ACCUPLACER®

Sample Questions Workbook

COMMUNITY COLLEGE of AURORA

Elementary Algebra • Arithmetic • College Level Mathematics • Sentence Skills • Reading Comprehension

Testing Center Hours and Locations

Testing Hours	***CentreTech Testing Center**** Administration Building Rm. 205	***Lowry Student Services Testing*** West Quad Rm. 119
	Testing must begin 2 hours before closing.	Testing must begin 2 hours before closing.
Mondays	9:00 a.m. - 5:00 p.m.	8:30 a.m. - 5:30 p.m.
Tuesdays	9:00 a.m. - 5:00 p.m.	8:30 a.m. - 5:30 p.m.
Wednesdays	9:00 a.m. - 7:00 p.m.	8:30 a.m. - 5:30 p.m.
Thursdays	9:00 a.m. - 5:00 p.m.*	8:30 a.m. - 5:30 p.m.
Fridays	9:00 a.m. - 5:00 p.m.	8:30 a.m. - 5:00 p.m.
Saturdays	9:00 a.m. - 1:00 p.m.**	Closed
If your test is not completed by closing time, you will have to return to finish.		

*The CentreTech Testing Center will remain open until 7:00 p.m. on Wednesdays and Thursdays during peak registration times between approximately July 15th and August 31st.
** The testing center is only open the second Saturday of the month from approximately February 1 through July 15 and September 1 through December 15. It is open every Saturday all other times.

For other CCA office hours visit: www.ccaurora.edu/hours

Study Resources

Resource Name and Website* (if available) * Please note that the CCA testing center has put together these resources for you as a courtesy. Because websites change frequently, some of these links may not work, and some of the tests may not function. We encourage you to alert us in this case, however, we do not accept responsibility for the functionality of the following resources.	***Sample Questions***		
	Essay	Math	Reading Comprehension
Community College of Aurora www.ccaurora.edu/students/academic-support/testing/assessment-testing	X	X	X
MATHNERDS www.mathnerds.com/best/best.aspx		X	
Algebra.help www.algebrahelp.com		X	
CollegeBoard SAT Practice http://sat.collegeboard.org/practice/sat-practice-test	X		X
majortests.com www.majortests.com/sat/reading-comprehension.php			X
Townsend Press www.townsendpress.net/class/exercises/assignment/22/menu			X
KhanAcademy www.khanacademy.org	X	X	X
***EdReady:** To create a student account sign into:* cccs.edready.org site using a personal email address. Use the code CCA-CCPT-Prep		X	

Reading Comprehension

In an ACCUPLACER placement test, there are 20 questions of two primary types in Reading Comprehension.

- The first type of question consists of a reading passage followed by a question based on the text. Both short and long passages are provided. The reading passages can also be classified according to the kind of information processing required, including explicit statements related to the main idea, explicit statements related to a secondary idea, application, and inference.
- The second type of question, sentence relationships, presents two sentences followed by a question about the relationship between these two sentences. The question may ask, for example, if the statement in the second sentence supports that in the first, if it contradicts it, or if it repeats the same information.

Reading Comprehension Sample Questions

Read the statement or passage and then choose the best answer to the question. Answer the question based on what is stated or implied in the statement or passage.

1. In the words of Thomas DeQuincey, "It is notorious that the memory strengthens as you lay burdens upon it." If, like most people, you have trouble recalling the names of those you have just met, try this: The next time you are introduced, plan to remember the names. Say to yourself, "I'll listen carefully; I'll repeat each person's name to be sure I've got it, and I will remember." You'll discover how effective this technique is and probably recall those names for the rest of your life.

   The main idea of the paragraph maintains that the memory
   A. always operates at peak efficiency.
   B. breaks down under great strain.
   C. improves if it is used often.
   D. becomes unreliable if it tires.

2. Unemployment was the overriding fact of life when Franklin D. Roosevelt became president of the United States on March 4, 1933. An anomaly of the time was that the government did not systematically collect statistics of joblessness; actually it did not start doing so until 1940. The Bureau of Labor Statistics later estimated that 12,830,000 persons were out of work in 1933, about one-fourth of a civilian labor force of more than 51 million.

   Roosevelt signed the Federal Emergency Relief Act on May 12, 1933. The president selected Harry L. Hopkins, who headed the New York relief program, to run FERA. A gifted administrator, Hopkins quickly put the program into high gear. He gathered a small staff in Washington and brought the state relief organizations into the FERA system. While the agency tried to provide all the necessities, food came first. City dwellers usually got an allowance for fuel, and rent for one month was provided in case of eviction.

   This passage is primarily about
   A. unemployment in the 1930s.
   B. the effect of unemployment on United States families.
   C. President Franklin D. Roosevelt's presidency.
   D. President Roosevelt's FERA program.

3. It is said that a smile is universally understood. And nothing triggers a smile more universally than a taste of sugar. Nearly everyone loves sugar. Infant studies indicate that humans are born with an innate love of sweets. Based on statistics, a lot of people in Great Britain must be smiling because on average, every man, woman, and child in that country consumes 95 pounds of sugar each year.

   From this passage it seems safe to conclude that the English
   A. do not know that too much sugar is unhealthy.
   B. eat desserts at every meal.
   C. are fonder of sweets than most people.
   D. have more cavities than any other people.

4. With varying success, many women around the world today struggle for equal rights. Historically, women have achieved greater equality with men during periods of social adversity. The following factors initiated the greatest number of improvements for women: violent revolution, world war, and the rigors of pioneering in an undeveloped land. In all three cases, the essential element that improved the status of women was a shortage of men, which required women to perform many of society's vital tasks.

   We can conclude from the information in this passage that

   A. women today are highly successful in winning equal rights.
   B. only pioneer women have been considered equal to men.
   C. historically, women have only achieved equality through force.
   D. historically, the principle of equality alone has not been enough to secure women equal rights.

5. In 1848, Charles Burton of New York City made the first baby carriage, but people strongly objected to the vehicles because they said the carriage operators hit too many pedestrians. Still convinced that he had a good idea, Burton opened a factory in England. He obtained orders for the baby carriages from Queen Isabella II of Spain, Queen Victoria of England, and the Pasha of Egypt. The United States had to wait another 10 years before it got a carriage factory, and only 75 carriages were sold in the first year.

   Even after the success of baby carriages in England,

   A. Charles Burton was a poor man.
   B. Americans were still reluctant to buy baby carriages.
   C. Americans purchased thousands of baby carriages.
   D. the United States bought more carriages than any other country.

6. All water molecules form six-sided structures as they freeze and become snow crystals. The shape of the crystal is determined by temperature, vapor, and wind conditions in the upper atmosphere. Snow crystals are always symmetrical because these conditions affect all six sides simultaneously.

   The purpose of the passage is to present

   A. a personal observation.
   B. a solution to a problem.
   C. actual information.
   D. opposing scientific theories.

7. In the words of Thomas DeQuincey, "It is notorious that the memory strengthens as you lay burdens upon it." If, like most people, you have trouble recalling the names of those you have just met, try this: The next time you are introduced, plan to remember the names. Say to yourself, "I'll listen carefully; I'll repeat each person's name to be sure I have it, and I will remember." You'll discover how effective this technique is and probably recall those names for the rest of your life.

   The writer believes people remember names best when they

   A. meet new people
   B. are intelligent
   C. decide to do so
   D. are interested in people

8. Many people have owned, or have heard of, traditional "piggy banks," coin banks shaped like pigs. A logical theory about how this tradition started might be that because pigs often symbolize greed, the object is to "fatten" one's piggy bank with as much money as possible.

   However, while this idea makes sense, it is not the correct origin of the term. The genesis of the piggy bank is the old English word "pygg", which was a common kind of clay hundreds of years ago in England. People used pots and jars made out of this red "pygg" clay for many different purposes in their homes. Sometimes they kept their money in one of the pots, and this was known as a pygg bank.

   Over the years, because "pygg" and "pig" sounded the same, glaziers began making novelty banks out of pottery in the shape of a pig as a kind of joke. These banks were given as gifts and exported to countries where people spoke other languages and where no one had ever heard of pygg clay. The tradition caught on all over the world, and today piggy banks come in all colors and are made of all kinds of materials, including plastic.

This passage is mainly about
- A. how people in different countries save their money
- B. how people in England made pottery centuries ago
- C. how a common expression began in a surprising way
- D. how an unusual custom got started

9. It is said that a smile is universally understood. And nothing triggers a smile more universally than the taste of sugar. Nearly everyone loves sugar. Infant studies indicate that humans are born with an innate love of sweets. Based on statistics, a lot of people in Great Britain must be smiling because on average, every man, woman and child in that country consumes 95 pounds of sugar each year.

