Overview

Lesson Plan #1 Title: Ace it! Lesson Nine

Attached Supporting Documents for Plan #1:

Teacher's Manual and reproductions of student worksheets to support the following lesson objective:

- Find products and quotients, using rules for exponents.

Lesson Plan #2 Title: Ace it! Lesson Twenty-two

Attached Supporting Documents for Plan #2:

Teacher's Manual and reproductions of student worksheets to support the following lesson objective:

- Solve equations with variables on both sides.

Lesson Plan #3 Title: Ace it! Lesson Twenty-eight

Attached Supporting Documents for Plan #3:

Teacher's Manual and reproductions of student worksheets to support the following lesson objective:

- Determine the slope when given the equation for a line.

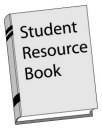
lesson nine

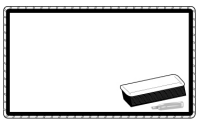
LESSON OBJECTIVE:
Find products and quotients, using rules for exponents.

Introduction	Direct Skill Instruction and Guided Practice	Summary/Closure	Fact Practice
5 mins.	25 mins.	10 mins.	7 mins.

Lesson:

- ❑ Student Resource Books: Student Resource Sheets (Lesson 9)
- ❑ Dry-erase boards and dry-erase markers





Fact Practice:
(Select one of these sets of materials for the Math Facts Games.)

- ❑ Individual Student Flashcards
- ❑ Buzz
- ❑ Math War or Salute!
  - Playing cards
- ❑ Soccer Ball Facts
  - Soccer ball
- ❑ Math Scramble
  - Index cards, each with a number 0–9; cards with the operations
- ❑ BINGO
  - Flashcards
  - BINGO boards, and tokens or colored squares
- ❑ Around the World
  - Triangle or regular flashcards

Vocabulary Definitions:
This lesson assumes that students know the following vocabulary words:

- product
- quotient

exponent or **power** — A number that is an abbreviation for repeated multiplication.
Example: 5 in 3^5

Welcome:

3 mins. Greet students by name and take attendance.

Introduction:

5 mins. ***A. Access Prior Knowledge***

- ***On your dry-erase board, write the expression 3^5.***
- ***Raise a hand to tell me what this expression means:***
  (3 ● 3 ● 3 ● 3 ● 3)
- ***On your dry-erase board, simplify the expression.*** (243)
- ***On your dry-erase board, simplify the following expressions:***
  - 5^3 (125)
  - 2^6 (64)
- ***On your dry-erase board, write the expression $\frac{27}{63}$.***
- ***Raise a hand to tell me if this expression is in simplest form.*** (No.)
- ***Raise a hand to tell me why not.***
  (Because 27 and 63 have a common factor.)
- ***Raise a hand to tell me the greatest common factor of 27 and 63.*** (9)
- ***On your dry-erase board, rewrite $\frac{27}{63}$ so that each number is written as a product of 9 and another factor.*** $(\frac{9 \bullet 3}{9 \bullet 7})$
- ***Now, on your dry-erase board, cancel the 9s to simplify this fraction.*** $(\frac{3}{7})$

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B. Explain Connection to New Skill

You already know how to simplify expressions by raising a number to a* power. *You also know how to simplify fractions by canceling factors that are common to both the numerator and denominator.

- ***On your dry-erase board, simplify the following expressions:***
  - 6^3 (216)
  - 4^4 (256)
  - $\frac{56}{40}$ $(\frac{7}{5})$

C. State Lesson Objective

***During today's lesson, we will find products and quotients by applying rules for* exponents.**

Direct Skill Instruction and Guided Practice:

25 mins.

In your Student Resource Book, below the Lesson Objective, you will see a Vocabulary Box that lists today's vocabulary terms and their definitions. Let's look at these terms together.

- ***Raise a hand to tell me what operation is represented by an* exponent *or a* power.** (Repeated multiplication.)

When I snap my fingers, everyone answer the following questions at the same time:

- ***In the expression 9^3, which number is the exponent?*** (3)
- ***What expression is equivalent to 9^3?*** (9 ● 9 ● 9)
- ***On your dry-erase board, finish simplifying this expression.*** (729)

Now, on your dry-erase board, write the expression 4^2 ● 4^3.

- ***Raise a hand to tell me what number 4^2 equals.*** (16)
- ***Raise a hand to tell me what number 4^3 equals.*** (64)
- ***On your dry-erase board, find 16 ● 64.*** (1,024)

Do not erase your dry-erase board.

On your dry-erase board, write the expression 4^5.

- ***On your dry-erase board, rewrite 4^5 as repeated multiplication.*** (4 ● 4 ● 4 ● 4 ● 4)

- ***On your dry-erase board, find 4 ● 4 ● 4 ● 4 ● 4.*** (1,024)

We can see that the answers to $4^2 \bullet 4^3$ and to 4^5 are the same.

On your dry-erase board, write the equation $4^2 \bullet 4^3 = 4^5$.

- ***Raise a hand if you can make an observation about the* exponents *in this equation.*** (2 + 3 = 5)

That is correct! Whenever we multiply two* exponential *expressions with the same base, we add the* exponent*s and keep the base.

Remember that $4^2 = 4 \bullet 4$, ***and*** $4^3 = 4 \bullet 4 \bullet 4$.
NOTE: Write $4 \bullet 4 \bullet 4 \bullet 4 \bullet 4$ on your dry-erase board.

Notice that when we have two 4s multiplied together times three 4s multiplied together, we have a total of five 4s multiplied together. That is why the rule works.

