

Multiplying a Polynomial and a Monomial

Name: _____ Date: _____ Score: _____ / 24

Q Quick Review

To multiply a monomial by a polynomial, **distribute** the monomial to *every* term inside the parentheses — not just the first one. Skipping a term is the most common error, so write each multiplication explicitly the first few times.

Quick check: $3(2x + 5) = 3 \cdot 2x + 3 \cdot 5 = 6x + 15$. With variables: $x(x + 4) = x \cdot x + x \cdot 4 = x^2 + 4x$. With monomial coefficients: $2x^2(3x - 5) = 2x^2 \cdot 3x + 2x^2 \cdot (-5) = 6x^3 - 10x^2$. The exponents add on each multiplication ($x^2 \cdot x = x^3$).

When the monomial out front is **negative**, the negative hits every term inside, flipping signs as it goes. So $-3x(x^2 - 2x + 4) = -3x^3 + 6x^2 - 12x$. Two flips give a +, one flip gives a -. Track the signs term by term to avoid mix-ups.

When two distributed pieces appear together with addition or subtraction between them, finish each distribution first, then combine like terms. So $2x(x^2 + 3) - x(x^2 - 5) = 2x^3 + 6x - x^3 + 5x = x^3 + 11x$. Save the like-term combine for the very end.

PRACTICE

Multiply and simplify. Write each answer in standard form.

- $3(2x + 5)$ _____
- $x(x + 4)$ _____
- Use the box method to expand $2x^2(3x - 5)$: fill each box, then combine. _____

×	$3x$	-5
$2x^2$		

- Use the box method to expand $4x(2x^2 - 3x + 1)$. _____

×	$2x^2$	$-3x$	1
$4x$			

- $-3x(x^2 - 2x + 4)$ _____
- $2x(x^2 + 3) - x(x^2 - 5)$ _____
- $5xy(2x^2y - 3xy^2 + 4)$ _____
- $3x(2x^2 - 5x + 4)$ _____
- $4x^2(2x^3 - 5x + 3)$ _____
- $-2x(3x^2 - x + 5)$ _____
- $6y(y^2 - 3y + 2)$ _____
- $x^2(x^2 - 4) + x(x^3 + 2)$ _____
- $3a^2(a - b)$ _____
- $-(x)(x^2 + 5x - 2)$ _____
- $2x(x + 1) + 3x(x - 2)$ _____
- $x^3(2x^2 + x - 4)$ _____
- $(3xy^2)(2x^2 + xy - y)$ _____



18. Use the area model (box method) to find the area of a rectangle with width $3x$ and length $2x^2 - 5x + 4$. _____
Fill the three boxes, then add.

\times	$2x^2$	$-5x$	4
$3x$			

19. Coefficient of x^3y^2 in $5xy(2x^2y - 3xy^2 + 4)$ _____
20. If $-2x(ax^2 + 3x - 5)$ has x^3 -coefficient 14, find a _____

◆ Word Problems

21. A rectangle has width $3x$ meters and length $(2x^2 - 5x + 4)$ meters. Write a simplified polynomial for its area. _____
22. A garden bed is a rectangle with width $x + 3$ feet, and a soil supplier sells topsoil at $4x$ dollars per foot of width times the bed's length $(2x - 1)$. Write a simplified polynomial for the supplier's revenue from covering the whole bed. _____
23. A box has square base of side x and height $(x + 5)$. Write a simplified polynomial for its volume. _____
24. Three customers each order a bundle of $(2x - 3)$ items at $\$5x$ per item. Write a simplified polynomial for the total revenue from all three customers. _____



