

3.1 Exponent Rules

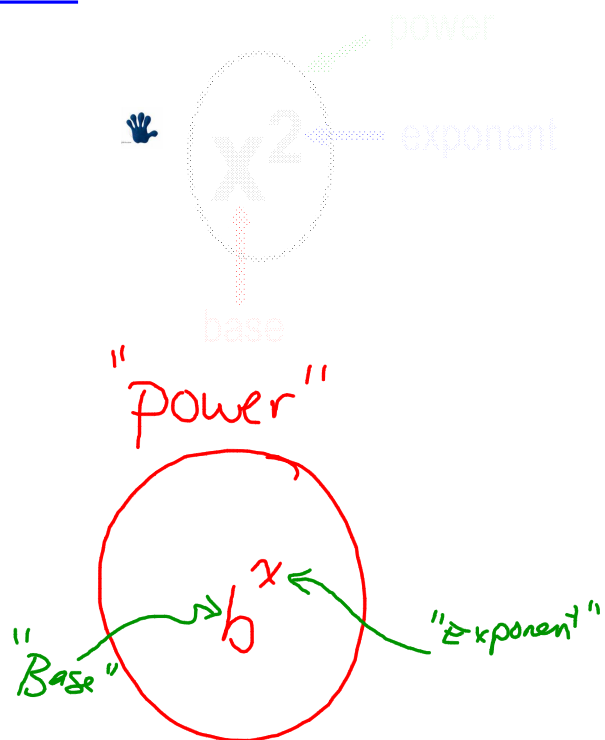
$$2 \times 2 \times 2 \times 2 \times 2 = 2^5$$

$$3 \times 3 \times 3 \times 3 \times 3 \times 3 \times 3 \times 3 \times 3 = 3^9$$

$$(-5)(-5)(-5)(-5)(-5) = (-5)^5$$

$$\underbrace{a \times a \times a \times a \times a \times a \times a \times a \times a \dots \times a}_n = a^n$$

n times



The Exponent Rules

MULTIPLYING powers with the **SAME** base

Keep the base the same and **ADD** the exponents

$$a^p \times a^r = a^{p+r}$$

$$2^3 \times 2^7 = 2^{3+7}$$

$$= 2^{10}$$

Example

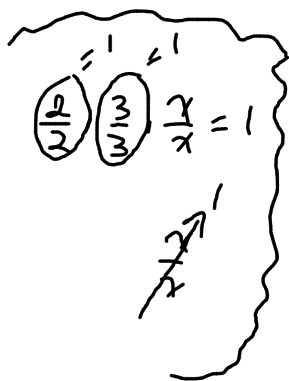
$$(2^3)(2^7)$$

$$= 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2$$

$$= 2^{10}$$

DIVIDING powers with the **SAME** base

Keep the base the same and **SUBTRACT** the exponents



$$a^p \div a^r = a^{p-r}$$

$$3^6 \div 3^4 = 3^{6-4}$$

$$= 3^2$$

Example

$$\frac{3^6}{3^4}$$

$$= \frac{\cancel{3} \cdot \cancel{3} \cdot \cancel{3} \cdot \cancel{3} \cdot 3 \cdot 3}{\cancel{3} \cdot \cancel{3} \cdot \cancel{3} \cdot \cancel{3}}$$

$$= 3 \cdot 3$$

$$= 3^2$$

Power of a power

Keep the base the same and **MULTIPLY** the exponents

$$(a^p)^r = a^{p \times r}$$

$$(5^2)^3 = 5^{2 \times 3}$$

$$= 5^6$$

Example

$$(5^2)^3$$

$$= (5^2)(5^2)(5^2)$$

$$= 5 \times 5 \times 5 \times 5 \times 5 \times 5$$

$$= 5^6$$

Remember exponents are attached to what they are beside:

$$\begin{aligned} -2^3 &= -2 \times 2 \times 2 \\ &= -8 \end{aligned}$$

$$\begin{aligned} (-2)^3 &= (-2)(-2)(-2) \\ &= -8 \end{aligned}$$

$$-5^2 = -25$$

$$\begin{aligned} (-5)^2 &= (-5)(-5) \\ &= 25 \end{aligned}$$

Very important when you have neg. base and even exponent

Also Remember

If you can't see an exponent it is 1

$$\text{ie } 3 = 3^1 \quad x = x^1$$

$$\begin{aligned} \text{ex: } & 3 \cdot 3^4 \\ &= 3^1 \cdot 3^4 \\ &= 3^{1+4} \\ &= 3^5 \end{aligned}$$

