Section 6.1 Exponents

# Objective 1: Evaluating Exponential Expressions

An exponent is a shorthand notation for repeated factors. For example, can be written as . The expression is called an **exponential expression**. The **base** of this expression is , and the **exponent** is .

If is a real number and is a positive integer, then is the product of factors of .



Evaluate the expression.

|  |  |
| --- | --- |
| a.  | b.  |

Evaluate the expression for the given value of .

|  |  |
| --- | --- |
| c. when  | d. when  |

# Objective 2: Using the Product Rule

Consider the expression . To multiply, let’s first write the expression in expanded form.

This suggests the following rule.

**Product Rule for Exponents**

If and are positive integers and is a real number, then

.

Use the product rule to simplify the expression.

|  |  |
| --- | --- |
| a.  | b.  |

# Objective 3: Using the Power Rule

Consider the expression . By definition of an exponential expression,

Then applying the product rule,

Notice that the result is the same if we multiply the exponents.

**Power Rule for Exponents**

If and are positive integers and is a real number, then

.

Use the power rule to simplify the expression.

|  |  |
| --- | --- |
| a.  | b.  |

# Objective 4: Using the Power Rules for Products and Quotients

Consider the expression . By definition of an exponential expression,

Then applying the commutative property of multiplication and the product rule,

Notice that both factors in the parentheses are raised to the power of .

In general, we have the following rule.

**Power of a Product Rule**

If is a positive integer and and are real numbers, then

.

Use the power rule and the power of a product rule to simplify the expression.

|  |  |
| --- | --- |
| a.  | b.  |

Now we will establish a similar rule for the quotient of a power.

Consider the expression .

**Power of a Quotient Rule**

If is a positive integer, and are real numbers, and , then

.

Use the power rule and the power of a product or quotient rule to simplify the expression.

|  |  |
| --- | --- |
| c.  | d.  |

# Objective 5: Using the Quotient Rule

Consider the expression . To simplify this expression, we can apply the fundamental principle of fractions and divide the numerator and denominator by the common factors. Assume throughout this section that the denominator does not equal .

This suggests the following rule.

**Quotient Rule for Exponents**

If and are positive integers, is a real number, and , then

.

Use the quotient rule to simplify the expression.

|  |  |
| --- | --- |
| a.  | b.  |

Now let’s examine the meaning of an exponent of .

Consider the expression . Applying the quotient rule,

.

Applying the fundamental principle for fractions,

.

Since and , we define that as long as .

So any base raised to the power is as long as the base is not .