**SUPPLEMENTAL INSTRUCTION ACTIVITY**

**TOPIC: Exponents**

**APPLICABLE COURSES:** All math courses starting from Math 058/059and other courses in other disciplines.

**LEARNING OUTCOME:** (What will students be able to do by the end of the workshop?)

After completing this workshop, students should be able to simplify exponential expressions by using the properties of exponents.

**CONTENT:** (What do students need to know to accomplish the outcome?)

1. Define an exponential expression
2. Simplify exponential expression by using the product property of exponents.
3. Simplify exponential expressions by using the power property of exponents.
4. Simplify exponential expressions by using the quotient property of exponents.
5. Simplify/Evaluate exponential expressions using the definitions of zero and negative exponents.
6. Simplify exponential expressions by using more than one property of exponents.

**METHOD:** (How will the instructor deliver content? Short lecture, handouts, Powerpoint, other audio-visual presentation)

Short lecture followed by active learning exercise and worksheet (40 minutes)

* Teach 1, 2, and 3 (10 minutes)

Practice 1, 2, and 3 (10 minutes)

* Teach 4, 5, and 6 (10 minutes)

Practice 4, 5, and 6 (10 minutes)

* The lesson is divided into segments composed of lecture and examples followed by student practice and sharing.
* First, the instructor distributes the exercise worksheet and any supporting handouts.
* Then the instructor presents segment 1, 2, and 3 (Definition of an exponential expression, simplifying exponential expressions by using the product and power properties).
* After this brief lecture with examples, students individually think about how they will solve the set of problems for these segments (2 min), and then complete them (5min).
* Next, in pairs, students each take a turn to explain to their partner how they solved one of the problems (3 min). At the end of this 10-minute segment, the instructor posts the solutions/answers on the screen/white board for students to check their work.
* Follow the same lecture/practice procedure for segments 4, 5, and 6 (Simplifying exponential expressions using the quotient property, the definitions of zero and negative exponents, and by using more than one property of exponents).

Note: If time is short, only one student explains his/her process to the partner for each segment of the lesson, taking turns for each segment.

**ACTIVE LEARNING STRATEGIES:** (How will students apply their knowledge? Solve a problem, create a project, analyze a case, and explain a process)

Students reflect on the exercises and teach each other by verbalizing the steps they took to reach their conclusions.

**ASSESSMENT METHOD:** (How will the instructor know that the students met the outcome? Check for understanding. )

(15 minutes.)

Students complete a quiz where they are asked simplify different expressions involving exponents. After completing the quiz, the instructor posts the solutions/answers on the screen/white board. Students check their results. The instructor can also look over the quizzes while the students are completing the self-reflection activity to give feedback to students.  
If students do not successfully complete the worksheet quiz, they may be referred to individual tutoring or a guided learning activity.

**SELF-REFLECTION ACTIVITY:** (What will the instructor do to get students to reflect on how they learned the content? What they learned, how they learned it, how they will apply it in their coursework)

(5 minutes.)

-Which segment of the exponential expressions was most challenging for you?

-What steps are you going to take to learn this subject?

|  |  |
| --- | --- |
| ***Exponents***  **Handout** | **Name: Date:** |

**Objective: Simplifying Exponential Expressions Using the Properties of Exponents**

**Segment 1**: **Definition of an Exponential Expression**

Given a real number ***a*** and ***n*** natural number, we define



***n factors***In the expression the number ***a*** is the base, and ***n*** is the exponent or power to which the base is raised.

**Segment 2: Simplifying Exponential Expressions Using the Product Property of Exponents**

**Product Property of Exponents**

If ***x*** is any real number and ***m*** and ***n***are natural numbers, then

When multiplying exponential expressions with the same base, retain the common base and add the exponents. Use this sum as the exponent of the common base.



**Example 1 **

**Example 2** 

**Segment 3: Simplifying Exponential Expression Using the Power Property of Exponents**

**Power Property for Powers of Exponential Expressions**

If ***x*** is any real number and ***m*** and ***n***are natural numbers, then

When an exponential expression is raised to a power, retain the base and multiply the exponents. Place the product of the exponents on the base and remove the parentheses.



**Example 3 **

**Example 4** 

**Power Property for Powers of Products**

If ***x*** and *y* are any real numbers ***m***isa natural number, then

When a product is raised to a power, then each factor in the product is raised to that power.

**Warning: ** (When a sum is raised to a power, the definition of an exponent and polynomial multiplication must be used.)



