Student Workbook Options

FOR PRECALCULUS

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*IR Worksheets can be purchased with both an Integrated Review
MyMathLab course or a regular MyMathLab course.
Available Titles

**Explorations and Notes**
Schulz © 2014
*Precalculus, First Edition (Sample)*

**Guided Lecture Notes**
Sullivan/Sullivan © 2015 Series
*College Algebra: Concepts Through Functions, Third Edition (Sample)*
*Precalculus: Concepts Through Functions, A Right Triangle Approach to Trigonometry, Third Edition*
*Precalculus: Concepts Through Functions, A Unit Circle Approach to Trigonometry, Third Edition*

Sullivan © 2016 Series
*College Algebra, Tenth Edition (Sample)*
*Trigonometry: A Unit Circle Approach, Tenth Edition*
*Algebra and Trigonometry, Tenth Edition*
*Precalculus, Tenth Edition*

**Guided Notebook**
Trigsted © 2015 Series
*College Algebra, Third Edition (Sample)*
*College Algebra Interactive, First Edition*
*Trigonometry, Second Edition*
*Algebra & Trigonometry, Second Edition*

**Learning Guide**
Blitzer © 2014 Series
*College Algebra, Sixth Edition*
*College Algebra: An Early Functions Approach, Third Edition*
*College Algebra Essentials, Fourth Edition*
*Trigonometry, First Edition (Sample)*
*Algebra and Trigonometry, Fifth Edition*
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*Precalculus Essentials, Fourth Edition*

**MyNotes**
Lial/Hornsby/Schneider/Daniels © 2013/15 Series
*College Algebra, Eleventh Edition*
*Essentials of College Algebra, Eleventh Edition (Sample)*
*Trigonometry, Tenth Edition*
*College Algebra and Trigonometry, Fifth Edition*
*Precalculus, Fifth Edition*

**Video Notebook**
Beecher/Penna/Bittinger © 2014/16 Series
*College Algebra, Fifth Edition (Sample)*
*Algebra and Trigonometry, Fifth Edition*
*Precalculus, Fifth Edition*

Dugopolski © 2015 Series
*College Algebra, Sixth Edition*
*Trigonometry, Fourth Edition (Sample)*
*College Algebra and Trigonometry, Sixth Edition*

**Integrated Review (IR) Worksheets**
Beecher/Penna/Bittinger © 2014/16 Series
*College Algebra with Integrated Review, Fifth Edition*
Blitzer © 2015 Series
*College Algebra with Integrated Review, First Edition*
Lial/Hornsby/Schneider/Daniels © 2015 Series
*Essentials of College Algebra with Integrated Review, First Edition*
Rockswold © 2016 Series
*College Algebra with Integrated Review, First Edition (Sample)*
Sullivan © 2016 Series
*College Algebra with Integrated Review, Tenth Edition*
Trigsted © 2015 Series
*College Algebra with Integrated Review, First Edition*
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*Binding types: B- Bound, LL- Loose Leaf

**The eText Reference for the Trigsted series is another option, and is essentially a printed version of the eText. If someone is looking for a “workbook” type resource, show them the Guided Notebook. If someone wants the full eText in printed format, show the eText Reference. Send the eText Reference for “instructor desk copies”.

***IR Worksheets can be purchased with both an Integrated Review MyMathLab course or a regular MyMathLab course.
Explorations and Notes

Note-taking guide designed to help students stay focused and to provide a framework for further exploration.

Includes:
- Learning Objectives
- Extra Practice Problems
- Extra Examples
- End of Chapter Review
- Vocab Exercises
- Note-taking/Organizational Tool
- Student Checklist

Available with the Following Titles:

Schulz © 2014
Precalculus, First Edition (Sample)
Chapter 1 Functions
Explorations & Notes: 1.1 What is a Function?

Definition of a Function

**DEFINITION** Function, Domain, Range

A is a relation between two sets assigning to each element in the first set exactly element in the second set. The first set is called the of the function, and the second set is called the of the function. The is the variable associated with the domain; the belongs to the range.

EXPLORE Example 1

1. Explain how, with two values of 1 appearing in the second column, Relation 1 is still a function.

EXPLORE Example 2

2. Explain why the price of an airplane ticket is not a function of the length of the flight.

EXPLORE Example 3

3. A plot of the tuition function is shown in Figure 1.2. Explain why the points cannot be connected.

Function Notation

\[ f(\overline{x}) \]
The **expression** of a function is the expression on which the function works.

**EXPLORE Example 4**

4. Explain why $f(x) + 1$ and $f(x + 1)$ are different (see QUICK CHECK 3).

**EXPLORE Example 5**

$$
\frac{f(x + h) - f(x)}{h} =
$$

$$
= \frac{f(x)}{h} - \frac{f(x)}{h}
$$

$$
= \frac{h}{h}
$$

$$
= \frac{h}{h}
$$

**The Natural Domain of a Function**

When a function is given without reference to a specific domain, the **expression** of the function is understood to be the set of real numbers for which outputs of the function are real numbers; that is, where the function is **defined**.

**EXPLORE Example 6**

5. Explain why the natural domain of $g$ is not the set of all real numbers.

6. Explain why the natural domain of $h$ is the set of all real numbers.
7. Explain why the natural domain of $m$ is not the set of all real numbers.

Check Your Progress

Upon completing this section, you should

- □ understand the definition of a function;
- □ be able to determine whether or not a relation given in words is a function;
- □ be able to determine whether or not a relation given in numeric form is a function;
- □ understand and be able to use function notation;
- □ be able to identify the domain and range of a function.
Guided Lecture Notes

Lecture notes designed to help students take thorough, organized, and understandable notes as they watch the Author in Action videos.

