

Monomials and Their Rules

2^2	4	2^3	8
3^2	9	3^3	27
4^2	16	4^3	64
5^2	25	5^3	125
6^2	36	6^3	216
7^2	49	7^3	343
8^2	64	2^4	16
9^2	81	3^4	81
10^2	100	4^4	256
11^2	121	5^4	625
12^2	144		
13^2	169	15^2	225
14^2	196	20^2	400

exponent/
power

base $\rightarrow x^3 = x \cdot x \cdot x$

exponent/
power \downarrow
 $2^4 = 2 \cdot 2 \cdot 2 \cdot 2$
 \uparrow
base

Product of Powers

In the blank, put the base to the correct power.

1.) $(x^3)(x^4) = (x \cdot x \cdot x) \cdot (x \cdot x \cdot x \cdot x)$

$(x^3)(x^4) = \underline{x^7}$

What do you notice about $(x^3)(x^4)$ and the exponent to your answer?

add the exponents

2.) $(4^2)(4^5)(4^3) = (4 \cdot 4) \cdot (4 \cdot 4 \cdot 4 \cdot 4 \cdot 4) \cdot (4 \cdot 4 \cdot 4)$

$(4^2)(4^5)(4^3) = \underline{4^{10}}$

What do you notice about $(4^2)(4^5)(4^3)$ and the exponent to your answer?

add the exponents

3.) $(2a^3)(3a^6)(4a^7) = (2 \cdot 3 \cdot 4) \cdot (a \cdot a \cdot a) \cdot (a \cdot a \cdot a \cdot a \cdot a \cdot a) \cdot (a \cdot a \cdot a \cdot a \cdot a \cdot a \cdot a)$

$(2a^3)(3a^6)(4a^7) = \underline{24a^{16}}$

What do you notice about $(2a^3)(3a^6)(4a^7)$ and the exponent to your answer?

add the exponents

Product of Powers:

When multiplying two powers that have the same base, add the exponents.

Practice

$$(r^4)(-12r^7)$$
$$-12r^{11}$$

$$(6cd^5)(5c^5d^2)$$
$$30c^6d^7$$

$$(4ab^6)(-7a^2b^3)$$
$$-28a^3b^9$$

$$(-4rx^2t^3)(-6r^5x^2t)$$
$$24r^6x^4t^4$$

Power of a Power

$$1.) (x^3)^4 = (x \cdot x \cdot x) \cdot (x \cdot x \cdot x) \cdot (x \cdot x \cdot x) \cdot (x \cdot x \cdot x)$$

$$(x^3)^4 = \underline{x^{12}}$$

What do you notice about $(x^3)^4$ and the exponent to your answer?

multiply the exponents

$$2.) (4^2)^3 = (4 \cdot 4) \cdot (4 \cdot 4) \cdot (4 \cdot 4)$$

$$(4^2)^3 = \underline{4^6}$$

What do you notice about $(4^2)^3$ and the exponent to your answer?

multiply the exponents

$$3.) (a^m)^n = a^{m \cdot n}$$

Power of a Power

When a power is taken to another power, multiply the exponents.

Practice

$$[(2^2)^2]^4$$

$$2^{16}$$

$$[(3^2)^3]^2$$

$$3^{12}$$

Quotient of a Powers

$$1.) \frac{x^{11}}{x^8} = \frac{(\cancel{x} * \cancel{x} * \cancel{x} * \cancel{x} * \cancel{x} * \cancel{x} * \cancel{x} * \cancel{x} * \cancel{x} * \cancel{x} * x * x * x)}{(\cancel{x} * \cancel{x} * \cancel{x} * \cancel{x} * \cancel{x} * \cancel{x} * \cancel{x} * \cancel{x})}$$

$$\frac{x^{11}}{x^8} = \underline{x^3}$$

What do you notice about $\frac{x^{11}}{x^8}$ and the exponent to your answer?

subtract

$$2.) \frac{2^7}{2^4} = \frac{2 * 2 * 2 * 2 * 2 * 2 * 2}{2 * 2 * 2 * 2}$$

$$\frac{2^7}{2^4} = \underline{2^3}$$

What do you notice about $\frac{2^7}{2^4}$ and the exponent to your answer?

subtract

$$3.) \frac{a^m}{a^n} = a^m \div a^n$$

Quotient of a Power

When two powers are divided with the same base, subtract the exponents.