   This passage implies that the writer thinks that 95 pounds of sugar per person per year is
   - A. a surprisingly large amount
   - B. a surprisingly small amount
   - C. about what one would expect
   - D. an unhealthy amount

10. The wheel has been used by humans since nearly the beginning of civilization and is considered one of the most important mechanical inventions of all time. Most primitive technologies since the invention of the wheel have been based on its principles, and since the industrial revolution, the wheel has been a basic element of nearly every machine constructed by humankind. No one knows the exact time and place of the invention of the wheel, but its beginnings can be seen across many ancient civilizations.

    According to this passage, the wheel is an important invention because
    - A. it is one of the world's oldest inventions
    - B. it forms the basis of so many later inventions
    - D. it is an invention that can be traced to many cultures
    - D. it is one the world's most famous inventions

11. Samuel Morse, best known today as the inventor of Morse Code and one of the inventors of the telegraph, was originally a prominent painter. While he was always interested in technology and studied electrical engineering in college, Morse went to Paris to learn from famous artists of his day and later painted many pictures that now hang in museums, including a portrait of former President John Adams. In 1825, Morse was in Washington, D.C., painting a portrait of the Marquis de Lafayette when a messenger arrived on horseback to tell him that his wife was gravely ill back at his home in Connecticut. The message had taken several days to reach him because of the distance. Morse rushed to his home as fast as he could, but his wife had already passed away by the time he arrived. Grief-stricken, he gave up painting and devoted the rest of his life to finding ways to transmit messages over long distances faster.

    Morse left the art world and helped to invent the telegraph
    - A. because he was tired of painting
    - B. because he wanted to communicate with people far away
    - C. because of a personal tragedy in his life
    - D. because he was fascinated by science

12. Leonardo DaVinci is not only one of the most famous artists in history, he was also a botanist, a writer and an inventor. Even though most of his inventions were not actually built in his lifetime, many of today's modern machines can be traced back to some of his original designs. The parachute, the military tank, the bicycle and even the airplane were foretold in the imaginative drawings that can still be seen in the fragments of Leonardo's notebooks. Over 500 years ago, this man conceived ideas that were far ahead of his time.

    The author of this passage is praising Leonardo DaVinci for his:
    - A. artistic talent
    - B. intelligence
    - C. vision
    - D. fame

Directions for questions 13–22

For the questions that follow, two underlined sentences are followed by a question or statement. Read the sentences, then choose the best answer to the question or the best completion of the statement.

13. The Midwest is experiencing its worst drought in 15 years.

    Corn and soybean prices are expected to be very high this year.

    What does the second sentence do?
    A. It restates the idea found in the first.
    B. It states an effect.
    C. It gives an example.
    D. It analyzes the statement made in the first.

14. Social studies classes focus on the complexity of our social environment.

    The subject combines the study of history and the social sciences and promotes skills in citizenship.

    What does the second sentence do?
    A. It expands on the first sentence.
    B. It makes a contrast.
    C. It proposes a solution.
    D. It states an effect.

15. Knowledge of another language fosters greater awareness of cultural diversity among the peoples of the world.

    Individuals who have foreign language skills can appreciate more readily other peoples' values and ways of life.

    How are the two sentences related?
    A. They contradict each other.
    B. They present problems and solutions.
    C. They establish a contrast.
    D. They repeat the same idea.

16. Serving on a jury is an important obligation of citizenship.

    Many companies allow their employees paid leaves of absence to serve on juries.

    What does the second sentence do?
    A. It reinforces what is stated in the first.
    B. It explains what is stated in the first.
    C. It expands on the first.
    D. It draws a conclusion about what is stated in the first.

17. While most people think of dogs as pets, some dogs are bred and trained specifically for certain types of work.

    The bloodhound's acute sense of smell and willing personality make it ideal for tracking people missing in the woods.

    What does the second sentence do?
    A. It makes a contrast.
    B. It restates an idea found in the first.
    C. It states an effect.
    D. It gives an example.

18. Paris, France, is a city that has always been known as a center of artistic and cultural expression.

    In the 1920s, Paris was home to many artists and writers from around the world who became famous, such as Picasso and Hemingway.

    What does the second sentence do?
    A. It reinforces the first.
    B. It states an effect.
    C. It draws a conclusion.
    D. It provides a contrast.

19. Studies show that the prevalence of fast-food restaurants corresponds with the rates of obesity in both children and adults.

    Obesity is now on the rise in countries outside the U.S., where fast food restaurants are becoming more common.

    How do the two sentences relate?
    A. They express roughly the same idea.
    B. They contradict each other.
    C. They present problems and solutions.
    D. They establish a contrast.

20. Compared with the rest of the country, North Dakota has a thriving economy, making it a place where more people want to live.

Winters in North Dakota are inhospitable, with average temperatures in January ranging from 2 degrees Fahrenheit to 17 degrees.

What does the second sentence do?

A. It reinforces the first.
B. It explains what is stated in the first.
C. It contradicts the first.
D. It analyzes a statement made in the first.

21. Some stores are testing a new checkout system that allows shoppers to use their mobile phones to scan items as they walk through stores and pay at self-service kiosks, skipping the cashiers' lines.

The new mobile checkout system is intended to reduce long lines and customer wait times in stores.

What does the second sentence do?

A. It expands on the first.
B. It states an effect.
C. It contrasts with the first.
D. It gives an example.

22. According to the American Sleep Disorders Association, the average teenager needs around 9.5 hours of sleep per night, possibly because critical growth hormones are released during sleep.

The average adult requires between six and eight hours of sleep per night for optimal health and productivity.

How do the two sentences relate?

A. They establish a contrast.
B. They contradict each other.
C. They reinforce each other.
D. They provide a problem and solution.

Sentence Skills

In an ACCUPLACER® placement test, there are 20 Sentence Skills questions of two types.

- The first type is sentence correction questions that require an understanding of sentence structure. These questions ask you to choose the most appropriate word or phrase for the underlined portion of the sentence.
- The second type is construction shift questions. These questions ask that a sentence be rewritten according to the criteria shown while maintaining essentially the same meaning as the original sentence.

Within these two primary categories, the questions are also classified according to the skills being tested. Some questions deal with the logic of the sentence, others with whether or not the answer is a complete sentence, and still others with the relationship between coordination and subordination.

Sentence Skills Sample Questions

Directions for questions 1–12

Select the best version of the underlined part of the sentence. Make sure you are only replacing the underlined portion with the choices given. The first choice is the same as the original sentence. If you think the original sentence is best, choose the first answer.

1. Stamp collecting being a hobby that is sometimes used in the schools to teach economics and social studies.

   A. being a hobby that is
   B. is a hobby because it is
   C. which is a hobby
   D. is a hobby

2. Knocked sideways, the statue looked as if it would fall.

   A. Knocked sideways, the statue looked
   B. The statue was knocked sideways, looked
   C. The statue looked knocked sideways
   D. The statue, looking knocked sideways,

3. To walk, biking, and driving are Pat's favorite ways of getting around.

   A. To walk, biking, and driving
   B. Walking, biking, and driving
   C. To walk, biking, and to drive
   D. To walk, to bike, and also driving

4. When you cross the street in the middle of the block, this is an example of jaywalking.

   A. When you cross the street in the middle of the block, this
   B. You cross the street in the middle of the block, this
   C. Crossing the street in the middle of the block
   D. The fact that you cross the street in the middle of the block

5. Walking by the corner the other day, a child, I noticed, was watching for the light to change.

   A. a child, I noticed, was watching
   B. I noticed a child watching
   C. a child was watching, I noticed,
   D. there was, I noticed, a child watching

6. Going back to his old school, everything there looked smaller than Don remembered.

   A. Going back to his old school,
   B. When he went back to his old school,
   C. To go back to his old school,
   D. As he went back to his old school,

7. Painting, drawing and to sculpt are some of the techniques artists such as Picasso used to express themselves.

   A. Painting, drawing and to sculpt
   B. To paint, to draw, and sculpting
   C. Painting, drawing and sculpting
   D. To paint, draw, and sculpting

8. Playing sports in school <u>which is an activity</u> meant to teach teamwork and leadership skills students can use later in life.

A. which is an activity
B. is an activity because it is
C. being an activity which is
D. is an activity

9. <u>Glancing at his watch</u>, Daniel picked up his speed.

A. Glancing at his watch
B. He glanced at his watch and
C. To glance at his watch
D. Since he glanced at his watch

10. <u>For a snake, shedding their skin</u> up to eight times a year is part of a natural process.

A. For a snake, shedding their skin
B. A snake's shedding its skin
C. When a snake sheds its skin
D. To shed its skin, for snakes

11. <u>To appear white or colorless</u>, light is actually composed of an entire spectrum of colors.