Includes:
- Extra Practice Problems
- Extra Examples
- Side-by-Side Examples and Practice
- Vocab Exercises
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**Sullivan © 2016 Series**
*College Algebra*, Tenth Edition *(Sample)*  
*Trigonometry: A Unit Circle Approach*, Tenth Edition  
*Algebra and Trigonometry*, Tenth Edition  
*Precalculus*, Tenth Edition
A relation is a _________________________________.
If \(x\) and \(y\) are two elements in these sets and if a relation exists between \(x\) and \(y\), then we say that \(x\) __________________ to \(y\) or that \(y\) ___________ \(x\), and we write ________.

What are the four ways to express relations between two sets?

**Definition:** Let \(X\) and \(Y\) be two nonempty sets. A function from \(X\) into \(Y\) is a relation that associates with each element of \(X\) ________________ of \(Y\).

In other words, for a function, no input has more than one output.

The domain of a function is:

The Range of a function is:

Can an element in the range be repeated in a function? For example, can a function contain the points \((2,4)\) and \((3,4)\)? Why or why not?

**Example 1*:** Determine Whether a Relation Represents a Function
Determine which of the following relations represent a function. If the relation is a function, then state its domain and range.

(a) Level of Education | Unemployment Rate
---|---
No High School Diploma | 7.7% 
High School Diploma | 5.9% 
Some College | 5.4% 
College Graduate | 3.4% 

(b) \(\{(2,3),(4,1),(3,-2),(2,-1)\}\)

(c) \(\{(-2,3),(4,1),(3,-2),(2,-1)\}\)

(d) \(\{(2,3),(4,3),(3,3),(2,-1)\}\)
Example 2*: Determine Whether a Relation Represents a Function

Determine whether the following are functions, with $y$ as a function of $x$.

(a) $y = -\frac{1}{2}x - 3$
(b) $x = 2y^2 + 1$

In general, the idea behind a function is its predictability. If the input is known, we can use the function to determine the output. With “nonfunctions,” we don’t have this predictability.

Sometimes it is helpful to think of a function $f$ as a machine that receives as input a number from the domain, manipulates it, and outputs the value with certain restrictions:

1. It only accepts numbers from _______________.
2. For each input, there is _______________.

For a function $y = f(x)$, the variable $x$ is called the _______________ because it can be assigned to any of the numbers in the domain. The variable $y$ is called the _______________ because its value depends $x$.

Example 3: Illustrate Language Used with Functions

State the name, independent variable, and dependent variable of the functions below.

(a) $y = g(x) = x + 6$
(b) $y = f(x) = 2x + 3$
(c) $p = r(n) = n^2$
Example 4*: Find the Value of a Function
For the function $f$ defined by $f(x) = -3x^2 + 2x$, evaluate:

(a) $f(3)$  
(b) $f(x) + f(3)$  
(c) $f(-x)$  

(d) $-f(x)$  
(e) $f(x + 3)$  
(f) $\frac{f(x + h) - f(x)}{h}, h \neq 0$

Example 4(f) is an example of finding the simplified difference quotient of a function. The difference quotient is used in calculus to find derivatives. In this class, we will only work on simplification. Let’s practice a few more of these.

Example 5: Find the Value of a Function
Find the simplified difference quotient of $f$; that is, find $\frac{f(x + h) - f(x)}{h}, h \neq 0$ for each of the functions below.

(a) $f(x) = -2x + 1$  
(b) $f(x) = 2x^2 - 5x - 1$
In general, when a function $f$ is defined by an equation $x$ and $y$, we say that $f$ is given _________. If it is possible to solve the equation for $y$ in terms of $x$, then we write $y = f(x)$ and say that the function is given ______________._

**Example 6**: Implicit Form of a Function
Circle the functions below that are written in their implicit form.

\[
3x + y = 5
\]

\[
y = f(x) = x^2 - 6
\]

\[
xy = 4
\]

The **domain** is the largest set of real numbers for which $f(x)$ is a real number. In other words, the domain of a function is the largest set of real numbers that produce real outputs.

**Steps for Finding the Domain of a Function Defined by an Equation**

1. Start with the domain as the set of _____________.

2. If the equation has a denominator, exclude any numbers that ___________________.
   Why do we have to exclude these numbers?

3. If the equation has a radical of *even* index, exclude any numbers that cause the expression inside the radical to be _________________.
   Why do we have to exclude these numbers?

**Example 7**: Find the Domain of a Function Defined by an Equation
Find the domain of each of the following functions using interval or set-builder notation:

(a) $f(x) = \frac{x + 4}{x^2 - 2x - 3}$

(b) $g(x) = x^2 - 9$

(c) $h(x) = \sqrt{3 - 2x}$

**Tip**: When finding the domain of application problems, we must take into account the context of the problem. For example, when looking at the formula for the area of a circle, $A = \pi r^2$, it does not make sense to have a negative radius or a radius of 0. The domain would be $\{r \mid r > 0\}$.

**Example 8**: Find the Domain of an Application
A rectangular garden has a perimeter of 100 feet. Express the area, $A$, of the garden as a function of the width, $w$. Find the domain.
Definition: Function Operations

The sum, \( f - g \), is defined by ______________________
   Domain of \( f - g \): __________________________

The difference, \( f + g \), is defined by __________________
   Domain of \( f + g \): __________________________

The product, \( f \cdot g \), is defined by __________________
   Domain of \( f \cdot g \): __________________________

The quotient, \( \frac{f}{g} \), is defined by __________________
   Domain of \( \frac{f}{g} \): __________________________

Example 9: Form the Sum, Difference, Product, and Quotient of Two Functions

For the functions \( f(x) = 2x - 4 \) and \( g(x) = -3x + 6 \), find the following. For parts a – d also find the domain.

