \)
   - \( x \geq 0 \times \)
### The Cartesian Plane

<table>
<thead>
<tr>
<th><strong>Rectangular Coordinate System</strong></th>
<th><strong>Quadrant II</strong></th>
<th><strong>Quadrant I</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Two number lines intersecting at the point 0 on each number line.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>X-AXIS</strong> - The horizontal number line</td>
<td><a href="#">Diagram</a></td>
<td><a href="#">Diagram</a></td>
</tr>
<tr>
<td><strong>Y-AXIS</strong> - The vertical number line</td>
<td><a href="#">Diagram</a></td>
<td><a href="#">Diagram</a></td>
</tr>
<tr>
<td><strong>ORIGIN</strong> - The point of intersection of the axes</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>QUADRANTS</strong> - Four areas which the rectangular coordinate system is divided into</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>ORDERED PAIR</strong> - A way of representing every point in the rectangular coordinate system ((x,y))</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Is an Ordered Pair a Solution?</strong></th>
<th><strong>Yes, if the equation is a true statement when the variables are replaced by the values of the ordered pair</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Example</td>
<td>(x + 2y = 7) is a solution because (1 + 2(3) = 7)</td>
</tr>
</tbody>
</table>

### Graphing Lines

<table>
<thead>
<tr>
<th><strong>General</strong></th>
<th><strong>Graphing by plotting random points</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Lines which intersect the (x)-axis contain the variable (x)</td>
<td>1. Solve equation for (y)</td>
</tr>
<tr>
<td>Lines which intersect the (y)-axis contain the variable (y)</td>
<td>2. Pick three easy (x)-values &amp; compute the corresponding (y)-values</td>
</tr>
<tr>
<td>Lines which intersect both axis contain (x) and (y)</td>
<td>3. Plot ordered pairs &amp; draw a line through them. (If they don’t line up, you made a mistake)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Graphing linear equations by using a point and a slope</strong></th>
<th><strong>Example</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Plot the point</td>
<td>(y = \frac{-1}{2}x + \frac{7}{2})</td>
</tr>
<tr>
<td>2. Starting at the plotted point, vertically move the rise of the slope and horizontally move the run of the slope. Plot the resulting point</td>
<td><strong>Point</strong> = (7/2)</td>
</tr>
<tr>
<td>3. Connect both points</td>
<td><strong>Slope</strong> = (-1/2)</td>
</tr>
</tbody>
</table>
### Line Basics

<table>
<thead>
<tr>
<th><strong>x-intercept</strong></th>
<th><strong>y-intercept</strong></th>
<th><strong>Slope of a Line</strong></th>
<th><strong>Properties of Slope</strong></th>
<th><strong>Standard Form</strong></th>
<th><strong>Slope-Intercept Form</strong></th>
<th><strong>Point-Slope Form</strong></th>
</tr>
</thead>
</table>
| (x, 0)          | (0, y)          | The slant of the line. Let Point 1: P₁ = (x₁, y₁) & Point 2: P₂ = (x₂, y₂) | Positive Slope - Line goes up (from left to right). The greater the number, the steeper the slope. Negative Slope - Line goes down (from left to right). The smaller the number (more negative), the steeper the slope. Horizontal Line - Slope is 0 Vertical Line - Slope is undefined Parallel Lines - Same slope Perpendicular Lines - The slope of one is the negative reciprocal of the other | \( ax + by = c \)  
\( x \) and \( y \) are on the same side  
The equations contain no fractions and \( a \) is positive | \( y = mx + b \), where \( m \) is the slope of the line, \& \( b \) is the \( y \)-intercept  
“\( y \) equals form”; “easy to graph form” | \( y - y₁ = m(x - x₁) \), where \( m \) is the slope of the line \& \((x₁, y₁)\) is a point on the line  
Simplified, it can give you Standard Form or Slope-Intercept Form | > \( x + 2y = 7 \)  
\( x + 2(0) = 7 \)  
\( x = 7 \)  
\( (7, 0) \) | > By solving \( x + 2y = 7 \) for \( y \)  
\( y = -\frac{x}{2} + \frac{7}{2} \) | > Using \((7, 0)\) and \( m = -\frac{1}{2} \)  
\( y - 0 = -\frac{1}{2}(x - 7) \) |

Ex: \( x + 2y = 7 \)  
\( x + 2(0) = 7 \)  
\( x = 7 \)  
\( (7, 0) \)  
Ex: \( x + 2y = 7 \)  
\( 0 + 2y = 7 \)  
\( y = 3.5 \)  
\( (0, 3.5) \)  
Ex Let \( P₁ = (x₁, y₁) \), \( P₂ = (x₂, y₂) \)  
\( m = \frac{y₂ - y₁}{x₂ - x₁} = \frac{4 - 1}{4 - 1} = 1 \)
### Finding the Equation of a Line

