Adding and Subtracting Polynomials

Name: _____	Date: _____	Score: _____ / 36

Quick Review

Adding polynomials is just like combining like terms: match the x^2's with the x^2's, the x's with the x's, the constants with the constants. Add the matched coefficients. The variable factors themselves don't change.

Subtracting polynomials uses one extra step: *distribute the minus sign across every term in the second polynomial.* So $(5x+7)-(2x+3)$ becomes $5x+7-2x-3$, not $5x+7-2x+3$. The minus flips every sign it passes, including the constants. This sign-flip is the single most common mistake in polynomial arithmetic — write the flipped expression out before combining.

The degree of a sum or difference is at most the larger of the two original degrees, but it can be *less* if the leading terms cancel. Quick check: $(x^2+1)+(-x^2+3)=4$ — the x^2 terms vanished, leaving a degree-0 polynomial. So degree of a sum equals the larger original degree is only *usually* true.

Properties: addition is commutative ($A+B=B+A$) and associative. Subtraction is not commutative — $A-B$ and $B-A$ are negatives of each other. The set of polynomials is closed under both addition and subtraction (you stay inside the polynomial world).

PRACTICE

Add or subtract. Write each answer in standard form.

1. Let $P=2x^2+3x+1$ and $Q=4x^2-x+5$. Find $(P+Q)(x)$ in standard form, then use the table to evaluate $(P+Q)(2)$. _____

x	-1	0	1
P	0	1	6
Q	10	5	8

2. $(5x+7)-(2x+3)$ _____

3. Let $A=3x^2-2x+5$ and $B=x^2+4x-1$. Find $(A-B)(x)$, then use the table to evaluate $(A-B)(3)$. _____

x	0	1	2
A	5	6	13
B	-1	4	11

4. $(x^3+2x-1)+(3x^3-x+4)-(2x^3+5)$ _____

5. $(3x^3-2x+5)-(x^3+4x^2-2x-1)$ _____

6. $(4x^2+x-3)+(2x^2-5x+8)$ _____

7. Let $C=7x^2+3x$ and $D=7x^2-4x+2$. Find $(C-D)(x)$, then use the table of $(C-D)$ values to predict $(C-D)(3)$. _____

x	-1	0	1	2
$(C-D)(x)$	-9	-2	5	12

8. $(x^4-3x^2+2)+(-x^4+x^3-x)$ _____

9. $(2y^2-5y+1)+(y^2+3y-4)$ _____

10. $(6x-9)-(2x-15)$ _____

11. $(3x^2-x+4)+(x^2+x-4)$ _____

12. $(5a+2b-c)-(3a-b+4c)$ _____

13. $(2x^3+x^2-4x+1)-(x^3-2x^2+x-3)$ _____

14. $(8-3x+x^2)+(2x-5)$ _____

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15. If $A + B = 5x^2 + 3x - 2$ and $A = 2x^2 - x + 4$, find B _____

16. If $P - Q = 4x^3 - 2x^2 + 7x - 5$ and $P = 6x^3 + x^2 - 3x + 8$, find Q _____

17. $(2x^2 + 3x - 5) + (2x^2 + 3x - 5)$ _____

18. $(x^2 + 4x + 3) - (x^2 + 4x + 3)$ _____

19. $(4x^3 - 2x + 7) + (-x^3 + 3x^2 - x + 5) - (2x^3 + x^2 - 4)$ _____

20. $(3x^2y + 2xy - y^2) - (x^2y - 2xy + 3y^2)$ _____

♦ Word Problems

21. Two revenue streams combine to give total revenue $A + B = 5x^2 + 3x - 2$ thousand dollars. If stream A alone is $A = 2x^2 - x + 4$ thousand dollars, write a polynomial for stream B in standard form. ____

22. Let $P(x) = 4x^3 - 2x + 7$, $Q(x) = -x^3 + 3x^2 - x + 5$, and $R(x) = 2x^3 + x^2 - 4$. Compute $P(x) + Q(x) - R(x)$ in standard form. ____

23. A garden's perimeter is $(8x + 14)$ meters and its length is $(3x + 4)$ meters. Write a simplified polynomial for the width. ____

24. A company's quarterly profit polynomial in thousands of dollars is the sum of two divisions' profits: division X contributes $(2x^2 - 3x + 5)$ and division Y contributes $(-x^2 + 4x + 3)$, where x is months since start of quarter. Find the company's total quarterly profit polynomial in simplified standard form. ____