- ***On your dry-erase board, rewrite the expression $2^3 \bullet 2^4$, using a single base.*** (2^7)

- ***On your dry-erase board, simplify 2^7.*** (128)

- ***Now, on your dry-erase board, with a partner, rewrite the following expressions, using a single base. Then simplify each expression.***

  - $3^4 \bullet 3^2$ ($3^6 = 729$)
  - $5^2 \bullet 5^3$ ($5^5 = 3{,}125$)
  - $10^5 \bullet 10^3$ ($10^8 = 100{,}000{,}000$)
  - $6 \bullet 6^2$ (***HINT: $6 = 6^1$***) ($6^3 = 216$)

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Now, on your dry-erase board, write the expression $x^a \bullet x^b$.

- ***Raise a hand to tell me how to rewrite this expression using a single base.*** (x^{a+b})

Good!

On your dry-erase board, write the equation $x^a \bullet x^b = x^{a+b}$. This equation shows us that when we multiply expressions with like bases, we can add the **exponents** ***and rewrite the expression with a single base.***

Now, on your dry-erase board, write the expression $\frac{4^5}{4^2}$.

- ***Raise a hand to tell me what number 4^5 equals.*** (1,024)
- ***Raise a hand to tell me what number 4^2 equals.*** (16)
- ***On your dry-erase board, find 1,024 ÷ 16.*** (64)

Do not erase your dry-erase board.

- ***Now, on your dry-erase board, rewrite the original expression, $\frac{4^5}{4^2}$, with the numerator and denominator each expressed as repeated multiplication.*** ($\frac{4 \bullet 4 \bullet 4 \bullet 4 \bullet 4}{4 \bullet 4}$)

Since this is a fraction, we can cancel common factors.

- ***When I point to you, everyone tell me how many factors of 4 we can cancel.*** (Two.)
- ***On your dry-erase board, cancel two factors of 4 from the numerator and denominator. Rewrite the resulting expression, but do not multiply yet.*** ($4 \bullet 4 \bullet 4$)
- ***Now, on your dry-erase board, find $4 \bullet 4 \bullet 4$.*** (64)

Notice that this is the same answer we found earlier. With the latter method, we multiplied $4 \bullet 4 \bullet 4$.

- ***Raise a hand to tell me how to write 4 ● 4 ● 4 in* exponential *notation.*** (4^3)

We can see that the answers to $\frac{4^5}{4^2}$ ***and*** 4^3 ***are the same.***

On your dry-erase board, write the equation $\frac{4^5}{4^2} = 4^3$.

- ***Raise a hand if you can make an observation about the* exponents *in this expression.*** (5 – 2 = 3)

***That's right! When we divide two* exponential *expressions with the same base, we can simply subtract the* exponents.**

- ***On your dry-erase board, rewrite the expression*** $\frac{7^8}{7^6}$***, using a single base.*** (7^2)
- ***On your dry-erase board, simplify*** 7^2. (49)

Now, on your dry-erase board, with your partner, rewrite the following expressions, using a single base. Then simplify each expression.

- $\frac{5^7}{5^4}$ ($5^3 = 125$)
- $\frac{2^{13}}{2^8}$ ($2^5 = 32$)

Now, on your dry-erase board, write the fraction $\frac{2}{6}$.

- ***On your dry-erase board, simplify this fraction.*** ($\frac{1}{3}$)
- ***Raise a hand to tell me why the answer can't be simply 3.***
  (A numerator of 1 is necessary to show that the 3 is in the denominator.)

The same rule applies to quotients of* exponential *expressions.

- ***On your dry-erase board, rewrite the expression*** $\frac{8^3}{8^5}$***, using a single base.*** $(\frac{1}{8^2})$
- ***On your dry-erase board, finish simplifying the expression.*** $(\frac{1}{64})$
- ***Now, on your dry-erase board, with your partner, rewrite the following expressions, using a single base. Then simplify each expression.***
  - $\frac{7^4}{7^6}$ $(\frac{1}{7^2} = \frac{1}{49})$
  - $\frac{3^3}{3^6}$ $(\frac{1}{3^3} = \frac{1}{27})$

We can use quotients of **exponential** ***expressions to learn an interesting and important fact.***

- ***On your dry-erase board, simplify the expression*** $\frac{73}{73}$**.** (1)
- ***Raise a hand to tell me why this expression is equal to 1.***
  (Any number divided by itself is equal to 1.)

Good!

- ***Now, on your dry-erase board, use this property to simplify*** $\frac{3^4}{3^4}$**.** (1)
- ***Now, on your dry-erase board, rewrite*** $\frac{3^4}{3^4}$ ***as an*** **exponential** ***expression, using only a single base.*** (3^0)

We know that 3^0 ***and 1 both equal*** $\frac{3^4}{3^4}$ ***and we know that they must equal each other, so*** $3^0 = 1$***. In fact, any number raised to the*** **power** ***of 0 is equal to 1.***

Remember that!

Summary/Closure:

A. Define Vocabulary Words

In your Student Resource Book, Lesson Nine, in the Summary/Closure section, there are some questions dealing with today's vocabulary terms. Take a few minutes to carefully complete these questions.

B. Summarize What We Learned Today

Let's summarize the skill that we have been working on today. In your Student Resource Book, in the Summary/Closure section, write three* exponential *expressions and simplify them. One expression should be a product, and two should be quotients, with one of the quotients having a greater number in the denominator. These examples will be your reference sheet when you need to remember how to do these types of problems in the future.

- ***Raise a hand to share your sample problems with the class.***

NOTE: Be alert to correct all student errors and to encourage students to show complete work so that they have accurate reference sheets. (Answers will vary.)

