Looking Ahead

The following example requires you to use the skills you learned to rewrite a number with a different base using negative exponents. Once the expressions on opposite sides of the equation have the same base, they can only be equal if their exponents are equal. This leads to a simple linear equation in one variable that can easily be solved.

Example Preview

Solve the following exponential equation.

$$3^{3x-5} = \frac{1}{9}$$

Solution

Solving this exponential equation involves rewriting the terms on both sides of the equation with the same base. Once this is done, the exponents can be equated, and the subsequent equation can be solved for x.

This exponential equation can be solved in the following manner.

$$\begin{aligned} 3^{3x-5} &= \frac{1}{9} \\ 3^{3x-5} &= \left(\frac{1}{3}\right)^2 \\ 3^{3x-5} &= 3^{-2} \\ 3x-5 &= -2 \qquad \text{Exponents must be equal with the same base.} \\ 3x &= 3 \\ x &= 1 \end{aligned}$$

7.R.1 Exercises

Concept Check

True/False. Determine whether each statement is true or false. If a statement is false, explain how it can be changed so the statement will be true. (**Note:** There may be more than one acceptable change.)

1. If a constant does not have an exponent written, it is assumed that the exponent is 0.

2. If a is a nonzero real number and n is an integer, then $a^{-n} = -a^n$.

3. Since the product rule is stated for integer exponents, the rule is also valid for 0 and negative exponents.

4. When using the quotient rule, you should subtract the smaller exponent from the larger exponent.

Practice

Simplify each expression. The final form of the expressions with variables should contain only positive exponents. Assume that all variables represent nonzero numbers.

5. $y^3 \cdot y^8$

6. $\dfrac{y^7}{y^2}$

7. $x^{-3} \cdot x^0 \cdot x^2$

8. $\dfrac{10^4 \cdot 10^{-3}}{10^{-2}}$

9. $\left(9x^2y^3\right)\left(-2x^3y^4\right)$

10. $\dfrac{-8x^{-2}y^4}{4x^2y^{-2}}$

Applications

Solve.

11. ***Computers:*** Rylee wants to move all her files to a new hard drive that has 2^{12} GB of storage on it. She wants to designate the same amount of storage for each of 2^4 projects. How much storage should be assigned to each project? Write your answer as a power of two.

12. ***Bacteria:*** Trey is studying patterns in bacteria. For a positive test result in his experiment, bacteria must grow in population at a minimum rate of 3^2 in 24 hours. If the initial population of the bacteria is 3^5 and his final measurement after 24 hours is 3^8, should he mark the test as positive or negative?