Additional Practice

25. Write $3x - 5 + x^3$ in standard form. _____

26. Find the degree of $7x^4 - 2x^2 + 9$. _____

27. Add $(2x^2 + 3x - 1) + (x^2 - 5x + 4)$. _____

28. Subtract $(5x^2 - x + 6) - (2x^2 + 3x - 1)$. _____

29. Multiply $(x + 4)(x - 3)$. _____

30. Factor $x^2 + 9x + 20$. _____

31. Factor $6x^2 + 9x$. _____

32. Find the GCF of $12x^3$ and $18x^2$. _____

33. Divide $(x^2 + 5x + 6)$ by $(x + 2)$. _____

34. Find the remainder when $x^2 - 1$ is divided by $x - 3$. _____

35. Zeros of $(x - 5)(x + 1)$. _____

36. Is $x = 2$ a zero of $x^2 - 4$? _____

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Answer Keys

1. $6x^2 + 2x + 6,\ (P + Q)(2) = 34$
2. $3x + 4$
3. $2x^2 - 6x + 6,\ (A - B)(3) = 6$
4. $2x^3 + x - 2$
5. $2x^3 - 4x^2 + 6$
6. $6x^2 - 4x + 5$
7. $7x - 2,\ (C - D)(3) = 19$
8. $x^3 - 3x^2 - x + 2$
9. $3y^2 - 2y - 3$
10. $4x + 6$
11. $4x^2$
12. $2a + 3b - 5c$
13. $x^3 + 3x^2 - 5x + 4$
14. $x^2 - x + 3$
15. $B = 3x^2 + 4x - 6$
16. $Q = 2x^3 + 3x^2 - 10x + 13$
17. $4x^2 + 6x - 10$
18. 0
19. $x^3 + 2x^2 - 3x + 16$
20. $2x^2y + 4xy - 4y^2$
21. $B = 3x^2 + 4x - 6$ thousand dollars
22. $x^3 + 2x^2 - 3x + 16$
23. $x + 3$ meters
24. $x^2 + x + 8$ thousand dollars

Additional Practice Answers

25. $x^3 + 3x - 5$
26. 4
27. $3x^2 - 2x + 3$
28. $3x^2 - 4x + 7$
29. $x^2 + x - 12$
30. $(x + 4)(x + 5)$
31. $3x(2x + 3)$
32. $6x^2$
33. $x + 3$
34. 8
35. $x = 5,\ -1$
36. yes

Additional Practice: Answers for all numbered items, including the added practice, are shown in the grid above.

Step-by-Step Explanations

1. Add by degree: $(2 + 4)x^2 + (3 - 1)x + (1 + 5) = 6x^2 + 2x + 6$. The table confirms it (at $x = 1$, $P + Q = 6 + 8 = 14 = 6 + 2 + 6$). Then $(P + Q)(2) = 24 + 4 + 6 = 34$.

2. Distribute the minus: $5x + 7 - 2x - 3 = 3x + 4$. The $+3$ inside becomes -3 after the flip.

3. Flip the signs in B: $-(x^2 + 4x - 1) = -x^2 - 4x + 1$. Combine: $(3 - 1)x^2 + (-2 - 4)x + (5 + 1) = 2x^2 - 6x + 6$. From the difference polynomial, $(A - B)(3) = 18 - 18 + 6 = 6$.

4. Start with the key idea: x^3 column: $1 + 3 - 2 = 2$. x column: $2 - 1 = 1$. Constants: $-1 + 4 - 5 = -2$. Result: $2x^3 + x - 2$. That gives a quick check on the answer.

5. Flip signs in the second: $-(x^3 + 4x^2 - 2x - 1) = -x^3 - 4x^2 + 2x + 1$. Combine: $(3 - 1)x^3 + (0 - 4)x^2 + (-2 + 2)x + (5 + 1) = 2x^3 - 4x^2 + 6$. The x-terms cancel out.

6. Adding, so no sign-flips — just match by degree and add: x^2 gives $4 + 2 = 6$, x gives $1 - 5 = -4$, constants give $-3 + 8 = 5$. Result $6x^2 - 4x + 5$.

7. Flip D's signs: $-7x^2 + 4x - 2$. Combine: $(7 - 7)x^2 + (3 + 4)x - 2 = 7x - 2$ — the squares cancel, so the table is a straight line climbing by 7 each step. Continuing, $(C - D)(3) = 21 - 2 = 19$.

8. The x^4 pieces cancel: $1 - 1 = 0$. The rest: $x^3, -3x^2, -x, 2$. Sort: $x^3 - 3x^2 - x + 2$.

9. Combine like terms: y^2 gives $2 + 1 = 3$, y gives $-5 + 3 = -2$, constants give $1 - 4 = -3$. So $3y^2 - 2y - 3$.

10. Flip signs in the second: $-2x + 15$. Combine: $(6 - 2)x + (-9 + 15) = 4x + 6$. The -15 becomes $+15$ — the minus-a-negative spot.

11. One steady path is: Linear: $-x + x = 0$. Constants: $4 - 4 = 0$. Only the squares survive: $3x^2 + x^2 = 4x^2$. That gives a quick check on the answer.