| If you have a horizontal line… | ▪ The slope is zero  
▪ \( y = b \), where \( b \) is the \( y \)-intercept | Ex. \( y = 3 \) |
|-------------------------------|-------------------------------------------------|----------------|
| If you have a vertical line…  | ▪ The slope is undefined  
▪ \( x = c \), where \( c \) is the \( x \)-intercept | Ex. \( x = -3 \) |
| If you have a slope & \( y \)-intercept… | ▪ Plug directly into Slope-Intercept Form | Ex. \( m = 4 \) & \( y \)-intercept \((0, 2)\) |
| If you have a point & a slope… | ▪ **METHOD 1**  
▪ 1. Use Point-Slope Form  
▪ 2. Work equation into Standard Form or Slope-Intercept Form | Ex. point \((3, 2)\) & \( m = 2 \) |
| | ▪ **METHOD 2**  
▪ 1. Plug the point into the Slope-Intercept Form and solve for \( b \)  
▪ 2. Use values for \( m \) and \( b \) in the Slope-Intercept Form | Ex. point \((3, 2)\) & \( m = 2 \) |
| If you have a point & a line that it is parallel or perpendicular to… | 1. Determine the slope of the parallel or perpendicular line (e.g., if it is parallel, it has the same slope)  
2. If the slope is undefined or 0, draw a picture  
3. If the slope is a non-zero real number, go to If you have a point & a slope… | Ex. point \((3, 2)\) & perpendicular to \( y = 2x - 4 \) |
| If you have 2 points… | 1. Use the slope equation to determine the slope  
2. Go to If you have a point & a slope… | Ex. \((0, 0)\) & \((3, 6)\) |

**Ex.**
- \( y = 4x + 2 \)
- \( 2 = 4(0) + 2 \sqrt{2} \)
- \( m = \frac{6 - 0}{3 - 0} = 2 \)
## Systems of Linear Equations

<table>
<thead>
<tr>
<th>Type of Intersection</th>
<th>Description</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>IDENTICAL (I)</strong></td>
<td>Same slope &amp; same y-intercept</td>
<td>Solve [ \begin{align*} y &amp;= -x \ y &amp;= -2x \end{align*} ] Identical Consistent Dependent</td>
</tr>
<tr>
<td><strong>NO SOLUTION (N)</strong></td>
<td>Same slope &amp; different y-intercept, the lines are parallel</td>
<td>[ y = -x ] No solution Inconsistent Independent</td>
</tr>
<tr>
<td><strong>ONE POINT</strong></td>
<td>Different slopes</td>
<td>Solve [ \begin{align*} y &amp;= -x \ y &amp;= -x + 1 \end{align*} ] One point Consistent Independent</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Terminology</th>
<th>Description</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CONSISTENT SYSTEM</strong></td>
<td>The lines intersect at a point or are identical. System has at least 1 solution</td>
<td>Solve [ \begin{align*} y &amp;= -x \ y &amp;= -x + 1 \end{align*} ] No solution Inconsistent Independent</td>
</tr>
<tr>
<td><strong>INCONSISTENT SYSTEM</strong></td>
<td>The lines are parallel. System has no solution</td>
<td>[ y = -x ] No solution Inconsistent Independent</td>
</tr>
<tr>
<td><strong>DEPENDENT EQUATIONS</strong></td>
<td>The lines are identical. Infinite solutions</td>
<td>[ y = -x ] No solution Inconsistent Independent</td>
</tr>
<tr>
<td><strong>INDEPENDENT EQUATIONS</strong></td>
<td>The lines are different. One solution or no solutions</td>
<td>[ y = -x ] No solution Inconsistent Independent</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Solving by Graphing</th>
<th>Instructions</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1.</strong> Graph both equations on the same Cartesian plane. See <em>Graphing Lines p.3</em></td>
<td></td>
<td>Solve [ \begin{align*} x - 2y &amp;= 1 \ 2x - 2 &amp;= 2y \end{align*} ] One point Consistent Independent</td>
</tr>
<tr>
<td><strong>2.</strong> The intersection of the graphs gives the common solution(s). If the graphs intersect at a point, the solution is an ordered pair.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>3.</strong> Check the solution in both original equations</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Solving Systems of Linear Equations

#### Solving by Substitution

1. Solve either equation for either variable. (pick the equation with the easiest variable to solve for)
2. Substitute the answer from step 1 into the other equation
3. Solve the equation resulting from step 2 to find the value of one variable *
4. Substitute the value from step 3 in any equation containing both variables to find the value of the other variable.
5. Write the answer as an ordered pair
6. Check the solution in both original equations

#### Solving by Addition or Subtraction of Equations

1. Rewrite each equation in standard form \( Ax + By = C \)
2. If necessary, multiply one or both equations by a number so that the coefficients of one of the variables are opposites.
3. Add equations (One variable will be eliminated)*
4. Solve the equation resulting from step 3 to find the value of one variable.
5. Substitute the value from step 4 in any equation containing both variables to find the value of the other variable.
6. Write the answer as an ordered pair
7. Check the solution in both original equations

*Solve \( \begin{cases} x - 2y = 1 \\ 2x - 4 = 6y \end{cases} \)

1. \( y = \frac{1-x}{-2} \)
2. \( 2x - 4 = -3 \left( \frac{1-x}{-2} \right) \)
3. \( 2x = -3 + 3x + 4 \)
   \( x = -1 \)
4. \( y = \frac{1 - (-1)}{-2} = -1 \)
5. \((-1, -1)\)
6. \((-1) - 2(-1) = 1 \)
   \( 1 = 1 \sqrt{6} \)
7. \(2(-1) - 4 = 6(-1) \)
   \(-6 = -6 \sqrt{6} \)

*Solve \( \begin{cases} x - 2y = 1 \\ 2x - 4 = 6y \end{cases} \)

