

**Lesson 7.1 Notes (Multiplication Properties of Exponents)**

**Objectives:**

- Multiply monomials using the properties of exponents.
- Simplify expressions using the multiplication properties of exponents.

- **Monomial** – a number, variable, or *product* of a number and one or more variables
  - A monomial has **only one term**.
  - An expression that involves **division by a variable is NOT a monomial**.
  - **Constant** – a monomial that is a real number

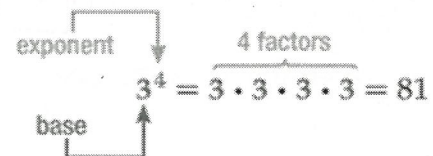
Monomial	Degree
10	0
3x	1
$\frac{1}{2}ab^2$	1 + 2 = 3
$-1.8m^5$	5

Not a monomial	Reason
$5 + x$	A sum is not a monomial.
$\frac{2}{n}$	A monomial cannot have a variable in the denominator.
$4^c$	A monomial cannot have a variable exponent.
$x^{-1}$	The variable must have a whole number exponent.

1. Determine whether each expression is a monomial. Write yes or no.

- a.  $f + 24$  **NO**                      c.  $h^2$  **Yes**                      e.  $23abcd^2$  **Yes**
- b.  $\frac{mp}{n}$  **NO**                                  d.  $j$  **Yes**                                  f.  $\frac{xyz^2}{2}$  **Yes**

- **Power** – an expression in the form  $x^n$ 
  - Represents the result of multiplying x by itself n times



- **Product of Powers:**  $a^m \cdot a^p = a^{m+p}$

**Words**                      To multiply two powers that have the same base, add their exponents.

**Symbols**                      For any real number  $a$  and any integers  $m$  and  $p$ ,  $a^m \cdot a^p = a^{m+p}$ .

**Examples**                       $b^3 \cdot b^5 = b^{3+5}$  or  $b^8$                        $g^4 \cdot g^6 = g^{4+6}$  or  $g^{10}$

2. Simplify each expression.

a.  $(6n^3)(2n^7)$

$12n^{10}$

b.  $(3pt^3)(p^3t^4)$

$3p^4t^7$

c.  $(-4rx^2t^3)(-6r^5x^2t)$

$24r^6x^4t^4$

- **Power of a Power:**  $(a^m)^p = a^{m \cdot p}$

Words	To find the power of a power, multiply the exponents.
Symbols	For any real number $a$ and any integers $m$ and $p$ , $(a^m)^p = a^{m \cdot p}$ .
Examples	$(b^3)^5 = b^{3 \cdot 5}$ or $b^{15}$ $(g^6)^7 = g^{6 \cdot 7}$ or $g^{42}$

3. Simplify each expression.

a.  $[(2^3)^2]^4 = (2^6)^4 = 2^{24}$

b.  $[(2^3)^3]^2 = (2^9)^2 = 2^{18}$

- **Power of a Product:**  $(ab)^m = a^m b^m$

Words	To find the power of a product, find the power of each factor and multiply.
Symbols	For any real numbers $a$ and $b$ and any integer $m$ , $(ab)^m = a^m b^m$ .
Example	$(-2xy^3)^5 = (-2)^5 x^5 y^{15}$ or $-32x^5 y^{15}$

4. Simplify each expression.

a.  $\pi(2xy^2)^2 = \pi(4x^2y^4) = 4\pi x^2 y^4$

b.  $(3xy^2)^2 = 3^2 x^2 y^4 = 9x^2 y^4$

- **Simplifying Expressions:**

To simplify a monomial expression, write an equivalent expression in which:

- each variable base appears exactly once,
- there are no powers of powers, and
- all fractions are in simplest form.

5. Simplify each expression.

a.  $(3xy^4)^2 [(-2y)^2]^3 = (9x^2y^8) [4y^2]^3 = (9x^2y^8)(64y^6) = 576x^2y^{14}$

b.  $(2a^2b^2)^3 [(-4b)^2]^2 = 8a^6b^6 [16b^2]^2 = 8a^6b^6 (256b^4) = 2048a^6b^{10}$