A. To appear white or colorless,
B. In appearing white or colorless,
C. As it appears white or colorless,
D. While it appears white or colorless,

12. <u>I was surprised by the noise peering</u> through the window to see who was at the door.

A. I was surprised by the noise peering
B. I was surprised by the noise, peered
C. The noise surprised me, peering
D. Surprised by the noise, I peered

Directions for questions 13–25

Rewrite the sentence in your head following the directions given below. Keep in mind that your new sentence should be well written and should have essentially the same meaning as the original sentence.

13. It is easy to carry solid objects without spilling them, but the same cannot be said of liquids.

Rewrite, beginning with
<u>Unlike liquids,</u>

The next words will be:
A. it is easy to
B. we can easily
C. solid objects can easily be
D. solid objects are easy to be

14. Although the sandpiper is easily frightened by noise and light, it will bravely resist any force that threatens its nest.

Rewrite, beginning with
<u>The sandpiper is easily frightened by noise and light,</u>

The next words will be:
A. but it will bravely resist
B. nevertheless bravely resisting
C. and it will bravely resist
D. even if bravely resisting

15. If he had enough strength, Todd would move the boulder.

Rewrite, beginning with
<u>Todd cannot move the boulder</u>

The next words will be:
A. when lacking
B. because he
C. although there
D. without enough

16. The band began to play, and then the real party started.

Rewrite, beginning with
<u>The real party started</u>

The next words will be:
A. after the band began
B. and the band began
C. although the band began
D. the band beginning

17. Chris heard no unusual noises when he listened in the park.

Rewrite, beginning with
<u>Listening in the park,</u>

The next words will be
A. no unusual noises could be heard
B. then Chris heard no unusual noises
C. and hearing no unusual noises
D. Chris heard no unusual noises

18. It is unusual to see owls during the daytime, since they are nocturnal animals.

    Rewrite, beginning with
    Being nocturnal animals,

    The next words will be:
    A. it is unusual to see owls
    B. owls are not usually seen
    C. owls during the daytime are
    D. it is during the daytime that

19. While bear attacks on humans are extremely rare, most occur when a mother bear's cubs are approached.

    Rewrite, beginning with
    Bear attacks on humans are extremely rare,

    The next words will be:
    A. but approaching a mother bear's cubs
    B. and approaching a mother bear's cubs
    C. even though approaching a mother bear's cubs
    D. nevertheless approaching a mother bear's cubs

20. If I want your opinion, I will ask for it.

    Rewrite, beginning with
    I won't ask for your opinion

    The next words will be
    A. if I want it
    B. when I want it
    C. although I want it
    D. unless I want it

21. It began to rain, and everyone at the picnic ran to the trees to take shelter.

    Rewrite, beginning with
    Everyone at the picnic ran to take shelter

    The next words will be:
    A. beginning to rain
    B. when it began to rain
    C. although it began to rain
    D. and it began to rain

22. Lucy saw an amazing sight when she witnessed her first sunrise.

    Rewrite, beginning with
    Witnessing her first sunrise,

    The next words will be:
    A. an amazing sight was seen
    B. when Lucy saw an amazing sight
    C. Lucy saw an amazing sight
    D. seeing an amazing sight

23. After three hours of walking the museum, the entire family felt in need of a rest.

    Rewrite, beginning with
    The entire family felt in need of a rest

    The next words will be:
    A. walking through the museum for three hours
    B. having walked through the museum for three hours.
    C. and they walked through the museum for three hours
    D. despite having walked through the museum for three hours.

24. Bats see extremely well in the dark; in fact, much better than humans.

    Rewrite, beginning with
    Unlike bats,

    The next words will be:
    A. humans can see
    B. humans do not see
    C. it is not easy to see
    D. seeing is difficult

25. The big celebration meal was over, and everyone began to feel sleepy.

    Rewrite, beginning with
    Everyone began to feel sleepy

    The next words will be:
    A. and the big celebration meal
    B. before the big celebration meal
    C. after the big celebration meal
    D. although the big celebration meal

Sentence Skills	
Question Number	***Correct Answer***
1	D
2	A
3	B
4	C
5	B
6	B
7	C
8	D
9	A
10	B
11	D
12	D
13	C
14	A
15	B
16	A
17	D
18	B
19	A
20	D
21	B
22	C
23	B
24	B
25	C

Reading Comprehension	
Question Number	***Correct Answer***
1	C
2	D
3	C
4	D
5	B
6	C
7	C
8	C
9	A
10	B
11	C
12	C
13	B
14	A
15	D
16	A
17	D
18	A
19	A
20	C
21	B
22	A

Some Basic Facts

This section will cover the following topics:

- Order of Operations
- Notation

Order of Operations

<table>
<tr><th colspan="2">PEMDAS</th><th>Description</th></tr>
<tr><td>1</td><td>P = Parentheses</td><td>In this case, the term parentheses will include anything that would be considered a grouping symbol such as [ ], which are called square brackets.

Also included in this list is the fraction line. For example, in the fraction $\frac{5+3}{2+7}$ first focus on the numerator and denominator separately to get $\frac{5+3}{2+7} = \frac{8}{9}$</td></tr>
<tr><td>2</td><td>E = Exponents</td><td>Exponents are a shortcut for multiplication. 2^4 means multiply 2 by itself 4 times.</td></tr>
<tr><td>3</td><td rowspan="2">M = Multiplication
and
D = Division</td><td rowspan="2">Multiplication and Division are considered the same in the order of operations. It is important to note, however, that they should be done left to right.

<table><tr><td>Example 1</td></tr><tr><td>$10 \div 2 \times 3 = 5 \times 3 = 15$</td></tr><tr><td>Example 2</td></tr><tr><td>$6 \times 3 \div 2 = 18 \div 2 = 9$</td></tr></table></td></tr>
<tr><td>4</td></tr>
<tr><td>5</td><td rowspan="2">A = Addition
and
S = Subtraction</td><td rowspan="2">As with multiplication and division, Addition and Subtraction are considered the same. They are also approached left to right.

<table><tr><td>Example 1</td></tr><tr><td>$10 - 2 + 3 = 8 + 3 = 11$</td></tr><tr><td>Example 2</td></tr><tr><td>$6 + 3 - 2 = 9 - 2 = 7$</td></tr></table></td></tr>
<tr><td>6</td></tr>
</table>

A Quick Tip

Even if you have not done math for a long time you are likely to remember a considerable amount. Taking just a few minutes reviewing notation can help you avoid missing problems you already know.

Notation

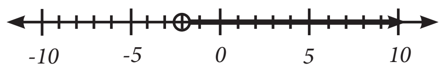
Math is a language of its own. It has vocabulary and punctuation (notation) just like any other language. To help you get ready for the placement exam, here is a list of some important notations to know.

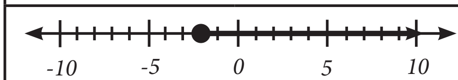
<table>
<tr><th>Notation</th><th>Description</th></tr>
<tr><td>Multiplication</td><td>Multiplication can be expressed by the symbols:
×, •, ∗, or ( )

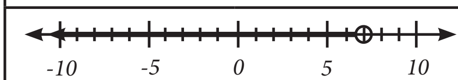
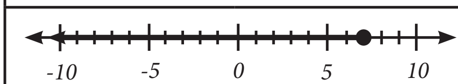
Examples:<table><tr><td>×</td><td>$5 \times 2 = 10$</td></tr><tr><td>•</td><td>$5 \cdot 2 = 10$</td></tr><tr><td>∗</td><td>$5 * 2 = 10$</td></tr><tr><td>( )</td><td>$5(2) = 10$</td></tr></table></td></tr>
<tr><td>Division</td><td>Division can be expressed by the symbols:
÷, /, –, or $\overline{)}$

Examples:<table><tr><td>÷</td><td>$10 \div 2 = 5$</td></tr><tr><td>/</td><td>$10 / 2 = 5$</td></tr><tr><td>$\frac{a}{b}$</td><td>$\frac{10}{2} = 5$</td></tr><tr><td>$\overline{)}$</td><td>$\begin{array}{r} 5 \\ 2\overline{)10} \\ -10 \\ \hline 0 \end{array}$</td></tr></table></td></tr>
<tr><td>Exponents</td><td>Exponents are a shortcut for multiplication. For example, 3^4 is a shortcut way of saying, “multiply 3 by itself 4 times.”