1. \( x - 2y = 1 \)
2. \( 2x - 6y = 4 \)
2. Multiply both sides of the first equation by \(-2\)
   \( -2x + 4y = -2 \)
   \( 2x - 6y = 4 \)
3. \(-2y = 2 \)
4. \( y = -1 \)
5. \( x - 2(-1) = 1 \)
   \( x = -1 \)
6. \((-1,-1)\)
7. \(-2(-1) + 4(-1) = -2 \)
   \(-2 = -2 \sqrt{6} \)
   \( 2(-1) - 4 = 6(-1) \)
   \(-6 = -6 \sqrt{6} \)

*If all variables disappear & you end up with a true statement (e.g. 5 = 5), then the lines are identical
If all variables disappear & you end up with a false statement (e.g. 5 = 4), then the lines are parallel
<table>
<thead>
<tr>
<th>Step</th>
<th>1 Variable, 1 Equation Method</th>
<th>2 Variables, 2 Equations Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Understand the Problem</td>
<td>In a recent election for mayor 800 people voted. Mr. Smith received three times as many votes as Mr. Jones. How many votes did each candidate receive?</td>
<td></td>
</tr>
</tbody>
</table>
| 2 Define Variables | Name what x is (Can only be one thing. When in doubt, choose the smaller thing) Define everything else in terms of x  
Let x = Number of votes Mr. J  
3x = Number of votes Mr. S |
| 3 Write the Equation(s) | x + 3x = 800  
4x = 800  
x = 200 |
| 4 Solve the Equation(s) | (3y) + y = 800 (Substitution)  
3y + y = 800  
4y = 800  
y = 200 |
| 5 Answer the Question | Go back to your “Let” statement  
200 = Number of votes Mr. J  
600 = Number of votes Mr. S |
| 6 Check | Plug answers into equation(s)  
(200) + 3(200) = 800  
800 = 800 √ |
|                  | 600 = 600 √  
(600) + (200) = 800  
800 = 800 √  
(600) = 3(200)  
600 = 600 √ |
## Polynomial Definitions

**Polynomial**
- A sum of terms which contains only whole number exponents and no variable in the denominator.
- Refers to an expression; can have polynomial equations

**Degree of a Polynomial**
- Express polynomial in simplified form. Sum the powers of each variable in the terms. The degree of a polynomial is the highest degree of any of its terms
- Determines number of x-intercepts

**Names for polynomials according to terms**
- **MONOMIAL** - 1 term
- **BINOMIAL** - 2 terms
- **TRINOMIAL** - 3 terms

**Names for polynomials according to degree**
- **LINEAR** – degree 1 (1\textsuperscript{st} power of a variable)
- **QUADRATIC** – degree 2
- **CUBIC** – degree 3
- **QUARTIC** – degree 4

## Polynomial Operations

### Multiplication
(Multiply each term of the first polynomial by each term of the second polynomial, and then combine like terms)

<table>
<thead>
<tr>
<th><strong>Horizontal Method</strong></th>
<th><strong>Ex:</strong> $(x-2)(x^2+5x-1)$</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Can be used for any size polynomials</td>
<td>$= x(x^2 + 5x - 1) - 2(x^2 + 5x - 1)$</td>
</tr>
<tr>
<td></td>
<td>$= x^3 + 5x^2 - x - 2x^2 - 10x + 2$</td>
</tr>
<tr>
<td></td>
<td>$= x^3 + 3x^2 - 11x + 2$</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Vertical Method</strong></th>
<th><strong>Ex:</strong> $(x-2)(x^2+5x-1)$</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Can be used for any size polynomials. Similar to multiplying two numbers together</td>
<td>$x^3$ $5x$ $-1$</td>
</tr>
<tr>
<td></td>
<td>$-2x^2$ $-10x$ $2$</td>
</tr>
<tr>
<td></td>
<td>$x^2$ $5x^2$ $-x$</td>
</tr>
<tr>
<td></td>
<td>$x^2$ $+3x^2$ $-11x$ $+2$</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>FOIL Method</strong></th>
<th><strong>Ex:</strong> $(x-2)(x-3)$</th>
</tr>
</thead>
<tbody>
<tr>
<td>- May only be used when multiplying two binomials. First terms, Outer terms, Inner terms, Last terms</td>
<td>$= x \cdot x + x(-3) + (-2)x + (-2)(-3)$</td>
</tr>
<tr>
<td></td>
<td>$= x^2 + 3x - 2x + 6$</td>
</tr>
<tr>
<td></td>
<td>$= x^2 - 5x + 6$</td>
</tr>
</tbody>
</table>

### Division
(Dividing a Polynomial by a Monomial)

| **Ex:** $\frac{2x+2}{4} = \frac{2x}{4} + \frac{2}{4} = \frac{x}{2} + \frac{1}{2}$ |

| **Ex:** $\frac{2x+2}{4} = \frac{2(x+1)}{4} = \frac{x+1}{2} = \frac{x}{2} + \frac{1}{2}$ |

| **Ex:** factor & cancel | $\frac{2x+2}{4} = \frac{2(x+1)}{4} = \frac{x+1}{2} = \frac{x}{2} + \frac{1}{2}$ |
# Factor Out the GCF

## Factoring
- Writing an expression as a product
- Numbers can be written as a product of primes. Polynomials can be written as a product of **prime polynomials**
- Useful to simplify rational expressions and to solve equations
- The opposite of multiplying

| > Factored $2(x + 2)$
| > Not factored $2x + 4$
| $2 \cdot x + 2 \cdot 2$
| $2x + 4 = 2(x + 2)$