C. Apply Skill

Rewrite the following expressions, using a single base. Then simplify each expression.

- $5^3 \bullet 5^1$ $(5^4 = 625)$
- $\frac{6^7}{6^5}$ $(6^2 = 36)$
- $\frac{9^3}{9^5}$ $(\frac{1}{9^2} = \frac{1}{81})$

lesson nine

Fact Practice:

7 mins.

Operation: Multiplication

Fact Activity: _____

Count/Record Tokens:

5 mins.

Count and record tokens in the Student Resource Book.

Lesson Objective: Find products and quotients, using rules for exponents.

Vocabulary Box

exponent or **power** — A number that is an abbreviation for repeated multiplication. Example: 5 in 3^5.

Guided Practice

Directions: Complete the following practice problems with your partner. Your teacher will review the answers. Make sure that you show all important work.

Rewrite the following expressions, using a single base. Then simplify each expression.

1. $2^5 \bullet 2^5$ *($2^{10} = 1{,}024$)*

2. $3^2 \bullet 3^4$ *($3^6 = 729$)*

3. $\frac{8^8}{8^5}$ *($8^3 = 512$)*

4. $\frac{3^4}{3}$ *($3^3 = 27$)*

5. $\frac{12^4}{12^6}$ *($\frac{1}{12^2} = \frac{1}{144}$)*

6. $\frac{17^9}{17^9}$ *($17^0 = 1$)*

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Summary/Closure

A. Vocabulary Words

1. What two words describe a number that indicates repeated multiplication?
   (Exponent and power.)

2. Write an exponential expression, and identify the number that is the exponent.
   (Possible answer: 6^7; 7 is the exponent.)

3. Write your exponential expression as repeated multiplication.
   (Possible answer: 6 ● 6 ● 6 ● 6 ● 6 ● 6 ● 6.)

B. Summarize What We Learned Today

Directions: Write three exponential expressions and simplify them. One expression should be a product, and two should be quotients, with one of the quotients having a greater number in the denominator. Then write a few sentences about simplifying exponential expressions using the rules we learned today. You will use this explanation as a personal reminder.

lesson nine – student resource sheet

Lesson Objective: Find products and quotients, using rules for exponents.

Vocabulary Box

exponent or **power** — A number that indicates the operation of repeated multiplication. Example: 5 in 3^5.

Guided Practice

Directions: Complete the following practice problems with your partner. Your teacher will review the answers. Make sure that you show all important work.

Rewrite the following expressions, using a single base. Then simplify each expression.

1. $2^5 \bullet 2^5$

2. $3^2 \bullet 3^4$

3. $\frac{8^8}{8^5}$

4. $\frac{3^4}{3}$

5. $\frac{12^4}{12^6}$

6. $\frac{17^9}{17^9}$

Summary/Closure

A. Vocabulary Words

1. What two words describe a number that indicates repeated multiplication?

2. Write an exponential expression, and identify the number that is the exponent.

3. Write your exponential expression as repeated multiplication.

B. Summarize What We Learned Today

Directions: Write three exponential expressions and simplify them. One expression should be a product, and two should be quotients, with one of the quotients having a greater number in the denominator. Then write a few sentences about simplifying exponential expressions using the rules we learned today. You will use this explanation as a personal reminder.

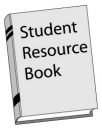
lesson twenty-two

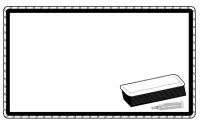
LESSON OBJECTIVE:
Solve equations with variables on both sides.

Introduction	Direct Skill Instruction and Guided Practice	Summary/Closure	Fact Practice
5 mins.	25 mins.	10 mins.	7 mins.

Lesson:

- ❑ Student Resource Books: Student Resource Sheets (Lesson 22)
- ❑ Dry-erase boards and dry-erase markers





Fact Practice:
(Select one of these sets of materials for the Math Facts Games.)

- ❑ Individual Student Flashcards
- ❑ Buzz
- ❑ Math War or Salute!
  - Playing cards
- ❑ Soccer Ball Facts
  - Soccer ball
- ❑ Math Scramble
  - Index cards, each with a number 0–9; cards with the operations
- ❑ BINGO
  - Flashcards
  - BINGO boards, and tokens or colored squares
- ❑ Around the World
  - Triangle or regular flashcards

Vocabulary Definitions:
This lesson assumes that students know the following vocabulary words:

- variable
- inverse operations
- additive inverse

constant — A value that does not change. Examples: 4, $-6\frac{2}{3}$, π.

combining like terms — Adding or subtracting two or more terms that contain exactly the same variable, or adding or subtracting two or more constant terms. Examples: 5x + 3x = 8x and (2w – 7) + (w – 4) = 3w – 11; however, 4m + 5n cannot be combined because the two terms are not the same.

Welcome:

3 mins.

Greet students by name and take attendance.

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Introduction:

5 mins.

A. Access Prior Knowledge

- ***On your dry-erase board, write the equation 7 times* x *minus 5 equals 37.*** (7x – 5 = 37)
- ***Solve the equation, showing your work.*** (x = 6)
- ***Raise a hand to share how you found the answer.*** (Possible answer: First I added 5 to both sides. Then I divided both sides by 7.)
- ***Raise a hand to tell me what we do after we find the solution to an equation.*** (Check the answer to see if it makes sense.)
- ***On your dry-erase board, check the answer to this equation.*** (7(6) – 5 = 37)
- ***On your dry-erase board, write the equation 63 equals* w *divided by 6 plus 56.*** $(63 = \frac{w}{6} + 56)$
- ***Solve the equation, showing your work.*** (w = 42)
- ***Raise a hand to share how you found the answer.*** (Possible answer: First I subtracted 56 from both sides. Then I multiplied both sides by 6.)
- ***On your dry-erase board, show how you would check the solution you just found.*** $(\frac{42}{6} + 56 = 63)$

B. Explain Connection to New Skill

You already know how to solve whole number equations that can be solved using two operations. You also know how to write these equations to solve word problems.