In other words:
$3^4 = 3 \times 3 \times 3 \times 3 = 81$</td></tr>
</table>

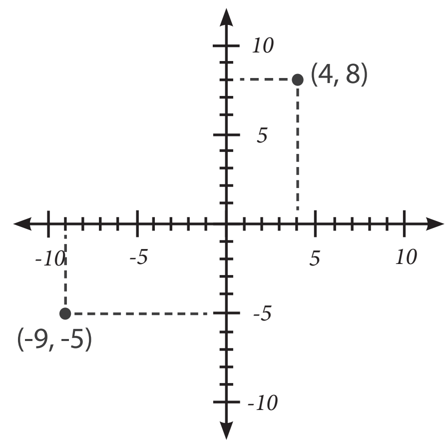
<table>
<tr><th>Notation</th><th>Description</th></tr>
<tr><td>Inequalities and Interval Notation</td><td>
Greater than:
<table>
<tr><td>Inequality</td><td>Interval Notation</td></tr>
<tr><td>$x > -2$</td><td>$(-2, \infty)$</td></tr>
<tr><td colspan="2">Number Line</td></tr>
<tr><td colspan="2">
</td></tr>
</table>
Note: the ">" in $x > -2$, the "(" in $(-2,\infty)$, and the hollow "○" mean include every number bigger than -2 but not -2 itself. For example, driving strictly faster than the speed limit may get you a ticket, but driving at the speed limit will not.

Greater than or Equal to:
<table>
<tr><td>Inequality</td><td>Interval Notation</td></tr>
<tr><td>$x \geq -2$</td><td>$[-2, \infty)$</td></tr>
<tr><td colspan="2">Number Line</td></tr>
<tr><td colspan="2">
</td></tr>
</table>
Note: the "≥" in $x \geq -2$, the "[" in $[-2,\infty)$, and the solid "●" mean include every number bigger than -2 AND -2 itself. The standard legal age for getting a driver's license is 16 or older. The age of 16 is included.

Less than:
<table>
<tr><td>Inequality</td><td>Interval Notation</td></tr>
<tr><td>$x < 7$</td><td>$(-\infty, 7)$</td></tr>
<tr><td colspan="2">Number Line</td></tr>
<tr><td colspan="2">
</td></tr>
</table>
Less than or Equal to:
<table>
<tr><td>Inequality</td><td>Interval Notation</td></tr>
<tr><td>$x \leq 7$</td><td>$(-\infty, 7]$</td></tr>
<tr><td colspan="2">Number Line</td></tr>
<tr><td colspan="2">
</td></tr>
</table>
</td></tr>
</table>

<table>
<tr><th>Notation</th><th>Description</th></tr>
<tr><td>Graphing Points in a Plane</td><td>
Points are written in the form of (x,y), which is called an "ordered pair."

The x represents the left-right distance from the center of the plane, while the y represents the up-down distance from the center.



</td></tr>
<tr><td>Square Roots</td><td>
The square root symbol is $\sqrt{}$.
It means the number that, when multiplied by itself, results in the value inside the root.

For example:
$\sqrt{4} = 2$ because $2 \times 2 = 4$

Common Roots:
<table>
<tr><td>$\sqrt{1} = 1$</td><td>$\sqrt{4} = 2$</td><td>$\sqrt{9} = 3$</td><td>$\sqrt{16} = 4$</td></tr>
<tr><td>$\sqrt{25} = 5$</td><td>$\sqrt{36} = 6$</td><td>$\sqrt{49} = 7$</td><td>$\sqrt{64} = 8$</td></tr>
<tr><td>$\sqrt{81} = 9$</td><td>$\sqrt{100} = 10$</td><td>$\sqrt{121} = 11$</td><td>$\sqrt{144} = 12$</td></tr>
</table>
</td></tr>
</table>

HE LP

Additional Help

CCA has a video on the Order of Operations at the following link: www.ccaurora.edu/mathprep
You can also search YouTube.com for "order of operations."

Basic Facts Practice Problems

1.) $3 + 4 \bullet 5 - 6$

2.) $3^2 + 4 * 5 - 6 \div 2$

3.) $3^2 + 4 * (6 - 2) - 5$

4.) $\dfrac{3 + 5 * 2}{4 * 6 - 9}$

Substitution

This section will cover the following topics:

- Definition of Expression and Equation
- Evaluating an Expression Using Substitution
- Checking the Solution to an Equation Using Substitution

Definition of Expression and Equation

Both expressions and equations combine numbers, variables (such as x and y), and arithmetic operations (such as $+$, $-$, $\times$, and $\div$). The difference between expressions and equations is equations have an equals sign and expressions do not. Below are some examples of each kind.

Expressions	Equations
$2x$	$2x = 6$
$2x + 3y$	$2x + 3y = 7$
$3xy^2 + 2x$	$3xy^2 + 2x = 5$

Evaluating an Expression Using Substitution

The word "evaluate" means to find the numerical value of an expression and it requires that you know the value of all variables. For example, the expression $2x$ cannot be evaluated unless we know what number x is equal to. Let's say, for example, that we did know $x=3$. We could then use substitution to find the value of $2x$ by simply replacing every x with 3. That is, $2x = 2(3)$ or $2x = 6$.

More Examples:

Example 1	
Expression	$2x + 3y$
Value of the Variables	$x = -1,\ y = 3$
Substitution and Evaluation	$2(-1) + 3(3) =$ $-2 + 9 = 7$

Example 2	
Expression	$3xy^2 + 2x$
Value of the Variables	$x = 1,\ y = 3$
Substitution and Evaluation	$3(1)(3)^2 + 2(1) =$ $27 + 2 = 29$

A Quick Tip

Substitution is a very useful tool when taking a placement exam. You can expect to see a few of these on the exam, and with just a bit of practice you can increase your placement score.

Checking the Solution to an Equation Using Substitution

The idea of using substitution with equations is the same as using substitution on expressions with one exception; both sides of the equation must be equal (the same number). For example, if we have the equation $2x = 6$ and we substitute $x = 3$, then get $2(3) = 6$ or $6 = 6$. This is a true statement; 6 does equal 6. We would say that the solution $x = 3$ "checks."
But let's say we instead have the equation $2x = 6$ and we substitute $x = 4$. We get $2(4) = 6$ or $8 = 6$. This is a false statement; 8 does not equal 6, and we say that the solution $x = 4$ "does not check."

More Examples:

Example 1	
Equation	$2x + 3y = 7$
Value of the Variables	$x = -1,\ y = 3$
Substitution and Evaluation	$2(-1) + 3(3) = 7$ $-2 + 9 = 7$ $7 = 7$ *The solution checks*

Example 2	
Equation	$3xy^2 + 2x = 5$
Value of the Variables	$x = 1,\ y = 3$
Substitution and Evaluation	$3(1)(3)^2 + 2(1) = 5$ $27 + 2 = 29$ $29 = 5$ *The solution does not check*

Substitution Practice Problems

Evaluate the following expressions or check the equation using substitution.

1.) $a + 2b - 3c$
$a = 1,\ b = -2,\ c = 3$

2.) $3xy^2z^3$
$x = \frac{1}{2},\ y = 3,\ z = 2$

3.) $x^2 - 2x + 7$
$x = -4$

4.) $3x + 1 = 4$
$x = 1$

5.) $3x - 2 = 4x^2$
$x = -2$

6.) $x^2 + 3x - 1 = -3$
$x = -1$

A Quick Tip

If you get an equation to solve on the placement exam, either solve it directly or check each possible answer using substitution as an alternative strategy. Choose the strategy that gives you the best chance to succeed!

Additional Help

CCA has a video on substitution at the following link:
www.ccaurora.edu/mathprep
You can also search YouTube.com for "substitute values into expressions."

Solving Linear Equations

This section will cover the following topics:

- What is a Linear Equation?
- Solving One-Step Linear Equations
- Solving Two-Step Linear Equations
- Solving Linear Equations That Include Parentheses

What is a Linear Equation?

A linear equation is an equation in which the variable (or variables) have an exponent of 1, and in which the variables to do not appear in the denominator. Here are some examples of equations that are both linear and non-linear.

Equation	Linear (Yes or No?)
$x + 7 = 5$	Yes: The x does not appear to have an exponent, but in fact there is an implied exponent of 1. That is, when we write x, we mean x^1.
$5x + 7y = 10$	Yes: Even though there are multiple variables, they each have an implied exponent of 1.
$x^2 + 7 = 5$	No: In this case, the exponent of the x is 2. Thus, the equation is not a linear equation.
$\frac{1}{x} + 7x = 5$	No: Although the x variable has no visible exponent, it is in the denominator of the first term. Thus, the equation is not a linear.

Solving One-Step Linear Equations

A key thing to keep in mind is that solving an equation means to isolate the variable on one side of the equals sign. That is, the end result should look like, "$x =$ ___".
A One-Step Linear Equation is a linear equation that is a single operation away from being solved; either through addition, subtraction, multiplication, or division.

