MULTIPLYING AND DIVIDING MONOMIALS

BIG IDEAS:

- When **multiplying and dividing monomials**, multiply/divide the coefficients and then apply the appropriate exponent laws to the variables
- **Combinations of exponent laws** can be used to simplify expressions involving monomial multiplication and division

LEARNING GOALS AND SKILL DEVELOPMENT:
You know you have met the goals for this lesson when you can:

EMERGING

LEARNING GOALS	ANCHOR QUESTIONS
Multiply monomials by multiplying the coefficients and adding the exponents of powers with the same base	1, 3
Divide monomials by dividing the coefficients and subtracting the exponents of powers with the same base	2, 4

SKILL BUILDING QUESTIONS			
1	2	3	4

EVOLVING

LEARNING GOALS	ANCHOR QUESTIONS
Simplify multi-step expressions involving multiplication and division of monomials	5
Determine simplified algebraic expressions to represent area	6
Combine exponent laws to simplify expressions involving multiplication and division of monomials with positive exponents	9, 10

SKILL BUILDING QUESTIONS			
5	6	7	8
9	10		

EXTENDING

LEARNING GOALS	ANCHOR QUESTIONS
Combine exponent laws to simplify expressions involving multiplication and division of monomials, including those with negative exponents	13
Perform calculations using numbers given in scientific notation	15, 17

SKILL BUILDING QUESTIONS			
11	12	13	14
15	16	17	18

BUILD YOUR SKILLS

1. Multiply.

a) $3\times 2x$ b) $5(4x)$ c) $-2(7y)$ d) $10\times 3x^2$ e) $x(9x)$

f) $(5x)(3x)$ g) $-2m(6m)$ h) $y(8y^2)$ i) $(-5p^2)(-3p^2)$ j) $2(5x)(-3x^2)$

2. Divide.

a) $6x\div 2$ b) $\dfrac{-12x}{4}$ c) $\dfrac{15x}{x}$ d) $\dfrac{14y}{7y}$ e) $\dfrac{25n^2}{n^2}$ f) $\dfrac{24h^2}{3h^2}$

g) $\dfrac{9x^2}{x}$ h) $\dfrac{-28x^3}{x}$ i) $\dfrac{16x^4}{8x^2}$ j) $\dfrac{-20r^6}{-4r^2}$ k) $-\dfrac{75u^{10}}{15u^7}$ l) $\dfrac{27x^{14}}{-3x^{10}}$

3. Multiply.

a) $4\times 6xy$ b) $(-2)(7xy)$ c) $6a\times 2b$ d) $(4m)(-3n)$

e) $(8x)(9yz)$ f) $9ab(4c)$ g) $(-2pq)(-10r)$ h) $17xy(-3z^2)$

4. Divide.

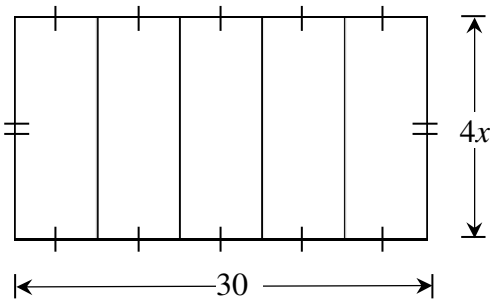
a) $16xy\div 2$ b) $\dfrac{32ab}{8}$ c) $\dfrac{24xy}{6x}$ d) $\dfrac{-36pqr}{9r}$ e) $\dfrac{60abc}{10ab}$ f) $\dfrac{-22st^2}{-11t^2}$

5. Simplify.

a) $\dfrac{4(3x)}{6}$ b) $\dfrac{(5x)(6x)}{15}$ c) $\dfrac{10(2x)}{5x}$ d) $\dfrac{(-3y)(12y)}{9y}$ e) $\dfrac{(12a)(4a)}{8a^2}$

f) $\dfrac{(3x)(16y)}{4}$ g) $\dfrac{-4(10xy)}{5xy}$ h) $\dfrac{(16m)(2n)}{4m}$ i) $\dfrac{(20q)(3r)}{(2q)(15r)}$ j) $\dfrac{2x(-2y)(-12z)}{24xz}$

6. A rectangle is divided into 5 equal sections as shown on the right.



a) Determine a simplified expression that represents the area of the entire rectangle.

b) Determine a simplified expression that represents the area of one section.

