

Rules of Exponents

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No calculator.

8

$$2^3 = 2 \cdot 2 \cdot 2 = \underline{4} \cdot 2 = 8$$

~~$$2^4 = 2 \times 4 + 2 = 10$$~~

~~$$2^3 = 2 \times 3 + 2$$~~

$$2^3 = 2^{(2)} = 4^{(2)} = 16 = 2^4 \quad 4^2 = 16$$

<u>Rules of Exponents</u>		Unit 9 Day 1
Product Rule →	Rule: $x^a \cdot x^b = x^{a+b}$ Examples: a. $x^5 \cdot x^3 = x^{5+3} = x^8$ b. $2^x \cdot 2^3 = 2^{x+3}$	$x \cdot x \cdot x \cdot x \cdot x = x^5$ $x \cdot x \cdot x = x^3$ $2 \cdot 2 \cdot 2 = 2^3 = 8$ x^8 $2 \cdot 2 \cdot 2 = 2^3 = 8$
Quotient Rule →	$\frac{x^a}{x^b} = x^{a-b}$ a. $\frac{x^7}{x^2} = x^{7-2} = x^5$ b. $\frac{4^x}{4^3} = 4^{x-3}$	$x' \cdot x' = x^2$ $x + x = 2x$ $2 \cdot 2 = 2^2 = 4$ $2 \cdot 2 \cdot 2 = 2^3 = 8$ $2 \cdot 2 \cdot 2 \cdot 2 = 2^4 = 16$ $2^x \cdot 2^3 = 2^{x+3}$ $2^2 \cdot 2^3 = 2^{2+3} = 2^5 = 32$
Power Rule →	$(x^a)^b = x^{ab}$ a. $(x^3)^4 = x^{3 \cdot 4} = x^{12}$ b. $(3^2)^3 = 3^{2 \cdot 3} = 3^6 = 729$	

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Power of a <u>Product</u> $\rightarrow$ $(x+y)^a \neq x^a + y^a$ $(x+y)^2 \neq x^2 + y^2$ $(x+y)(x+y)$	$(xy)^a = x^a y^a$ $x^a y^a = (xy)^a$	a. $(ab)^6 = a^6 b^6$ b. $2^3 \cdot 3^3 = (2 \cdot 3)^3 = 6^3$
Power of a <u>Quotient</u> $\rightarrow$	$\left(\frac{x}{y}\right)^a = \frac{x^a}{y^a}$	a. $\left(\frac{x}{y}\right)^7 = \frac{x^7}{y^7}$ b. $\left(\frac{x^3}{4}\right)^2 = \frac{(x^3)^2}{4^2} = \frac{x^6}{16}$
Zero Exponent $\rightarrow$ $\frac{x^1}{x^1} = x^0$ $\neq 0^0 \rightarrow$ undefined	$x^0 = 1$	a. $3x^0 = 3(1) = 3$ b. $(3x)^0 = 1$ c. $-(3x)^0 = -1$

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Simplify each expression:

PEMDAS

$$\textcircled{1.} \quad 3a^2b^3c^4 \cdot 5ab^2c^6$$

$$= 15a^3b^5c^{10}$$

$$\textcircled{2.} \quad \frac{35x^4y^7z^{10}}{7xy^5z^{10}} = 5x^3y^2z^0$$

$$= 5x^3y^2$$

$$\textcircled{3.} \quad 3(2x^3y^2)^3 = 3(8x^9y^6)$$

$$= 24x^9y^6$$

$$\textcircled{4.} \quad -2(-2x^3y)^2 = -2(4x^6y^2)$$

$$= -8x^6y^2$$

$$\textcircled{5.} \quad \frac{x^{3b}}{x^b} = x^{3b-b} = x^{2b}$$

$$\textcircled{6.} \quad y^{a+1} \cdot y^{a-1} = y^{(a+1)+(a-1)}$$

$$= y^{a+1+a-1} = y^{2a}$$

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$$\textcircled{7.} \quad \frac{5x^3y^7}{4x^2y^2} = \frac{5xy^5}{4}$$

$$\textcircled{8.} \quad \left(\frac{5x^2}{2y}\right)^3 = \frac{125x^6}{8y^3}$$

$$\textcircled{9.} \quad \left(\frac{-12a^8b^5}{6a^2b^4}\right)^2 = (-2a^6b)^2$$

$$= 4a^{12}b^2$$

$$\textcircled{10.} \quad -\frac{4^0}{5} = -\frac{1}{5}$$

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Do the following without a calculator. Use the rules of exponents to help you evaluate the expression.

11. Express 8^3 as a power of 2.

$$\downarrow$$

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



12. Divide 4^{15} by 2^{10} .

$$\frac{4^{15}}{2^{10}} = \frac{(2^2)^{15}}{2^{10}} = \frac{2^{30}}{2^{10}} = 2^{20}$$

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13. Using the power rule evaluate 16 times 9.

power of a product

$$(xy)^a = x^a y^a$$

$$x^a y^a = (xy)^a$$

$$16(9)$$

$$4^2(3^2) = (4 \cdot 3)^2 = 12^2$$

$$= 144$$

14. Using the power rule multiply 25 times 9.

power of a product

$$25(9)$$

$$5^2(3^2) = (5 \cdot 3)^2 = 15^2$$

$$= 225$$

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15. If $x = 3a^3$ and $a = 5b^2$, express x in terms of b .

$$x = 3(5b^2)^3 = 3(125b^6) = 375(b^2)$$

16. If $x = 1/2a^4$ and $a = 2b^4$, express x in terms of b .

$$x = \frac{1}{2}a^4 = \frac{1}{2}(2b^4)^4 = \frac{1}{2}(16b^{16}) = 8b^{16}$$

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