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

Using Factors To Combine the Exponent Laws

Part One:

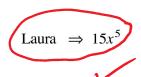
Three students are attempting to simplify the following expression:

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

Their answers are shown below. $\frac{3x^2 \times 5x^3}{}$

Harry $\Rightarrow 8x^5$

Janet $\Rightarrow 15x^6$



Explain using factors which student is correct.

Part Two:

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

$$6 \div 3 = 2$$
 > $2a^4$



State the simplified form of the following.

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

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

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

tate the shiplined form of the following.
(-7
$$a^8$$
) (6 a^{12}) b) $3a^4 \times a^5 \times 6a^3$
 $-42a^{8+12} = -42a^{80} = 18a^{12}$

$$= 180^{12}$$

$$\frac{8n^{5-1}}{(-8n^4)}$$

d)
$$\frac{20y^{5}}{5y^{5}}$$
 $y^{5-5} = y^{6} = 1$ e) $\frac{30b^{14}}{45b^{10}}$

e)
$$\frac{30b^{14}}{45b^{10}}$$



$$\frac{3}{3}b^{14-10} = \frac{3}{3}b^{4}$$
 or $\frac{3}{3}b^{4}$



Simplify the following.



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

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

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

$$= X^{5+3} y^{8+4}$$
$$= X^{8} y^{17}$$

$$= \chi^{5-3} y^{8-1}$$

$$= \chi^{2} u^{7}$$

$$-3.-4 = 12$$

 $0^{1+2+2} = 0^{6}$
 $= 120^{6}C^{4}$

a)
$$x^{5}y^{8}x^{3}y^{4}$$
 b) $\frac{x^{5}y^{8}}{x^{3}y}$ c) $(-3bc)(b^{3}c^{2})(-4b^{2}c)$ d) $\frac{10e^{8}f^{12}}{4e^{4}f^{7}}$

$$= \chi^{5+3}y^{8+4} = \chi^{5-3}y^{8-1} = 3\cdot -4 = 13$$

$$= \chi^{8}y^{12} = \chi^{2}y^{7} = 13$$

$$= \chi^{2}y^{7} = 13$$

$$= (-17)^{12} = 0$$

$$= \frac{5}{3}e^{8-4}\int_{-12-7}^{12-7} e^{-17}f^{12-7}$$
Complete Assignment Questions #1 - #4

Complete Assignment Questions #1 - #4

$$\int = |ab^{6}C^{4}|$$
ont Questions #1 #4

=5ets or 5ets

Complete Assignment Questions #1 - #4

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Combining the Exponent Laws

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



Simplify.

a)
$$(3x^2)^3$$

$$=3^3 \chi^{a}$$

$$= 27x^{6}$$

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

$$\mathbf{c)} \ \frac{x^3 x^5}{x^2 x}$$

$$\frac{\chi^{3+5}}{\chi^{3+1}} = \frac{\chi^8}{\chi^3}$$



$$= -\frac{8a^3}{y^9}$$

d) $(5ab^6)^2 (4a^2b)$

 $=(25a^2b^2)(4a^2b)$



Simplify the following.



b)
$$\left(\frac{4y^3 \times 3x^6}{6x^5}\right)^4$$

 $-\left(-1\right)^5 \bigcap^{10}$ $=\left(\frac{12y^3x^6}{6x^5}\right)^4$
 $-\left(-1\right)^5 \bigcap^{10}$

$$(-)^{\text{even}} = + \text{ ex}$$

ex.
$$(-1)^2 = -1 \cdot -1 = +1$$



Write in simplest form.

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

$$\left(-0\right)^{6-4} = \left(-0\right)^{2}$$

b)
$$-\underline{a}^6 \div (\underline{-a})^4$$

$$= -0^{2}$$

c)
$$-a^7 \div (-a)^3$$

$$-0^{7} \div -0^{3} = +0^{7-3} = 0^{4}$$





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.



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

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

a)
$$3a^3 \times 3a^4$$
 b) $(10b^7)(3b^8)$ **c)** $3a^3 \cdot 5a^3$

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

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

d)
$$(-2x^4)$$
 $(12x^9)$ **e**) $\left(-\frac{1}{2}e^7\right)$ $(-14e^8)$ **f**) $0.4c^3 \times 0.5c$

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

2. Simplify.

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

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

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

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

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

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

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

4. Simplify.

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

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

b)
$$(2p^3)(4p^7)(-2p)$$
 c) $(-2xy)(x^2y^3)(-3xy)$

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

d)
$$(-8b^6c) \div (2b^3c)$$
 e) $(-10t^8y^6) \div (-2t^7y^3)$ **f**) $(4x^5z^7) \div (-16xz^6)$

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

5. Write in simplest form.

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

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

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

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.

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

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

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

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

e)
$$-5^6 \times 5^2$$
 f) $(-5)^6 \times (-5)^2$ **g**) $-10^{10} \div (-10)^8$ **h**) $\frac{-10^{10}}{-10^8}$

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

9. Write each expression in simplest form without brackets.

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

b)
$$(-a)^6 \div (-a^4)$$
 c) $-p^{10} \div (-p)^2$

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

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

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

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.
$$x^8y^2$$

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.
$$2x^5v^6$$

C.
$$2x^2y^6$$

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

If the expression $\frac{4x^{-4}}{6x^{-3}}$ 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)



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

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

4. a)
$$\frac{1}{3}e^{f}$$
 b) $-10p$ c) $6x^{2}y$ d) $-4p$ e) $3ty$ 1) $-\frac{1}{4}x^{2}z$
5. a) $a^{8}b^{12}$ b) $-a^{10}b^{15}$ c) $\frac{b^{12}}{a^{9}}$ d) c^{2}
6. a) $81a^{4}b^{8}$ b) $256a^{20}c^{8}$ c) $-32m^{17}n^{23}$ d) $-512x^{7}y^{17}$ e) $27a^{6}b^{7}c^{11}$
7. a) $\frac{d^{18}}{8}$ b) $-64a^{18}b^{6}$ c) $-5k^{13}$

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)** $10^2 = 100$

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