

Exponent Rules

ID: 9730

 Time required
 30 minutes

Activity Overview

This activity allows students to work independently to discover rules for working with exponents, such as the Power of a Power rule. Students also investigate the value of a power whose exponent is zero or negative. As an optional extension, students investigate the value of a power whose exponent is a fraction with a numerator of one.

Topic: Polynomials

- Use technology to verify for various values of a and n that $a^{-n} = \frac{1}{a^n}$ where n is an integer.
- Evaluate simple numerical expressions raised to integral exponents (including zero exponents).
- Use technology to evaluate more complex numerical expressions involving exponents.

Teacher Preparation and Notes

- *This activity is designed to be used in an Algebra 1 classroom. It can also be used in a Pre-Algebra classroom, or by any student learning the rules for operating with exponents.*
- *Students should already be familiar with basic powers, exponents, and bases, such as $2^3 = 8$.*
- *While students can use the Home screen at any time, you may wish to review the positive powers of two before beginning this activity (2, 4, 8, 16, 32, 64...).*
- *Before beginning the activity, clear out all functions from the $\boxed{Y=}$ screen and turn off all stat plots.*
- *Information for an optional extension is provided at the end of this activity. Should you not wish students to complete the extension, you may have students disregard that portion of the worksheet.*
- **To download the EXPRULES program and student worksheet, go to education.ti.com/exchange and enter "9730" in the keyword search box.**

Associated Materials

- *ExponentRules_Student.doc*
- *EXPRULES.8xp (program)*

Suggested Related Activities

To download any activity listed, go to education.ti.com/exchange and enter the number in the keyword search box.

- *Explore Order of Operations (TI-84 Plus family) — 6333*
- *Number Sense (TI-84 Plus family) — 2143*

Discovering Exponent Rules

For this activity, students will use the program **EXPRULES** to make conjectures about expressions with exponents. The program can be selected from the menu when students press **PRGM**.

To begin, choose **Experiment**, then type **1** to explore Rule 1. For this rule, students can input values for x and y but cannot change the values of the bases, they remain set at 2.

The program will calculate the expression for the values of x and y entered by the student. They should make and test a conjecture, recording the rule on the worksheet once they think they have figured it out.

Students are to repeat this process to explore rules 2 – 6. They should pay close attention to the prompts, as they are different for several of the rules.

NOTE: To exit a rule, press **ON** and select **Quit**.

Then once on the home screen, press **ENTER** immediately to select run the program again and select another rule.

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EXPRULES
1: Experiment
2: ViewLastRound
3: Exit
    
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Rule 1      2^x * 2^y = ?
2^1 * 2^1 = 4
2^1 * 2^2 = 8
2^2 * 2^1 = 8
2^2 * 2^2 = 16
    
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- Rule 1: product of two powers with like bases $b^x \times b^y = b^{(x+y)}$
- Rule 2: quotient of two powers with like bases $\frac{b^x}{b^y} = b^{(x-y)}$
- Rule 3: power of a power $(b^x)^y = b^{(x \cdot y)}$
- Rule 4: power with a negative exponent $b^{-x} = \frac{1}{b^x}$
- Rule 5: power with a zero exponent $b^0 = 1$
- Rule 6: power of a quotient $\left(\frac{a}{b}\right)^x = \frac{a^x}{b^x}$

After students have determined rules for all 6 experiments, discuss them as a class. Help students to see that for the rules, the values of the bases can be changed and the rule will remain the same.

Extension

Students are to use the Home screen to evaluate each of the expressions with a fractional exponent. Then they will make a conjecture for $m^{\frac{1}{n}}$.

$$36^{\frac{1}{2}} = 6$$

$$8^{\frac{1}{3}} = 2$$

$$49^{\frac{1}{2}} = 7$$

$$16^{\frac{1}{2}} = 4$$

$$16^{\frac{1}{4}} = 2$$

Students should conjecture easily that $m^{\frac{1}{2}} = \sqrt{m}$, but they may need help to see that $m^{\frac{1}{n}} = \sqrt[n]{m}$.

If using Mathprint OS:

When students press the \wedge key, the cursor will move to the exponent position. They can either type 1 $\frac{\square}{\square}$ 2 or press \square [ALPHA] [F1], select **n/d**, type 1 in the top of the fraction, press \square to move to the bottom, and type 2. For either way, students can press \square [ENTER] while still in the exponent.

