

Simplifying Polynomials

Name: _____ Date: _____ Score: _____ / 24

Q Quick Review

To **simplify** a polynomial, combine *like terms* — terms with the *same variable raised to the same exponent*. So $3x^2$ and $5x^2$ are like (both x^2); $3x^2$ and $5x$ are not. When you combine, you add the coefficients and keep the variable factor untouched: $3x^2 + 5x^2 = 8x^2$, not $8x^4$.

When a minus sign sits outside parentheses, **distribute it** to every term inside. The classic trap: $-(x^2 + 4x - 5) = -x^2 - 4x + 5$, not $-x^2 + 4x - 5$. The negative flips each sign, including the constants. Write it out explicitly before combining — saves heartache later.

When a coefficient sits outside parentheses, distribute that coefficient to every term, then combine. So $2(x^2 - 3x + 1) = 2x^2 - 6x + 2$, hitting each piece. After distributing, group and combine like terms by degree and write the result in **standard form** (descending exponents).

Watch for: constants are always like terms with each other (sign doesn't matter — 7 and -3 are like terms). Coefficients combine; exponents do not change. Multivariable terms like $3xy$ are like with $-5xy$ but not with $3x$ or $3y$.

PRACTICE

Simplify each expression and write the result in standard form.

1. $5x + 3x - 2$ _____
2. $-(2x - 5) + 3x$ _____
3. $4x^2 - 3x + 5 - 2x^2 + x - 7$ _____
4. $2(x^2 - 3x + 1) - (x^2 + 4x - 5)$ _____
5. $3xy + 2x - 5xy + 4 - x$ _____
6. $3x(x^2 - 2) - x(2x - 5)$ _____
7. $4(2x^3 - x + 1) - 2x(x^2 - 3) + 5$ _____
8. $2(3x^2 - x + 4) - (x^2 - 5x - 6)$ _____
9. $x^2 + 5x + 3 - 2(x^2 - x + 1)$ _____
10. $(7x^2 - 4) - (3x^2 + x - 9)$ _____
11. $5x^3 + 2x - x^3 + 4 - 3x + x^3$ _____
12. $a(a - 3) + 2(a^2 - a + 1)$ _____
13. $3(2x - 1) - 2(x + 4) + 5$ _____
14. $x^2y - 2xy^2 + 3x^2y + xy^2$ _____
15. $-(x^3 - 2x^2 + x) - (2x^3 + x^2 - 3x)$ _____
16. $4y^2 - (y^2 - 2y + 3) + y$ _____
17. Simplify $P(x) = 4x^2 - 3x + 7 + 2x^2 + 5x - 9$. The table gives $P(x)$ at several inputs — use the pattern to also find $P(3)$. _____

x	-1	0	1	2
$P(x)$	2	-2	6	26

18. Coefficient of x in $3(x^2 + ax - 2) - (2x^2 - 5x + 4)$ is 11. Find a . _____



19. The table breaks two terms into their variable and exponent. Are $5x$ and $5x^2$ like terms? _____

Term	Variable	Exponent
$5x$	x	1
$5x^2$	x	2

20. Simplify $S(x) = -2(3x - 4) + 5(x - 1) - 3$. The table shows $S(x)$ for a few inputs; use it to predict $S(3)$. _____

x	-2	-1	0	1	2
$S(x)$	2	1	0	-1	-2

◆ Word Problems

21. A rectangle's length is $(3x + 5)$ feet and its width is $(2x - 1)$ feet. Write a simplified expression for the perimeter. _____

22. A school's expected ticket revenue is $R(x) = 12x^2 + 8x + 150$ and its expected costs are $C(x) = 5x^2 + 11x + 90$. Write a simplified expression for the expected profit $R(x) - C(x)$. _____

23. Three friends combine their savings. Aria has $(2x + 5)$ dollars, Ben has $(3x - 2)$ dollars, and Cara has $(x + 7)$ dollars. Write a simplified expression for their total, then evaluate it when $x = 10$. _____