## GCF (Greatest Common Factor) of a List of Integers
1. Write each number as a product of prime numbers
2. Identify the common prime factors
3. The **PRODUCT OF ALL COMMON PRIME FACTORS** found in Step 2 is the GCF. If there are no common prime factors, the GCF is 1

| > Find the GCF of 18 & 30
| $18 = 2 \cdot 3 \cdot 3$
| $30 = 2 \cdot 3 \cdot 5$
| GCF $= 2 \cdot 3$
| $= 6$

## GCF of a List of Variables
- The variables raised to the smallest power in the list

| > Find the GCF of $x$ & $x^2$
| GCF $= x$

## GCF of a List of Terms
- The product of the GCF of the numerical coefficients and the GCF of the variable factors

| > Find the GCF of $18x$ & $30x^2$
| GCF $= 6x$

## Factor by taking out the GCF
1. Find the GCF of all terms
2. Write the polynomial as a product by factoring out the GCF
3. Apply the distributive property
4. Check by multiplying

| $-2x^2 + 6x^3$
| $= (-2x^2)g + (-2x^2)g(-3x)$
| $= -2x^2(1-3x)$
| $= -2x^2 + 6x^3$
| $> -x^2 + 1$
| $= (-1)(x^2) + (-1)(-1)$
| $= -1(x^2 - 1)$
| $= -x^2 + 1$

## Factor 4 Term Expressions

\[ a + b + c + d = (?, ?)(?, ?) \]

### FACTOR BY GROUPING

1. Arrange terms so the 1st 2 terms have a common factor and the last 2 have a common factor
2. For each pair of terms, factor out the pair’s GCF
3. If there is now a common binomial factor, factor it out
4. If there is no common binomial factor, begin again, rearranging the terms differently. If no rearrangement leads to a common binomial factor, the polynomial cannot be factored.

> Factor 10ax - 6xy - 9y + 15a
1. 10ax + 15a - 6xy - 9y
2. 5a(2x + 3) - 3y(2x + 3)

\[ (2x + 3)(5a - 3y) \]

---

## Factor Trinomials: Leading Coefficient of 1

\[ x^2 + bx + c = (x + ?)(x + ?) \]

### TRIAL & ERROR

- Product is \( c \)
- Sum is \( b \)

1. Place \( x \) as the first term in each binomial, then determine whether addition or subtraction should follow the variable

\[
x^2 + bx + c = (x + d)(x + e) \]
\[
x^2 - bx + c = (x - d)(x - e) \]
\[
x^2 \pm bx - c = (x + d)(x - e) \]

2. Find all possible pairs of integers whose product is \( c \)
3. For each pair, test whether the sum is \( b \)
4. Check with FOIL

Ex: Factor \( x^2 + 7x + 10 \)
1. \( (x + ?)(x + ?) \)

\[
\begin{align*}
2 & \text{ g 5 = 10 } \\
1 & \text{ g 10 = 10 } \\
2 & \text{ + 5 = 7 - YES } \\
1 & \text{ + 10 = 11 - NO } \\
(x + 5)(x + 2) & \\
4 & \text{ } x^2 + 7x + 10 \checkmark
\end{align*}
\]
## Factor Any Trinomial

### \( ax^2 + bx + c = (?x + ?)(?x + ?) \)

### METHOD 1 (trial & error)
1. Try various combinations of factors of \( ax^2 \) and \( c \) until a middle term of \( bx \) is obtained when checking.
2. Check with FOIL \( \sqrt{ } \)

### METHOD 2 (ac, factor by grouping)
1. Identify \( a \), \( b \), and \( c \)
2. Find 2 “magic numbers” whose product is \( ac \) and whose sum is \( b \). Factor trees can be very useful if you are having trouble finding the magic numbers (See MA090)
3. Rewrite \( bx \), using the “magic numbers” found in Step 2
4. Factor by grouping
5. Check with FOIL \( \sqrt{ } \)

### METHOD 3 (quadratic formula)
1. Use the quadratic formula to find the \( x \) values (or roots)
2. For each answer in step 1., rewrite the equation so that it is equal to zero
3. Multiply the two expressions from step 2, and that is the expression in factored form.
4. Check with FOIL \( \sqrt{ } \)

### Ex: Factor: \( 3x^2 + 14x - 5 \)
- \( a = 3 \)
- \( b = 14 \)
- \( c = -5 \)
- \( ac = (3)(-5) = -15 \)
- \( b = 14 \)
- \( (15)(-1) = -15 \sqrt{ } \)
- \( (15) + (-1) = 14 \sqrt{ } \)
- “magic numbers” \( 15, -1 \)
- \( 3x^2 + [15x - x - 5] \)
- \( 3x(x + 5) - 1(x + 5) \)
- \( (x + 5)(3x - 1) \)

### Ex: Factor: \( 2x^2 + 14x - 5 \)
- \( a = 2 \)
- \( b = 14 \)
- \( c = -5 \)
- \( ac = (2)(-5) = -10 \)
- \( b = 14 \)
- \( (10)(-1) = -10 \sqrt{ } \)
- \( (10) + (-1) = 9 \sqrt{ } \)
- “magic numbers” \( 10, -1 \)
- \( 2x^2 + [10x - x - 5] \)
- \( 2x(x + 5) - 1(x + 5) \)
- \( (x + 5)(2x - 1) \)
# Easy to Factor Polynomial Types