Remember, an equation is like a balance: what we do to one side, we have to do to the other.

C. State Lesson Objective

During today's lesson, we are going to solve equations with variables on both sides.

Direct Skill Instruction and Guided Practice:

In your Student Resource Book, below the Lesson Objective, you will see a Vocabulary Box that lists two vocabulary terms and their definitions. Let's look at these terms together.

- ***Remember that a variable represents a value that can change. Raise a hand to tell us which vocabulary word means the opposite of variable.*** (Constant.)

A* constant *is a value that does not change. For example, the value of the number 8 is* constant*. It does not change unless you perform a math operation such as addition or subtraction. On a number line, 8 is always after 7 and before 9. As you know, a variable is a letter that represents a value within an equation. It can change. For example, the value of* x *may be 10 in one equation and 15 in a different equation.

- ***Raise a hand to give me an example of a* constant*.***
  (Possible answers: 4, –2.75, $\sqrt{2}$)
  NOTE: Call on several students for numerous answers.

When we have to simplify an expression like 4*x *plus 5*x*, we use a process called* combining like terms*.

- ***Raise a hand to tell me how we would simplify 4*x *plus 5*x*.*** (Possible answer: Add them together to get 9x.)

- ***Raise a hand to explain why we can combine them.***
  (Because both have the same variable, or they are like terms.)

When we have an equation with variables on both sides of the equal sign, we need to use inverse operations to isolate the variable on one side of the equal sign. Remember, it is important that we always show our work when solving equations so we can keep track of what we are doing.

- ***On your dry-erase board, write the equation 7 times* x *equals 5 times* x *plus 30.*** (7x = 5x + 30)

- ***Raise a hand to tell me how to isolate the variable,* x*, on the left side of the equation?*** (Subtract 5x from both sides.)

- ***Raise a hand to tell me what would be wrong with subtracting 7*x *from both sides?*** (This would not isolate the variable. The variable and the constant would both be on the right side of the equation, and there would be zero remaining on the left side of the equation.)

- ***On your dry-erase board, show the step for subtracting 5*x *from both sides of the equation. Don't perform the operation yet, just show the step.***
  (7x – 5x = 5x – 5x + 30)
  NOTE: Students might use a different method, such as placing the operation below the equation and working vertically. Do not try to change a student's method, as long as it shows the operation being done to both sides.

Now we can **combine like terms.**

Raise a hand to tell me:

  - ***What are the like terms on the left side of the equation?***
    (7x and – 5x)

  - ***What are the like terms on the right side of the equation?***
    (5x and – 5x)

  - ***What happens to the 5*x *and the –5*x *on the right side of the equation?***
    (Possible answers: They cancel each other; they add to zero.)

- ***Raise a hand to tell me why they add to zero.***
  (They are additive inverses.)

- ***When I snap my fingers, everyone tell me what 7*x *minus 5*x *equals.***
  (2x)
  NOTE: Wait two seconds, then snap.

We know how to solve this equation! When you have a more complicated equation, the goal is always to try to get it to become a simpler equation, as we have done here. We do this by **combining like terms** ***whenever possible.***

- ***On your dry-erase board, subtract 5x from both sides.*** (2x = 30)
- ***Raise a hand to tell me the next step.*** (Divide both sides by 2.)
- ***Finish solving this equation on your dry-erase board.*** (x = 15)
- ***Raise a hand to tell me the important final step.*** (Check your answer.)

Discuss with a partner how you would check your answer. NOTE: Allow the students to discuss this step briefly. They should understand that to check the answer, they should solve the equation with the value 15 in place of the x.

Erase your dry-erase board.

- ***Now, on your dry-erase board, write the equation 7 times*** **m** ***plus 85 equals 4 times*** **m** ***plus 112.*** (7m + 85 = 4m + 112)

Notice that both sides of the equation contain variable terms and **constants**. ***We will still begin by making sure the variable occurs on only one side. Again, we are*** **combining like terms**.

- ***Raise a hand to tell me how to get all the variables on the left side.*** (Subtract 4m from both sides.)
- ***On your dry-erase board, subtract 4m from both sides of the equation, showing careful work. Write the resulting equation.*** (3m + 85 = 112)

This equation can be solved with two operations. First, we need to combine the **constants** ***in the equation, 85 and 112.***

- ***When I count to three, everyone tell me the first operation we must do to complete this equation. One, two, three!*** (Subtraction.)

Good. We must first subtract 85 from both sides. Then we can divide both sides by 3.

- ***Show your work as you solve this equation on your dry-erase board.*** (m = 9)

- ***Check your answer to see that 7 times 9 plus 85 equals 4 times 9 plus 112.*** (7(9) + 85 = 4(9) + 112; 148 = 148)

Now erase everything on your dry-erase board except the original equation, 7m plus 85 equals 4m plus 112.

- ***Everyone, show me a "thumbs up" if you think it would matter whether we isolated the variable on the right side instead of the left side.*** (Students should not put up their thumbs.)

Well, let's find out!

- ***On your dry-erase board, subtract 7m from both sides. Show your work.*** (85 = –3m + 112)

- ***Raise a hand to tell me the next step.*** (Subtract 112 from both sides.)