(a) \((f + g)(x)\)  (b) \((f - g)(x)\)  (c) \((f \cdot g)(x)\)  (d) \(\left(\frac{f}{g}\right)(x)\)

(e) \((f + g)(1)\)  (f) \((f - g)(1)\)  (g) \((f \cdot g)(-1)\)  (h) \(\left(\frac{f}{g}\right)(1)\)

Example 10*: Form the Sum, Difference, Product, and Quotient of Two Functions

For the functions \( f(x) = \frac{1}{x - 2} \) and \( g(x) = \frac{x}{x + 4} \), find the following and determine the domain in each case.

(a) \((f + g)(x)\)  (b) \((f - g)(x)\)  (c) \((f \cdot g)(x)\)  (d) \(\left(\frac{f}{g}\right)(x)\)
A linear equation in one variable is an equation equivalent in form to \( ax + b = 0 \) where \( a \) and \( b \) are real numbers and \( a \neq 0 \).

Why does the definition say \( a \neq 0 \)? What type of equation would it be if \( a = 0 \)?

To solve an equation means to find all the solutions of the equation that make it true. Solutions can be written in set notation, called the solution set. One method to solve is to write a series of equivalent equations. Multiple properties from previous courses can help with this, including the Addition and Multiplication Properties of Equality along with the Distributive Property.

**Example 1**: Solve Linear Equations
Solve the equations:

(a) \( 6 + y = 11 \)  
(b) \( \frac{1}{7} x = 4 \)

(c) \( 3a - 9 = -24 \)  
(d) \( 3a - 8 = 2a - 15 \)

(e) \( 12 - 2x - 3(x + 2) = 4x + 12 - x \)  
(f) \( \frac{2}{5} + v = \frac{1}{2} - \frac{3}{10} \)

(g) \( 0.9t - 1.2 = 0.4 + 0.1t \)
Sometimes in solving what ends up as a linear equation, does not begin that way.

**Example 2: Solve Equations That Lead to Linear Equations**
Solve \((x + 2)(x - 4) = (x + 3)^2\) by simplifying first to see the linear equation.

**Example 3: Solve Equations That Lead to Linear Equations**
Solve \(\frac{2x}{x + 5} = \frac{-6}{x + 5} - 2\) by simplifying first to see the linear equation.

**Example 4: Solve Equations That Lead to Linear Equations**
Solve \(\frac{2x}{x + 3} = \frac{-6}{x + 3} - 2\) by simplifying first to see the linear equation. Why does the solution to this equation end up being \(\emptyset\)?

Many applied problems require the solution of a quadratic equation. Let’s look at one in the next example.

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Example 5: Solve Problems That Can Be Modeled by Linear Equations
A total of $15,000 is to be divided between Jon and Wendy, with Jon to receive $2500 less than Wendy. How much will each receive?

Step 1: Determine what you are looking for.

Step 2: Assign a variable to represent what you are looking for. If necessary, express any remaining unknown quantities in terms of this variable.

Step 3: Translate the English into mathematical statements. A table can be used to organize the information. Use the information to build your model.

Step 4: Solve the equation and answer the original question.

Step 5: Check your answer with the facts presented in the problem.

Example 6: Solve Problems That Can Be Modeled by Linear Equations
Sierra, who is paid time-and-a-half for hours worked in excess of 40 hours, had gross weekly wages of $935 for 50 hours worked. Use the steps for solving applied problems to determine her regular hourly rate.
Guided Notebook

Interactive workbook that guides students through the course by asking them to write down key definitions and work through important examples for each section of the eText.

Includes:
- Learning Objectives
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- Note-taking/Organizational Tool
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College Algebra, Third Edition (Sample)
College Algebra Interactive, First Edition
Trigonometry, Second Edition
Algebra & Trigonometry, Second Edition
Section 1.1

Section 1.1 Guided Notebook

Section 1.1 Linear Equations

☐ Work through Section 1.1 TTK
☐ Work through Objective 1
☐ Work through Objective 2
☐ Work through Objective 3
☐ Work through Objective 4
☐ Work through Objective 5

Section 1.1 Linear Equations

1.1 Things To Know

1. Factoring Trinomials with a Leading Coefficient Equal to 1

Can you factor the polynomial \( b^2 - 9b + 14 \)? Try working through a “You Try It” problem or refer to section R.5 or watch the video.
2. Factoring Trinomials with a Leading Coefficient Not Equal to 1.

Can you factor the polynomial $15x^2 - 17x - 4$? Try working through a “You Try It” problem or refer to section R.5 or watch the video.

Section 1.1 Objective 1 Recognizing Linear Equations

What is the definition of an **algebraic expression**?

What is the definition of a **linear equation in one variable**?
Section 1.1

In the Interactive Video following the definition of a linear equation in one variable, which equation is not linear? Explain why it is not linear.

---

Section 1.1 Objective 2 Solving Linear Equations with Integer Coefficients

What does the term integer coefficient mean?

Work through Example 1 and Example 2 in your eText and take notes here:
Section 1.1

Try this one on your own: Solve the following equation: \(3 - 4(x + 4) = 6x - 32\) and see if you can get an answer of \(x = \frac{19}{10}\). You might want to try a “You Try It” problem now.

Section 1.1 Objective 3 Solving Linear Equations Involving Fractions

What is the definition of a **least common denominator (LCD)**?

What is the first thing to do when solving linear equations involving fractions?
Work through the video that accompanies Example 3 and write your notes here: Solve \[ \frac{1}{3}(1-x) - \frac{x+1}{2} = -2 \]

Try this one on your own: Solve the following equation: \[ \frac{1}{5}x - \frac{1}{3}(x-4) = \frac{1}{2}(x+1) \] and see if you can get an answer of \( x = \frac{25}{19} \). You might want to try a “You Try It” problem now.

