

NAME _____ DATE _____ PERIOD _____

8-1 Skills Practice

Adding and Subtracting Polynomials

Find each sum or difference.

- $(2x + 3y) + (4x + 9y)$ $6x + 12y$
- $(6s + 5t) + (4t + 8s)$ $14s + 9t$
- $(5a + 9b) - (2a + 4b)$ $3a + 5b$
- $(11m - 7n) - (2m + 6n)$ $9m - 13n$
- $(m^2 - m) + (2m + m^2)$ $2m^2 + m$
- $(x^2 - 3x) - (2x^2 + 5x) - x^2 - 8x$
- $(d^3 - d + 5) - (2d + 5)$ $d^3 - 3d$
- $(2k^2 - 5h) + (7h - 3k^2) - h^2 + 2h$
- $(6k^2 + 2k + 9) + (4k^2 - 5k)$
 $10k^2 - 3k + 9$
- $5t^2 + g - 2) + (-2f + 8)$
 $3f + g + 1$

Determine whether each expression is a polynomial. If it is a polynomial, find the degree and determine whether it is a *monomial*, *binomial*, or *trinomial*.

- $5mt + t^2$ **yes; 2; binomial**
- $4by + 2b - by$ **yes; 2; binomial**
- -32 **yes; 0; monomial**
- $\frac{3x}{7}$ **yes; 1; monomial**
- $5x^2 - 3x - 1$ **no**
- $2c^2 + 8c + 9 - 3$ **yes; 2; trinomial**
- $3x + 1 + 2x^2$ **yes; 2; trinomial**
- $5x - 6 + 3x^2$ **yes; 2; trinomial**
- $2x^2 + 3x + 1; 2$ **yes; 2; trinomial**
- $3x^2 + 5x - 6; 3$ **yes; 2; trinomial**
- $9x^2 + 2 + x^3 + x$ **yes; 3; trinomial**
- $x^3 + 9x^2 + x + 2; 1$ **yes; 3; trinomial**
- $x^2 + 3x^3 + 27 - x$ **yes; 3; trinomial**
- $3x^3 + x^2 - x + 27; 3$ **yes; 3; trinomial**
- $x - 3x^2 + 4 + 5x^2$ **yes; 2; trinomial**
- $5x^3 - 3x^2 + x + 4; 5$ **yes; 3; trinomial**

Write each polynomial in standard form. Identify the leading coefficient.

- $3x + 1 + 2x^2$ $2x^2 + 3x + 1; 2$
- $5x - 6 + 3x^2$ $3x^2 + 5x - 6; 3$
- $9x^2 + 2 + x^3 + x$ $x^3 + 9x^2 + x + 2; 1$
- $x^2 + 3x^3 + 27 - x$ $3x^3 + x^2 - x + 27; 3$
- $x - 3x^2 + 4 + 5x^2$ $5x^2 - 3x^2 + x + 4; 5$
- $x^2 + 64 - x + 7x^3$ $7x^3 + x^2 - x + 64; 7$

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8-1 Study Guide and Intervention *(continued)*

Adding and Subtracting Polynomials

Add and Subtract Polynomials To add polynomials, you can group like terms horizontally or write them in column form, aligning like terms vertically. Like terms are monomial terms that are either identical or differ only in their coefficients, such as $3p$ and $-5p$ or $2x^2y$ and $8x^2y$.

You can subtract a polynomial by adding its additive inverse. To find the additive inverse of a polynomial, replace each term with by adding its additive inverse. To find the additive inverse of a polynomial, replace each term with its additive inverse or opposite.

Example Find $(3x^2 + 2x - 6) - (2x + x^2 + 3)$.

Horizontal Method

Use additive inverses to rewrite as addition. Then group like terms.

$$\begin{aligned} &(3x^2 + 2x - 6) - (2x + x^2 + 3) \\ &= (3x^2 + 2x - 6) + [(-2x) + (-x^2) + (-3)] \\ &= [3x^2 + (-x^2)] + [2x + (-2x)] + [-6 + (-3)] \\ &= 2x^2 + (-9) \\ &= 2x^2 - 9 \end{aligned}$$

The difference is $2x^2 - 9$.

Vertical Method

Align like terms in columns and subtract by adding the additive inverse.

$$\begin{array}{r} 3x^2 + 2x - 6 \\ (-) \quad x^2 + 2x + 3 \\ \hline 3x^2 + 2x - 6 \\ (+) -x^2 - 2x - 3 \\ \hline 2x^2 \quad - 9 \end{array}$$

The difference is $2x^2 - 9$.

Exercises

Find each sum or difference.