- ***On your dry-erase board, subtract 112 from both sides. Show your work.*** (–27 = –3m)

- ***On the count of three, everyone tell me the final step. One, two, three!*** (Divide both sides by –3.)

Look at that! The answer, 9, is the same. As long as we correctly perform an operation on both sides of an equation, we will solve it correctly.

- ***Raise a hand to tell me which way you think was easier and why.*** (Possible answer: The first way was easier because we didn't have to deal with negative numbers.)

Sometimes it will be easier to isolate the variable on the left, and sometimes it will be easier to isolate it on the right. As you practice solving these equations, you will learn which way is best.

- ***On your dry-erase board, write the equation negative 3 times r plus 7 equals negative 5 times r minus 13.*** (–3r + 7 = –5r – 13)

- ***Raise a hand to tell me what we should do first.*** (Possible answer: Add 5r to both sides.)

We could either add 5r to both sides or add 3r to both sides. Since adding 5r will give us a positive result, let's do that.

- ***On your dry-erase board, add 5r to both sides of the equation. Show your work.*** (2r + 7 = –13)

Be careful to notice that the constant that remains on the right side of the equation is negative 13, not positive 13.

- ***The variable is now on the left side of the equation. Raise a hand to tell me the next step.*** (Subtract 7 from both sides.)

- ***On your dry-erase board, subtract 7 from both sides of the equation. Show your work.*** (2r = –20)

- ***Now finish solving the equation on your dry-erase board and check your answer.*** (r = –10; –3(–10) + 7 = –5(–10) – 13; 37 = 37)

NOTE: Place the students in pairs. Name one student Partner A and the other Partner B. As they work in pairs on the following exercise, walk around to check their dry-erase boards after each step.

You will now solve equations with your partner.

- ***On Partner A's dry-erase board, write the following equation: 7 times n minus 9 equals negative 3 times n plus 21.*** (7n – 9 = –3n + 21)

- ***Partner A, complete the first step in solving the equation.***
(10n – 9 = 21)

- ***Partner B, complete the second step.*** (10n = 30)

- ***Partner A, complete the final step.*** (n = 3)

- ***Partner B, check the answer.*** (7(3) – 9 = –3(3) + 21; 12 = 12)

Now switch roles.

- ***On Partner B's dry-erase board, write the following equation: negative 5 times n plus 8 equals negative 1 times n plus 24.***
(–5n + 8 = –n + 24)

- ***Partner B, complete the first step in solving the equation.***
(8 = 4n + 24)

- ***Partner A, complete the second step.*** (–16 = 4n)

- ***Partner B, complete the final step.*** (–4 = n)

- ***Partner A, check the answer.*** (–5(–4) + 8 = –(–4) + 24; 28 = 28)

Summary/Closure:


10 mins.

A. Define Vocabulary Words

In your Student Resource Book, Lesson Twenty-Two, in the Summary/Closure section, there are some exercises dealing with today's vocabulary terms. Take a few minutes to carefully complete these exercises.

B. Summarize What We Learned Today

Let's summarize the skill that we have been working on today. In your Student Resource Book, in the Summary/Closure section, write three sample equations with variables on both sides. Then solve them. Remember to check your answers! The sample problems will be your reference sheet when you need to remember how to do these types of problems in the future.

- ***Raise a hand to share your sample problems with the class.*** NOTE: Be sure to correct all student errors and to encourage students to show complete work so they have accurate reference sheets.

C. Apply Skill

On your dry-erase board, solve the following equations, showing work and checking answers:

- ***8 times* z *plus 12 equals 3 times* z *plus 107.*** (z = 19)

- ***–6 times* y *plus 100 equals 2 times* y *plus 48.*** (y = 6.5)

- ***–13 times* x *minus 88 equals –20 times* x *plus 3.*** (x = 13)

lesson twenty-two

Fact Practice:

7 mins.

Operation: Addition

Fact Activity: _____

Count/Record Tokens:

5 mins.

Count and record tokens in the Student Resource Book.

Lesson Objective: Solve equations with variables on both sides.

Vocabulary Box

constant — A value that does not change. Examples: 4, $-6\frac{2}{3}$, π.

combining like terms — Adding or subtracting two or more terms that contain exactly the same variable, or adding or subtracting two or more constant terms. Examples: 5x + 3x = 8x and (2w – 7) + (w – 4) = 3w – 11; however, 4m + 5n cannot be simplified because the two terms are not the same.

Guided Practice

Directions: Complete the following practice problems. Your teacher will review the answers. Make sure that you show all your work, and remember to check your answers!

I. Solve each equation. You may work with a partner.

1. 2a + 17 = 4a + 9 *(a = 4)*

2. 5c – 21 = c – 37 *(c = –4)*

3. –8w + 140 = 12w *(w = 7)*

II. Work independently to solve each equation.

1. $12x - 42 = 5x + 77$ *(x = 17)*

2. $-9y - 15 = 6y + 75$ *(y = –6)*

Summary/Closure

A. Vocabulary Words

Directions: In the following list of numbers, circle the terms that are constants.

$-5 \quad 2x \quad \frac{2}{3} \quad 1 \quad -3y \quad 0 \quad \pi \quad x^2 \quad 7.75 \quad 7.7n$

($-5, \frac{2}{3}$, 1, 0, π, and 7.75)

Directions: Draw lines connecting groups of like terms. Then combine like terms to make a number sentence.