Section 1.1 Objective 4 Solving Linear Equations Involving Decimals

When encountering a linear equation involving decimals, how do you eliminate the decimals?
Work through the video that accompanies Example 4 and write your notes here:

Solve \( .1(y - 2) + .03(y - 4) = .02(10) \)

Try this one on your own: Solve the following equation: \( 0.004(9 - k) + 0.04(k - 9) = 1 \) and see if you can get an answer of \( x = \frac{331}{9} \). You might want to try a “You Try It” problem now.
Section 1.1

Section 1.1 Objective 5  Solving Equations that Lead to Linear Equations

Work through Example 5 and take notes here: Solve $3a^2 - 1 = (a + 1)(3a + 2)$

Work through Example 6 and take notes here:

$$\frac{2-x}{x+2} + 3 = \frac{4}{x+2}$$

What is an extraneous solution?
Work through Example 7 and take notes here: Solve \[ \frac{12}{x^2 + x - 2} - \frac{x + 3}{x - 1} = \frac{1 - x}{x + 2} \]
(What do you have to do BEFORE you find the lowest common denominator?)

Try this one on your own: Solve the following equation:
\[ \frac{10}{x^2 - 2x} - \frac{4}{x} = \frac{4}{x - 2} \]
and see if you can get an answer of \( x = \frac{9}{4} \). You might want to try a “You Try It” problem now.
Learning Guide

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- Study Skills Tips
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- Trigonometry, First Edition (Sample)
- Algebra and Trigonometry, Fifth Edition
- Precalculus, Fifth Edition
- Precalculus Essentials, Fourth Edition
Ever Feel Like You’re Just Going in Circles?

You’re riding on a Ferris wheel and wonder how fast you are traveling. Before you got on the ride, the operator told you that the wheel completes two full revolutions every minute and that your seat is 25 feet from the center of the wheel. You just rode on the merry-go-round, which made 2.5 complete revolutions per minute. Your wooden horse was 20 feet from the center, but your friend, riding beside you was only 15 feet from the center. Were you and your friend traveling at the same rate?

In this section, we study both angular speed and linear speed and solve problems similar to those just stated.

### Objective #1: Recognize and use the vocabulary of angles.

#### Solved Problem #1

1a. True or false: When an angle is in standard position, its initial side is along the positive $y$-axis.

False; When an angle is in standard position, its initial side is along the positive $x$-axis.

1b. Fill in the blank to make a true statement: If the terminal side of an angle in standard position lies on the $x$-axis or the $y$-axis, the angle is called a/an _________ angle.

Such an angle is called a quadrantal angle.

#### Pencil Problem #1

1a. True or false: When an angle is in standard position, its vertex lies in quadrant I.

1b. Fill in the blank to make a true statement: A negative angle is generated by a __________ rotation.

### Objective #2: Use degree measure.

#### Solved Problem #2

2. Fill in the blank to make a true statement: An angle that is formed by $\frac{1}{2}$ of a complete rotation measures ________ degrees and is called a/an _________ angle.

Such an angle measures 180 degrees and is called a straight angle.

#### Pencil Problem #2

2. Fill in the blank to make a true statement: An angle that is formed by $\frac{1}{4}$ of a complete rotation measures ________ degrees and is called a/an _________ angle.

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Objective #3: Use radian measure.

✓ Solved Problem #3

3. A central angle, $\theta$, in a circle of radius 12 feet intercepts an arc of length 42 feet. What is the radian measure of $\theta$?

The radian measure of the central angle, $\theta$, is the length of the intercepted arc, $s$, divided by the radius of the circle, $r$: $\theta = \frac{s}{r}$. In this case, $s = 42$ feet and $r = 12$ feet.

$$\theta = \frac{42 \text{ feet}}{12 \text{ feet}} = 3.5$$

The radian measure of $\theta$ is 3.5.

Pencil Problem #3

3. A central angle, $\theta$, in a circle of radius 10 inches intercepts an arc of length 40 inches. What is the radian measure of $\theta$?

Objective #4: Convert between degrees and radians.

✓ Solved Problem #4

4a. Convert $60^\circ$ to radians.

To convert from degrees to radians, multiply by $\frac{\pi \text{ radians}}{180^\circ}$. Then simplify.

$$60^\circ \cdot \frac{\pi \text{ radians}}{180^\circ} = \frac{60\pi \text{ radians}}{180} = \frac{\pi}{3} \text{ radians}$$

4b. Convert $-300^\circ$ to radians.

$$-300^\circ \cdot \frac{\pi \text{ radians}}{180^\circ} = \frac{-300\pi \text{ radians}}{180} = -\frac{5\pi}{3} \text{ radians}$$

Pencil Problem #4

4a. Convert $135^\circ$ to radians. Express your answer as a multiple of $\pi$.

4b. Convert $-225^\circ$ to radians. Express your answer as a multiple of $\pi$. 

4c. Convert $\frac{\pi}{4}$ radians to degrees.

To convert from radians to degrees, multiply by $\frac{180^\circ}{\pi \text{ radians}}$. Then simplify.

$$\frac{\pi}{4} \text{ radians} \cdot \frac{180^\circ}{\pi \text{ radians}} = \frac{180^\circ}{4} = 45^\circ$$

4d. Convert 6 radians to degrees.

$$6 \text{ radians} \cdot \frac{180^\circ}{\pi \text{ radians}} = \frac{1080^\circ}{\pi} = 343.8^\circ$$

Objective #5: Draw angles in standard position.

Solved Problem #5

5a. Draw the angle $\theta = -\frac{\pi}{4}$ in standard position.

Since the angle is negative, it is obtained by a clockwise rotation. Express the angle as a fractional part of $2\pi$.

$$\left| -\frac{\pi}{4} \right| = \frac{\pi}{4} = \frac{1}{8} \cdot 2\pi$$

The angle $\theta = -\frac{\pi}{4}$ is $\frac{1}{8}$ of a full rotation in the clockwise direction.

