

Multiplying and Dividing Monomials

Name: _____ Date: _____ Score: _____ / 24

Quick Review

A **monomial** is a single term — a coefficient times one or more variables with whole-number exponents (like $3x^2y$ or $-7x^5$). When you *multiply* monomials, multiply the coefficients and *add* the exponents on each matching base: $(3x^2)(4x^5) = 12x^{2+5} = 12x^7$.

When you *divide* monomials, divide the coefficients and *subtract* exponents on matching bases: $\frac{18x^6}{6x^2} = 3x^{6-2} = 3x^4$. (Assume the variables in the denominator aren't zero.) Multiple bases work independently: $\frac{20x^5y^3}{4x^2y^3} = 5x^{5-2}y^{3-3} = 5x^3$ (the y 's cancel because $y^0 = 1$).

Power-of-a-power and **power-of-a-product**: $(x^m)^n = x^{mn}$ (multiply the exponents) and $(xy)^n = x^n y^n$ (distribute the exponent to each factor). Don't forget the coefficient: $(2x^3)^4 = 2^4(x^3)^4 = 16x^{12}$ — the coefficient gets raised too.

Common traps: $x^m + x^n$ is *not* x^{m+n} — you can't add exponents on a sum. $x^2 + x^2 = 2x^2$, not x^4 . Negative exponents flip across the bar: $a^{-2} = \frac{1}{a^2}$ and $\frac{1}{a^{-2}} = a^2$. And for any nonzero x , $x^0 = 1$ (not 0).

PRACTICE

Simplify each expression. Assume all variables are nonzero. Use positive exponents in final answers.

1. The table separates the two factors of $(3x^2)(4x^5)$ into coefficient and power of x . Use it to simplify. _____

| Factor | Coefficient | Power of x |
|--------|-------------|--------------|
| $3x^2$ | 3 | 2 |
| $4x^5$ | 4 | 5 |

2. $\frac{18x^6}{6x^2}$ _____

3. The table splits the factors of $(2x^3y)(5xy^4)$ into coefficient and the powers of x and y . Use it to simplify. _____

| Factor | Coef. | Power x | Power y |
|---------|-------|-----------|-----------|
| $2x^3y$ | 2 | 3 | 1 |
| $5xy^4$ | 5 | 1 | 4 |

4. $(2x^3)^4$ _____

5. $\frac{20x^5y^3}{4x^2y^3}$ _____

6. $\frac{(2x^2)^3 \cdot 3x^4}{6x^5}$ _____

7. $\frac{(4x^3y^2)^2}{8x^4y}$ _____

8. $\frac{12a^3b^{-2}}{3a^{-1}b^4}$ _____

9. $(-3x^2)(2x^5)$ _____

10. $(5x^2y^3)^2$ _____

11. $\frac{30x^4}{-5x}$ _____

12. $(4x^2y)(3xy^2)(2y)$ _____

13. $(2a^3)^2(3a)$ _____



14. Simplify $g(x) = \frac{x^8}{x^3}$, then use the table of g values to find $g(2)$. _____

| | | | | |
|--------|-----|----|---|---|
| x | -2 | -1 | 0 | 1 |
| $g(x)$ | -32 | -1 | 0 | 1 |

15. $(x^2)^0$ _____

16. $\left(\frac{2x^3}{y}\right)^2$ _____

17. $\frac{15a^5b^2}{3a^2b^2}$ _____

18. $(2x^{-1}y^3)(3xy^{-2})$ _____

19. $(x^m)^2 \cdot x^3$ _____

20. If $\frac{(kx^2)^3}{2x} = 108x^5$, find $k > 0$ _____

◆ Word Problems

21. A box has length $3x^2$ inches, width $2x$ inches, and height $5x^3$ inches. Find a simplified expression for its volume. _____

22. A square has side length $4x^3y^2$. Write a simplified expression for its area. _____

23. A rectangle has area $24x^5y^3$ and length $6x^2y$. Write a simplified expression for its width. _____

24. A scientist's data table shows population growth: colony A has $2x^4$ bacteria and colony B has $5x^2$ bacteria. How many times larger is colony A than colony B, in simplified form? _____



Answer Keys

1. $12x^7$

2. $3x^4$

3. $10x^4y^5$

4. $16x^{12}$

5. $5x^3$

6. $4x^5$

7. $2x^2y^3$

8. $\frac{4a^4}{b^6}$

9. $-6x^7$

10. $25x^4y^6$

11. $-6x^3$

12. $24x^3y^4$

13. $12a^7$

14. $x^5, g(2) = 32$

15. 1

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

17. $5a^3$

18. $6y$

19. x^{2m+3}

20. $k = 6$

21. $30x^6$ cubic inches

22. $16x^6y^4$

23. $4x^3y^2$

24. $\frac{2x^2}{5}$

Step-by-Step Explanations

1. Multiply down the coefficient column: $3 \cdot 4 = 12$. Add down the power column: $2 + 5 = 7$. Result: $12x^7$.

2. Keep the rule visible: Divide coefficients: $18/6 = 3$. Subtract exponents: $6 - 2 = 4$. Result: $3x^4$. That gives a quick check on the answer.

3. Multiply the coefficients: $2 \cdot 5 = 10$. Add each power column: x gives $3 + 1 = 4$, y gives $1 + 4 = 5$. Result: $10x^4y^5$.

4. Power of a product: $(2x^3)^4 = 2^4 \cdot (x^3)^4 = 16x^{12}$. The coefficient gets the exponent too — skipping that step gives $2x^{12}$, which is wrong.