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Perfect Square Trinomials</strong></td>
<td>▪ Factors into perfect squares (a binomial squared)</td>
<td>▪ $a^2 + 2ab + b^2 = (a + b)^2$</td>
</tr>
<tr>
<td></td>
<td>▪ $a^2 - 2ab + b^2 = (a - b)^2$</td>
<td>▪ $9x^2 + 24x + 16 = (3x)^2 + 2(3x)(4) + (4)^2 = (3x + 4)^2$ (a = 3x, b = 4)</td>
</tr>
<tr>
<td></td>
<td>▪ $9x^2 - 24x + 16 = (3x)^2 - 2(3x)(4) + (4)^2 = (3x - 4)^2$ (a = 3x, b = 4)</td>
<td></td>
</tr>
<tr>
<td><strong>Difference of Squares</strong></td>
<td>▪ Factors into the sum &amp; difference of two terms</td>
<td>▪ $a^2 - b^2 = (a + b)(a - b)$</td>
</tr>
<tr>
<td></td>
<td>▪ $x^2 - 1 = (x)^2 - (1)^2$ (a = x, b = 1)</td>
<td>▪ $(x + 1)(x - 1)$</td>
</tr>
<tr>
<td><strong>Sum of Squares</strong></td>
<td>▪ Does not factor</td>
<td>▪ $x^2 + 1$ is prime</td>
</tr>
<tr>
<td></td>
<td>$a^2 + b^2 = Prime$</td>
<td></td>
</tr>
<tr>
<td><strong>Difference of Cubes</strong></td>
<td>▪ $a^3 - b^3 = (a - b)(a^2 + ab + b^2)$</td>
<td>▪ $8x^3 - 27 = (2x)^3 - (3)^3$ (a = 2x, b = 3) = $(2x - 3)(4x^2 + 6x + 9)$</td>
</tr>
<tr>
<td></td>
<td>▪ $8x^3 + 27 = (2x)^3 + (3)^3$ (a = 2x, b = 3)</td>
<td>▪ $(2x + 3)(4x^2 - 6x + 9)$</td>
</tr>
<tr>
<td><strong>Sum of Cubes</strong></td>
<td>▪ $a^3 + b^3 = (a + b)(a^2 - ab + b^2)$</td>
<td>▪ $8x^3 + 27 = (2x)^3 + (3)^3$ (a = 2x, b = 3) = $(2x + 3)(4x^2 - 6x + 9)$</td>
</tr>
<tr>
<td></td>
<td>(MA103)</td>
<td></td>
</tr>
<tr>
<td><strong>Prime Polynomials</strong></td>
<td>▪ Can not be factored</td>
<td>▪ $x^2 + 3x + 1$ is prime</td>
</tr>
<tr>
<td></td>
<td>(P)</td>
<td>▪ $x^2 - 3$ is prime</td>
</tr>
</tbody>
</table>

## Factor Any Polynomial

1. Are the variable terms in descending order of degree with the constant term last? If not, put them in descending order.  
   Ex. $-32 + 2x^4 = 2x^4 - 32$

2. Are there any common factors? If so, see **Factor Out the GCF (p.10)**  
   Ex. $2(x^4 - 16) = 2(x^2 + 4)(x^2 - 4)$

3. How many terms?  
   ▪ 2 TERMS – see if one of the following can be applied  
     • *Difference of Squares (p.13)*  
     • *Sum of Cubes (p.13)*  
     • *Difference of Cubes (p.13)*  
   ▪ 3 TERMS – try one of the following  
     • *Perfect Square Trinomial (p.13)*  
     • *Factor Trinomials: Leading Coefficient of 1 (p.11)*  
     • *Factoring Any Trinomial (p.12)*  
   ▪ 4 TERMS – try **Factor by Grouping (p.11)**

4. If both steps 2 & 3 produced no results, the polynomial is prime. You’re done 😊 Skip steps 5 & 6

5. See if any factors can be factored further  
   Ex. $2(x^2 + 4)(x + 2)(x - 2)$

6. Check by multiplying  
   Ex. $(2(x^2 + 4))(x + 2)(x - 2) = (2x^2 + 8)(x^2 - 4) = 2x^4 - 32$
# Quadratic Methods

<table>
<thead>
<tr>
<th>Standard Form</th>
<th>( ax^2 + bx + c = 0 )</th>
<th>( x^2 - 3x + 2 = 0 )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solutions</td>
<td>Has ( n ) solutions, where ( n ) is the highest exponent</td>
<td>( x^2 - 3x^2 + 2x = 0 ) (has 3 solutions)</td>
</tr>
<tr>
<td>Zero Factor Property</td>
<td>If a product is 0, then a factor is 0</td>
<td>( xy = 0 ) (either ( x ) or ( y ) must be zero)</td>
</tr>
</tbody>
</table>

## Solve by Factoring

1. Write the equation in standard form (equal 0)
2. Factor
3. Set each factor containing a variable equal to zero
4. Solve the resulting equations

### Example
\( x^2 - 3x + 2 = 0 \)
\( a = 1, b = -3, c = 2 \)
\( x = \frac{-(-3) \pm \sqrt{(-3)^2 - 4(1)(2)}}{2(1)} = \frac{3 \pm \sqrt{1}}{2} = 2, 1 \)