Pencil Problem #5

5a. Draw the angle $\theta = -\frac{5\pi}{4}$ in standard position.
5b. Draw the angle $\alpha = \frac{3\pi}{4}$ in standard position.

Since the angle is positive, it is obtained by a counterclockwise rotation. Express the angle as a fractional part of $2\pi$.

$$\frac{3\pi}{4} = \frac{3}{8} \cdot 2\pi$$

The angle $\alpha = \frac{3\pi}{4}$ is $\frac{3}{8}$ of a full rotation in the counterclockwise direction.

5c. Draw the angle $\gamma = \frac{13\pi}{4}$ in standard position.

Since the angle is positive, it is obtained by a counterclockwise rotation. Express the angle as a fractional part of $2\pi$.

$$\frac{13\pi}{4} = \frac{13}{8} \cdot 2\pi$$

The angle $\gamma = \frac{13\pi}{4}$ is $\frac{13}{8}$ or $1 \frac{5}{8}$ full rotation in the counterclockwise direction. Complete one full rotation and then $\frac{5}{8}$ of a full rotation.

5b. Draw the angle $\alpha = \frac{7\pi}{6}$ in standard position.

5c. Draw the angle $\gamma = \frac{16\pi}{3}$ in standard position.
**Objective #6:** Find coterminal angles.

---

**Solved Problem #6**

6a. Find a positive angle less than 360° that is coterminal with a 400° angle.

Since 400° is greater than 360°, we subtract 360°.

\[ 400° - 360° = 40° \]

A 40° angle is positive, less than 360°, and coterminal with a 400° angle.

---

**Pencil Problem #6**

6a. Find a positive angle less than 360° that is coterminal with a 395° angle.

6b. Find a positive angle less than 2π that is coterminal with a \(-\frac{\pi}{15}\) angle.

Since \(-\frac{\pi}{15}\) is negative, we add 2π.

\[ \frac{\pi}{15} + 2\pi = \frac{30\pi}{15} = \frac{29\pi}{15} \]

A \(\frac{29\pi}{15}\) angle is positive, less than 2π, and coterminal with a \(-\frac{\pi}{15}\) angle.
6c. Find a positive angle less than $2\pi$ that is coterminal with a $\frac{17\pi}{3}$ angle.

Since $\frac{17\pi}{3}$ is greater than $4\pi$, we subtract two multiples of $2\pi$.

$$\frac{17\pi}{3} - 2 \cdot 2\pi = \frac{17\pi}{3} - 4\pi = \frac{17\pi}{3} - \frac{12\pi}{3} = \frac{5\pi}{3}$$

A $\frac{5\pi}{3}$ angle is positive, less than $2\pi$, and coterminal with a $\frac{17\pi}{3}$ angle.

---

**Objective #7:** Find the length of a circular arc.

**Solved Problem #7**

7. A circle has a radius of 6 inches. Find the length of the arc intercepted by a central angle of $45^\circ$. Express arc length in terms of $\pi$. Then round your answer to two decimal places.

We begin by converting $45^\circ$ to radians.

$$45^\circ \cdot \frac{\pi \text{ radians}}{180^\circ} = \frac{45\pi}{180} = \frac{\pi}{4} \text{ radians}$$

Now we use the arc length formula $s = r\theta$ with the radius $r = 6$ inches and the angle $\theta = \frac{\pi}{4}$ radians.

$$s = r\theta = (6 \text{ in.}) \left(\frac{\pi}{4}\right) = \frac{6\pi}{4} \text{ in.} = \frac{3\pi}{2} \text{ in.} = 4.71 \text{ in.}$$

---

**Pencil Problem #7**

7. A circle has a radius of 8 feet. Find the length of the arc intercepted by a central angle of $225^\circ$. Express arc length in terms of $\pi$. Then round your answer to two decimal places.
Objective #8: Find the area of a sector.

Solved Problem #8

8. A circle has a radius of 6 feet. Find the area of the sector formed by a central angle of 150°. Express the area in terms of $\pi$. Then round your answers to two decimal places.

To use the formula $A = \frac{1}{2} r^2 \theta$, $\theta$ must be expressed in radians, so we convert 150° to radians.

$150° = 150° \cdot \frac{\pi}{180°} = \frac{150\pi}{180} \text{ radians} = \frac{5\pi}{6} \text{ radians}$

Now we use the formula with $r = 6$ feet and $\theta = \frac{5\pi}{6}$ radians.

$A = \frac{1}{2} r^2 \theta = \frac{1}{2} (6)^2 \left(\frac{5\pi}{6}\right)$

$= 15\pi = 47.12$ square feet

The area of the sector is approximately 47.12 square feet.

Pencil Problem #8

8. A circle has a radius of 10 meters. Find the area of the sector formed by a central angle of 18°. Express the area in terms of $\pi$. Then round your answers to two decimal places.

Objective #9: Use linear and angular speed to describe motion on a circular path.

Solved Problem #9

9. A 45-rpm record has an angular speed of 45 revolutions per minute. Find the linear speed, in inches per minute, at the point where the needle is 1.5 inches from the record’s center.

We are given the angular speed in revolutions per minute: $\omega = 45$ revolutions per minute. We must express $\omega$ in radians per minute.

$\omega = \frac{45 \text{ revolutions}}{1 \text{ minute}} \cdot \frac{2\pi \text{ radians}}{1 \text{ revolution}}$

$= \frac{90\pi \text{ radians}}{1 \text{ minute}}$ or $\frac{90\pi}{1 \text{ minute}}$

Now we use the formula $v = r\omega$.

