Lesson Plan

A.SSE.B.3c: Use Properties of Exponents to Transform Expressions

EQUATIONS AND INEQUALITIES

A.SSE.B.3c: Use Properties of Exponents to Transform Expressions

B. Write expressions in equivalent forms to solve problems.

3. Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression.

c. Use the properties of exponents to transform expressions for exponential functions. *For example the expression* $(1.15)^t$ *can be rewritten as* $\left(1.15^{\frac{1}{12}}\right)^{12t} \approx 1.012^{12t}$ *to reveal the approximate equivalent monthly interest rate if the annual rate is* 15%.

Overview of Lesson

- activate prior knowledge and review learning objectives (see above)

- explain vocabulary and/or big ideas associated with the lesson

- connect assessment practices with curriculum

- model an assessment problem and solution strategy

- facilitate guided discussion of student activity

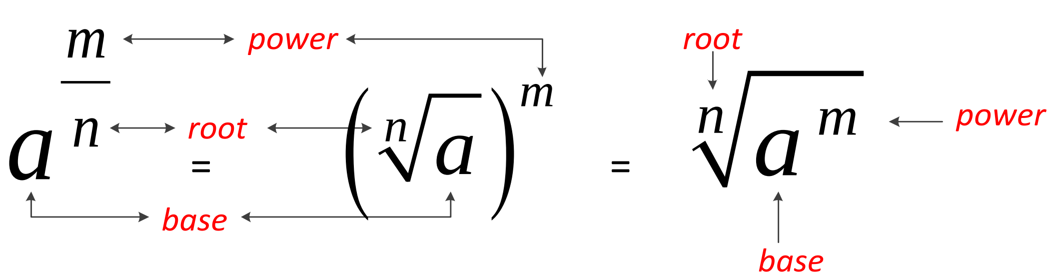
- facilitate guided practice of student activity

Selected problem set(s)

- facilitate a summary and share out of student work

Homework – Write the Math Assignment

Big Ideas



Rules for Rational Exponents:

Rule: For any nonzero number a, $a^0 = 1$, and $a^{-n} = \frac{1}{a^n}$

Rule: For any nonzero number a and any rational numbers m and n, $a^m \cdot a^n = a^{m+n}$

Rule: For any nonzero number a and any rational numbers m and n, $(a^m)^n = a^{mn}$

Rule: For any nonzero numbers a and b and any rational number n $(ab)^n = a^n b^n$

Rule: For any nonzero number a and any rational numbers m and n, $\frac{a^m}{a^n} = a^{m-n}$

A number is in **scientific notation** if it is written in the form $a \times 10^n$, where n is an integer and $1 \le |a| < 10$

REGENTS PROBLEMS TYPICAL OF THIS STANDARD

1. The growth of a certain organism can be modeled by $C(t) = 10(1.029)^{24t}$, where $C(t)$ is the total number of cells after *t* hours. Which function is approximately equivalent to $C(t)$?
   a. $C(t) = 240(.083)^{24t}$
   b. $C(t) = 10(.083)^{t}$
   c. $C(t) = 10(1.986)^{t}$
   d. $C(t) = 240(1.986)^{\frac{t}{24}}$

2. Miriam and Jessica are growing bacteria in a laboratory. Miriam uses the growth function $f(t) = n^{2t}$ while Jessica uses the function $g(t) = n^{4t}$, where *n* represents the initial number of bacteria and *t* is the time, in hours. If Miriam starts with 16 bacteria, how many bacteria should Jessica start with to achieve the same growth over time?
   a. 32
   b. 16
   c. 8
   d. 4

3. Jacob and Jessica are studying the spread of dandelions. Jacob discovers that the growth over *t* weeks can be defined by the function $f(t) = (8) \cdot 2^t$. Jessica finds that the growth function over *t* weeks is $g(t) = 2^{t+3}$.

   Calculate the number of dandelions that Jacob and Jessica will each have after 5 weeks.

   Based on the growth from both functions, explain the relationship between $f(t)$ and $g(t)$.

