

5.1: Multiplying and Dividing Expressions

5.1.1

Note Title

10/1/2018

with Common Bases

Know these powers: $2^2 = 4$

Note: $2^3 = 2(2)(2) = 8 \Rightarrow 2^3 = 8$
 $2^4 = 16$

$$2^5 = 32$$

$$2^6 = 64$$

$$2^7 = 128$$

$$2^8 = 256$$

$$2^9 = 512$$

$$2^{10} = 1024$$

$$7^2 = 49$$

$$7^3 = 343$$

$$8^2 = 64$$

$$8^3 = 512$$

$$9^2 = 81$$

$$9^3 = 729$$

$$3^2 = 9$$

$$3^3 = 27$$

$$3^4 = 81$$

$$3^5 = 243$$

$$3^6 = 729$$

$$4^2 = 16$$

$$4^3 = 64$$

$$4^4 = 256$$

$$5^2 = 25$$

$$5^3 = 125$$

$$5^4 = 625$$

$$6^2 = 36$$

$$6^3 = 216$$

$$10^2 = 100$$

$$10^3 = 1000$$

$$10^4 = 10000$$

...

$$10^6 = 1,000,000$$

Powers of Positive and Negative Numbers

5.1.2

Example: $-3^2 = -(3)(3) = \boxed{-9}$

$$(-3)^2 = (-3)(-3) = \boxed{9}$$

Ex: $(-2)^6 = \underbrace{(-2)(-2)}_{+} \underbrace{(-2)(-2)}_{+} \underbrace{(-2)(-2)}_{+} = 4 \cdot 4 \cdot 4 = \boxed{64}$

$$(-2)^5 = \underbrace{(-2)(-2)}_{+} \underbrace{(-2)(-2)}_{+} \underbrace{(-2)}_{-} = \boxed{-32}$$

$$-2^6 = -(2)(2)(2)(2)(2)(2) = \boxed{-64}$$

$$-2^5 = -(2)(2)(2)(2)(2) = \boxed{-32}$$

Important: * If you raise a negative number to an even power, you get a positive number.

* If you raise a negative number to an odd power, you get a negative number.

Ex: $(-3)^4 = \boxed{81}$
 $(-3)^5 = \boxed{-243}$

Ex: $-(-2)^4 = \boxed{-16}$

Ex: $-(-1)^n$
 $-(-1) = \boxed{1}$

5.1.3

Properties (laws) of Exponents

$$1) x^a x^b = x^{a+b}$$

$$\underline{\text{Ex:}} \quad x^2 x^3 = (xx)(xxx) = x^5$$

$$2) (x^a)^b = x^{ab}$$

$$\underline{\text{Ex:}} \quad (x^2)^3 = (xx)^3 = (xx)(xx)(xx) = x^6$$

$$3) \frac{x^a}{x^b} = x^{a-b}$$

$$\underline{\text{Ex:}} \quad \frac{x^6}{x^2} = \frac{\cancel{xxxxxx}}{\cancel{xx}} = \frac{x^4}{1} = x^4$$

$$4) (xy)^a = x^a y^a$$

$$\underline{\text{Ex:}} \quad (xy)^3 = (xy)(xy)(xy) = \overset{\text{xxxx}}{\underset{=x^3y^3}{yyyy}}$$

$$5) \left(\frac{x}{y}\right)^a = \frac{x^a}{y^a}$$

$$\underline{\text{Ex:}} \quad \left(\frac{x}{y}\right)^3 = \left(\frac{x}{y}\right)\left(\frac{x}{y}\right)\left(\frac{x}{y}\right) = \frac{x^3}{y^3}$$

Examples: Simplify.

$$\underline{\text{Ex:}} \quad \left(\frac{1}{4}\right)^2 = + \frac{1^2}{4^2} = \boxed{\frac{1}{16}}$$

$$\underline{\text{Ex:}} \quad \left(-\frac{2}{3}\right)^4 = + \frac{2^4}{3^4} = \boxed{\frac{16}{81}}$$

$$\underline{\text{Ex:}} \quad \frac{3^{11}}{3^9} = 3^{11-9} = 3^2 = \boxed{9}$$

← Property #3

Ex.: $2x^3x^5 = 2x^8 \rightarrow (\text{Property \#1})$ 5.1.4

Ex.: $(2x)^4 = 2^4x^4 = 16x^4$

Ex.: $(xy)^4 = x^4y^4$

Ex.: $(6a^4)(-3a^2) = 6(-3)a^4a^2 = -18a^6 \rightarrow (\text{Prop. \#1})$

Ex.: $(-2c^2d^3)(6c^3d) = -12c^5d^{3+1} = -12c^5d^4$

↑
d

Ex.: $\frac{a^3a^{11}}{a^4a^5} = \frac{a^{14}}{a^9} = a^{14-9} = a^5$

↑
(Prop. \#1)
↑
(Prop. \#3)

Ex.: $\frac{\cancel{15}^5 m^5 n^{12}}{\cancel{3} m^4 n^7} = \frac{5 m^5 n^{12}}{1 m^4 n^7} = 5 m^{5-4} n^{12-7}$

$= 5 m^1 n^5$
 $= 5mn^5$

5.2: More properties of exponents

5.2.1

$$\underline{\text{Ex.}} \quad (3xy)^4 = 3^4 x^4 y^4 = \boxed{81 x^4 y^4}$$

$$\underline{\text{Ex.}} \quad (-2a)^4 = (-2)^4 a^4 = \boxed{16 a^4}$$

$$\underline{\text{Ex.}} \quad (3x^2)^3 = 3^3 (x^2)^3 \xleftarrow{\text{Prop \# 4}} 27 x^6 \xleftarrow{\text{Prop \# 2}}$$

$$\underline{\text{Ex.}} \quad (x^3 y^4)^5 = \boxed{x^{15} y^{20}}$$

$$\underline{\text{Ex.}} \quad 6(c^3 d)^4 = \boxed{6 c^{12} d^4}$$

$$\underline{\text{Ex.}} \quad (-a)^6 = (-1a)^6 = (-1)^6 a^6 = 1 a^6 = \boxed{a^6}$$

Ex: $(-3x^4y^2)^2 (-2x^5yz)^3$

5.2.2

$$= (-3)^2 x^8 y^4 (-2)^3 x^{15} y^3 z^3$$

$$= 9 x^8 y^4 (-8) x^{15} y^3 z^3$$

$$= \boxed{-72 x^{23} y^7 z^3}$$

Ex:
$$\frac{(2x^2yz)(-x^4y^2z^3)^4}{(3xy)^2}$$

$$= \frac{2x^2yz(-1)^4 x^{16} y^8 z^{12}}{(3)^2 x^2 y^2} = \frac{2(1) x^{18} y^9 z^{13}}{9 x^2 y^2}$$

$$= \boxed{\frac{2 x^{16} y^7 z^{13}}{9}}$$

$$\text{or } \boxed{\frac{2}{9} x^{16} y^7 z^{13}}$$