- $(4a - 5) + (3a + 6)$
 $7a + 1$
- $(6x + 9) + (4x^2 - 7)$
 $4x^2 + 6x + 2$
- $(6xy + 2y + 8x) + (4xy - x)$
 $10xy + 5x + 2y$
- $(3p^2 - 2p + 3) + (p^2 - 7p + 7)$
 $4p^2 - 9p + 10$
- $(8x^2 - 5x) - (-6p^2 + 6r - 8)$
 $6p^2 + 8p - 11r + 3$
- $(3x^2 - 2x) - (3x^2 + 5x - 1)$
 $-7x + 1$
- $(8x^2 - 4x - 3) - (-2x - x^2 + 5)$
 $9x^2 - 2x - 8$
- $(4x^2 + 6xy + 2y^2) - (-x^2 + 2xy - 5y^2)$
 $5x^2 + 4xy + 7y^2$
- $(9xy^2 + 5xy) - (-2xy - 8xy^2)$
 $17xy^2 + 7xy$

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8-1 Practice

Adding and Subtracting Polynomials

Find each sum or difference.

1. $(4y + 5) + (-7y - 1)$
 $-3y + 4$
2. $(-x^2 + 3x) - (5x + 2x^2)$
 $-3x^2 - 2x$
3. $(4k^2 + 8k + 2) - (2k + 3)$
 $4k^2 + 6k - 1$
4. $(2m^2 + 6m) + (m^2 - 5m + 7)$
 $3m^2 + m + 7$
5. $(5a^2 + 6a + 2) - (7a^2 - 7a + 5)$
 $-2a^2 + 13a - 3$
6. $(-4p^2 - p + 9) + (p^2 + 3p - 1)$
 $-3p^2 + 2p + 8$
7. $(x^3 - 3x + 1) - (x^2 + 7 - 12x)$
 $9x - 6$
8. $(6x^2 - x + 1) - (-4 + 2x^2 + 8x)$
 $4x^2 - 9x + 5$
9. $(4y^2 + 2y - 8) - (7y^2 + 4 - y)$
 $-3y^2 + 3y - 12$
10. $(u^2 - 4u - 1) + (-5 + 5u^2 - 3u)$
 $6u^2 - 7u - 6$

Determine whether each expression is a polynomial. If it is a polynomial, find the degree and determine whether it is a *monomial*, *binomial*, or *trinomial*.

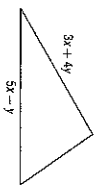
11. $7a^2b + 3b^2 - a^2b$
yes; 3; binomial
12. $\frac{1}{5}y^3 + y^2 - 9$
yes; 3; trinomial
13. $6g^2h^3k$
yes; 6; monomial
14. $\frac{x + 3x^4 - 21x^2}{x^2}$
not a polynomial

Write each polynomial in standard form. Identify the leading coefficient.

15. $8x^2 - 15 + 5x^5$
 $5x^5 + 8x^2 - 15$; 5
16. $10x - 7 + x^4 + 4x^3$
 $x^4 + 4x^3 + 10x - 7$; 1
17. $13x^2 - 5 + 6x^3 - x$
 $6x^3 + 13x^2 - x - 5$; 6
18. $4x + 2x^5 - 6x^3 + 2$
 $2x^5 - 6x^3 + 4x + 2$; 2

19. **BUSINESS** The polynomial $s^3 - 70s^2 + 1500s - 10,800$ models the profit a company makes on selling an item at a price s . A second item sold at the same price brings in a profit of $s^3 - 30s^2 + 450s - 5000$. Write a polynomial that expresses the total profit from the sale of both items. $2s^3 - 100s^2 + 1950s - 15,800$

20. **GEOMETRY** The measures of two sides of a triangle are given. If P is the perimeter, and $P = 10x + 5y$, find the measure of the third side. $2x + 2y$



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8-1 Word Problem Practice

Adding and Subtracting Polynomials

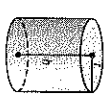
1. **PRIMES** Mei is trying to list as many prime numbers as she can for a challenge problem for her math class. She finds that the polynomial expression $n^2 - n + 41$ can be used to generate some, but not all, prime numbers. What is the degree of Mei's polynomial? **2**

2. **PHONE CALLS** A long-distance telephone company charges a standard monthly service fee of \$19.95 plus \$0.05 per minute of long-distance use. Write a polynomial to express the monthly cost of the phone plan if x minutes of long-distance time are used per month. What is the degree of the polynomial? **\$0.05x + \$19.95; 1**

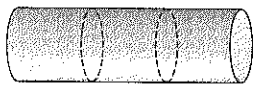
3. **FIREWORKS** Two bottle rockets are launched straight up into the air. The height, in feet, of each rocket at t seconds after launch is given by the polynomial equations below. Write an equation to show how much higher Rocket A traveled.
Rocket A: $D_1 = -16t^2 + 122t$
Rocket B: $D_2 = -16t^2 + 84t$
 $D = 38t$