A.SSE.B.3c: Use Properties of Exponents to Transform Expressions
Answer Section

1. ANS: C

   Step 1. Understand that this problem wants you to find the function in the answer choices that is equivalent to $C(t) = 10(1.029)^{24t}$.

   Step 2. Strategy. Use properties of exponents to rewrite the expression.

   Step 3. Execute the strategy.

   $$C(t) = 10(1.029)^{24t}$$

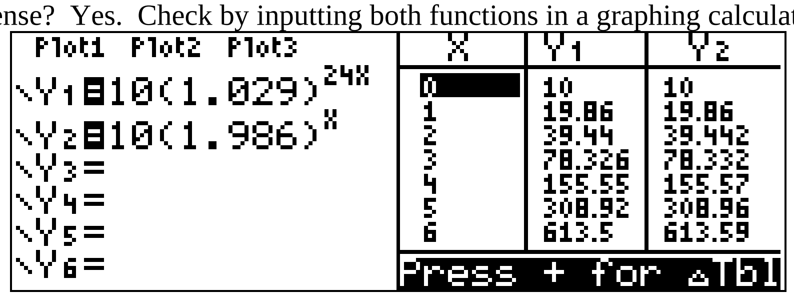
   $$C(t) = 10(1.029^{24})^{t}$$

   Use a calculator to find the value of 1.029^{24}

   $$C(t) \approx 10(1.986)^{t}$$

   Choice c is the correct answer.

   Step 4. Does it make sense? Yes. Check by inputting both functions in a graphing calculator.



   PTS: 2 REF: 061614ai NAT: A.SSE.B.3c TOP: Exponential Equations

2. ANS: D

   Understanding the Problem.

   Miriam's exponential growth function is modeled by $f(t) = n^{2t}$. The problem tells us that *n* equals 16, so Miriam's exponential growth function can be rewritten as $f(t) = 16^{2t}$

   Jessica's exponential growth function is modeled by $g(t) = n^{4t}$. The quantity *n* is unknown for Jessica's exponential growth function and the problem wants us to find the value of *n* that will make $f(t) = g(t)$.

   Strategy: Substitute equivalent expresseions for $f(t)$ and $g(t)$, then solve for *n*.

   $$f(t) = g(t) \quad\text{or}\quad f(t) = g(t) \quad\text{or}\quad f(t) = g(t)$$

   $$16^{2t} = n^{4t} \qquad 16^{2t} = n^{4t} \qquad 16^{2t} = n^{4t}$$

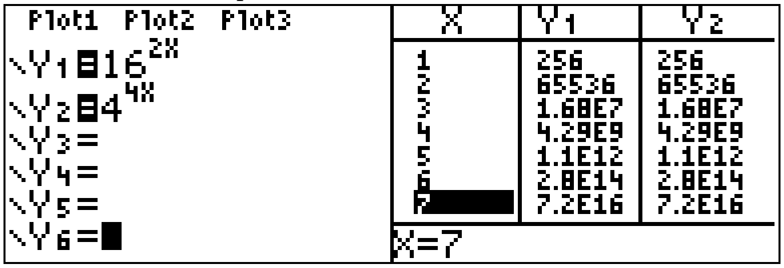
   $$16^{2t} = \left(n^{2}\right)^{2t} \qquad 16^{2} = n^{4} \qquad 16^{2} = n^{4}$$

   $$16 = n^{2} \qquad 256 = n^{4} \qquad \sqrt{16^{2}} = \sqrt{n^{4}}$$

   $$4 = n \qquad 256^{\frac{1}{4}} = \left(n^{4}\right)^{\frac{1}{4}} \qquad 16 = n^{2}$$

   $$4 = n \qquad 4 = n$$

DIMS? Does It Make Sense? Yes. The outputs of $f(t) = 16^{2t}$ and $g(t) = 4^{4t}$ are identical.



PTS: 2 REF: 011519ai NAT: A.SSE.B.3c TOP: Solving Exponential Equations

3. ANS:

Jacob and Jessica will both have 256 dandelions after 5 weeks.