Example 1:

$x + 7 = 5$	In this example, the only step that needs to be done is to eliminate the +7 from the left hand side of the equation. This is done by the "– 7". Remember that what is done to one side of the equation must be done to both.
$x + 7 - 7 = 5 - 7$	
$x = -2$	

Example 2:

$2x = 10$	In this example, the only step that needs to be done is to eliminate the 2 in front of the x. This is done by dividing both sides of the equation by 2.
$\frac{2x}{2} = \frac{10}{2}$	
$x = 5$	

Solving Two-Step Linear Equations

Solving Two-Step Linear Equations puts together the pieces in the above examples to solve a single problem. In other words, we will (1) add/subtract and then (2) multiply/divide. It will be done in that order, too.

Example 1:

$2x + 7 = 5$	In this example, the two steps that will need to be done are to divide by 2 and subtract 7 from both sides. We must do the "– 7" first. And will finish by dividing both sides by 2.
$2x + 7 - 7 = 5 - 7$	
$2x = -2$	
$\frac{2x}{2} = \frac{-2}{2}$	
$x = -1$	

Example 2:

$\frac{x}{2} - 3 = 5$	In this example, the two steps that will need to be done are to multiply by 2 and add 3 to both sides. We must do the "+ 3" first. And will finish by multiplying both sides by 2.
$\frac{x}{2} - 3 + 3 = 5 + 3$	
$\frac{x}{2} = 8$	
$2 \cdot \frac{x}{2} = 8 \cdot 2$	
$x = 16$	

A Quick Tip

If you get an equation to solve on the placement exam, either solve it directly or check each possible answer using substitution as an alternative strategy. Choose the strategy that gives you the best chance to succeed!

Solving Linear Equations That Include Parentheses

To solve linear equations that involve parentheses, the first thing we must do is eliminate the parentheses on each side of the equation and then combine like terms. At that point, all we need to do is apply the same techniques we have already been doing.

Example 1:

$5(x+2) - x = 14$	First, distribute the 5 over the parentheses
$5x + 10 - x = 14$	Then, combine the terms $5x$ and $-x$.
$4x + 10 = 14$	
$4x = 4$	To finish, use the techniques from above; subtract 10 from each side followed by dividing both sides by 4.
$x = 1$	

Example 2:

$3 + 7(x - 1) = 2$	First, distribute the 7 over the parentheses
$3 + 7x - 7 = 2$	Then, combine the terms 3 and -7.
$-4 + 7x = 2$	
$7x = 6$	To finish, use the techniques from above; add 4 to each side followed by dividing both sides by 7.
$x = \frac{6}{7}$	

Additional Help

CCA has a video on substitution at the following link:
www.ccaurora.edu/mathprep
You can also search YouTube.com for "solving linear equations."

Linear Equations Practice Problems

Solve the following Linear Equations.

1.) $x + 13 = 4$

2.) $x - 7 = 15$

3.) $5x = 15$

4.) $3x = -14$

5.) $2x - 7 = 3$

6.) $-5x + 2 = -13$

7.) $3(2x + 4) - 5 = 9$

8.) $6 - 4(x + 2) + 3x = 1$

Polynomials

This section will cover the following topics:

- Definitions; "Polynomial," "Like Terms" and "Combine Like Terms"
- Adding and Subtracting Polynomials
- Multiplying Polynomials
- Dividing a Polynomial by a Monomial

Definitions; "Polynomial," "Like Terms" and "Combine Like Terms"

A simple way to think of a **Polynomial** is that it is an expression that combines numbers and variables through addition, subtraction and multiplication. It is important to note that division is missing from this list. Additionally, this also implies that the exponent of each variable must be a positive counting number (1, 2, 3, 4, ...). Here are some examples to illustrate this.

Expressions	Polynomial (Yes or No?)
$x^3 - x^2 + 2x + 7$	Yes – only addition/subtraction/ multiplication are used, and the exponents are positive counting numbers.
$2x^{-5} + \frac{7}{y^2} - \sqrt{x}$	No – this expression includes the negative exponent "–5", division by y, and a square root – all of which are not allowed for polynomials.
$2x^5 + 7y^2$	Yes – even though there are multiple variables (x and y) this is still a polynomial.

Like Terms are parts of an expression that share the same variable (or variables) and each of those variables has the same exponent.

Terms	Like Terms (Yes or No?)
$2x^2y^3z$ and $7x^2y^3z$	Yes: Both terms share the same variables with the same exponents; x^2, y^3, and z.
$2x^2y^3z$ and $7x^2y^3$	No: The first term contains the variable z, however the second term does not.
$2x^2y^3z$ and $7x^4y^3z$	No: Although the variables are shared by both terms, the exponent of the x variable is "2" in the first term and "4" in the second term.

Now that we know what like terms are, we can define the phrase, "**Combine Like Terms.**" Think apples and oranges; Adding 2 apples to 7 apples to get 9 apples is combining like terms, however we cannot add 2 apples with 7 oranges because they are not "like." Like terms can be added or subtracted just like two sets of apples.

Examples:

$x^2 + x^2 = 2x^2$	$10x^2y + 5x^2y = 15x^2y$	Note that combining like terms is just adding or subtracting the numbers. e.g. 8 – 2 = 6
$4x^2 - 9x^2 = -5x^2$	$8x^2y^3z - 2x^2y^3z = 6x^2y^3z$	

Adding and Subtracting Polynomials

Adding and subtracting polynomials is really just combining like terms with one exception; that exception will be highlighted in example two.

Example 1:

$3x^2 + 7x - 5 + 5x^3 - 4x^2 + 7x + 11$	First look for terms with the same variables AND exponents, and then add or subtract as needed. If a term is by itself, like $5x^3$, there is no need to do anything.
$3x^2 + 7x - 5 + 5x^3 - 4x^2 + 7x + 11$	
$5x^3 - x^2 + 14x + 6$	

Example 2:

$-(2x^2 - 5x + 2) + 4(6x^2 - 9x + 1)$	In this case, there are parentheses that need to be removed before collecting like terms. This is done by distributing the "–" and the 4, which means multiplying every term inside the first set of parentheses by "–" and every term in the second set of parentheses by 4. Then, collect like terms.
$-2x^2 + 5x - 2 + 24x^2 - 36x + 4$	
$22x^2 - 31x + 2$	

Multiplying Polynomials

Let's start with a quick lesson on multiplying two single term expressions together. We will use the following rule; $x^a \cdot x^b = x^{a+b}$. That is when two expressions with the same base are multiplied (x is the base, a and b are the exponents) we can add the exponents together. Let's look at a few examples.

Example:

$2x^2 \cdot 5x^3 = 10x^5$	Multiply the numbers as usual. Then match up the variables (x with x, y with y, etc.) and add their exponents.
$12x^2y^5 \cdot 3x^7y = 36x^9y^6$	
$8x^3y^3z^5 \cdot 2x^2y^7z^2 = 16x^5y^{10}z^7$	

Next, let's take a look at multiplying a single term by a polynomial with multiple terms.

Example:

$3x^2(2x^3 - 3x^2 + 5x - 4)$	We must first distribute the $3x^2$ to each term inside the parentheses, and then multiply as we did in the last example.
$3x^2 \cdot 2x^3 - 3x^2 \cdot 3x^2 + 3x^2 \cdot 5x - 3x^2 \cdot 4$	
$6x^5 - 9x^4 + 15x^3 - 12x^2$	

To finish the multiplication of polynomials, we will multiply two binomials together using the technique called FOIL. FOIL gives the order in which the terms of each binomial should be multiplied; First – Outside – Inside – Last.

A Quick Recap

When adding/subtracting polynomials, remember apples and oranges. If terms have the same variables with the same exponents, they are like terms and can be added/subtracted.

Example:

First Term • First Term	$(x + 3)(x - 7) = x \cdot x$
Outside Term • Outside Term	$(x + 3)(x - 7) = x^2 - 7 \cdot x$
Inside Term • Inside Term	$(x + 3)(x - 7) = x^2 - 7x + 3 \cdot x$
Last Term • Last Term	$(x + 3)(x - 7) = x^2 - 7x + 3x - 21$
Finally, combine any like terms.	$(x + 3)(x - 7) = x^2 - 4x - 21$

Dividing a Polynomial by a Monomial

Dividing a polynomial by a monomial means dividing a polynomial by a single term. Here are a couple of examples of what that looks like.

Example 1:

$\frac{10x^7}{2x^2}$	This is an example of dividing a single term polynomial by a single term. It is best to work with numbers and variables separately.
$\frac{10x^7}{2x^2} = \frac{5x^7}{x^2}$	$10 \div 2 = 5$
$\frac{5x^7}{x^2} = 5x^{7\text{-}2} = 5x^5$	Then subtract the exponent of x in the denominator from the exponent in the numerator.