4. **ENVELOPES** An office supply company produces yellow document envelopes. The envelopes come in a variety of sizes, but the length is always 4 centimeters more than double the width. Write a polynomial expression to give the perimeter of any of the envelopes.
 $6x + 8$

5. **INDUSTRY** Two identical right cylindrical steel drums containing oil need to be covered with a fire-resistant sealant. In order to determine how much sealant to purchase, George must find the surface area of the two drums. The surface area including the top and bottom bases is given by the following formula.
 $S = 2\pi rh + 2\pi r^2$



- a. Write a polynomial to represent the total surface area of the two drums.
 $4\pi rh + 4\pi r^2$
- b. Find the total surface area if the height of each drum is 2 meters and the radius of each is 0.5 meter. Let $\pi = 3.14$. **15.7 m²**
- c. The fire resistant sealant must be applied while they are stacked vertically in groups of three. If h is the height of each drum and r is the radius, write a polynomial to represent the exposed surface area.
 $6\pi rh + \pi r^2$



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8-2 Skills Practice

Multiplying a Polynomial by a Monomial

Find each product.

- $a(4a + 3)$
 $4a^2 + 3a$
- $x(2x - 5)$
 $2x^2 - 5x$
- $-3n(n^2 + 2n)$
 $-3n^3 - 6n^2$
- $3x(5x^2 - x + 4)$
 $15x^3 - 3x^2 + 12x$
- $-4b(1 - 9b - 2b^2)$
 $-4b + 36b^2 + 8b^3$
- $2m^2(2m^2 + 3m - 5)$
 $4m^4 + 6m^3 - 10m^2$
- $7c(5 - 2c^2 + c^3)$
 $35c - 14c^3 + 7c^4$
- $6y(-5 - y + 4y^2)$
 $-30y - 6y^2 + 24y^3$
- $-3x^2(-2x^2 + 3x + 4)$
 $6x^4 - 9x^3 - 12x^2$
- $f(5f - 3) - 2f$
 $5f^2 - 5f$
- $y^2(-4y + 5) - 6y^2$
 $-4y^3 - y^2$
- $4a(5a^2 - 4) + 9a$
 $20a^3 - 7a$
- $3m(3m + 6) - 3(m^2 + 4m + 1)$
 $6m^2 + 6m - 3$

Simplify each expression.

- $w(3w + 2) + 5w$
 $3w^2 + 7w$
- $-p(2p - 8) - 5p$
 $-2p^2 + 3p$
- $2x(3x^2 + 4) - 3x^3$
 $3x^3 + 8x$
- $4b(-5b - 3) - 2(b^2 - 7b - 4)$
 $-22b^2 + 2b + 8$
- $3(a + 2) + 5 = 2a + 4 - 7$
- $5(y + 1) + 2 = 4(y + 2) - 6 - 5$
- $6(m - 2) + 14 = 3(m + 2) - 10 - 2$
- $-c(11c + 4)$
 $-11c^2 - 4c$
- $2y^2(-4y + 5) - 6y^2$
 $-4y^3 - y^2$
- $2(4x + 2) - 8 = 4(x + 3) - 4$
- $4(b + 6) + 2 = 2(b + 5) + 2 - 6$
- $3(c + 5) - 2 = 2(c + 6) + 2 - 1$

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8-2 Practice

Multiplying a Polynomial by a Monomial

Find each product.

- $2h(-7h^2 - 4h)$
 $-14h^3 - 8h^2$
- $5jk(3jk + 2k)$
 $15j^2k^2 + 10jk^2$
- $-\frac{1}{4}m(8m^2 + m - 7)$
 $-\frac{1}{4}m^3 - \frac{1}{4}m^2 + \frac{7}{4}m$
- $3w(-7w + 3) + 2w(-2w^2 + 19w + 2)$
 $-4w^3 + 3w^2 + 19w$
- $-2(3\ell - 4) + 7\ell$
 $-6\ell^2 + 15\ell$
- $6t(2t - 3) - 5(2t^2 + 9t - 3)$
 $2t^2 - 63t + 15$
- $-3g(7g - 2) + 3(g^2 + 2g + 1) - 3g(-5g + 3) - 3g^2 + 3g + 3$
- $3(3u + 2) + 5 = 2(2u - 2) - 3$
- $8(3b + 1) = 4(b + 3) - 9 - 4$
- $u(u - 5) + 8u = u(u + 2) - 4 - 4$

Solve each equation.

