Mathematicians, scientists, and economists commonly encounter very large and very small numbers. Let’s review the rules of exponents and then apply them to calculations involving very large or small numbers.

# Rules of Exponents

**Product Rule** of Exponents

For any real number and natural numbers and , the product rule of exponents states that

Examples: Write each of the following products with a single base. Do not simplify further.

**Quotient Rule** of Exponents

For any real number and natural numbers and , such that , the quotient rule of exponents states that

Examples: Write each of the following with a single base. Do not simplify further.

**Power Rule** of Exponents

For any real number and natural numbers and , the power rule of exponents states that

Examples: Write each of the following with a single base. Do not simplify further.

**Zero Exponent Rule** of Exponents

For any nonzero real number , the zero exponent rule of exponents states that

Examples: Write each of the following with a single base. Do not simplify further.

**Negative Rule** of Exponents

For any nonzero real number and natural number , the negative rule of exponents states that

Examples: Write each of the following with a single base. Do not simplify further. Write answers with positive exponents.

# Simplifying Exponential Expressions

Recall that to simplify an expression means to rewrite it by combing terms or exponents; in other words, to write the expression more simply with fewer terms. The rules for exponents may be combined to simplify expressions.

Examples: Simplify each expression and write the answer with positive exponents only.