Ex 1. Write as a single power then evaluate the following:

$$\begin{aligned} \text{a) } 3^2 \times 3^4 \\ &= 3^{2+4} \\ &= 3^6 \\ &= 729 \end{aligned}$$

$$\begin{aligned} \text{b) } 2^8 \div 2^5 \\ &= 2^{8-5} \\ &= 2^3 \\ &= 8 \end{aligned}$$

$$\begin{aligned} \text{c) } (0.1)^2 \times (0.1) \\ &= (0.1)^{2+1} \\ &= (0.1)^3 \\ &= 0.001 \end{aligned}$$

$$\begin{aligned} \text{d) } (-5)^2 \times (-5) \\ &= (-5)^3 \\ &= -125 \end{aligned}$$

$$\begin{aligned} \text{e) } (-5)^2 \times (-5)^2 \\ &= (-5)^4 \\ &= 625 \end{aligned}$$

ON CALC

$$\boxed{x^y}$$

$$\boxed{\wedge}$$

YOU TRY - Simplify then evaluate

$$\begin{aligned} \text{a) } 4^2 \times 4^3 \\ &= 4^5 \\ &= 1024 \end{aligned}$$

$$\begin{aligned} \text{b) } 8^{16} \div 8^{13} \\ &= 8^3 \\ &= 512 \end{aligned}$$

$$\begin{aligned} \text{c) } (5^2)^3 \\ &= 5^6 \\ &= 15625 \end{aligned}$$

$$\begin{aligned} \text{d) } (4^1)^5 \\ &= 4^5 \\ &= 1024 \end{aligned}$$

$$\begin{aligned} \text{e) } 10^{12} \div 10^4 \div 10^5 \\ &= 10^{12-4-5} \\ &= 10^3 \\ &= 1000 \end{aligned}$$

$$\begin{aligned} \text{f) } (-3)^3 \times (-3)^2 \\ &= (-3)^5 \\ &= -243 \end{aligned}$$

$$\begin{aligned} \text{g) } (-5)^4 \div (-5)^2 \\ &= (-5)^2 \\ &= 25 \end{aligned}$$

$$\begin{aligned} \text{h) } 2^3 \times 3^2 \\ &= 8 \times 9 \\ &= 72 \end{aligned}$$

NO
SPECIAL
EXPONENT
LAWS

$$\begin{aligned} \text{i) } 6^2 + 6^3 \\ &= 36 + 216 \\ &= 252 \end{aligned}$$

NOT
multiplication
can't use
exp. laws

Extend the rules:

Power of a product:

Keep the base the same and the exponent goes to each part of the base

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

Example

$$(x^2 y)^3 = x^2 \cdot y \cdot x^2 \cdot y \cdot x^2 \cdot y$$

$$\rightarrow (x^2)^3 y^3 = x^6 y^3$$

Power of a quotient:

Keep the base the same and the exponent goes to each part of the base

$$\left(\frac{a}{b}\right)^m = \frac{a^m}{b^m}$$

Example

$$\left(\frac{2}{7}\right)^2$$

$$= \frac{2}{7} \times \frac{2}{7}$$

$$= \frac{2 \cdot 2}{7 \cdot 7}$$

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

$$(ab)^3 = (ab)(ab)(ab)$$

$$= a \cdot b \cdot a \cdot b \cdot a \cdot b$$

$$= a \cdot a \cdot a \cdot b \cdot b \cdot b$$

$$= a^3 b^3$$

Putting the rules together:

Ex: Simplify

a) $\left(\frac{2}{3}\right)^7 \div \left(\frac{2}{3}\right)^5$

$$= \left(\frac{2}{3}\right)^2$$

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

$$= \frac{4}{9}$$

b) $\left(\frac{1}{3^2}\right)^4$

$$= \frac{1^4}{3^8}$$

$$= \frac{1}{6561}$$

$$\cancel{3^2} \cdot 3^4$$

OR

$$(3^2)^4$$

Homework:
p. 360# 1-3 eoo, 5
eoo, 8, 9, 16b, 17

DO WORKSHEET
FIRST!

$$\begin{aligned}(4a^3)(3a^2) \\ &= 4 \cdot a^3 \cdot 3 \cdot a^2 \\ &= 4 \cdot 3 \cdot a^3 \cdot a^2 \\ &= 12a^5\end{aligned}$$

$$\begin{aligned}\frac{-18k^4j^4}{9j^4k^2} \\ &= -\frac{18}{9} \frac{k^4}{k^2} \frac{j^4}{j^4} \\ &= -2k^2(1) \\ &= -2k^2\end{aligned}$$