- $5(2t - 1) + 3 = 3(3t + 2) - 8$
- $4(8n + 3) - 5 = 2(6n + 8) + 1 - \frac{1}{2}$
- $t(t + 4) - 1 = t(t + 2) + 2 - \frac{3}{2}$
- NUMBER THEORY** Let x be an integer. What is the product of twice the integer added to three times the next consecutive integer? $5x + 3$
- INVESTMENTS** Kent invested \$5000 in a retirement plan. He allocated x dollars of the money to a bond account that earns 4% interest per year and the rest to a traditional account that earns 5% interest per year.

- Write an expression that represents the amount of money invested in the traditional account. $5000 - x$
- Write a polynomial model in simplest form for the total amount of money T Kent has invested after one year. (Hint: Each account has $A + IA$ dollars, where A is the original amount in the account and I is its interest rate.) $T = 5250 - 0.01x$
- If Kent put \$500 in the bond account, how much money does he have in his retirement plan after one year? **\$5245**

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8-3 Skills Practice

Multiplying Polynomials

Find each product.

1. $(m + 4)(m + 1)$
 $m^2 + 5m + 4$

3. $(b + 3)(b + 4)$
 $b^2 + 7b + 12$

5. $(r + 1)(r - 2)$
 $r^2 - r - 2$

7. $(3c + 1)(c - 2)$
 $3c^2 - 5c - 2$

9. $(d - 1)(5d - 4)$
 $5d^2 - 9d + 4$

11. $(3n - 7)(n + 3)$
 $3n^2 + 2n - 21$

13. $(3b + 9)(3b - 2)$
 $9b^2 + 3b - 6$

15. $(4c + 1)(2c + 1)$
 $8c^2 + 6c + 1$

17. $(4h - 2)(4h - 1)$
 $16h^2 - 12h + 2$

19. $(w + 4)(w^2 + 3w - 6)$
 $w^3 + 7w^2 + 6w - 24$

21. $(k + 4)(k^2 + 3k - 6)$
 $k^3 + 7k^2 + 6k - 24$

2. $(x + 2)(x + 2)$
 $x^2 + 4x + 4$

4. $(t + 4)(t - 3)$
 $t^2 + t - 12$

6. $(n - 5)(n + 1)$
 $n^2 - 4n - 5$

8. $(2x - 6)(x + 3)$
 $2x^2 - 18$

10. $(2\ell + 5)(\ell - 4)$
 $2\ell^2 - 3\ell - 20$

12. $(g + 5)(5g - 1)$
 $5g^2 + 24g - 5$

14. $(2m + 2)(3m - 3)$
 $6m^2 - 6$

16. $(5a - 2)(2a - 3)$
 $10a^2 - 19a + 6$

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

20. $(t + 1)(t^2 + 2t + 4)$
 $t^3 + 3t^2 + 6t + 4$

22. $(m + 3)(m^2 + 3m + 5)$
 $m^3 + 6m^2 + 14m + 15$

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ANSWERS

Answers (Lesson 8-3)

Lesson 8-3

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8-3 Practice

Multiplying Polynomials

Find each product.

1. $(q + 6)(q + 5)$
 $q^2 + 11q + 30$

3. $(n - 4)(n - 6)$
 $n^2 - 10n + 24$

5. $(4b + 6)(b - 4)$
 $4b^2 - 10b - 24$

7. $(6a - 3)(7a - 4)$
 $42a^2 - 45a + 12$

9. $(3a - b)(2a - b)$
 $6a^2 - 5ab + b^2$

11. $(m + 5)(m^2 + 4m - 8)$
 $m^3 + 9m^2 + 12m - 40$

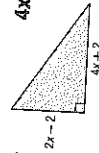
13. $(2h + 3)(2h^2 + 3h + 4)$
 $4h^3 + 12h^2 + 17h + 12$

15. $(3g + 2)(9g^2 - 12g + 4)$
 $27g^3 - 18g^2 - 12g + 8$

17. $(3n^2 + 2n - 1)(2n^2 + n + 9)$
 $6n^4 + 7n^3 + 27n^2 + 17n - 9$

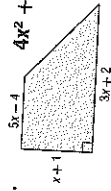
19. $(2x^2 - 2x - 3)(2x^2 - 4x + 3)$
 $4x^4 - 12x^3 + 9x^2 + 6x - 9$

21. **GEOMETRY** Write an expression to represent the area of each figure.



$4x^2 - 2x - 2$ units²

22. $4x^2 + 3x - 1$ units²



23. **NUMBER THEORY** Let x be an even integer. What is the product of the next two consecutive even integers? $x^2 + 6x + 8$

24. **GEOMETRY** The volume of a rectangular pyramid is one third the product of the area of its base and its height. Find an expression for the volume of a rectangular pyramid whose base has an area of $3x^2 + 12x + 9$ square feet and whose height is $x + 3$ feet.
 $x^3 + 7x^2 + 15x + 9$ ft³

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