## Solve with the Quadratic Equation

- To solve a quadratic equation that is difficult or impossible to factor
- Steps
  1. Write the values for \( a, b, \) & \( c \) (if a term does not exist, the coefficient is 0)
  2. Plug values into the quadratic equation below:
     \( x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} \)
  3. Simplify solutions and usually leave them in their most exact form
     (Negative radicand means no real solutions)

### Example
\( x^2 + 6x - 1 = 0 \)
\( a = 1, b = 6, c = -1 \)
\( x = \frac{-6 \pm \sqrt{6^2 - 4(1)(-1)}}{2(1)} = \frac{-6 \pm 2\sqrt{10}}{2} = -3 \pm \sqrt{10} \)

### Example
\( 4x^2 - x - 1 = 0 \)
\( a = 4, b = -1, c = -1 \)
\( x = \frac{1 \pm \sqrt{17}}{8} \)
Solve Any 1 Variable Equation

Is it really an equation?

If it’s not an equation, it’s an expression, you can’t solve it. You can factor, expand & simplify it

If it’s an equation, can it easily be put in factored form?

Make an equivalent, simpler equation
- If the equation contains fractions, eliminate the fractions (multiplying both sides by the LCD)
- If there is a common factor in each term, divide both sides of the equation by the common factor

Can the variable be isolated?

Solve by ‘undoing’ the equation
- Linear equations can by undone with the addition, subtraction, multiplication & division equality properties MA090
- Quadratics, of the form \((x + a)^2 = b\), can be undone with the square root property MA101/103

Write the equation in standard form
- Make one side equal to zero
- Put variable terms in descending order of degree with the constant term last

Can it easily be put in factored form?

Yes

Solve by Factoring p. 14

No

Is it a quadratic equation?

Yes

Solve with the Quadratic Equation p. 14
- or-
Solve by Completing the Square MA101/103

No

Not covered in this class

No

Check solutions in the original equation
Graph Quadratic Equations in 2 Variables

<table>
<thead>
<tr>
<th>Standard Form</th>
<th>$y = ax^2 + bx + c$</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$a$, $b$, and $c$ are real constants</td>
</tr>
<tr>
<td>Solution</td>
<td>A parabola</td>
</tr>
<tr>
<td>Simple Form</td>
<td>$y = ax^2$</td>
</tr>
<tr>
<td></td>
<td>Vertex (high/low point) is (0,0)</td>
</tr>
<tr>
<td></td>
<td>Line of symmetry is $x = 0$</td>
</tr>
<tr>
<td></td>
<td>The parabola opens up if $a &gt; 0$, down if $a &lt; 0$</td>
</tr>
<tr>
<td>Graph</td>
<td>1. Plot $y$ value at vertex</td>
</tr>
<tr>
<td></td>
<td>2. Plot $y$ value one unit to the left of the vertex</td>
</tr>
<tr>
<td></td>
<td>3. Plot $y$ value one unit to the right of the vertex</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>$y = x^2 - 9x + 20$</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>$y = -4x^2$</th>
</tr>
</thead>
</table>

$y$-value at vertex:

<table>
<thead>
<tr>
<th>$x$</th>
<th>$y$</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>-1</td>
<td>-4</td>
</tr>
<tr>
<td>1</td>
<td>-4</td>
</tr>
</tbody>
</table>
## Exponents & Powers

<table>
<thead>
<tr>
<th><strong>Exponential notation</strong></th>
<th>Shorthand for repeated multiplication</th>
<th>$2^3 = 2 \cdot 2 \cdot 2 = 8$</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Multiplying common bases</strong></td>
<td>Add powers</td>
<td>$x^n \cdot x^b = x^{a+b}$</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$(3x^2)(2y)(4x) = 24x^3y$</td>
</tr>
<tr>
<td><strong>Dividing common bases</strong></td>
<td>Subtract powers</td>
<td>$\frac{x^m}{x^n} = x^{m-n}$</td>
</tr>
<tr>
<td><strong>Raising a product to a power</strong></td>
<td>Raise each factor to the power</td>
<td>$(xy)^a = x^a \cdot y^a$</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$(x^m \cdot y^n)^a = x^{ma} \cdot y^{na}$</td>
</tr>
<tr>
<td><strong>Raising a quotient to a power</strong></td>
<td>Raise the dividend and divisor to the power</td>
<td>$\left(\frac{x}{y}\right)^n = x^n \div y^n$</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$\left(\frac{2}{z}\right)^2 = \frac{2^2}{z^2} = \frac{4}{z^2}$</td>
</tr>
<tr>
<td><strong>Raising a power to a power</strong></td>
<td>Multiply powers</td>
<td>$(x^a)^b = x^{a \cdot b}$</td>
</tr>
<tr>
<td><strong>Raising to the zero power</strong></td>
<td>One</td>
<td>$x^0 = 1$, when $x \neq 0$</td>
</tr>
<tr>
<td><strong>Raising to a negative power</strong></td>
<td>Reciprocal of positive power</td>
<td>$x^{-n} = \frac{1}{x^n}$</td>
</tr>
</tbody>
</table>