7. Write as a single power and then evaluate. Express all answers in exact form.

a) $\left(3\times3^{2}\right)^{2}$ b) $\left(2^{3}\right)^{2}\left(2^{2}\right)^{2}$ c) $\left(\frac{2^{3}}{2^{2}}\right)^{7}$ d) $\frac{\left(5^{3}\right)^{4}}{\left(5^{2}\right)^{5}}$

8. Simplify.

a) $x^{5}\left(x^{4}\right)^{2}$ b) $\left(x^{2}\right)^{3}\left(x^{4}\right)^{2}$ c) $\frac{\left(k^{4}\right)^{3}}{k^{2}}$ d) $\frac{\left(y^{3}\right)^{5}}{\left(y^{2}\right)^{3}}$ e) $\frac{\left(a^{4}a^{2}\right)^{3}}{\left(a^{3}a^{5}\right)^{2}}$

f) $\left(\frac{y^{9}}{y^{5}}\right)^{4}$ g) $\left(5x^{4}\times6x^{8}\right)^{2}$ h) $\left[\left(-2a\right)\left(5a^{9}\right)\right]^{3}$ i) $\left(3x\right)^{2}\left(2x^{4}\right)^{3}$ j) $\frac{\left(4p^{5}\right)^{3}}{\left(-2p^{3}\right)^{4}}$

9. Simplify.

a) $x^{7}\times x^{6}\times y^{4}\times y^{3}$ b) $a^{3}b^{8}a^{9}b^{2}$ c) $\left(x^{4}y^{5}\right)\left(x^{2}y^{3}\right)$ d) $\left(9x^{2}y^{3}\right)\left(4x^{4}y^{2}\right)$

e) $\left(-52ab^{2}\right)\left(3a^{9}b^{10}\right)$ f) $x^{6}\left(xy\right)^{4}$ g) $-6m\left(2n\right)^{3}$ h) $\left(2x\right)^{4}\left(3y\right)^{2}$

i) $\left(3x^{4}\right)^{2}\left(2y^{5}\right)^{3}$ j) $\left(2a^{2}\right)^{4}\left(3a^{6}b^{5}\right)^{2}$ k) $-3x^{2}y\left(-2x^{7}y^{4}z^{2}\right)^{3}$ l) $\left(-2p^{2}q^{3}\right)^{4}\left(4p^{5}q\right)^{3}$

10. Simplify.

a) $\frac{x^{5}y^{6}}{x^{2}y^{2}}$ b) $\frac{38a^{2}b^{4}}{2ab}$ c) $\frac{-12xy^{6}}{3xy^{2}}$ d) $\frac{\left(4m^{5}n^{6}\right)^{2}}{\left(2m^{2}n^{3}\right)^{3}}$ e) $\frac{\left(-2xy^{3}\right)^{4}}{\left(-2y^{4}\right)^{3}}$ f) $\frac{\left(-4a^{5}b^{2}\right)^{2}\left(2a^{3}b^{2}\right)^{3}}{\left(2a^{3}b\right)^{4}}$

11. Write as a single power and then evaluate. Express all answers in exact form.

a) $\left(5^{8}\times5^{-7}\right)^{3}$ b) $\left(3^{2}\right)^{-3}\left(3^{-1}\right)^{-2}$ c) $\left(\frac{6^{-7}}{6^{-6}}\right)^{2}$ d) $\frac{\left(7^{3}\right)^{-2}}{\left(7^{-2}\right)^{4}}$

12. State whether the two expressions are equivalent or not equivalent.

a) $\left(x^3\right)^5\left(x^{-7}\right)$ and $\dfrac{\left(x^{10}\right)\left(x^4\right)}{x^6}$ b) $\dfrac{40a^7b^8}{5a^2b}$ and $\left(2ab\right)^3\left(ab^2\right)^2$

13. Simplify. Express all answers using positive exponents.

a) $\left(x^9x^{-4}\right)^3$ b) $\dfrac{\left(x^{10}\right)\left(x^{-4}\right)}{x^2}$ c) $\left(a^{-6}\right)^3\left(a^2\right)^{-5}$ d) $\dfrac{\left(b^4\right)^{-2}}{\left(b^{-3}\right)^4}$

e) $\left(\dfrac{y^{-5}}{y^4}\right)^3$ f) $\left(2a^{-5}b^6\right)\left(5ab^{-4}\right)$ g) $\dfrac{18x^{-4}y^{10}}{6x^3y^{-2}}$ h) $\dfrac{\left(2x^5y\right)^3\left(x^{-3}y^2\right)^{-4}}{\left(10x^6y^{-7}\right)^2}$

14. The length of a triangle's base is $5x^2y^3$ cm and its height is $4xy^2$ cm.

a) Determine a simplified expression for the area of the triangle.

b) If the triangle is the base of a prism with a length of x cm, find a simplified expression for the volume of the prism.

c) If $x = 4$ cm and $y = 3$ cm, determine the area of the triangle and the volume of the triangular prism.