24. A cost function is $C(x) = 3(x^2 + 2x - 1) + 2(x^2 - x + 4)$. Write $C(x)$ in simplified standard form. _____



Answer Keys

- | | |
|----------------------|---|
| 1. $8x - 2$ | 13. $4x - 6$ |
| 2. $x + 5$ | 14. $4x^2y - xy^2$ |
| 3. $2x^2 - 2x - 2$ | 15. $-3x^3 + x^2 + 2x$ |
| 4. $x^2 - 10x + 7$ | 16. $3y^2 + 3y - 3$ |
| 5. $-2xy + x + 4$ | 17. $6x^2 + 2x - 2, P(3) = 58$ |
| 6. $3x^3 - 2x^2 - x$ | 18. $a = 2$ |
| 7. $6x^3 + 2x + 9$ | 19. no — different exponents on x |
| 8. $5x^2 + 3x + 14$ | 20. $-x, S(3) = -3$ |
| 9. $-x^2 + 7x + 1$ | 21. $10x + 8$ feet |
| 10. $4x^2 - x + 5$ | 22. $P(x) = 7x^2 - 3x + 60$ |
| 11. $5x^3 - x + 4$ | 23. $6x + 10$ dollars; \$70 when $x = 10$ |
| 12. $3a^2 - 5a + 2$ | 24. $C(x) = 5x^2 + 4x + 5$ |