6a	–7b
10	5c
3b	–a
4c	–4

(6a and –a; 3b and –7b; 4c and 5c; 10 and –4; 5a –4b + 9c +6)

B. Summarize What We Learned Today

Directions: Write three sample equations with variables on both sides and solve them. Remember to check your answers! Then write a few sentences explaining how to solve these equations. You will use this explanation as a personal reminder. *(Answers will vary.)*

lesson twenty-two – student resource sheet

Lesson Objective: Solve equations with variables on both sides.

Vocabulary Box

constant — a value that does not change. Examples: 4, $-6\frac{2}{3}$, π.

combining like terms — Adding or subtracting two or more terms that contain exactly the same variable, or adding or subtracting two or more constant terms. Examples: 5x + 3x = 8x and (2w – 7) + (w – 4) = 3w – 11; however, 4m + 5n cannot be simplified because the two terms are not the same.

Guided Practice

Directions: Complete the following practice problems. Your teacher will review the answers. Make sure that you show all your work, and remember to check your answers!

I. Solve each equation. You may work with a partner.

1. 2a + 17 = 4a + 9

2. 5c – 21 = c – 37

3. –8w + 140 = 12w

II. Work independently to solve each equation.

1. $12x - 42 = 5x + 77$

2. $-9y - 15 = 6y + 75$

Summary/Closure

A. Vocabulary Words

Directions: In the following list of numbers, circle the terms that are constants.

$-5 \quad 2x \quad \frac{2}{3} \quad 1 \quad -3y \quad 0 \quad \pi \quad x^2 \quad 7.75 \quad 7.7n$

Directions: Draw lines connecting groups of like terms. Then combine like terms to make a number sentence.

6a	–7b
10	5c
3b	–a
4c	–4

lesson twenty-two – student resource sheet

B. Summarize What We Learned Today

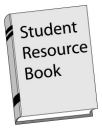
Directions: Write three sample equations with variables on both sides and solve them. Remember to check your answers! Then write a few sentences explaining how to solve these equations. You will use this explanation as a personal reminder.

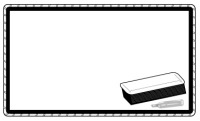
lesson twenty-eight

LESSON OBJECTIVE:
Determine the slope when given the equation for a line.

Introduction	Direct Skill Instruction and Guided Practice	Summary/Closure	Fact Practice
5 mins.	25 mins.	10 mins.	7 mins.

Lesson:





- ❑ Student Resource Books: Student Resource Sheets (Lesson 28)
- ❑ Dry-erase boards and dry-erase markers
- ❑ Graph paper
- ❑ Ruler, 1 per student

Fact Practice:

(Select one of these sets of materials for the Math Facts Games.)

- ❑ Individual Student Flashcards
- ❑ Buzz
- ❑ Math War or Salute!
  - Playing cards
- ❑ Soccer Ball Facts
  - Soccer ball
- ❑ Math Scramble
  - Index cards, each with a number 0–9; cards with the operations
- ❑ BINGO
  - Flashcards
  - BINGO boards, and tokens or colored squares
- ❑ Around the World
  - Triangle or regular flashcards

Vocabulary Definitions:

This lesson assumes that students know the following vocabulary words:

- table of values
- coordinate plane
- linear equation
- graph of a function
- distributive property

slope — The steepness of a line expressed as a ratio, using any two points on the line.
Example: In $y = \frac{1}{2}x + 6$, $\frac{1}{2}$ is the slope.

y-intercept — The value of *y* at a point where the line crosses the *y*-axis.
Example: In $y = \frac{1}{2}x + 6$, 6 is the *y*-intercept.

Welcome:


3 mins.

Greet students by name and take attendance.

Introduction:


5 mins.

A. Access Prior Knowledge
NOTE: Write y = 3x – 1 on your board.

- ***Everyone, show me a "thumbs up" if you think the equation on my board is a linear equation.*** (Students should put up their thumbs.)
- ***Raise a hand to tell me what type of table we should create in order to graph the line in the coordinate plane.*** (A table of (x, y) values.)
- ***On your dry-erase board, create and complete a table of values for the line represented by the equation. For the*** x ***values use –1, 0, 1, and 2.***
  (y values: –4, –1, 2, and 5, respectively)

Plot these on your graph paper:

- ***Prepare a coordinate plane.***
  (Horizontal x-axis and vertical y-axis intersect at the origin.)
  NOTE: Check for appropriate coordinate planes, including axis labels.
- ***Graph the four (***x, y***) points from the table of values.***
  ((–1, –4), (0, –1),(1, 2), and (2, 5) graphed correctly.)
- ***Use your ruler to graph the line through these points.***
  (Correctly drawn straight line, including arrows.)

This line is the graph of the function represented by the linear equation y ***equals 3 times*** x ***minus 1.***

lesson twenty-eight

B. Explain Connection to New Skill

You already know how to create a table of (x, y) values for a given linear equation, and you know how to graph its function.

C. State Lesson Objective

During today's lesson, we are going to determine the* slope *when given the equation for a line.

Direct Skill Instruction and Guided Practice:

In your Student Resource Book, below the Lesson Objective, you will see a Vocabulary Box that lists two vocabulary words and their definitions. Let's look at these words together.

Today, we will learn about the concept of* slope*. Slope is an important number that is used in determining the graph of a linear function.

- ***Raise a hand to define* slope*.***
  (The steepness of a line expressed as a ratio, using any two points on the line.)

Another important number that is used in determining the graph of a linear function is the* y-intercept*.

- ***Raise a hand to define* y-intercept *for us.***
  (The value of y at the point where a line crosses the y-axis.)