## Scientific Notation

<table>
<thead>
<tr>
<th><strong>Scientific Notation</strong></th>
<th>Shorthand for writing very small and large numbers</th>
<th>$(1.2 \cdot 10^2) \times (1.2 \cdot 10^3)$</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$a \cdot 10^r$, where $1 \leq a &lt; 10$ &amp; $r$ is an integer</td>
<td>$= 1.44 \cdot 10^5$</td>
</tr>
<tr>
<td><strong>Standard Form</strong></td>
<td>Long way of writing numbers</td>
<td>$120 \times 1200 = 144000$</td>
</tr>
<tr>
<td><strong>Standard Form to Scientific Notation</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1. Move the decimal point in the original number to the left or right so that there is one digit before the decimal point</td>
<td>$510.$</td>
</tr>
<tr>
<td></td>
<td>2. Count the number of decimal places the decimal point is moved in step 1</td>
<td>$5.10$</td>
</tr>
<tr>
<td></td>
<td>▪ If the original number is 10 or greater, the count is positive</td>
<td>$+2$</td>
</tr>
<tr>
<td></td>
<td>▪ If the original number is less than 1, the count is negative</td>
<td>$-2$</td>
</tr>
<tr>
<td></td>
<td>3. Multiply the new number is step 1 by 10 raised to an exponent equal to the count found in step 2</td>
<td>$5.1 \cdot 10^2$</td>
</tr>
<tr>
<td><strong>Scientific Notation to Standard Form</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1. Multiply numbers together</td>
<td>$5.1 \cdot 10^2$</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$= 5.1 \cdot 100$</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$= 510$</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$5.1 \cdot 10^{-2}$</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$= 5.1 \cdot \frac{1}{100}$</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$= .051$</td>
</tr>
</tbody>
</table>
### Roots

**Roots**
- Undoes raising to powers
  - \( \sqrt[2]{81} = 9 \)
  - because \( 9^2 = 81 \)

<table>
<thead>
<tr>
<th>Radical</th>
<th>Radicalicand</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \sqrt[2]{81} )</td>
<td>( 81 )</td>
</tr>
</tbody>
</table>

- \( \sqrt[n]{a} = |a| \)
  - The radical \( \sqrt[n]{\cdot} \) represents only the non-negative square root of \( a \).
  - The \( -\sqrt[n]{\cdot} \) represents the negative square root of \( a \).
- **If \( n \) IS AN ODD POSTIVIE INTEGER**, then
  - \( \sqrt[n]{a^n} = a \)

<table>
<thead>
<tr>
<th>Computation</th>
</tr>
</thead>
<tbody>
<tr>
<td>If ( n ) IS AN EVEN POSITIVE INTEGER, then ( \sqrt[n]{a^n} =</td>
</tr>
</tbody>
</table>
| \( \sqrt{9} = \sqrt{3^2} = |3| = 3 \)
| \( \sqrt{(-3)^2} = |-3| = 3 \)
| \( \sqrt{(x+1)^2} = |x+1| \)
| \( \sqrt{-9} "Not a real number" \)
| \( -\sqrt{9} = -\sqrt{3^2} = -|3| = -3 \)
| \( \sqrt{0.09} = \sqrt{0.3 \cdot 0.3} = 0.3 \)
| \( \sqrt[3]{27} = \sqrt[3]{3^3} = 3 \)
| \( \sqrt[3]{-27} = \sqrt[3]{(-3)^3} = -3 \)

### Notation: Radical vs. Rational Exponent
- The root of a number can be expressed with a radical or a rational exponent
- **Rational exponents**
  - The numerator indicates the power to which the base is raised.
  - The denominator indicates the index of the radical
  - \( (\sqrt[2]{a})^3 = \frac{3}{2} \) \( a \)

<table>
<thead>
<tr>
<th>Expression</th>
</tr>
</thead>
</table>
| \( \frac{1}{2} \sqrt[2]{7} \) \( = \frac{1}{\sqrt[2]{27}} \) \( = \frac{1}{3} \) \( = 0.3 \) \( \approx 0.3 \approx 0.3 \approx 0.3 \approx 0.3 \approx 0.3 \approx 0.3 \)

### Operations
- Roots are powers with fractional exponents, thus power rules apply.
  - \( \sqrt[-8]{x^3} = (-8x^3)^{1/3} \)
  - \( = (-8)^{1/3}(x^3)^{1/3} = -2x \)

<table>
<thead>
<tr>
<th>Product Rule</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \sqrt[5]{a} \sqrt[5]{b} = \sqrt[5]{ab} )</td>
</tr>
<tr>
<td>( \sqrt[5]{6\sqrt[5]{7}} = \sqrt[5]{42} )</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Quotient Rule</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \sqrt[n]{\frac{a}{b}} = \frac{\sqrt[n]{a}}{\sqrt[n]{b}} ), provided ( \sqrt[n]{b} \neq 0 )</td>
</tr>
<tr>
<td>( \sqrt[25]{\frac{1}{25}} = \frac{1}{\sqrt[25]{25}} = \frac{1}{5} )</td>
</tr>
</tbody>
</table>

### Simplifying Expressions
1. Separate radicand into “perfect squares” and “leftovers”
2. Compute “perfect squares”
3. “Leftovers” stay inside the radical so the answer will be exact, not rounded

<table>
<thead>
<tr>
<th>Expression</th>
</tr>
</thead>
<tbody>
<tr>
<td>Just perfect squares... ( \sqrt[3]{36x^2} = 6x )</td>
</tr>
<tr>
<td>Prefect squares &amp; leftovers... ( \sqrt[3]{32x^3} = \sqrt[3]{16x^3} \sqrt[3]{2x} = 4x\sqrt[3]{2x} )</td>
</tr>
<tr>
<td>Just leftovers... ( \sqrt[3]{33x} = \sqrt[3]{33x} )</td>
</tr>
</tbody>
</table>
### Rational Expressions

