Multiplication Properties of Exponents

Grade Level and Content

8th grade Algebra

Big Idea

Students discover the multiplication properties of exponents through three launch-explore-summarize activities. Each activity involves students in a *think pair share* group activity as they make and share conjectures about the properties. Selected pairs share their conjecture before practicing each property.

Objectives

Students will be able to …

1. Use multiplication properties of exponents to evaluate and simplify expressions.

PA State Standards

A1.1.1.5.3: Simplify/reduce a rational algebraic expression.

A1.1.1.3.1: Simplify/evaluate expressions involving properties/laws of exponents, roots and/or absolute value to solve problems (exponents should be integers from -10 to 10).

Rationale for Students

The multiplication properties of exponents are necessary for students to proceed to more advanced math. The three exploration activities are designed for students to discover the properties on their own. This alone can be motivational for some students.

Materials

- 1 promethean board with computer
- 25 copies each: Simplifying Exponential Expressions graphic organizer

Adaptations for Special Needs

The graphic organizer is designed to help students understand how to determine if an expression is simplified or not. This will be particularly beneficial for the ELL student, who has benefited from other graphic organizers.

Technology

The promethean board will be used to present the lesson and enables the teacher and the students to work out solutions together. Students have access to online tutorials for each section so they can review concepts and have guided practice at home. All assignments will be posted on the class website so students who miss class won't fall behind.

Anticipatory Set — 5 minutes, 5 minutes

Students look at a real-life application problem that they can solve now but will understand better after learning the multiplication properties of exponents.

Yesterday we reviewed scientific notation, which is writing large and small numbers as products of powers of ten. What do you think we need to do to solve this problem? Take a minute to set up the equation.

If we multiply 8.7 by 344, we have 2992.8×10^5. Is that in scientific notation? What do we do to put it into scientific notation?

Procedure — 35 minutes, 40 minutes

Activity 1 — 10 minutes, 15 minutes

LAUNCH

Today, we are going to continue simplifying expressions with exponents. The target is to use multiplication properties of exponents to evaluate and simplify expressions. We are going to explore patterns to find out what those properties are. I have three activities for you, one for each property.

If you have already started your notes with today's target, you can start completing this table. Take a few minutes on your own to complete each statement. Look at how the first one is done and model the rest after it. The object is to expand the exponential term and then to rewrite it in a reduced form.

EXPLORE

THINK Students individually complete a table to reveal the pattern involved with multiplying powers with like bases.

PAIR Students work with their seat partners to make a conjecture about the general property they will use to simplify product of powers expressions.

SHARE Students share their conjectures.

SUMMARIZE

Student reads the Product of Powers Property and Applying the Property statements:

- The product of two powers with the same base equals that base raised to the sum of the exponents.
- If the powers have the same base, keep the base and add the exponents.

What do you think we would do if we were multiplying three powers with the same base? Four?

PRACTICE

After learning the logic behind the properties for simplifying expressions with zero and negative integer exponents, you learned that you needed to be able to simplify quickly. That is what we need to do with these new properties. You are not going to expand the expressions to determine the simplified version. You are just going to apply the property.

Toss the Ball

Each student with the ball simplifies the expression and tosses the ball to another student to do the same. This happens quickly.

Activity 2 10 minutes, 25 minutes

LAUNCH

We are going to switch seat partners. Listen to my instructions. Don't move until I tell you. *Select rows to switch and instruct.*

There are two more properties. In your notes, complete this table using the first example as a template. Do this on your own. After you complete the table, you can discuss it with your partner.

EXPLORE

THINK Students individually complete a table to reveal the pattern involved with raising a power to a power.

PAIR Students work with their seat partners to make a conjecture about the general property they will use to simplify power of a power expression.

SHARE Students share their conjectures.

SUMMARIZE

Student reads the Power of a Power Property and Applying the Property statements:

- A power raised to another power equals that base raised to the product of the exponents.
- If a power is being raised to another power, keep the base and multiply the exponents.

PRACTICE

Let's do some of these quickly.

Toss the Ball

Each student with the ball simplifies the expression and tosses the ball to another student to do the same. This happens quickly.

Activity 3 10 minutes, 35minutes

LAUNCH

We are going to switch seat partners one more time for our last property. Listen to my instructions. Don't move until I tell you. *Select rows to switch and instruct.*

On your own again, take a few minutes to complete this table using the first example as a template.

EXPLORE

THINK Students individually complete a table to reveal the pattern involved with powers of products.

PAIR Students work with their seat partners to make a conjecture about the general property they will use to simplify powers of products expressions.

SHARE Students share their conjectures.

SUMMARIZE

Student reads the Power of a Product Property and Applying the Property statements:

- A product raised to a power equals the product of each factor raised to that power.
- If a product is being raised to a power, separate the factors and raise each to that power.

PRACTICE

Let's do some of these quickly.

Toss the Ball

Each student with the ball simplifies the expression and tosses the ball to another student to do the same. This happens quickly.

Guided Practice 5 minutes, 40 minutes

Do you remember 'The Beast'? That problem requires all of the exponent properties that we will be discussing in chapter 7. We learned three properties today. We will learn the three division properties next week. You will have to be able to

put all of these properties together to complete ‘The Beast’. Let’s practice some ‘Baby Beast’ problems using all of the properties so far.

Closing 5 minute, 45 minutes

Here’s the problem you saw at the beginning of the lesson. Let’s review it in a bit more detail so you can see the multiplication properties at work.

Exit Ticket

Homework