5. Coefficients: $20/4 = 5$. x : $5 - 2 = 3$. y : $3 - 3 = 0$, and $y^0 = 1$ so the y 's vanish. Result: $5x^3$.

6. Keep the rule visible: Top: $(2x^2)^3 = 8x^6$, then $8x^6 \cdot 3x^4 = 24x^{10}$. Divide: $24x^{10}/(6x^5) = 4x^5$. That gives a quick check on the answer.

7. Top: $(4x^3y^2)^2 = 16x^6y^4$. Divide: coefficients $16/8 = 2$; x exponent $6 - 4 = 2$; y exponent $4 - 1 = 3$. Result: $2x^2y^3$.

8. Coefficient: $12/3 = 4$. a : $3 - (-1) = 4$. b : $-2 - 4 = -6$. So $4a^4b^{-6} = \frac{4a^4}{b^6}$. Subtracting a negative flips its sign — a small but key move.

9. A careful way to see it: Coefficients: $-3 \cdot 2 = -6$. Exponents: $2 + 5 = 7$. The negative travels along. That gives a quick check on the answer.

10. Keep the rule visible: Distribute the square: $5^2 = 25$, $x^{2 \cdot 2} = x^4$, $y^{3 \cdot 2} = y^6$. Result: $25x^4y^6$. That gives a quick check on the answer.

11. One steady path is: $30/(-5) = -6$ and $x^{4-1} = x^3$. The sign comes from the coefficient division, not the exponents. That gives a quick check on the answer.

12. Start with the key idea: Coefficients: $4 \cdot 3 \cdot 2 = 24$. x : $2 + 1 + 0 = 3$. y : $1 + 2 + 1 = 4$. Result: $24x^3y^4$. That gives a quick check on the answer.

13. A careful way to see it: $(2a^3)^2 = 4a^6$, then $4a^6 \cdot 3a = 12a^7$. This is the part to check before moving on, because it keeps the answer tied to the original question.

14. Subtract exponents on the matching base: $8 - 3 = 5$, so $g(x) = x^5$. The table fits (e.g. $g(-2) = (-2)^5 = -32$). Then $g(2) = 2^5 = 32$.

15. One steady path is: Anything (nonzero) raised to the 0 power is 1. So $(x^2)^0 = 1$, not 0. That gives a quick check on the answer.

16. Start with the key idea: Distribute the square to numerator and denominator: $\frac{(2x^3)^2}{y^2} = \frac{4x^6}{y^2}$. That gives a quick check on the answer.

17. A careful way to see it: $15/3 = 5$, $a^{5-2} = a^3$, $b^{2-2} = b^0 = 1$. Result: $5a^3$. This is the part to check before moving on, because it keeps the answer tied to the original question.

18. Keep the rule visible: Coefficients: $2 \cdot 3 = 6$. x : $-1 + 1 = 0$, so $x^0 = 1$. y : $3 + (-2) = 1$. Result: $6y$. That gives a quick check on the answer.

19. One steady path is: $(x^m)^2 = x^{2m}$, then $x^{2m} \cdot x^3 = x^{2m+3}$. Add exponents when multiplying same-base powers. That gives a quick check on the answer.

20. Simplify the left side: $(kx^2)^3 = k^3x^6$, then divide by $2x$: $\frac{k^3x^6}{2x} = \frac{k^3}{2}x^5$. Set equal to $108x^5$: $\frac{k^3}{2} = 108$, so $k^3 = 216$, giving $k = 6$.

21. Volume is $L \cdot W \cdot H$. Multiply the coefficients and add the exponents: $3 \cdot 2 \cdot 5 = 30$ and $x^2 \cdot x \cdot x^3 = x^{2+1+3} = x^6$. So $V = 30x^6$ cubic inches. (At $x = 2$, that's $30 \cdot 64 = 1920$ in³ — a sensible size for a small storage box.)

22. Area of a square is side squared: $(4x^3y^2)^2 = 4^2 \cdot x^{3 \cdot 2} \cdot y^{2 \cdot 2} = 16x^6y^4$. The exponent distributes to every factor inside, including the coefficient.

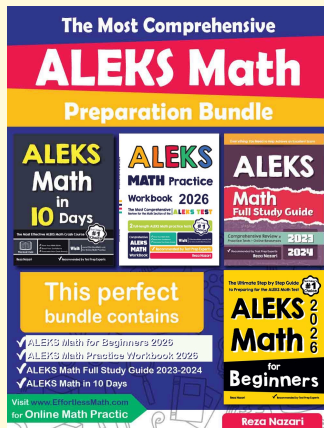
23. Width is $\frac{\text{area}}{\text{length}} = \frac{24x^5y^3}{6x^2y}$. Divide coefficients: $24/6 = 4$. Subtract exponents: $x^{5-2} = x^3$, $y^{3-1} = y^2$. Width is $4x^3y^2$.

24. How many times larger is the ratio $A/B = \frac{2x^4}{5x^2} = \frac{2}{5}x^{4-2} = \frac{2x^2}{5}$. At $x = 10$, the ratio is $\frac{2(100)}{5} = 40$, so colony A is 40 times larger — a clean positive multiplier.



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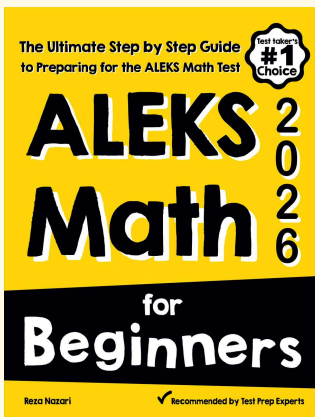
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