**Example 5 **

**Example 6** 

**Practice 1** The expression is written in \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_form, where 10 is the \_\_\_\_\_\_\_\_\_\_\_\_\_ and 4 is the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

**Practice 2** ****

**Practice 3** ****

**Practice 4** ****

**Segment 4: Simplifying Exponential Expression Using the Quotient Property of Exponents**

**Quotient Property of Exponents**

If ***x*** is any nonzero real number and ***m*** and ***n***are natural numbers, then

When dividing exponential expressions with the same nonzero base, retain the common base and subtract the exponent in the denominator from the exponent in the numerator. Use this difference as the exponent of the common base.



**Example 7 **

**Example 8 **

**Power Property for Powers of Quotients**

If ***x*** and *y* are any real numbers, such that  and ***m***isa natural number, then

When a quotient is raised to a power, then both the numerator and denominator are raised to that power.



**Example 10 **

**Example 11 **

**Segment 5: Simplifying/Evaluating Exponential Expression Using the Definitions of Zero and Negative Exponents**

**Definition of a Negative Exponent**

If ***x*** and ***y*** are any nonzero real numbers and ***n*** is any natural number, then

**Definition of a Zero Exponent**

If ***x*** is any nonzero real number,





**Example 12 **

**Example 13 **

**Example 14 **

**Example 15 **

**Segment 6: Simplifying Exponential Expression Using More Than One Property of Exponents**

**Example 16** 

**Example 17 **

**Practice 5** 

**Practice 6 **

**Practice 7** ****

**Practice 8 **

**SELF-REFLECTION**

-Which segment of the exponential expressions was most challenging for you?

-What steps are you going to take to learn this subject?

|  |  |
| --- | --- |
| ***Exponents***  **Handout-*Answers*** | **Name: Date:** |

**Objective: Simplifying Exponential Expressions Using the Properties of Exponents**

**Segment 1**: **Definition of an Exponential Expression**

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**Segment 2: Simplifying Exponential Expressions Using the Product Property of Exponents**

**Product Property of Exponents**

If ***x*** is any real number and ***m*** and ***n***are natural numbers, then

When multiplying exponential expressions with the same base, retain the common base and add the exponents. Use this sum as the exponent of the common base.



**Example 1  **

**Example 2** 

**Segment 3: Simplifying Exponential Expression Using the Power Property of Exponents**

**Power Property for Powers of Exponential Expressions**

If ***x*** is any real number and ***m*** and ***n***are natural numbers, then

When an exponential expression is raised to a power, retain the base and multiply the exponents. Place the product of the exponents on the base and remove the parentheses.



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When a product is raised to a power, then each factor in the product is raised to that power.

**Warning: ** (When a sum is raised to a power, the definition of an exponent and polynomial multiplication must be used.)



**Example 5 **

**Example 6** 

**Practice 1** The expression is written in \_\_\_\_exponential\_\_\_\_form, where 10 is the \_\_\_base\_\_\_\_ and 4 is the \_\_\_exponent\_\_\_\_.

**Practice 2** ****

**Practice 3** ****

**Practice 4** ****

**Segment 4: Simplifying Exponential Expression Using the Quotient Property of Exponents**

**Quotient Property of Exponents**

If ***x*** is any nonzero real number and ***m*** and ***n***are natural numbers, then

When dividing exponential expressions with the same nonzero base, retain the common base and subtract the exponent in the denominator from the exponent in the numerator. Use this difference as the exponent of the common base.



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When a quotient is raised to a power, then both the numerator and denominator are raised to that power.



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**egment 5: Simplifying/Evaluating Exponential Expression Using the Definitions of Zero and Negative Exponents**

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If ***x*** and ***y*** are any nonzero real numbers and ***n*** is any natural number, then

**Definition of a Zero Exponent**

If ***x*** is any nonzero real number,





**Example 12 **

**Example 13 **

**Example 14 **

**Example 15 **

**Segment 6: Simplifying Exponential Expression Using More Than One Property of Exponents**

**Example 16** 

**Example 17 **

**Practice 5** 

**Practice 6 **

**Practice 7** ****

**Practice 8 **

|  |  |
| --- | --- |
| ***Exponents***  **Quiz** | **Name: Date:** |

1.  1. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
2.  2. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
3.  3. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
4.  4. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
5.  5.\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
6. **** 6**.\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

|  |  |
| --- | --- |
| ***Exponents***  **Quiz-***Answers* | **Name: Date:** |

1. 
2. 
3. 
4. 
5. 
6. ****