Answer Keys

- | | |
|---------------------------------|--|
| 1. $6x + 15$ | 13. $3a^3 - 3a^2b$ |
| 2. $x^2 + 4x$ | 14. $-x^3 - 5x^2 + 2x$ |
| 3. $6x^3 - 10x^2$ | 15. $5x^2 - 4x$ |
| 4. $8x^3 - 12x^2 + 4x$ | 16. $2x^5 + x^4 - 4x^3$ |
| 5. $-3x^3 + 6x^2 - 12x$ | 17. $6x^3y^2 + 3x^2y^3 - 3xy^3$ |
| 6. $x^3 + 11x$ | 18. $6x^3 - 15x^2 + 12x$ |
| 7. $10x^3y^2 - 15x^2y^3 + 20xy$ | 19. 10 |
| 8. $6x^3 - 15x^2 + 12x$ | 20. $a = -7$ |
| 9. $8x^5 - 20x^3 + 12x^2$ | 21. $6x^3 - 15x^2 + 12x$ square meters |
| 10. $-6x^3 + 2x^2 - 10x$ | 22. $8x^3 + 20x^2 - 12x$ dollars |
| 11. $6y^3 - 18y^2 + 12y$ | 23. $x^3 + 5x^2$ |
| 12. $2x^4 - 4x^2 + 2x$ | 24. $30x^2 - 45x$ dollars |

