

Lesson 4: Combining the Exponent Laws

Friday, August 31, 2018 2:20 AM

Prime Factorization and Exponents Lesson #4: Combining the Exponent Laws

Using Factors To Combine the Exponent Laws

Part One:

Three students are attempting to simplify the following expression:

$$3x^2 \times 5x^3$$

Their answers are shown below.

~~Harry~~ $\Rightarrow 8x^5$

~~Janet~~ $\Rightarrow 15x^6$

Laura $\Rightarrow 15x^5$

Explain using factors which student is correct.

$$3 \times 5 = 15 \quad x^2 \cdot x^3 = x^{2+3} = x^5$$

Part Two:

Use factors to explain why $6a^6 \div 3a^2 = 2a^4$.

$$\frac{6}{3} = 2 \quad \frac{a^6}{a^2} = a^{6-2} = a^4$$


State the simplified form of the following.

a) $(-7a^8)(6a^{12})$

$$= -7 \cdot 6 \cdot a^8 \cdot a^{12} = -42a^{8+12} = -42a^{20}$$

b) $3a^4 \times a^5 \times 6a^3$

$$3 \cdot 6 \cdot a^4 \cdot a^5 \cdot a^3 = 18a^{4+5+3} = 18a^{12}$$

c) $-16n^5 \div (-2n)$

$$\frac{-16n^5}{-2n} = 8n^{5-1} = 8n^4$$

d) $\frac{20y^7}{5y^7} = 4y^{7-7} = 4y^0 = 4$

e) $\frac{30b^{14}}{45b^{10}} = \frac{2b^{14-10}}{3} = \frac{2b^4}{3}$

$$= 8n^4$$



Simplify the following.

a) $x^5 y^8 x^3 y^4$

$$= x^{5+3} y^{8+4} = x^8 y^{12}$$

b) $\frac{x^5 y^8}{y^3}$

$$= x^{5-3} y^{8-1} = x^2 y^7$$

c) $(-3b)(b^3 c^2)(-4b^2 c)$

$$= -3 \cdot -4 \cdot b^{1+3+2} c^{1+2+1} = 12b^6 c^4$$

d) $\frac{10e^8 f^{12}}{4e^4 f^7}$

$$= \frac{5}{2} e^{8-4} f^{12-7} = \frac{5}{2} e^4 f^5$$

Complete Assignment Questions #1 - #4

Combining the Exponent Laws

The following examples use two or more of the exponent laws in their solution.



Class Ex. #3

Simplify.

a) $(3x^2)^3$
 $= 3^3 x^{2 \cdot 3}$
 $= 27x^6$

b) $(-2a^2b^5)^2$
 $= (-2)^2 a^{2 \cdot 2} b^{5 \cdot 2}$
 $= 4a^4b^6$

c) $\frac{x^2 x^5}{x^2}$
 $= \frac{x^{2+5}}{x^{2+1}}$
 $= \frac{x^7}{x^3} = x^{7-3} = x^4$

d) $\left(\frac{2a}{y^3}\right)^3$
 $= \frac{2^3 a^3}{y^{3 \cdot 3}} = \frac{8a^3}{y^9}$



Class Ex. #4

Simplify the following.

BEDMAS

a) $-(-n^2)^3$
 $= -(-n^{2 \cdot 3})$
 $= -(-n^6)$
 $= n^6$

b) $\left(\frac{4^3 \times 3x^6}{6x^5}\right)^4$
 $= \left(\frac{4 \cdot 3 y^3 x^{6-5}}{6}\right)^4$
 $= (2y^3x)^4$
 $= 2^4 y^{3 \cdot 4} x^{4 \cdot 1}$
 $= 16y^{12}x^4$

c) $\frac{16(x^3y^5)^2}{(2x^2)^3}$
 $= \frac{16x^{3 \cdot 2}y^{5 \cdot 2}}{2^3 x^{2 \cdot 3}}$
 $= \frac{16x^6y^{10}}{8x^6}$
 $= 2y^{10}$

d) $(5ab^6)^2 (4a^2b)$
 $= (5^2 a^2 b^{6 \cdot 2})(4a^2b)$
 $= 25a^2 b^{12} \cdot 4a^2 b$
 $= 25 \cdot 4 a^{2+2} b^{12+1}$
 $= 100a^4 b^{13}$



Class Ex. #5

Write in simplest form.

a) $(-a)^6 \div (-a)^4$
 base = -a
 $(-a)^{6-4} = (-a)^2$
 $= a^2$

b) $-a^6 \div (-a)^4$
 base = a base = -a
 $-a^6 \div a^4$
 base = a
 $-a^{6-4} = -a^2$

c) $-a^7 \div (-a)^3$
 $= +a^{7-3}$
 $= a^4$

Complete Assignment Questions #5 - #12

Extension

In higher level mathematics courses, you may meet variable bases and variable exponents including binomial exponents.