Example 2:

$\frac{10x^5 - 4x^4 + 7x^3 + 2x^2}{2x^2}$	This is an example of dividing a polynomial with multiple terms by a single term. We will again work with numbers and variables separately.
$\frac{10x^5}{2x^2} - \frac{4x^4}{2x^2} + \frac{7x^3}{2x^2} + \frac{2x^2}{2x^2}$	Before we do that, we must split the polynomial in the numerator.
$5x^3 - 2x^2 + \frac{7}{2}x + 1$	Once that is done, work term by term using the same techniques as was done in example 1.

Polynomial Practice Problems

Perform the following polynomial arithmetic.

1.) $2(3x^2 - 8x + 9) - 3(6x^2 - 4x + 1)$

2.) $7(5x^3 - x^2 + 4x) - (2x^2 - 3x + 4)$

3.) $2x^2(6x^2 - 4x + 1)$

4.) $(2x + 7)(3x - 1)$

5.) $\dfrac{9x^4 - x^3 + 3x^2}{3x^2}$

Additional Help

CCA has a video on Polynomials at the following link: www.ccaurora.edu/mathprep You can also search YouTube for "adding polynomials," "multiplying polynomials," or "dividing polynomials."

Factoring Polynomials

This section will cover the following topics:

- Factoring the Greatest Common Factor
- Factoring Trinomials by Trial and Error
- Solving Equations by Factoring

Factoring the Greatest Common Factor

The most basic type of factoring for polynomials is to factor out the Greatest Common Factor (GCF). The goal of factoring is to undo multiplication. Let's take a look at what multiplying a single term into a polynomial looks like, and then we will work backwards.

Example of Multiplication of a Polynomial by a Single Term

$\mathbf{3x^2}(2x^3 - 3x^2 + 5x - 4)$	We must first distribute the $\mathbf{3x^2}$ to each term inside the parentheses, and then multiply term by term.
$\mathbf{3x^2} \cdot 2x^3 - \mathbf{3x^2} \cdot 3x^2 + \mathbf{3x^2} \cdot 5x - \mathbf{3x^2} \cdot 4$	
$6x^5 - 9x^4 + 15x^3 - 12x^2$	

Additional Help

CCA has a video on factoring at the following link: www.ccaurora.edu/mathprep You can also search YouTube.com for "factoring the GCF," "factoring trinomials," or "solving quadratic equations by factoring."

A Quick Tip

Factoring can get complicated very quickly, and so can factoring techniques. On the placement exam, keep it simple. These represent the difficulty level you will find on the exam.

Working backwards, let's start with the polynomial $6x^5 - 9x^4 + 15x^3 - 12x^2$. When factoring the GCF, deal with the numbers and each variable separately to determine the overall GCF.

Finding the GCF of $6x^5 - 9x^4 + 15x^3 - 12x^2$

GCF of the Coefficients (dealing with the numbers)	6, 9, 15, and 12 are the coefficients. All of these numbers are divisible by 1 and 3 only. Always take the highest number, which in this case is 3.
GCF of the Variable (dealing with the x-variable)	These include x^5, x^4, x^3, and x^2. To find the GCF of variables, take the variable raised to the lowest exponent. In this case, that is x^2.
The Overall GCF	Putting the GCF of the numbers and variables together, we get GCF = $3x^2$
Factor the GCF Start by factoring $3x^2$ from each term. Then factor $3x^2$ outside parentheses with the remaining terms inside	$6x^5 - 9x^4 + 15x^3 - 12x^2$ $\mathbf{3x^2} \cdot 2x^3 - \mathbf{3x^2} \cdot 3x^2 + \mathbf{3x^2} \cdot 5x - \mathbf{3x^2} \cdot 4$ $\mathbf{3x^2}(2x^3 - 3x^2 + 5x - 4)$

Factoring Trinomials by Trial and Error

Once again, we will start with the idea that factoring will undo multiplication. For trinomials (polynomials with three terms), this means we will be undoing FOIL-ing (see the review on Polynomials for details).

Example of FOIL-ing

First Term • First Term	$(x + 3)(x - 7) =$ $x \cdot x$
Outside Term • Outside Term	$(x + 3)(x - 7) =$ $x^2 - 7 \cdot x$
Inside Term • Inside Term	$(x + 3)(x - 7) =$ $x^2 - 7x + 3 \cdot x$
Last Term • Last Term	$(x + 3)(x - 7) =$ $x^2 - 7x + 3x - 21$
Finally, combine any like terms	$(x + 3)(x - 7) =$ $x^2 - 4x - 21$

To work backwards, we will start by considering the possible ways to factor the first term, x^2 and the last term, -21. We will then write all possible factorizations based on those.

Example 1: Factor $x^2 - 4x - 21$

Possible Factors of First Term	Possible Factors of Last Term	Possible Factorization	Check by FOIL-ing
$x^2 = x \cdot x$	$-21 = -3 \cdot 7$	$(x - 3)(x + 7)$	$x^2 + 4x - 21$
$x^2 = x \cdot x$	$-21 = 3 \cdot -7$	$(x + 3)(x - 7)$	$x^2 - 4x - 21$*
$x^2 = x \cdot x$	$-21 = -1 \cdot 21$	$(x - 1)(x + 21)$	$x^2 + 20x - 21$
$x^2 = x \cdot x$	$-21 = 1 \cdot -21$	$(x + 1)(x - 21)$	$x^2 - 20x - 21$

*Note that we could have stopped at the second row because we found the factorization.

Example 2: Factor $2x^2 - 5x + 3$

Possible Factors of First Term	Possible Factors of Last Term	Possible Factorization	Check by FOIL-ing
$2x^2 = 2x \cdot x$	$3 = 1 \cdot 3$	$(2x + 1)(x + 3)$	$2x^2 + 7x + 3$
		$(2x + 3)(x + 1)$	$2x^2 + 5x + 3$
$2x^2 = 2x \cdot x$	$3 = -1 \cdot -3$	$(2x - 1)(x - 3)$	$2x^2 - 7x + 3$
		$(2x - 3)(x - 1)$	$2x^2 - 5x + 3$

Solving Equations by Factoring

A very important point about solving equations by factoring is that one side of the equation must be equal to zero. Once you have that, solving equations by factoring is easy; simply factor and then set each factor equal to zero.

Example 1: $2x^2 - 6x = 0$

Factor out the GCF.	$2x(x - 3) = 0$	
Set each factor equal to zero.	$2x = 0$	$x - 3 = 0$
Solve each equation.	$x = 0$	$x = 3$

Factoring Polynomials Practice Problems

Example : $3x^2 - 5x = 2$

Write equation with = 0.	$3x^2 - 5x - 2 = 0$	
Factor.	$(3x + 1)(x - 2) = 0$	
Set each factor equal to zero.	$3x + 1 = 0$	$x - 2 = 0$
Solve each equation.	$x = -\frac{1}{3}$	$x = 2$

Factor the following expressions, or factor to solve the following equations.

1.) $6x^5 + 9x^4 - 24x^3 + 18x^2$

2.) $x^2 - 4x - 32$

3.) $3x^2 + 14x - 5$

4.) $3x^2 - 4x = 0$

5.) $x^2 - 3x - 28 = 0$

6.) $2x^2 - 5x = 7$

Fractions

This section will cover the following topics:

- Reducing to Lowest Terms
- Converting between Mixed Numbers and Improper Fractions
- Multiplying and Dividing
- Adding and Subtracting

Reducing

Fractions have the ability to look different without changing value. A common example that is given is slicing a pizza. Suppose someone was feeling very hungry and wanted a very large slice of pizza so they cut the pizza into two slices by cutting right down the middle. Eating only one of those very large slices would mean eating exactly ½ of the pizza. But if the pizza were bought from a shop where it was already sliced into eight pieces, that person could easily still eat ½ of the pizza by eating 4 out of 8 slices. In fractions, that means $\frac{4}{8} = \frac{1}{2}$. Even though these fractions look quite different, they still represent the same value. Here are some examples to illustrate how fractions are reduced, and what it means to be reduced to **lowest terms**. The key is to look for common divisors.

Example 1:

$\frac{6}{9} = \frac{6 \div 3}{9 \div 3} = \frac{2}{3}$	In looking at the fraction $\frac{6}{9}$, we are looking for a number which will divide both 6 and 9, which is 3. 3 is called a common divisor. $\frac{2}{3}$ is in lowest terms because 2 and 3 do not share a common divisor, so we are done.

A Quick Tip

Whenever doing math, either in a class or on the placement exam, fractions are always reduced.