Step-by-Step Explanations

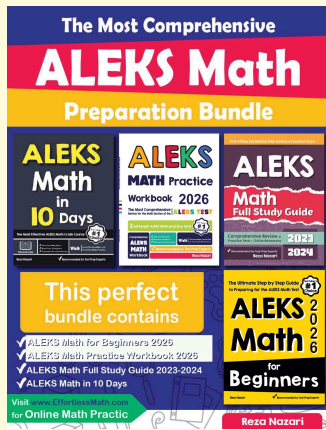
- A careful way to see it: Distribute the 3: $3 \cdot 2x + 3 \cdot 5 = 6x + 15$. The 3 must reach every term inside. That gives a quick check on the answer.
- Keep the rule visible: $x \cdot x = x^2$ and $x \cdot 4 = 4x$. Add: $x^2 + 4x$. This is the part to check before moving on, because it keeps the answer tied to the original question.
- One steady path is: $2x^2 \cdot 3x = 6x^3$ fills the first box and $2x^2 \cdot (-5) = -10x^2$ the second. Adding them gives $6x^3 - 10x^2$. That gives a quick check on the answer.
- Fill the boxes: $4x \cdot 2x^2 = 8x^3$, $4x \cdot (-3x) = -12x^2$, $4x \cdot 1 = 4x$. Adding gives $8x^3 - 12x^2 + 4x$.
- Distribute the $-3x$: $-3x \cdot x^2 = -3x^3$, $-3x \cdot (-2x) = +6x^2$ (negative times negative is positive), $-3x \cdot 4 = -12x$.
- Keep the rule visible: $2x(x^2 + 3) = 2x^3 + 6x$ and $-x(x^2 - 5) = -x^3 + 5x$. Combine: $(2 - 1)x^3 + (6 + 5)x = x^3 + 11x$. That gives a quick check on the answer.
- One steady path is: $5xy \cdot 2x^2y = 10x^3y^2$, $5xy \cdot (-3xy^2) = -15x^2y^3$, $5xy \cdot 4 = 20xy$. Add exponents on each base. That gives a quick check on the answer.
- Start with the key idea: $3x \cdot 2x^2 = 6x^3$, $3x \cdot (-5x) = -15x^2$, $3x \cdot 4 = 12x$. This is the part to check before moving on, because it keeps the answer tied to the original question.
- A careful way to see it: $4x^2 \cdot 2x^3 = 8x^5$, $4x^2 \cdot (-5x) = -20x^3$, $4x^2 \cdot 3 = 12x^2$. Note the missing x^4 and x terms — they don't exist after distribution. That gives a quick check on the answer.
- Keep the rule visible: Distribute the $-2x$: $-2x \cdot 6x^3 + 2x^2$ (the inner $-x$ becomes $+$), $-10x$. That gives a quick check on the answer.
- One steady path is: $6y \cdot y^2 = 6y^3$, $6y \cdot (-3y) = -18y^2$, $6y \cdot 2 = 12y$. This is the part to check before moving on, because it keeps the answer tied to the original question.
- Start with the key idea: $x^2(x^2 - 4) = x^4 - 4x^2$ and $x(x^3 + 2) = x^4 + 2x$. Add: $(x^4 + x^4) + (-4x^2) + (2x) = 2x^4 - 4x^2 + 2x$. In standard form: $2x^4 - 4x^2 + 2x$ (re-sorted). That gives a quick check on the answer.
- A careful way to see it: $3a^2 \cdot a = 3a^3$ and $3a^2 \cdot (-b) = -3a^2b$. This is the part to check before moving on, because it keeps the answer tied to the original question.
- Keep the rule visible: $-x$ times each term: $-x \cdot x^2 = -x^3$, $-x \cdot 5x = -5x^2$, $-x \cdot (-2) = +2x$. That gives a quick check on the answer.
- One steady path is: $2x(x + 1) = 2x^2 + 2x$ and $3x(x - 2) = 3x^2 - 6x$. Combine: $5x^2 - 4x$. That gives a quick check on the answer.
- Start with the key idea: $x^3 \cdot 2x^2 = 2x^5$, $x^3 \cdot x = x^4$, $x^3 \cdot (-4) = -4x^3$. This is the part to check before moving on, because it keeps the answer tied to the original question.
- A careful way to see it: Distribute: $3xy^2 \cdot 2x^2 = 6x^3y^2$, $3xy^2 \cdot xy = 3x^2y^3$, $3xy^2 \cdot (-y) = -3xy^3$. That gives a quick check on the answer.
- Each box is $3x$ times a column term: $3x \cdot 2x^2 = 6x^3$, $3x \cdot (-5x) = -15x^2$, $3x \cdot 4 = 12x$. Add the boxes: $6x^3 - 15x^2 + 12x$.
- Distribute: only the first term yields x^3y^2 . $5xy \cdot 2x^2y = 10x^3y^2$, so the coefficient is 10.
- Distribute: $-2x(ax^2 + 3x - 5) = -2ax^3 - 6x^2 + 10x$. The x^3 -coefficient is $-2a$. Set $-2a = 14$: $a = -7$.
- Area = width \times length = $3x(2x^2 - 5x + 4)$. Distribute: $3x \cdot 2x^2 = 6x^3$, $3x \cdot (-5x) = -15x^2$; $3x \cdot 4 = 12x$. Result: $6x^3 - 15x^2 + 12x$ square meters.
- Revenue is rate times width times length: $4x(x + 3)(2x - 1)$. Multiply the monomial $4x$ into one bracket first: $4x(x + 3) = 4x^2 + 12x$. Then multiply by $(2x - 1)$: $(4x^2 + 12x)(2x - 1) = 8x^3 - 4x^2 + 24x^2 - 12x = 8x^3 + 20x^2 - 12x$.
- Volume = base area \times height = $x^2(x + 5)$. Distribute: $x^2 \cdot x + x^2 \cdot 5 = x^3 + 5x^2$. (At $x = 4$, that's $64 + 80 = 144$, a reasonable volume.)
- One customer pays $5x(2x - 3) = 10x^2 - 15x$ dollars. Three customers pay $3(10x^2 - 15x) = 30x^2 - 45x$. At $x = 10$, that's \$2550 — a clean positive revenue total.



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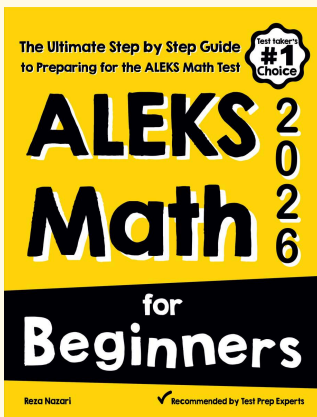
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