$v = r\omega = 1.5 \text{ in.} \cdot \frac{90\pi}{1 \text{ min}} = \frac{135\pi \text{ in.}}{\text{min}} = 424 \text{ in./min}$

Pencil Problem #9

9. A Ferris wheel has a radius of 25 feet. The wheel is rotating at two revolutions per minute. Find the linear speed, in feet per minute, of a seat on this Ferris wheel.
Answers for Pencil Problems (Textbook Exercise references in parentheses):

1a. False  
1b. clockwise

2. 90; right

3. 4 radians (1.1 #7)

4a. \(\frac{3\pi}{4}\) radians (1.1 #15)  
4b. \(-\frac{5\pi}{4}\) radians (1.1 #19)  
4c. 90° (1.1 #21)  
4d. 114.59° (1.1 #35)

5a.  
5b.  
5c.  

6a. 35° (1.1 #57)  
6b. \(\frac{99\pi}{50}\) (1.1 #67)  
6c. \(\frac{11\pi}{7}\) (1.1 #69)

7. 10\(\pi\) ft = 31.42 ft (1.1 #73)

8. 5\(\pi\) = 15.71 sq m (1.1 #75)

9. 100\(\pi\) ft/min = 314 ft/min (1.1 #106)
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Section 1.1 Linear Equations

Chapter 1 Equations and Inequalities

1.1 Linear Equations

- Basic Terminology of Equations
- Solving Linear Equations
- Identities, Conditional Equations, and Contradictions
- Solving for a Specified Variable (Literal Equations)

Key Terms: equation, solution or root, solution set, equivalent equations, linear equation in one variable, first-degree equation, identity, conditional equation, contradiction, simple interest, literal equation, future or maturity value

Basic Terminology of Equations

A number that makes an equation a true statement is called a _________________ or _________________ of the equation.

The set of all numbers that satisfy an equation is called the _________________ _________________ of the equation.

Equations with the same solution set are _________________ _________________.

Addition and Multiplication Properties of Equality

Let $a$, $b$, and $c$ represent real numbers.

If $a = b$, then $a + c = b + c$.

That is, the same number may be added to each side of an equation without changing the solution set.

If $a = b$ and $c \neq 0$, then $ac = bc$.

That is, each side of an equation may be multiplied by the same nonzero number without changing the solution set. (Multiplying each side by zero leads to $0 = 0$.)
Solving Linear Equations

Linear Equation in One Variable
A linear equation in one variable is an equation that can be written in the form

\[ ax + b = 0, \]

where \(a\) and \(b\) are real numbers with \(a \neq 0\).

EXAMPLE 1 Solving a Linear Equation
Solve \(3(2x - 4) = 7 - (x + 5)\).

EXAMPLE 2 Solving a Linear Equation with Fractions.
Solve \(\frac{2x + 4}{3} + \frac{1}{2}x = \frac{1}{4}x - \frac{7}{3}\).
identities, conditional equations, and contradictions

example 3 identifying types of equations
determine whether each equation is an identity, a conditional equation, or a contradiction. give the solution set.

(a) \(-2(x + 4) + 3x = x - 8\)

(b) \(5x - 4 = 11\)

(c) \(3(3x - 1) = 9x + 7\)

identifying types of linear equations
1. if solving a linear equation leads to a true statement such as \(0 = 0\), the equation is an \(\underline{\text{identity}}\). its solution set is \(\underline{\text{all real numbers}}\). (see example 3(a).)

2. if solving a linear equation leads to a single solution such as \(x = 3\), the equation is \(\underline{\text{conditional}}\). its solution set consists of \(\underline{\text{a single solution}}\). (see example 3(b).)

3. if solving a linear equation leads to a false statement such as \(-3 = 7\), the equation is a \(\underline{\text{contradiction}}\). its solution set is \(\underline{\text{no solution}}\). (see example 3(c)).
EXAMPLE 4 Solving for a Specified Variable

Solve for the specified variable.

(a) \( I = Prt, \) for \( t \)

(b) \( A - P = Prt, \) for \( P \)

(c) \( 3(2x - 5a) + 4b = 4x - 2, \) for \( x \)

Reflect: How is solving a literal equation for a specified variable similar to solving an equation? How is solving a literal equation for a specified variable different from solving an equation?
EXAMPLE 5 Applying the Simple Interest Formula
Becky Brugman 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?
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Section 1.1 Introduction to Graphing

Plotting Points, \((x, y)\), in a Plane

Each point \((x, y)\) in the plane is described by an ordered pair. The first number, \(x\), indicates the point’s horizontal location with respect to the \(y\)-axis, and the second number, \(y\), indicates the point’s vertical location with respect to the \(x\)-axis. We call \(x\) the first coordinate, the \(x\)-coordinate, or the abscissa. We call \(y\) the second coordinate, the \(y\)-coordinate, or the ordinate.

Example 1 Graph and label the points \((-3, 5)\), \((4, 3)\), \((3, 4)\), \((-4, -2)\), \((3, -4)\), \((0, 4)\), \((-3, 0)\), and \((0, 0)\).

Example 2 Determine whether each ordered pair is a solution of the equation \(2x + 3y = 18\).

a) \((-5, 7)\) \[\begin{align*} 2x + 3y &= 18 \\ 2(-5) + 3(7) &= 18 \\ -10 + 21 &= 18 \\ \text{True / False} \\
(-5, 7) &\text{ is / is not} a solution. \]

b) \((3, 4)\) \[\begin{align*} 2x + 3y &= 18 \\ 2(3) + 3(4) &= 18 \\ 6 + 12 &= 18 \\ \text{True / False} \\
(3, 4) &\text{ is / is not} a solution. \]
**Section 1.1 Introduction to Graphing**

### x- and y-Intercepts

An **x-intercept** is a point \((a, 0)\). To find \(a\), let \(y = 0\) and solve for \(x\).

A **y-intercept** is a point \((0, b)\). To find \(b\), let \(x = 0\) and solve for \(y\).