#### Rational Numbers
- Can be expressed as quotient of integers (fraction) where the denominator ≠ 0
- All integers are rational
- All “terminating” decimals are rational

\[ > 0 = 0/1 \]
\[ > 4 = 4/1 \]
\[ > 4.25 = 17/4 \]

#### Irrational Numbers
- Cannot be expressed as a quotient of integers. Is a non-terminating decimal

\[ > \pi = 3.141592654... \]
\[ > \sqrt{2} = 1.414213562... \]

#### Rational Expression
1. An expression that can be written in the form \( \frac{P}{Q} \), where \( P \) and \( Q \) are polynomials
2. Denominator ≠ 0

\[ > \frac{x}{x + 6} \text{, Find real numbers for which this expression is undefined: } x + 6 = 0; \ x = -6 \]

#### Simplifying Rational Expressions (factor)
1. Completely factor the numerator and denominator
2. Cancel factors which appear in both the numerator and denominator

\[ > \text{Simplify } \frac{4x + 20}{x^2 - 25} \]
\[ = \frac{4(x + 5)}{(x + 5)(x - 5)} \]
\[ = \frac{4}{x - 5} \]

#### Multiplying/Dividing Rational Expressions (multiply across)
1. If it’s a division problem, change it to a multiplication problem
2. Factor & simplify
3. Multiply numerators and multiply denominators
4. Write the product in simplest form

\[ > \text{Simplify } \frac{x}{x + 6} \cdot \frac{g}{x} = \frac{3x}{x(x + 6)} \]
\[ = \frac{3}{x + 6} \]

#### Adding/Subtracting Rational Expressions (get common denominator)
1. Factor & simplify each term
2. Find the LCD
   - The LCD is the product of all unique factors, each raised to a power equal to the greatest number of times that it appears in any one factored denominator
3. Rewrite each rational expression as an equivalent expression whose denominator is the LCD
4. Add or subtract numerators and place the sum or difference over the common denominator
5. Write the result in simplest form

\[ > \text{Simplify } \frac{x}{x + 6} + \frac{3}{6} \]
\[ = \frac{(6)x}{6(x + 6)} + \frac{3(x + 6)}{3(x + 6)} \]
\[ = \frac{6x}{6(x + 6)} + \frac{3x + 18}{6(x + 6)} \]
\[ = \frac{9x + 18}{6(x + 6)} \]
\[ = \frac{3x + 6}{2(x + 6)} \]
### Solving Rational Equations

#### Solving by Eliminating the Denominator

1. Factor & simplify each term
2. Multiply both sides \((\text{all terms})\) by the LCD
3. Remove any grouping symbols
4. Solve
5. Check answer in original equation. If it makes any of the denominators equal to 0 (undefined), it is not a solution

Solve \(\frac{x}{x+6} + \frac{3}{x} = 1\)

1. \(\text{LCD} = x(x+6)\)
2. \(\left[\frac{x}{x+6}\right] + \left[\frac{3}{x}\right] = [x(x+6)]1\)
3. \(x(x) + 3(x+6) = 1(x^2 + 6x)\)
4. \(x^2 + 3x + 18 = x^2 + 6x\)
5. \(x = 6\)

Check \(\frac{(6)}{(6)} + \frac{3}{(6)} = 1\)

\(\frac{1}{2} + \frac{1}{2} = 1\sqrt{\text{ }}\)

### Solving Proportions with the Cross Product

\(\frac{a}{b} = \frac{c}{d}\)

1. Set the product of the diagonals equal to each other
2. Solve
3. Check

**If your rational equation is a proportion, it’s easier to use this shortcut**

Solve \(\frac{3}{4} = \frac{x-1}{x}\)

1. \(3(x-1) = 4x\)
2. \(3x - 3 = 4x\)
3. \(x = -3\)

Check \(\frac{3}{4} = \frac{(-3)}{(-3) - 1}\sqrt{\text{ }}\)
## Formulas

### Geometric

<table>
<thead>
<tr>
<th>Triangle</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="Triangle" /></td>
</tr>
<tr>
<td><strong>SUM OF ANGLES:</strong> Angle 1 + Angle 2 + Angle 3 = 180°</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Right Triangle</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="Right Triangle" /></td>
</tr>
</tbody>
</table>
| **PYTHAGOREAN THEOREM:** $a^2 + b^2 = c^2$  
(a = leg, b = leg, c = hypotenuse)  
~The hypotenuse is the side opposite the right angle. It is always the longest side. |

### Other

<table>
<thead>
<tr>
<th>Distance</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="Distance" /></td>
</tr>
</tbody>
</table>
| **DISTANCE:** $d = rt$  
($r =$ rate, $t =$ time) |

## Dictionary of Terms

### Real Numbers

- Points on a number line
- Whole numbers, integers, rational and irrational numbers
- $> 7, -7, \frac{7}{2}, \pi$

### Positive Infinity (Infinity)

- An unimaginably large positive number. (If you keep going to the right on a number line, you will never get there)
- $\infty$ or $+\infty$

### Negative Infinity

- An unimaginably small negative number. (If you keep going to the left on a number line, you will never get there)
- $-\infty$