12. Flip the second: $-3a + b - 4c$. Combine: $(5 - 3)a + (2 + 1)b + (-1 - 4)c = 2a + 3b - 5c$. Three variables, but the rule is the same — match by variable letter.

13. Flip: $-x^3 + 2x^2 - x + 3$. Combine: $(2 - 1)x^3 + (1 + 2)x^2 + (-4 - 1)x + (1 + 3) = x^3 + 3x^2 - 5x + 4$.

14. Combine: x^2 stays alone. Linear: $-3x + 2x = -x$. Constants: $8 - 5 = 3$. Sort: $x^2 - x + 3$.

15. From $A + B = S$, $B = S - A = (5x^2 + 3x - 2) - (2x^2 - x + 4)$. Flip signs in A: $-2x^2 + x - 4$. Combine: $(5 - 2)x^2 + (3 + 1)x + (-2 - 4) = 3x^2 + 4x - 6$.

16. From $P - Q = D$, $Q = P - D$. Compute $(6x^3 + x^2 - 3x + 8) - (4x^3 - 2x^2 + 7x - 5)$. Flip D's signs: $-4x^3 + 2x^2 - 7x + 5$. Combine: $(6 - 4)x^3 + (1 + 2)x^2 + (-3 - 7)x + (8 + 5) = 2x^3 + 3x^2 - 10x + 13$.

17. Adding a polynomial to itself doubles every coefficient: $2(2x^2 + 3x - 5) = 4x^2 + 6x - 10$. Equivalent to scaling by 2.

18. Keep the rule visible: Subtracting a polynomial from itself gives 0. Every matched pair cancels. That gives a quick check on the answer.

19. Cubes: $4 - 1 - 2 = 1$. Squares: $0 + 3 - 1 = 2$. Linear: $-2 - 1 - 0 = -3$. Constants: $7 + 5 - (-4) = 7 + 5 + 4 = 16$. Final: $x^3 + 2x^2 - 3x + 16$. Watch the double negative on the last constant.

20. Match by signature. x^2y: $3 - 1 = 2$. xy: $2 - (-2) = 4$. y^2: $-1 - 3 = -4$. Result: $2x^2y + 4xy - 4y^2$.

21. Solve for B by subtracting A from the sum: $B = (5x^2 + 3x - 2) - (2x^2 - x + 4)$. Flip signs on A: $-2x^2 + x - 4$. Combine: $(5 - 2)x^2 + (3 + 1)x + (-2 - 4) = 3x^2 + 4x - 6$. A student who adds A to the sum by accident gets the wrong polynomial — the key word is *stream B alone*.

22. Line up by degree. x^3: $4 + (-1) - 2 = 1$. x^2: $0 + 3 - 1 = 2$. x: $-2 + (-1) - 0 = -3$. Constants: $7 + 5 - (-4) = 16$ (the double negative gives $+4$). Stack: $x^3 + 2x^2 - 3x + 16$.

23. Perimeter $= 2L + 2W$, so $W = \frac{P - 2L}{2}$. Compute $2L = 2(3x + 4) = 6x + 8$. Then $P - 2L = (8x + 14) - (6x + 8)$. Flip signs: $-6x - 8$, so $P - 2L = 2x + 6$. Divide by 2: $W = x + 3$ meters. (At $x = 5$ this gives a width of 8 m and length of 19 m, and the perimeter is $2(8) + 2(19) = 54 = 8(5) + 14$. Sanity-check passes.)

24. Add the two polynomials: $(2x^2 - 3x + 5) + (-x^2 + 4x + 3)$. Combine like terms: $(2 - 1)x^2 + (-3 + 4)x + (5 + 3) = x^2 + x + 8$. (At $x = 0$, the profit is $\$8{,}000$, a sensible starting value.)

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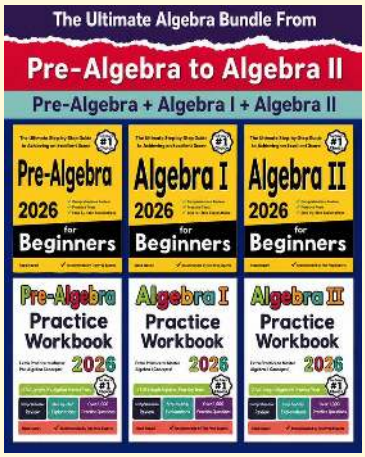

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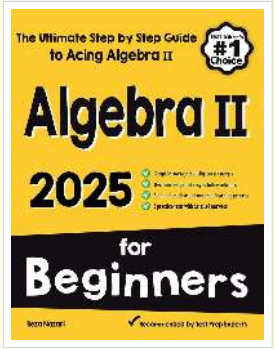

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