#### Example 3

Graph: \(2x + 3y = 18\).

Find the **y-intercept**: \((0, \square)\)

Find the **x-intercept**: \((\square, 0)\)

\[
2 \cdot \square + 3y = 18 \\
0 + 3y = 18 \\
3y = 18 \\
y = \square \\
2x + 3 \cdot \square = 18 \\
2x + 0 = 18 \\
2x = 18 \\
x = \square \\
2 \cdot \square + 3y = 18 \\
10 + 3y = 18 \\
3y = \square \\
y = \square \\
\]

Find a third point: \((5, \square)\)

#### Example 4

Graph: \(3x - 5y = -10\).

\[
3y - 5y = -10 \\
-5y = \square - 10 \\
y = \frac{3}{5}x + \square \\
\]

When \(x = -5\), \(y = \frac{3}{5} \cdot \square + 2 = -3 + 2 = \square\).

When \(x = 0\), \(y = \frac{3}{5} \cdot \square + 2 = 0 + 2 = \square\)

When \(x = 5\), \(\frac{3}{5} \cdot \square + 2 = 3 + 2 = \square\)

<table>
<thead>
<tr>
<th>(x)</th>
<th>(y)</th>
<th>((x, y))</th>
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<tbody>
<tr>
<td>-5</td>
<td>-1</td>
<td>((-5, -1))</td>
</tr>
<tr>
<td>0</td>
<td>\square</td>
<td>((0, \square))</td>
</tr>
<tr>
<td>5</td>
<td>5</td>
<td>((5, 5))</td>
</tr>
</tbody>
</table>
Example 5  Graph: \( y = x^2 - 9x - 12. \)

\[
\begin{align*}
x = -3: & \quad y = (\underline{-3})^2 - 9(\underline{-3}) - 12 = 9 + \underline{27} - 12 = 24 \\
x = 2: & \quad y = (\underline{2})^2 - 9(\underline{2}) - 12 = \underline{4} - 18 - 12 = -26
\end{align*}
\]

<table>
<thead>
<tr>
<th>( x )</th>
<th>( y )</th>
<th>( (x, y) )</th>
</tr>
</thead>
<tbody>
<tr>
<td>-3</td>
<td>24</td>
<td>(-3, 24)</td>
</tr>
<tr>
<td>-1</td>
<td>-2</td>
<td>(-1, -2)</td>
</tr>
<tr>
<td>0</td>
<td>-12</td>
<td>(0, -12)</td>
</tr>
<tr>
<td>2</td>
<td>-26</td>
<td>(2, -26)</td>
</tr>
<tr>
<td>4</td>
<td>-32</td>
<td>(4, -32)</td>
</tr>
<tr>
<td>5</td>
<td>-32</td>
<td>(5, -32)</td>
</tr>
<tr>
<td>10</td>
<td>-2</td>
<td>(10, -2)</td>
</tr>
<tr>
<td>12</td>
<td>24</td>
<td>(12, 24)</td>
</tr>
</tbody>
</table>

The Distance Formula

The distance \( d \) between any two points \( (x_1, y_1) \) and \( (x_2, y_2) \) is given by

\[
d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}.
\]

Example 6  Find the distance between each pair of points.

a)  \((-2, 2) \) and \((3, -6)\)

\[
d = \sqrt{(3 - (-2))^2 + (-6 - 2)^2} = \sqrt{5^2 + (-8)^2} = \sqrt{25 + 64} = \sqrt{90} \approx 9.5
\]

b)  \((-1, -5) \) and \((-1, 2)\)

\[
d = \sqrt{0^2 + (2 - (-5))^2} = \sqrt{0^2 + 7^2} = \sqrt{49} = 7
\]

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Example 7  The point \((-2, 5)\) is on a circle that has \((3, -1)\) as its center. Find the length of the radius of the circle.

\[
d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}
\]

\[
d = \sqrt{(-2 - 3)^2 + (5 - (-1))^2}
\]

\[
= \sqrt{(-5)^2 + 6^2}
\]

\[
= \sqrt{25 + 36}
\]

\[
= \sqrt{61} \approx 7.8
\]

The Midpoint Formula

If the endpoints of a segment are \((x_1, y_1)\) and \((x_2, y_2)\), then the coordinates of the midpoint of the segment are

\[
\left( \frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2} \right).
\]

Example 8  Find the midpoint of the segment whose endpoints are \((-4, -2)\) and \((2, 5)\).

\[
\left( \frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2} \right)
\]

\[
= \left( \frac{-4 + 2}{2}, \frac{-2 + 5}{2} \right)
\]

\[
= \left( \frac{-2}{2}, \frac{3}{2} \right)
\]

\[
= \left( -1, \frac{3}{2} \right)
\]

Example 9  The diameter of a circle connects the points \((2, -3)\) and \((6, 4)\) on the circle. Find the coordinates of the center of the circle.

\[
\left( \frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2} \right)
\]

\[
= \left( \frac{2 + 6}{2}, \frac{-3 + 4}{2} \right)
\]

\[
= \left( 4, \frac{1}{2} \right)
\]
The Equation of a Circle

The standard form of the equation of a circle with center \((h, k)\) and radius \(r\) is

\[(x-h)^2 + (y-k)^2 = r^2.\]

**Example 10**  Find an equation of the circle having radius 5 and center \((3, -7)\).

\[(x-h)^2 + (y-k)^2 = r^2\]

\[h = 3 \quad k = \square \quad r = 5\]

\[(x-3)^2 + [y-(\square)]^2 = 5^2\]

\[(x-3)^2 + (y+\square)^2 = \square\]

**Example 11**  Graph the circle \((x+5)^2 + (y-2)^2 = 16\).

\[(x-h)^2 + (y-k)^2 = r^2\]