Let's look at the graph that you drew for the linear equation* y *equals 3 times* x *minus 1. Find the point at which the line crosses, or intercepts, the* y*-axis. The* y*-intercept is the value of* y *at this particular point.

- ***Raise a hand to tell me the* y*-intercept of this line.*** (–1)

Correct, the line crosses the* y*-axis at the point (0, –1), so the* y*-intercept is simply the* y *value, –1. We can always find the* y*-intercept value of any line by using 0 as the* x *value. This makes sense because if* x *equals 0, we will always be somewhere along the* y*-axis.

As we follow this line from left to right, we first come to the point (–1, –4) on the coordinate plane. Then we come to the point (0, –1).

Let's look at how we travel from the first point to the second point. In order to move from point to point, we travel vertically or horizontally, not diagonally.

- ***Raise a hand to answer: How many units do you move up?*** (Three.)

- ***Raise a hand to answer: How many units do you move to the right?*** (One.)

The number of units that you move up or down represents the change in y ***because you are moving along the*** y***-axis. A move upward is a positive change in*** y***, and a move downward is a negative change in*** y**.**

The number of units that you move left or right represents the change in x**.** ***A move to the right is a positive change in*** x***, and a move to the left is a negative change in*** x**.**

These two facts can be written as the ratio of the change in y ***over the change in*** x**.** NOTE: Write this ratio on your board.

- ***Raise a hand to tell me what this ratio is for the line that we are examining.*** (3 over 1.)

Yes, that is correct, although we often state this simply as 3**.** ***We moved up three units and to the right one unit. Look again at our linear equation,*** y ***equals 3 times*** x ***minus 1.***

- ***Raise a hand to tell me what number in the equation for this line appears just before the*** x**.** (3)

Correct! When the equation of a line is written in this form, the number in front of the x ***is the*** **slope** ***of the line. The*** **slope** ***of the line is the ratio change in*** y ***over change in*** x**.** ***This is also referred to as the rise, the change in the vertical direction, over the run, the change in the horizontal direction. In this particular equation, the*** **slope** ***equals 3 over 1, that is, 3.***

For a particular line, the **slope** ***between any two points will be the same. Use your finger to trace the path from point (–1, –4) to point (2, 5). You can see that we move nine units up and three units to the right.***

- ***On the count of three, everyone tell me the simplest form for the ratio 9 over 3. One, two, three!*** (3)

Notice that the **slope** ***is the same between any two points on a line.***

lesson twenty-eight

- ***On your dry-erase board, write the equation*** **y** ***equals*** $-\frac{2}{3}$ ***times*** **x** ***minus 1.*** $\left(y = -\frac{2}{3}x - 1\right)$

Raise a hand to tell me:

- ***What is the*** **slope** ***of this line?*** $\left(-\frac{2}{3}\right)$
- ***How do we know this is the*** **slope*****?***
  (It is the number written before ***x***.)
- ***What is the*** ***y*****-intercept*****?*** (–1)
- ***How do we know this is the*** ***y*****-intercept*****?***
  (When x equals 0, y equals –1.)
  NOTE: If students have trouble with this, show them the solution to the equation with 0 as the ***x*** value on your board.

When you make a table of values to graph a line, it is easiest to use values for x ***that are multiples of the denominator of the*** **slope.**

- ***When I snap my fingers, everyone tell me the denominator of the*** **slope.**
  (3)
  NOTE: Wait a couple of seconds, then snap.
- ***Raise a hand to tell me four good values to choose for*** x**.**
  (Any multiple of 3, such as –3, 0, 3, and 6.)

Let's all use –3, 0, 3, and 6 for our x ***values.***

- ***On your graph paper, graph the line represented by this equation.*** (An appropriately labeled graph of the line including the points: (–3, 1), (0, –1), (3, –3), and (6, –5).)
- ***On your graph paper, starting at point (–3, 1), use a finger to follow the path from one point to another. Make sure you use horizontal and vertical movements, not diagonal movements.***
  (Students should follow a path of two units down and three units to the right between each point.)

Notice that this line has a negative **slope.** ***Any line that goes down and to the right has a negative*** **slope,** ***and any line that goes up and to the right has a positive*** **slope.**

- ***When I point toward you, everyone tell me the* slope *of the line for the equation* y *equals – 2 times* x *plus 3.*** (–2)
  NOTE: Wait about three seconds, then point toward the class.

- ***On your dry-erase board and graph paper, complete all the steps for graphing this line. Use four points for (*x, y*) values.***
  (An appropriately labeled graph of the line including four (x, y) points with correct values.)

- ***Discuss with a partner why the line you graphed has a* slope *of –2.***
  (Possible answer: Negative 2 as a ratio is –2 over 1. In order to move from one point to the next, you move down two units and to the right one unit.)
  NOTE: Circulate to make sure students are having accurate discussions.

***All of the equations that we have used so far are called* slope-*intercept form, or* y *equals* m *times* x *plus* b*, where* m *is the slope and* b *is the* y-intercept.**
NOTE: Write y = mx + b on your board. Point out that the y is isolated on the left side, and that if x equals 0, b will equal the y-intercept.

***If an equation is not in this form, we have to change it into this form before we can find the* slope.**

- ***On your dry-erase board, write the equation 2 times* y *equals –6 times* x *plus 10.*** (2y = –6x + 10)

- ***Raise a hand to tell me what to do in order to isolate the* y *on the left side of the equation.*** (Divide both sides by 2.)

Remember, when we divide both sides by a number, the distributive property requires that we divide all terms.

- ***On your dry-erase board, divide all the terms by 2. Hold up your dry-erase board when you are finished.*** (y = –3x + 5)
  NOTE: Check all dry-erase boards for accuracy. If some students have incorrect work, review the division steps.

