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

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

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

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

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

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

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

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

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

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

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14. Simplify $g(x) = \dfrac{x^8}{x^3}$, 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. $\left(\dfrac{2x^3}{y}\right)^2$ _____

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

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

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

20. If $\dfrac{(kx^2)^3}{2x} = 108x^5$, 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. $\boxed{12x^7}$
2. $\boxed{3x^4}$
3. $\boxed{10x^4y^5}$
4. $\boxed{16x^{12}}$
5. $\boxed{5x^3}$
6. $\boxed{4x^5}$
7. $\boxed{2x^2y^3}$
8. $\boxed{\frac{4a^4}{b^6}}$
9. $\boxed{-6x^7}$
10. $\boxed{25x^4y^6}$
11. $\boxed{-6x^3}$
12. $\boxed{24x^3y^4}$
13. $\boxed{12a^7}$
14. $\boxed{x^5,\ g(2)=32}$
15. $\boxed{1}$
16. $\boxed{\frac{4x^6}{y^2}}$
17. $\boxed{5a^3}$
18. $\boxed{6y}$
19. $\boxed{x^{2m+3}}$
20. $\boxed{k=6}$
21. $\boxed{30x^6 \text{ cubic inches}}$
22. $\boxed{16x^6y^4}$
23. $\boxed{4x^3y^2}$
24. $\boxed{\frac{2x^2}{5}}$

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: $5^2 = 25$, $x^{2\cdot2} = x^4$, $y^{3\cdot2} = y^6$. 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 $2x$: $\frac{k^3}{2}x^5$. 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 $30 \cdot 64 = 1920$ in^3 — a sensible size for a small storage box.)

22. Area of a square is side squared: $(4x^3y^2)^2 = 4^2 \cdot x^{3\cdot2} \cdot y^{2\cdot2} = 16x^6y^4$. 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 largerïs 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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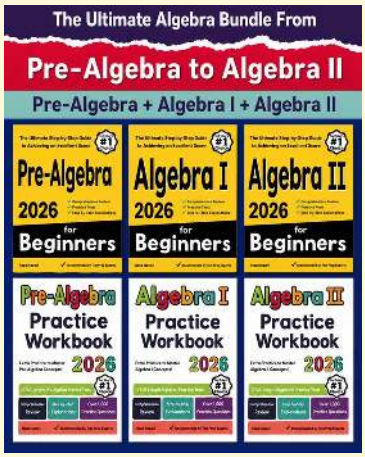

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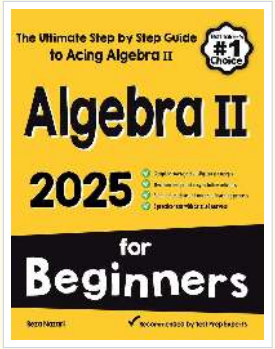

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