8.1: Investigating Powers and Products

*After this lesson you will be able to: use properties of exponents involving products to simplify expressions.*

**Exploration A: Finding products of powers**

1. Complete the table.

|  |  |  |  |
| --- | --- | --- | --- |
| Expression | Expression as repeated multiplication | Number of factors | Simplified expression |
| $$7^{4}•7^{5}$$ | $$\left(7•7•7•7\right)•(7•7•7•7•7)$$ | 9 | $$7^{9}$$ |
| $$\left(-4\right)^{2}•\left(-4\right)^{3}$$ | $$\left[\left(-4\right)•\left(-4\right)\right]•[\left(-4\right)•\left(-4\right)•\left(-4\right)]$$ | 5 |  |
| $$x^{1}•x^{5}$$ |  |  |  |
| $$\left(2x\right)^{3}•\left(2x\right)^{4}$$ |  |  |  |

1. Find a pattern that relates the exponents of the factors in the first column and the exponent of the expression in the last column.

**Exploration B: Finding powers of powers.**

1. Complete the table.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Expression | Expanded expression | Expression as repeated multiplication | Number of factors | Simplified expression |
| $$\left(5^{3}\right)^{2}$$ | $$\left(5^{3}\right)•(5^{3})$$ | $$\left(5•5•5\right)•(5•5•5)$$ | 6 | $$5^{6}$$ |
| $$\left[\left(-6\right)^{2}\right]^{4}$$ | $$\left[\left(-6\right)^{2}\right]•\left[\left(-6\right)^{2}\right]•\left[\left(-6\right)^{2}\right]•\left[\left(-6\right)^{2}\right] $$ | $$\left(-6•-6\right)•\left(-6•-6\right)•\left(-6•-6\right)•(-6•-6)$$ |  |  |
| $$\left(x^{3}\right)^{3}$$ |  |  |  |  |

1. Find a pattern that relates the exponents of the expression in the first column and the exponent of the expression in the last column.

**Exploration 3: Finding Powers of a Product**

1. Complete the table.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Expression | Expanded expression | Rearranging and Combining Like Terms | Simplified with Exponents | Simplified expression |
| $$\left(5xy\right)^{3}$$ | $$\left(5xy\right)·\left(5xy\right)·\left(5xy\right)$$ | $$5⋅5⋅5⋅x⋅x⋅x⋅y⋅y⋅y$$ | $$(5^{3})(x^{3})(y^{3})$$ | $$125x^{3}y^{3}$$ |
| $$\left(2x\right)^{3}•\left(2x\right)^{4}$$ | $$\left(2x·2x·2x\right)⋅(2x⋅2x⋅2x⋅2x)$$ |  |  |  |
| $$[\left(4x\right)^{3}]^{2} $$ | $$\left[\left(4x\right)\left(4x\right)\left(4x\right)\right]⋅[\left(4x\right)\left(4x\right)\left(4x\right)]$$ | $$4⋅4⋅4⋅4⋅4⋅4⋅x⋅x⋅x⋅x⋅x⋅x$$ |  |  |
| $$\left(-10x^{6}\right)^{2}$$ |  |  |  |  |

1. Find a pattern that relates the original expressions in the first column to the simplified expressions in the last column.

**Practice Problems:**

 For each problem, write the expression as repeated multiplication and simplified expression like you did in the above tables.

|  |  |  |  |
| --- | --- | --- | --- |
| # | 22-32 even  | Expression as Repeated Multiplication | Simplified Expression |
| ***1.*** | $$3^{4}•3^{6}$$ |  |  |
| ***2.*** | $$\left(2^{3}\right)^{2}$$ |  |  |
| ***3.*** | $$x•x^{6}$$ |  |  |
| ***4.*** | $$\left(2x\right)^{2}$$ |  |  |
| **5.** | $$\left(-2x^{4}n^{6}\right)^{2}$$ |  |  |
| **6.** | $$\left[\left(-5xy\right)^{2}\right]^{5}$$ |  |  |

**7.** a.Complete the table of values.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **x** | **0** | **1** | **2** | **3** | **4** |
| **2x** |  |  |  |  |  |
| **2x** |  |  |  |  |  |

 b. Sketch the graphs of y=2x and y=2x
in the same coordinate plane.

 c. Compare the graphs.
How are they the same?
How are they different?