Example 2:

$\frac{24}{30} = \frac{24 \div 6}{30 \div 6} = \frac{4}{5}$	$\frac{24}{30}$ is a bit more challenging because there are many numbers which divide both 24 and 30. They are 2, 3, and 6. We will use 6 to do the reduction because it is the greatest; called the greatest common divisor.

Example 3:

$\frac{216}{240} = \frac{216 \div 2}{240 \div 2} =$ $\frac{108 \div 2}{120 \div 2} = \frac{54 \div 2}{60 \div 2} =$ $\frac{27 \div 3}{30 \div 3} = \frac{9}{10}$	$\frac{216}{240}$ looks nearly impossible, but will turn out to be much easier than it looks if we take it step-by-step. That is, let's start with dividing both 216 and 240 by 2 since they are both even numbers. From there we will continue by dividing by 2, 2, and finally 3.

Converting between Mixed Numbers and Improper Fractions

Let's start by giving an example of a mixed number and an improper fraction. $3\frac{1}{2}$ is a mixed number because is mixes a whole number (the 3) with a fraction (the $\frac{1}{2}$). The fraction $\frac{7}{2}$ is an improper fraction because the numerator is larger than the denominator. We can convert between these two forms in the following ways.

Convert a Mixed Number to an Improper Fraction:

$3\frac{1}{2}$ to $\frac{7}{2}$

First multiply the whole 3 by the denominator 2.	$3\frac{1}{2} : 3 \times 2 = 6$
Then take the resulting 6 and add the numerator of 1.	$3\frac{1}{2} : 6 + 1 = 7$
The 7 becomes the new numerator and the 2 remains the denominator.	$\frac{7}{2}$

Convert an Improper Fraction to a Mixed Number:
$\mathbf{\frac{7}{2}}$ **to 3** $\mathbf{\frac{1}{2}}$

First we must determine how many times 2 goes into 7 without going over 7. The answer (bolded) is 3 times with 1 left over. The 3 becomes the whole number, the 1 becomes the numerator and the 2 remains the denominator.	$2 \times 1 = 2$ $2 \times 2 = 4$ $\mathbf{2 \times 3 = 6}$ $2 \times 4 = 8$
	$\frac{7}{2} = 3\frac{1}{2}$:

Multiplying and Dividing

Multiplication and Division are relatively straightforward. For multiplication remember to multiply across (numerator × numerator and denominator × denominator) and then reduce. For division of fractions, simply change division to multiplication. To change division into multiplication, remember Copy – Dot – Flip. That is, copy the first fraction – change division (÷) to multiplication (·) – and flip the section fraction ($\frac{a}{b} \rightarrow \frac{b}{a}$).

Multiplication Example 1: $\mathbf{\frac{4}{5} \cdot \frac{3}{8}}$

$\frac{4}{5} \cdot \frac{3}{8} = \frac{12}{40}$	Multiply Across
$\frac{12 \div 4}{40 \div 4} = \frac{3}{10}$	Reduce to Lowest Terms

Multiplication Example 2: $\mathbf{\frac{10}{6} \cdot \frac{9}{12}}$

$\frac{10}{6} \cdot \frac{9}{12} = \frac{90}{72}$	Multiply Across
$\frac{90 \div 18}{72 \div 18} = \frac{5}{4}$	Reduce to Lowest Terms

Division Example 1: $\mathbf{\frac{5}{6} \div \frac{10}{7}}$

$\frac{5}{6} \div \frac{10}{7} = \frac{5}{6} \cdot \frac{7}{10}$	Copy - Dot - Flip
$\frac{5}{6} \cdot \frac{7}{10} = \frac{35}{60}$	Multiply Across
$\frac{35 \div 5}{60 \div 5} = \frac{7}{12}$	Reduce to Lowest Terms

Division Example 2: $\mathbf{\frac{8}{9} \div \frac{6}{5}}$

$\frac{8}{9} \div \frac{6}{5} = \frac{8}{9} \cdot \frac{5}{6}$	Copy - Dot - Flip
$\frac{8}{9} \cdot \frac{5}{6} = \frac{40}{54}$	Multiply Across
$\frac{40 \div 2}{54 \div 2} = \frac{20}{27}$	Reduce to Lowest Terms

Adding and Subtracting

While multiplying and dividing fractions are straightforward, adding and subtracting fractions are not – UNLESS – you have a common denominator between the two fractions. So that's the trick – get a common denominator before adding/subtracting.

Addition Example: $\mathbf{\frac{2}{3} + \frac{1}{4}}$

$\frac{2 \cdot 4}{3 \cdot 4} = \frac{8}{12}$ $\frac{1 \cdot 3}{4 \cdot 3} = \frac{3}{12}$	The common denominator is 12. Multiply first fraction by 4's and the second by 3's.
$\frac{8}{12} + \frac{3}{12} = \frac{11}{12}$	Add the numerators and reduce if necessary.

Subtraction Example: $\mathbf{\frac{5}{6} - \frac{2}{9}}$

$\frac{5 \cdot 3}{6 \cdot 3} = \frac{15}{18}$ $\frac{2 \cdot 2}{9 \cdot 2} = \frac{4}{18}$	The common denominator is 18. Multiply first fraction by 3's and the second by 2's
$\frac{15}{18} - \frac{4}{18} = \frac{11}{18}$	Subtract the numerators and reduce if necessary.

A Quick Tip

It is easy to confuse the techniques between multiplying/dividing fractions and adding/subtracting fractions, and it often is related to when a common denominator is needed. Remember that a common denominator is needed only for addition and subtraction of fractions.

Fractions Practice Problems

Reduce the following fractions to lowest terms.

1.) $\frac{12}{15}$

2.) $\frac{32}{40}$

3.) $\frac{12}{16}$

Convert the following mixed numbers to improper fractions, and improper fractions to mixed numbers.

4.) $2\frac{1}{3}$

5.) $5\frac{3}{7}$

6.) $\frac{22}{3}$

7.) $\frac{19}{8}$

Perform the following multiplication/division problems with fractions.

8.) $\frac{2}{5} \cdot \frac{10}{3}$

9.) $\frac{6}{9} \cdot \frac{3}{8}$

10.) $\frac{3}{4} \div \frac{1}{2}$

11.) $\frac{2}{7} \div \frac{5}{14}$

Perform the following addition/subtraction problems with fractions.

12.) $\frac{1}{4} + \frac{3}{5}$

13.) $\frac{4}{9} + \frac{2}{6}$

14.) $\frac{5}{6} - \frac{3}{4}$

15.) $\frac{4}{5} - \frac{2}{3}$

Additional Help

CCA has a video on factoring at the following link: www.ccaurora.edu/mathprep.
You can also search YouTube.com for “reducing fractions,” “converting fractions” or “adding/subtracting/multiplying/dividing fractions.”

Graphing Lines

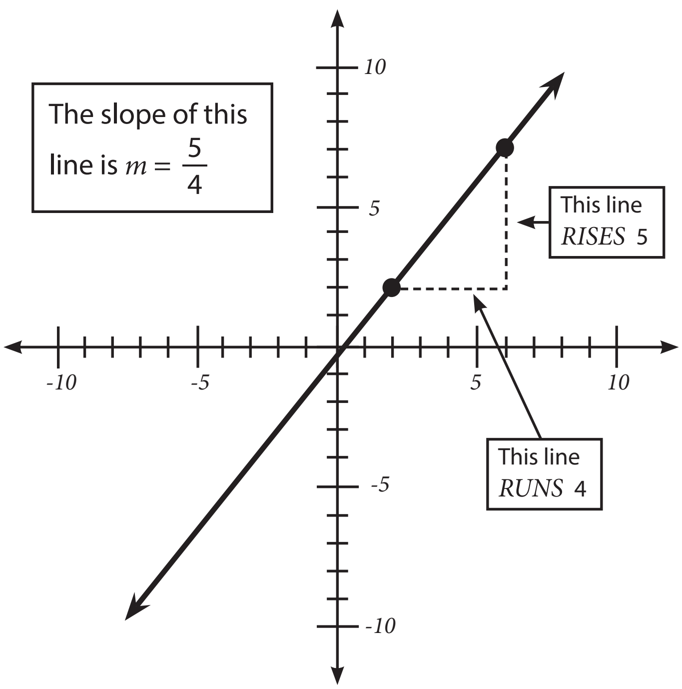
This section will cover the following topics:

- Slope and the Slope Formula
- Equation of a Line in Slope-Intercept Form
- Graphing Lines