\((h, k)\) center, \(r\) radius

\[\left[(x-(\square))^2 + (y-2)^2 = \square^2\right]\]

Center: \((-5, \square)\)

Radius: \(\square\)
Section 1.1 – Angles and Degree Measure

Angles

Draw a picture of an example of Ray $\overline{AB}$:

Draw a picture of an example of Angle $\angle CAB$:

Initial Side, Terminal Side, Central Angle, and Intercepted Arc

Angle in Standard Position
Chapter 1 Angles and the Trigonometric Functions

Degree Measure of Angles

Definition – Degree Measure

A degree measure of an angle is

Draw an example of each of the following:

<table>
<thead>
<tr>
<th>Acute Angle</th>
<th>Obtuse Angle</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Straight Angle</th>
<th>Right Angle</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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Negative Angles

Definition – Coterminal Angles

Angles $\alpha$ and $\beta$ in standard position are coterminal if and only if

Example – Find two positive angles and two negative angles that are coterminal with $-50^\circ$.

Solution: $310^\circ, 670^\circ, -410^\circ, -770^\circ$

Definition – Quadrantal Angles

A quadrantal angle is an angle with one of the following measures:
Example – Name the quadrant in which each angle lies.

a. 230°
b. −580°
c. 1380°

Solution: a. Quadrant III; b. Quadrant II; c. Quadrant IV

Minutes and Seconds

Important Concept – Minutes and Seconds

The conversion factors for minutes and seconds are as follows:

- 1 degree = 60 minutes
- 1 minute = 60 seconds
- 1 degree = 3600 seconds

Example – Convert the measure 44°12′30″ to decimal degrees. Round to four places.

Solution: 44.2083°

Example – Convert the measure 44°235′ to degrees-minutes-seconds format.
Example – Perform the indicated operations. Express answers in degree-minutes-seconds format.

a. $13^\circ45'33'' + 9^\circ33'39''$
b. $45^\circ - 6^\circ45'30''$
c. $(21^\circ27'36'') / 2$

Solution:
a. $23^\circ19'12''$
b. $38^\circ14'30''$
c. $10^\circ43'48''$
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1.R.1 Use properties of integer exponents.


STUDY PLAN

Read: Read the assigned section in your worktext or eText.
Practice: Do your assigned exercises in your __ Book __ MyMathLab __ Worksheets
Review: Keep your corrected assignments in an organized notebook and use them to review for the test.

Key Terms

Exercises 1-5: Use the vocabulary terms listed below to complete each statement. Note that some terms or expressions may not be used.

<table>
<thead>
<tr>
<th>exponent</th>
<th>power rule for exponents</th>
<th>base</th>
<th>product rule for exponents</th>
<th>power of a product rule for exponents</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

1. The ________________ states that for any real number base $a$ and natural number exponents $m$ and $n,$ \((a^m)^n = a^{mn}\).

2. A mathematical concept called ________________ is used to indicate repeated multiplication.

3. The ________________ states that for any real number base $a$ and natural number exponents $m$ and $n,$ \(a^m \cdot a^n = a^{m+n}\).

4. The exponential expression $3^4$ has ________________ 3 and ________________ 4.

5. The ________________ states that for any real numbers $a$ and $b$ and natural number exponent $n,$ \((ab)^n = a^n b^n\).
Review of Exponents

Write each exponential expression as repeated multiplication.

1. \((−5)^2\)

2. \(y^5\)

3. \((−6x)^4\)

4. \(−7^3\)

The Product Rule

Multiply.

5. \(x^3 \cdot x^5\)

6. \(y^n \cdot y\)
The Power Rule

Simplify.

11. \((z^3)^4\)

12. \((x^2)^4 \cdot (x^3)^3\)
The Power of a Product Rule

Simplify.

13. \((3b)^4\)  

14. \((x^3y)^2\)  

15. \((6x^5y^3)^2\)  

16. \((-3a^3b^4)^3\)  

17. \((3st^2)^3(4s^4t)^2\)
Key Terms

Exercises 1-7: Use the vocabulary terms listed below to complete each statement. 
Note that some terms or expressions may not be used.

<table>
<thead>
<tr>
<th>Base</th>
<th>Negative Integer Exponents</th>
</tr>
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<tbody>
<tr>
<td>undefined</td>
<td>quotient rule for exponents</td>
</tr>
<tr>
<td>exponent</td>
<td>zero power rule</td>
</tr>
<tr>
<td>reciprocal</td>
<td></td>
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</tbody>
</table>

1. The rule for ________________ states that \( a^{-n} = \frac{1}{a^n} \).

2. The exponential expression \( 2^{-5} \) has ________________ 2 and ________________ \(-5\).

3. The ________________ states that for any nonzero real number base \( a \), \( a^0 = 1 \).

4. The expression \( 0^0 \) is ________________.

5. The ________________ states that for any nonzero real number base \( a \) and integer exponents \( m \) and \( n \), \( \frac{a^m}{a^n} = a^{m-n} \).

6. \( a^{-n} \) is the ________________ of \( a^n \).

The Quotient Rule

Divide. Assume that all variables represent nonzero numbers.

1. \( \frac{5^0}{5^6} \) 

2. \( \frac{y^7}{y^3} \)

3. \( \frac{28x^6}{7x} \)
The Zero Power Rule

_Simplify each expression. Assume that all variables represent nonzero numbers._

4. $9^0$  
   4. ______________

5. $(-4)^0$  
   5. ______________

6. $-5^0$  
   6. ______________

7. $7x^0$  
   7. ______________

Negative Exponents

_Simplify each expression using the definition of negative integer exponents. Assume that all variables represent nonzero numbers._

8. $3^{-4}$  
   8. ______________

9. $x^{-1}$  
   9. ______________

10. $2y^{-6}$  
   10. ______________