Use the exponent laws to simplify the following.



a) $\frac{b^{4x+y}}{b^{x-2y}}$

b) $\frac{x^{5a+7b} \cdot x^{3a+b}}{x^a \cdot x^{2a-7b}}$

Complete Assignment Question #13

Assignment

1. Simplify the following.

a) $3a^3 \times 3a^4$

b) $(10b^7)(3b^8)$

c) $3a^3 \cdot 5a^3$

d) $(-2x^4)(12x^9)$

e) $\left(-\frac{1}{2}e^7\right)(-14e^8)$

f) $0.4c^3 \times 0.5c$

2. Simplify.

a) $12x^4 \div 6x^2$

b) $(81e^9) \div (9e^8)$

c) $\frac{21d^6}{7d^2}$

d) $\frac{-80d^{80}}{8d^8}$

e) $(-10e^{10}) \div (-5e^5)$

f) $\frac{12f^6}{12f^5}$

3. Write in simplest form.

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

b) $x^9y^0x^2y^4$

c) $\frac{6x^4y^7}{2x^3y^2}$

d) $\frac{5x^4y^7}{x^3y^2}$

e) $\frac{4f^{12}d^3}{12f^4d}$

f) $(7b^4c)(bc^2)(-2b^2c^6)$

4. Simplify.

a) $\frac{10e^8f^8}{15e^4f^2}$

b) $(2p^3)(4p^7)(-2p)$

c) $(-2xy)(x^2y^3)(-3xy)$

d) $(-8b^6c) \div (2b^3c)$

e) $(-10t^8y^6) \div (-2t^7y^3)$

f) $(4x^5z^7) \div (-16xz^6)$

5. Write in simplest form.

a) $(-a^2b^3)^4$

b) $(-a^2b^3)^5$

c) $\left(\frac{b^4}{a^3}\right)^3$

d) $\frac{c^5 \times c^2}{c^4 \times c}$

6. Simplify.

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

b) $(-4a^5c^2)^4$

c) $(-2m^3n^4)^5(m^2n^3)$

d) $(-4x^2y^3)^3(8xy^8)$

e) $(a^3b^4c^5)(3abc^2)^3$

7. Write each expression in simplest form without brackets.

a) $\left(\frac{2d^5 \times d^4}{4d^3}\right)^3$

b) $\left(\frac{-16a^5b^3 \cdot 2a^2b^6}{8ab^7}\right)^3$

c) $\left(\frac{-5k^3 \cdot k^2}{k}\right)^2 \left(\frac{(-k)^5 \cdot k^2}{5k^2}\right)$

8. Write in a simpler form and evaluate.

a) $\frac{6^6 \times 6}{6^4}$

b) $(-3^3)^2$

c) $\left(\frac{2^{10}}{2^5}\right)^3$

d) $\frac{(0.7)^8}{(0.7)^4 \times (0.7)^2}$

e) $-5^6 \times 5^2$

f) $(-5)^6 \times (-5)^2$

g) $-10^{10} \div (-10)^8$

h) $\frac{-10^{10}}{-10^8}$

9. Write each expression in simplest form without brackets.

a) $(-x)^{12} \div (-x)^6$

b) $(-a)^6 \div (-a^4)$

c) $-p^{10} \div (-p)^2$

d) $c^5 \div (-c)^2$

e) $-(-t)^4 \div (-t)^3$

f) $-(-t^4) \div (-t)^3$

**Multiple
Choice**

10. The simplified form of $\frac{1}{36}(2x^3)^2(-3yx^2)$ is

A. x^8y^2

B. $-\frac{1}{3}x^8y$

C. $-\frac{1}{3}x^7y$

D. $-\frac{1}{6}x^6y$

11. The expression $\frac{6(x^3y^5)^2}{(3xy)^4}$ is equivalent to the expression

A. $\frac{4}{9}x^2y^6$

B. $2x^5y^6$

C. $2x^2y^6$

D. $\frac{2}{27}x^2y^6$

Numerical Response

12. If the expression $\frac{4x^{-4}}{8x^{-3}}$ is written in the form ax^b , then the value of $a - b$ is _____ .

(Record your answer in the numerical response box from left to right)

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Extension

13. Simplify each expression.

a) $a^{x+y}a^{2x+3y}$

b) $\frac{m^{x+9}}{m^3}$

c) $\frac{a^{3m+2}}{a^{m-3}}$

d) $\frac{x^{2y+7} \cdot x^{3y+2}}{x^{y+8}}$

Answer Key

1. a) $9a^7$ b) $30b^{15}$ c) $15a^6$ d) $-24x^{13}$ e) $7e^{15}$ f) $0.2c^4$
2. a) $2x^2$ b) $9e$ c) $3d^4$ d) $-10d^{72}$ e) $2e^5$ f) f
3. a) $15a^6b^{11}$ b) $x^{11}y^4$ c) $3xy^5$ d) $5xy^5$ e) $\frac{1}{3}f^8d^2$ f) $-14b^7c^9$
4. a) $\frac{2}{3}e^4f^6$ b) $-16p^{11}$ c) $6x^4y^5$ d) $-4b^3$ e) $5ty^3$ f) $-\frac{1}{4}x^4z$
5. a) a^8b^{12} b) $-a^{10}b^{15}$ c) $\frac{b^{12}}{a^9}$ d) c^2
6. a) $81a^4b^8$ b) $256a^{20}c^8$ c) $-32m^{17}n^{23}$ d) $-512x^7y^{17}$ e) $27a^6b^7c^{11}$
7. a) $\frac{d^{18}}{8}$ b) $-64a^{18}b^6$ c) $-5k^{13}$
8. a) $6^3 = 216$ b) $3^6 = 729$ c) $2^{15} = 32768$ d) $(0.7)^2 = 0.49$
 e) $-5^8 = -390625$ f) $(-5)^8 = 390625$ g) $-10^2 = -100$ h) $10^2 = 100$
9. a) x^6 b) $-a^2$ c) $-p^8$ d) c^3 e) t f) $-t$
10. B 11. D 12.

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13. a) a^{3x+4y} b) m^{x+6} c) a^{2m+5} d) x^{4y+1}