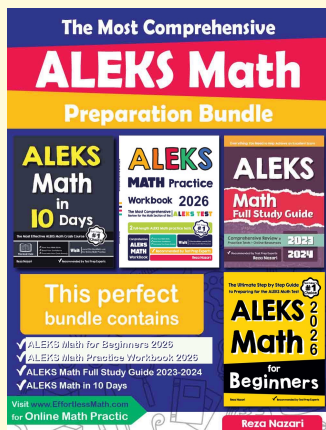
Step-by-Step Explanations

- Combine the x -terms: $5x + 3x = 8x$. The constant -2 has no partner and stays as is.
- Distribute the leading minus: $-(2x-5) = -2x+5$. Then $-2x+5+3x = x+5$. The minus flips both signs inside, so the -5 becomes $+5$.
- Group like terms by degree and add the coefficients: x^2 terms $4 - 2 = 2$, x terms $-3 + 1 = -2$, constants $5 - 7 = -2$. That gives $2x^2 - 2x - 2$.
- Distribute first: $2(x^2 - 3x + 1) = 2x^2 - 6x + 2$ and $-(x^2 + 4x - 5) = -x^2 - 4x + 5$. Combine: $(2 - 1)x^2 + (-6 - 4)x + (2 + 5) = x^2 - 10x + 7$.
- A careful way to see it: xy terms combine: $3xy - 5xy = -2xy$. x terms combine: $2x - x = x$. Constant: 4 . Note xy and x are not like terms — different variable factors. That gives a quick check on the answer.
- Distribute each monomial: $3x(x^2 - 2) = 3x^3 - 6x$ and $-x(2x - 5) = -2x^2 + 5x$. Combine: $3x^3 - 2x^2 + (-6 + 5)x = 3x^3 - 2x^2 - x$. The negative in front of $x(2x - 5)$ flips both inner signs.
- One steady path is: $4(2x^3 - x + 1) = 8x^3 - 4x + 4$. $-2x(x^2 - 3) = -2x^3 + 6x$. Add the $+5$. Combine: $(8 - 2)x^3 + (-4 + 6)x + (4 + 5) = 6x^3 + 2x + 9$. That gives a quick check on the answer.
- Distribute: $2(3x^2 - x + 4) = 6x^2 - 2x + 8$, and $-(x^2 - 5x - 6) = -x^2 + 5x + 6$. Combine: $5x^2 + 3x + 14$. Three minus-sign flips in the second piece; write them out.
- A careful way to see it: $-2(x^2 - x + 1) = -2x^2 + 2x - 2$. Combine: $(1 - 2)x^2 + (5 + 2)x + (3 - 2) = -x^2 + 7x + 1$. That gives a quick check on the answer.
- Distribute the minus: $-(3x^2 + x - 9) = -3x^2 - x + 9$. Combine: $(7 - 3)x^2 - x + (-4 + 9) = 4x^2 - x + 5$.
- One steady path is: Cubes: $5x^3 - x^3 + x^3 = 5x^3$. Linear: $2x - 3x = -x$. Constant: 4 . Final: $5x^3 - x + 4$. That gives a quick check on the answer.
- Distribute: $a(a - 3) = a^2 - 3a$ and $2(a^2 - a + 1) = 2a^2 - 2a + 2$. Combine: $(1 + 2)a^2 + (-3 - 2)a + 2 = 3a^2 - 5a + 2$.
- A careful way to see it: $3(2x - 1) = 6x - 3$, $-2(x + 4) = -2x - 8$. Combine with the $+5$: $(6 - 2)x + (-3 - 8 + 5) = 4x - 6$. That gives a quick check on the answer.
- Match the multivariable signatures. x^2y terms: $x^2y + 3x^2y = 4x^2y$. xy^2 terms: $-2xy^2 + xy^2 = -xy^2$. These are different multivariable monomials — they don't combine with each other.
- Both groups carry a leading minus, so flip every sign: $-x^3 + 2x^2 - x$ and $-2x^3 - x^2 + 3x$. Combine: $(-1 - 2)x^3 + (2 - 1)x^2 + (-1 + 3)x = -3x^3 + x^2 + 2x$.
- Start with the key idea: $-(y^2 - 2y + 3) = -y^2 + 2y - 3$. Combine: $(4 - 1)y^2 + (2 + 1)y - 3 = 3y^2 + 3y - 3$. That gives a quick check on the answer.
- Combine like terms: $(4 + 2)x^2 + (-3 + 5)x + (7 - 9) = 6x^2 + 2x - 2$. That matches the table (for instance $P(2) = 24 + 4 - 2 = 26$). Then $P(3) = 54 + 6 - 2 = 58$.
- Distribute: $3(x^2 + ax - 2) = 3x^2 + 3ax - 6$ and $-(2x^2 - 5x + 4) = -2x^2 + 5x - 4$. Combine the linear pieces: $3ax + 5x = (3a + 5)x$. Set $3a + 5 = 11$ to get $a = 2$.
- Like terms need matching variables *and* matching exponents. The table shows the same variable x but exponents 1 and 2, so they don't combine.
- Start with the key idea: $-2(3x - 4) = -6x + 8$ and $5(x - 1) = 5x - 5$. With the -3 : $(-6 + 5)x + (8 - 5 - 3) = -x$. The constants cancel, leaving the tidy line in the table, so $S(3) = -3$. That gives a quick check on the answer.
- Perimeter is $2(\text{length}) + 2(\text{width}) = 2(3x + 5) + 2(2x - 1)$. Distribute: $6x + 10 + 4x - 2$. Combine: $10x + 8$. (The width restriction $x > 1/2$ keeps the width positive, but that doesn't change the simplification.)
- Subtract term by term, distributing the minus across every term in C : $R - C = 12x^2 + 8x + 150 - 5x^2 - 11x - 90$. Group: $(12 - 5)x^2 + (8 - 11)x + (150 - 90) = 7x^2 - 3x + 60$. A student who adds rather than subtracts gets a wrong answer — profit is *revenue minus cost*.
- Add: $(2x + 5) + (3x - 2) + (x + 7) = (2 + 3 + 1)x + (5 - 2 + 7) = 6x + 10$. At $x = 10$: $6(10) + 10 = \$70$. (The problem's answer should be a positive number of dollars — \$70 is a clean, physically sensible total.)
- Distribute each coefficient: $3(x^2 + 2x - 1) = 3x^2 + 6x - 3$ and $2(x^2 - x + 4) = 2x^2 - 2x + 8$. Combine like terms: $(3 + 2)x^2 + (6 - 2)x + (-3 + 8) = 5x^2 + 4x + 5$. Standard form has descending exponents, which is exactly what we get.



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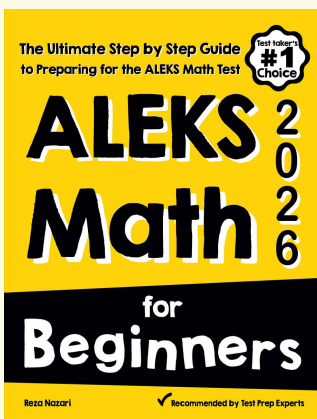
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