Practice

$$\frac{r^5}{r^2} \quad r^3$$

$$\frac{9^{25}}{9^{20}} \quad 9^5$$

Power of a Product

$$(ab)^m = a^m b^m$$

$$(-2x^2y)^3 = -8x^6y^3$$

$$[(\frac{1}{2}a^3b^5)^2]^2 = (\frac{1}{2}a^3b^5)^4 = \frac{1}{16}a^{12}b^{20}$$

When a product is taken to a power distribute the power to everything inside the parentheses.

Practice

$$(j^5k^7)^4 \quad j^{20} k^{28}$$

$$(n^3p)^4 \quad n^{12} p^4$$

$$[(4r^2t)^3]^2$$

$$4^6 r^{12} t^6$$

$$4096 r^{12} t^6$$

Practice

1. $(-2a^6)(6a^6)$

$$-12a^{12}$$

2. $(9w^2x^8)(w^6x^4)$

$$9w^8x^{12}$$

3. $(2a^4)^3(a^3)^4$

$$2^3 a^{12} a^{12}$$

$$8a^{24}$$

4. $(5a^2b^3c^4)(2a^3b^4c^2)^2$

$$(5a^2b^3c^4)(4a^6b^8c^4)$$

$$20a^8b^{11}c^8$$

5. $(-3x^2y^5)^3(2x^4y^2)(3xy)$

$$(-3^3x^6y^{15})(2x^4y^2)(3xy)$$

$$-54x^{11}y^{18}$$

Power of a Quotient

$$\left(\frac{r}{t}\right)^5 = \frac{r^5}{t^5}$$

$$\left(\frac{3p^3}{7}\right)^2 = \frac{(3p^3)^2}{7^2} = \frac{3^2(p^3)^2}{7^2} = \frac{9p^6}{49}$$

$$\left(\frac{2y^2}{3z^3}\right)^2 = \frac{2^2(y^2)^2}{3^2(z^3)^2} = \frac{4y^4}{9z^6}$$

When a power of a quotient needs to be found, find the power of the numerator and the power of the denominator

Practice

$$\left(\frac{3x^4}{4}\right)^3 = \frac{3^3 x^{12}}{4^3} = \frac{27x^{12}}{64}$$

$$\left(\frac{4x^3}{5y^4}\right)^3 = \frac{4^3 x^9}{5^3 y^{12}} = \frac{64x^9}{125y^{12}}$$

$$\left(\frac{5x^5y}{6}\right)^2 = \frac{25x^{10}y^2}{36}$$

$$\left(\frac{4xy^3}{6y^2}\right)^4 = \frac{256x^4y^{12}}{1296y^8} = \frac{16x^4y^4}{81}$$

Negative Exponents:

$$1. \frac{n^2}{n^6} = \frac{n \cdot n}{n \cdot n \cdot n \cdot n \cdot n \cdot n} = \frac{1}{n^4} = (n^{-4})$$

$$2. \left(\frac{n^{-5}p^4}{r^{-2}}\right) = \left(\frac{n^{-5}}{1}\right)\left(\frac{p^4}{1}\right)\left(\frac{1}{r^{-2}}\right) = \left(\frac{1}{n^5}\right)\left(\frac{p^4}{1}\right)\left(\frac{r^2}{1}\right) = \frac{p^4r^2}{n^5}$$

What do you notice about the negative exponents versus a positive exponent?

negative exponents means the power is flipped
positive stays the same

Practice:

$$\frac{v^{-3}wx^2}{wy^{-6}} = \frac{y^6x^2}{v^3}$$

$$\frac{32a^{-8}b^3c^{-4}}{4a^3b^5c^{-2}} = \frac{8a^{-11}b^{-2}c^{-2}}{1} =$$

$$\frac{8}{a^{11}b^2c^2}$$

$$\frac{5j^{-3}k}{25k^{-4}} = \frac{k^5}{5j^3}$$

To simplify a monomial expression:

1. Make sure that each variable base appears exactly once
2. There are no powers of powers (no exponents outside of parentheses)
3. All fractions are in simplest form