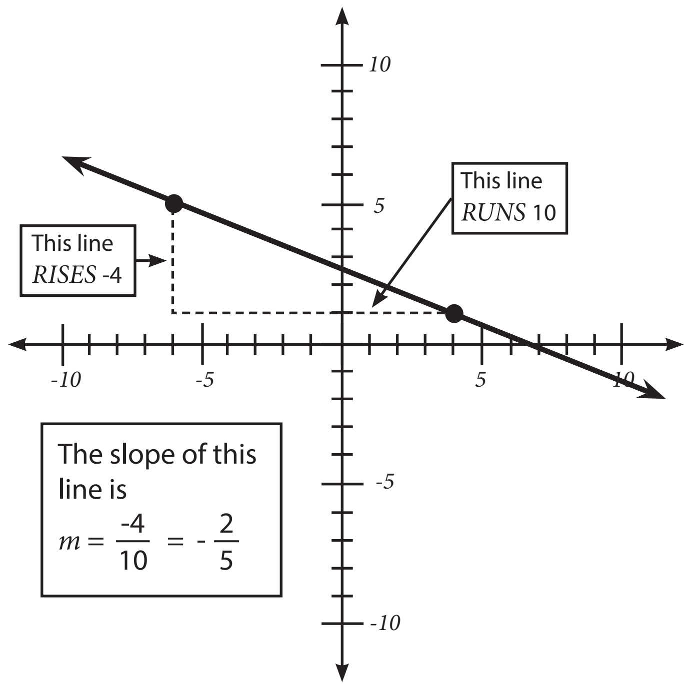
Slope and the Slope Formula

Every line travels in a specific direction. That direction is referred to as the slope of a line, which is often expressed as $m = \dfrac{RISE}{RUN}$; that is, a measure of how quickly a line rises (or falls) relative to how quickly it runs (or travels to the right). The examples below illustrate this.

Example 1:



Example 2:

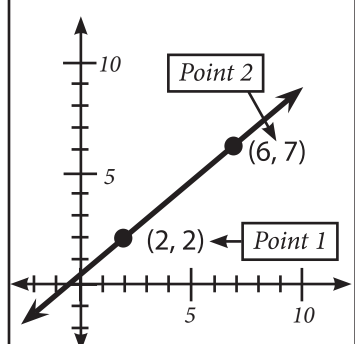


An analytical way of determining the slope of a line is through the slope formula, which is $m = \dfrac{y_2 - y_1}{x_2 - x_1}$
Here is an example of how the slope formula is used.

Using the graph on the right, will let
$(x_1, y_1) = (2, 2)$, and
$(x_2, y_2) = (6, 7)$.

From here we do a substitution into the slope formula to get,

$$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{7-2}{6-2} = \frac{5}{4}$$



> ***A Quick Tip***
> With *x-intercepts* and *y-intercepts*, we already know half of the ordered pair; Remember a line crosses the *y-axis* (the *y-intercept*) when $x = 0$ and a line crosses the *x-axis* (the *x-intercept*) when $y = 0$.

> ***Additional Help***
> Search YouTube.com for "slope of a line," "slope formula," or "graphing a line."

Equation of a Line in Slope-Intercept Form

The slope-intercept form of the equation of a line is $y = mx + b$, where m represents the slope and b represents the *y-intercept*. More precisely, the *y-intercept* is the point (0, b). Note that the *y-intercept* occurs when $x = 0$, thus the *y-intercept* is (0, b) no matter what the value of b. Let's look at some examples of identifying the slope and intercept from such equations.

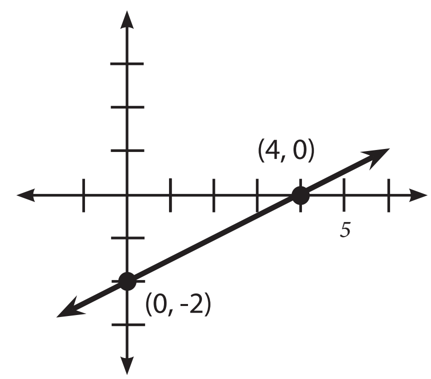
Equation	Slope	y-intercept	Notes
$y = 5x - 2$	$m = 5$	(0, -2)	It may be helpful to write $m = \frac{5}{1}$; that is, $RISE = 5$ and $RUN = 1$
$y = -\frac{3}{5}x + \frac{1}{2}$	$m = -\frac{3}{5}$	(0, $\frac{1}{2}$)	Be sure to include the negative sign with the slope.

Graphing Lines

Graphing lines starts with a very simple concept. Draw two points and then connect them with a straight line. The only question is how you get the two points. We will take a look at two methods to graph the line $y = \frac{1}{2}x - 2$

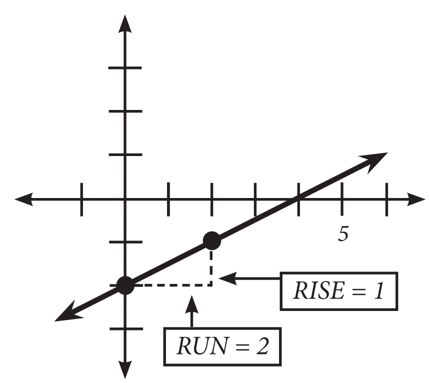
Method 1: Determine the *x* and *y-intercepts.*

y-intercept	*x-intercept*
This one is easy because the equation $y = \frac{1}{2}x - 2$ tells us that the *y-intercept* is the point (0, -2)	We let $y = 0$ $0 = \frac{1}{2}x - 2$ Solving for x gives $x = 4$ The *x-intercept* is (4, 0)



Method 2: Graph the *y-intercept* and then use the slope to create a second point.

y-intercept	*slope*
Again this is easy because the equation $y = \frac{1}{2}x - 2$ tells us that the *y-intercept* is the point (0, -2)	Here we will interpret the slope $m = \frac{1}{2}$ as $\frac{RISE}{RUN}$. From (0, -2), we will *RISE 1* and *RUN 2*.



Graphing Lines Practice Problems

Use the slope formula to find the slope of the line that connects the following points.

1.) (-2, 7) and (4, 1)

2.) (-1, -3) and (3, 6)

Identify the slope and y-intercept given the following equations.

3.) $y = -3x + 4$

4.) $y = \frac{2}{3}x - \frac{5}{7}$

Graph the following lines.

5.) $y = -2x + 5$

6.) $y = \frac{3}{4}x - 2$

Basic Facts Practice Problems	
Question #	**Correct Answer**
1	17
2	26
3	20
4	$\frac{13}{15}$

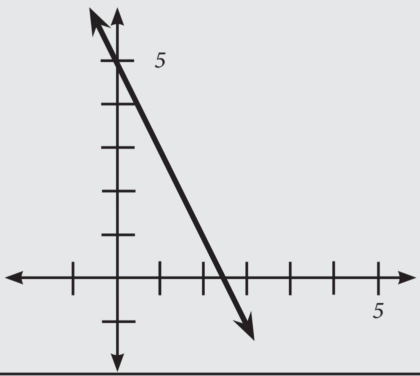
Substitution Practice Problems	
Question #	**Correct Answer**
1	-12
2	108
3	31
4	*The solution checks.*
5	*The solution does not check.*
6	*The solution checks.*

Linear Equations Practice Problems	
Question #	**Correct Answer**
1	$x = -9$
2	$x = 22$
3	$x = 3$
4	$x = -\frac{14}{3}$
5	$x = 5$
6	$x = 3$
7	$x = \frac{1}{3}$
8	$x = -3$

Polynomial Practice Problems	
Question #	**Correct Answer**
1	$-12x^2 - 4x + 15$
2	$35x^3 - 9x^2 + 31x - 4$
3	$12x^4 - 8x^3 + 2x^2$
4	$6x^2 + 19x - 7$
5	$3x^2 - \frac{1}{3}x + 1$

Factoring Polynomials Practice Problems	
Question #	**Correct Answer**
1	$3x^2(2x^3 + 3x^2 - 8x + 6)$
2	$(x - 8)(x + 4)$
3	$(3x - 1)(x + 5)$
4	$x = 0, \frac{4}{3}$
5	$x = 7, -4$
6	$x = -1, \frac{7}{2}$

Fractions Practice Problems	
Question #	**Correct Answer**
1	$\frac{4}{5}$
2	$\frac{4}{5}$
3	$\frac{3}{4}$
4	$\frac{7}{3}$
5	$\frac{38}{7}$
6	$7\frac{1}{3}$
7	$2\frac{3}{8}$
8	$\frac{4}{3}$
9	$\frac{1}{4}$
10	$\frac{3}{2}$
11	$\frac{4}{5}$
12	$\frac{17}{20}$
13	$\frac{7}{9}$
14	$\frac{1}{12}$
15	$\frac{2}{15}$

Graphing Lines Practice Problems	
Question #	**Correct Answer**
1	$m = -1$
2	$m = \frac{9}{4}$
3	$m = -3$, (0, 4)
4	$m = \frac{2}{3}$, $(0, -\frac{5}{7})$
5	
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