

1.2 Properties of Exponents

An **exponent** a number that tells us how many times a quantity is multiplied by itself. Another word for exponent is **power**. The quantity that is being multiplied by itself is called the **base**.

Ex: $5^3 = 5 \cdot 5 \cdot 5$

$7^2 = 7 \cdot 7$

$21^4 = 21 \cdot 21 \cdot 21 \cdot 21$

Using this information, see if you can figure out some shortcuts or rules for simplifying exponents. Be sure to show your work to help you.

Product of Powers

Simplify the following exponents:

$6^3 \cdot 6^5 = 6^8$

$4^7 \cdot 4^2 = 4^9$

$12^4 \cdot 12^4 = 12^8$

$(6 \cdot 6 \cdot 6) \cdot (6 \cdot 6 \cdot 6 \cdot 6 \cdot 6)$ $(4 \cdot 4 \cdot 4 \cdot 4 \cdot 4 \cdot 4 \cdot 4) \cdot (4 \cdot 4)$ $(12 \cdot 12 \cdot 12 \cdot 12) \cdot (12 \cdot 12 \cdot 12 \cdot 12)$

Quotient of Powers

Simplify the following exponents:

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

$\frac{8^5}{8^2} = 8^3$

$\frac{10^9}{10^4} = 10^5$

$\frac{2 \cdot 2 \cdot 2 \cdot 2 \cdot 2 \cdot 2 \cdot 2}{2 \cdot 2 \cdot 2 \cdot 2}$

$\frac{8 \cdot 8 \cdot 8 \cdot 8 \cdot 8}{8 \cdot 8}$

$\frac{10 \cdot 10 \cdot 10 \cdot 10 \cdot 10 \cdot 10 \cdot 10 \cdot 10 \cdot 10}{10 \cdot 10 \cdot 10 \cdot 10}$

Power of Powers

Simplify the following exponents:

$(2^3)^3 = 2^9$

$(5^2)^4 = 5^8$

$(8^4)^3 = 8^{12}$

$2^3 \cdot 2^3 \cdot 2^3$

$5^2 \cdot 5^2 \cdot 5^2 \cdot 5^2$

$8^4 \cdot 8^4 \cdot 8^4$

Property	Notation	Rule	Examples
Product of Powers	$x^m \cdot x^n$	Add exponents $x^m \cdot x^n = x^{m+n}$	$a^4 \cdot a^3 = a^7$ $5x^2 \cdot 2x^9 = 10x^{11}$
Quotient of Powers	$\frac{x^m}{x^n}$	Subtract exponents $\frac{x^m}{x^n} = x^{m-n}$	$\frac{a^7}{a^2} = a^5$ $\frac{6x^{10}}{2x^{-1}} = 3x^{10-(-1)} = 3x^{11}$
Power of Powers	$(x^m)^n$	Multiply exponents $(x^m)^n = x^{m \cdot n}$	$(a^3)^2 = a^6$ $(2x^2)^5 = 2^5 x^{10} = 32x^{10}$

* exponent applies to everything

* Must have like bases to simplify exponents *
 ex: $4^3 \cdot 4^5 = 4^8$ ex: $2^3 \cdot 6^2$ Can't simplify

Other Properties

Property	Rule	Examples
Zero Exponent Property	Anything to the 0 power is 1	$5^0 = 1$ $x^0 = 1$ $572^0 = 1$
Negative Exponent Property	A negative exponent means a term is in the wrong spot in a fraction; <u>switch the position and make the exponent positive</u>	$x^{-5} = \frac{1}{x^5}$ $2a^{-2} = \frac{2}{a^2}$ $\frac{5}{3m^{-6}} = \frac{5m^6}{3}$

* exponent only applies to what it is directly attached to

1) a) $(2b^4)^0 = 1$

b) $(2b)^4$
 $2^4 b^4 = 16b^4$

c) $(2m^2 \cdot 3m)^2$
 $(6m^3)^2 = 6^2 m^6 = 36m^6$

d) $\frac{(b^4)^2}{b^5} = \frac{b^8}{b^5} = b^3$

e) $\frac{5a^7}{4a^4} = \frac{5a^3}{4}$

f) $(3x^2)^{-3}$
 $= \frac{1}{(3x^2)^3} = \frac{1}{3^3 x^6}$
 $= \frac{1}{27x^6}$

* tackle top & bottom separately, then simplify

g) $\frac{6y^4 \cdot 3y^2}{2y^3}$
 $= \frac{18y^6}{2y^3} = 9y^3$

h) $\frac{6x^{-2}}{2x^4}$
 $= \frac{6}{2x^4 x^2} = \frac{3}{x^6}$

i) $\frac{(3m^3)^2}{2m^{-4}}$
 $= \frac{3^2 m^6}{2m^{-4}} = \frac{9m^6 m^4}{2} = \frac{9m^{10}}{2}$