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Good. Now we have the equation written in* slope-*intercept form.

- ***When I snap my fingers, everyone tell me the* slope *of the line.*** (–3)
  NOTE: Wait two seconds, then snap.

- ***Raise a hand to tell me the* y-intercept.** (5)

Great job! Let's try another equation.

- ***On your dry-erase board, write the equation –4 times* x *plus* y *equals –3.*** (–4x + y = –3)
- ***Raise a hand to tell me what to do to both sides of the equation to isolate the* y.** (Add 4x to both sides.)
- ***Remembering what you know about like terms, on your dry-erase board, show how to add 4x to both sides.*** (y = 4x – 3)
- ***When I snap my fingers, everyone tell me the* slope *of this line.*** (4)
  NOTE: Wait a moment, then snap.
- ***On the count of two, everyone tell me the y-intercept. One, two!*** (–3)

Good job! In your Student Resource Book, complete the problems in the Guided Practice section, Lesson Twenty-Eight.

Summary/Closure:

A. Define Vocabulary Words

In your Student Resource Book, Lesson Twenty-Eight, in the Summary/Closure section, there are some questions dealing with today's vocabulary words. Take a few minutes to carefully complete these questions.

B. Summarize What We Learned Today

Let's summarize the skill that we have been working on today. In your Student Resource Book, in the Summary/Closure section, write three sample equations and find the* slope *of each equation. Be sure that at least two of your sample equations are not originally in* slope*-intercept form. Then write a few sentences explaining how to find the* slopes *for these equations. The examples will be your reference sheet when you need to remember how to do these types of problems in the future.

- ***Raise a hand to share your sample problems with the class.***
  NOTE: Be alert to correct all student errors and to encourage students to show complete work so that they have accurate reference sheets.

C. Apply Skill

On your dry-erase board, find the* slope *of the line represented by each of the following equations:

- $y = -7x - 2$ (–7)
- $y - 2x = 3x + 4$ (5)
- $12x + 3y = 21$ (–4)

NOTE: Write out each equation on your board as you read them to the class.

Fact Practice:

7 mins.

Operation: Subtraction

Fact Activity: _____

Count/Record Tokens:

5 mins.

Count and record tokens in the Student Resource Book.

lesson twenty-eight – teacher resource sheet

Lesson Objective: Determine the slope when given the equation for a line.

Vocabulary Box

slope — The steepness of a line expressed as a ratio, using any two points on the line.
Example: In $y = \frac{1}{2}x + 6$, $\frac{1}{2}$ is the slope.

***y*-intercept** — The value of y at a point where the line crosses the *y*-axis.
Example: In $y = \frac{1}{2}x + 6$, 6 is the *y*-intercept.

Guided Practice

Directions: Complete the following practice problems. Your teacher will review the answers. Make sure that you show all your work.

I. Work with a partner to find the slope of the line that is represented by each equation.

1. $y = \frac{5}{2}x - 3$ $\left(\frac{5}{2}\right)$
2. $y = -1.3x + 0.8$ *(–1.3)*
3. $y = x$ *(1)*
4. $-8y = 4x - 24$ $\left(-\frac{1}{2}\right)$

II. Work independently to find the slope of the line that is represented by each equation.

1. $5x + 5y = 20$ *(–1)*
2. $-4x - 7y = -9x + 42$ $\left(\frac{5}{7}\right)$

Summary/Closure

A. Vocabulary Words
Directions: Answer the following questions about today's vocabulary words.

1. What is the slope of the line represented by the equation y = –5x + 4? *(–5 or $\frac{-5}{1}$)*

2. Describe the vertical and horizontal movement of the line with this slope when it is graphed on a coordinate plane.
   (Possible answer: Between any two points on this line, you move down five units and right one unit.)

3. What is the *y*-intercept of this line? *(4)*

4. Explain how you found the *y*-intercept.
   (Possible answer: I found the value of y when x equals 0. This is where the line crosses the y-axis.)

B. Summarize What We Learned Today
Directions: Write three sample equations and find the slope of each. Be sure that at least two of your sample equations are not originally in slope-intercept form. Then write a few sentences explaining how to find the slopes for these equations. You will use this explanation as a personal reminder. *(Answers will vary.)*

lesson twenty-eight – student resource sheet

Lesson Objective: Determine the slope when given the equation for a line.

Vocabulary Box

slope — The steepness of a line expressed as a ratio, using any two points on the line.
Example: In $y = \frac{1}{2}x + 6$, $\frac{1}{2}$ is the slope.

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I. Work with a partner to find the slope of the line that is represented by each equation.

1. $y = \frac{5}{2}x - 3$

2. $y = -1.3x + 0.8$

3. $y = x$

4. $-8y = 4x - 24$

II. Work independently to find the slope of the line that is represented by each equation.

1. $5x + 5y = 20$

2. $-4x - 7y = -9x + 42$

Summary/Closure

A. Vocabulary Words

Directions: Answer the following questions about today's vocabulary words.

1. What is the slope of the line represented by the equation $y = -5x + 4$?

2. Describe the vertical and horizontal movement of the line with this slope when it is graphed on a coordinate plane.

3. What is the *y*-intercept of this line?

4. Explain how you found the *y*-intercept.

lesson twenty-eight – student resource sheet

B. Summarize What We Learned Today

Directions: Write three sample equations and find the slope of each. Be sure that at least two of your sample equations are not originally in slope-intercept form. Then write a few sentences explaining how to find the slopes for these equations. You will use this explanation as a personal reminder.