Scientific Notation

15. The numbers 5.2×10^9 and 2.0×10^{11} are expressed in scientific notation. Express the product of these numbers in scientific notation.

16. Evaluate $\left(7.8\times10^{12}\right)\left(5.6\times10^{14}\right)$ and express the result in scientific notation.

17. Approximately 7.4×10^{11} kg of rice is produced globally every year. If the population of the world is about 7.6×10^9 people, approximately how many kilograms of rice is produced per person each year? Express your answer in scientific notation.

18. Lisa is a photographer who uses an 8 TB hard drive to store her images. Typically, her images have a file size of about 4 MB each.

a) Using scientific notation, express the storage capacity of the hard drive in kilobytes.

b) Using scientific notation, express the image file size in kilobytes.

c) Approximately how many images can Lisa store on the hard drive? Express your answer using scientific notation.

CHECK YOUR UNDERSTANDING

1. a) $6x$ b) $20x$ c) $-14y$ d) $30x^2$ e) $9x^2$ f) $15x^2$ g) $-12m^2$ h) $8y^3$

i) $15p^4$ j) $-30x^3$

2. a) $3x$ b) $-3x$ c) 15 d) 2 e) 25 f) 8 g) $9x$ h) $-28x^2$ i) $2x^2$

j) $5r^4$ k) $-5u^3$ l) $-9x^4$

3. a) $24xy$ b) $-14xy$ c) $12ab$ d) $-12mn$

e) $72xyz$ f) $36abc$ g) $20pqr$ h) $-51xyz^2$

4. a) $8xy$ b) $4ab$ c) $4y$ d) $-4pq$ e) $6c$ f) $2s$

5. a) $2x$ b) $2x^2$ c) 4 d) $-4y$ e) 6

f) $12xy$ g) -8 h) $8n$ i) 2 j) $2y$

6. a) $120x^2$ b) $24x^2$

7. a) 3^6 ; 729 b) 2^{10} ; 1024 c) 2^7 ; 128 d) 5^2 ; 25

8. a) x^{13} b) x^{14} c) k^{10} d) y^9 e) a^2 f) y^{16} g) $900x^{24}$ h) $-1000a^{30}$

i) $72x^{14}$ j) $4p^3$

9. a) $x^{13}y^7$ b) $a^{12}b^{10}$ c) x^6y^8 d) $36x^6y^5$ e) $-156a^{10}b^{12}$ f) $x^{10}y^4$

g) $-48mn^3$ h) $144x^4y^2$ i) $72x^8y^{15}$ j) $144a^{20}b^{10}$ k) $24x^{23}y^{13}z^6$ l) $1024p^{23}q^{15}$

10. a) x^3y^4 b) $19ab^3$ c) $-4y^4$ d) $2m^4n^3$ e) $-2x^4$ f) $8a^7b^6$

11. a) 5^3 ; 125 b) 3^{-4} ; $\frac{1}{81}$ c) 6^{-2} ; $\frac{1}{36}$ d) 7^2 ; 49

12. a) equivalent b) equivalent

13. a) x^{15} b) x^4 c) $\frac{1}{a^{28}}$ d) b^4 e) $\frac{1}{y^{27}}$ f) $\frac{10b^2}{a^4}$ g) $\frac{3y^{12}}{x^7}$ h) $\frac{2x^{15}y^9}{25}$

14. a) $10x^3y^5$ cm^2 b) $10x^4y^5$ cm^3

c) area of triangle $= 155520$ cm^2, volume of prism $= 622080$ cm^3

ANSWERS

ANSWERS

15. 10.4×10^{20}

16. 4.4×10^{27}

17. 9.7×10^{1} kg/person

18. a) 8×10^{9} KB b) 4×10^{3} KB c) 2×10^{6} images