$f(t) = 8 \cdot 2^t$	$g(t) = 2^{t+3}$
$f(5) = (8) \cdot 2^5$	$g(5) = 2^{5+3}$
$f(5) = 8 \cdot 32$	$g(5) = 2^8$
$f(5) = 256$	$g(5) = 256$

Both functions express the same mathematical relationships.

$f(t) = g(t)$

$8 \cdot 2^t = 2^{t+3}$

$8 \cdot 2^t = 2^t \cdot 2^3$

$8 \cdot 2^t = 2^t \cdot 8$

PTS: 2 REF: 011632ai NAT: A.SSE.B.3c TOP: Exponential Equations

Homework - Write the Math Assignment

START — Write your name, date, topic of lesson, and class on your paper.

NAME:	Mohammed Chen
DATE:	December 18, 2015
LESSON:	Missing Number in the Average
CLASS:	Z

PART 1a. Copy **the problem** from the lesson and underline/highlight key words.
PART 1b. State your understanding of **what the problem is asking**.
PART 1c. **Answer** the problem.
PART 1d. Explanation of **strategy** with all work shown.

PART 2a. Create **a new problem** that addresses the same math idea.
PART 2b. State your understanding of **what the new problem is asking**.
PART 2c. **Answer** the new problem.
PART 2d. Explanation of **strategy** used in solving the new problem with all work shown.

Clearly label each of the eight parts.

Grading Rubric

Each homework writing assignment is graded using a four point rubric, as follows:

Part 1. The Original Problem	**Up to 2** points will be awarded for: a) correctly restating the original problem; b) explicitly stating what the original problem is asking; c) answering the original problem correctly; and d) explaining the math.
Part 2. My New Problem	**Up to 2** points will be awarded for: a) creating a new problem similar to the original problem; b) explicitly stating what the new problem is asking; c) answering the new problem correctly; and d) explaining the math.

This assignment/activity is designed to incorporate elements of Polya's four step universal algorithm for problem solving with the idea that writing is thinking. Polya's four steps for solving any problem are:

1. Read and understand the problem.
2. Develop a strategy for solving the problem.
3. Execute the strategy.
4. Check the answer for reasonableness.

EXEMPLAR OF A WRITING THE MATH ASSIGNMENT

Part 1a. **The Problem**

TOP Electronics is a small business with five employees. The mean (average) weekly salary for the five employees is $360. If the weekly salaries of four of the employees are $340, $340, $345, and $425, what is the salary of the fifth employee?

Part 1b. **What is the problem asking?**

Find the salary of the fifth employee.

Part 1c. **Answer**

The salary of the fifth employee is $350 per week.

Part 1d. **Explanation of Strategy**

The arithmetic mean or average can be represented algebraically as:

$$\overline{X} = \frac{x_1 + x_2 + ... + x_n}{n}$$

I put information from the problem into the formula. The problem says there are 5 employees, so $n = 5$. The problem also gives the mean (average) salary and the salaries of 4 of the employees. These numbers can be substituted into the formula as follows:

$$360 = \frac{340 + 340 + 345 + 425 + x_5}{5}$$

$$1800 = 340 + 340 + 345 + 425 + x_5$$

$$1800 = 1450 + x_5$$

$$1800 - 1450 = x_5$$

$$350 = x_5$$

Check: $360 = \frac{340 + 340 + 345 + 425 + 350}{5} = \frac{1800}{5} = 360$

Part 2a. **A New Problem**

Joseph took five math exams this grading period and his average score on all of the exams is 88. He remembers that he received test scores of 78, 87, 94, and 96 on four of the examinations, but he has lost one examination and cannot remember what he scored on it. What was Joseph's score on the missing exam?

Part 2b **What is the new problem asking?**

Find Joseph's score on the missing exam.

Part 2c. **Answer to New Problem**

Joseph received a score of 85 on the missing examination.

Part 2d. **Explanation of Strategy**

I substitute information from the problem into the formula for the arithmetic mean, as follows:

$$88 = \frac{78 + 87 + 94 + 96 + x_5}{5}$$

$$440 = 355 + x_5$$

$$85 = x_5$$

$$88 = \frac{78 + 87 + 94 + 96 + 85}{5} = \frac{440}{5} = 88$$

The answer makes sense.